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Financial Contracting Theory Meets the Real World: An Empirical Analysis of Venture Capital Contracts

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We compare the characteristics of real-world financial contracts to their counterparts in financial contracting theory. We do so by studying the actual contracts between venture capitalists (VCs) and entrepreneurs. The distinguishing characteristic of VC financings is that they allow VCs to separately allocate cash flow rights, board rights, voting rights, liquidation rights, and other control rights. We describe and measure these rights. We then interpret our results in relation to existing financial contracting theories. We also describe the interrelation and the evolution across financing rounds of the different rights.

1. INTRODUCTION

There is a large academic literature on the principal–agent problem in financial contracting.[1] The papers in this literature often begin with a situation in which an investor negotiates with an entrepreneur over the financing of a project or company. Despite the large volume of theory, relatively little empirical work exists that compares the characteristics of real-world financial contracts to their counterparts in financial contracting theory.[2] In this paper, we attempt to inform theory by describing in detail the contracts between VCs and entrepreneurs. We compare the actual contracts to the assumed and predicted ones in different financial contracting theories.

In doing this, we assume that VCs are real-world entities who closely approximate the investors of theory. VCs invest in entrepreneurs who need financing to fund a promising venture. VCs have strong incentives to maximize value, but, at the same time, receive few or no private benefits of control. Although they are intermediaries, VCs typically receive at least 20% of the profits on their portfolios.[3]

We study 213 VC investments in 119 portfolio companies by 14 VC firms. Each VC firm provided the contractual agreements governing each financing round in which the firm participated. The VC firm also provided (if available) the company's business plan, internal analyses evaluating the investment, and information on subsequent performance.

We find that VC financings allow VCs to separately allocate cash flow rights, board rights, voting rights, liquidation rights, and other control rights. These rights are often contingent on

1. For a recent summary, see Hart (2001). Extensive theoretical overviews can be found in Harris and Raviv (1992), Allen and Winton (1995) and Hart (1995).
2. For earlier, related work, see Sahlman (1990), Black and Gilson (1998), Gompers (1998) and Baker and Gompers (1999, 2000). Kaplan and Strömberg (2001) discuss other ways that venture capitalists (VCs) mitigate principal–agent problems.
3. See Gompers and Lerner (1999).

observable measures of financial and non-financial performance. In general, board rights, voting rights, and liquidation rights are allocated such that if the firm performs poorly, the VCs obtain full control. As performance improves, the entrepreneur retains/obtains more control rights. If the firm performs very well, the VCs retain their cash flow rights, but relinquish most of their control and liquidation rights.

We also report that it is common for VCs to include non-compete and vesting provisions that make it more expensive for the entrepreneur to leave the firm, thus mitigating the potential hold-up problem between the entrepreneur and the investor.

Finally, the cash flow incentives, control rights and contingencies in these contracts are used more as complements than as substitutes. Ventures in which the VCs have voting and board majorities are also more likely to make the entrepreneur's equity claim and the release of committed funds contingent on performance milestones.

Our results have the following implications. First, cash flow rights matter in a way that is consistent with the principal–agent theories of Holmström (1979), Lazear (1986) and others. For example, the entrepreneur's equity compensation function is more sensitive to performance when incentive and asymmetric information problems are more severe.

Second, the allocation of control rights between the VC and the entrepreneur is a central feature of the financial contracts. This strongly suggests that despite the prevalence of contingent contracting, contracts are inherently incomplete. This finding gives support to the incomplete contracting approach pioneered by Grossman and Hart (1986) and Hart and Moore (1990).

Third, cash flow rights and control rights can be separated and made contingent on observable and verifiable measures of performance. This is most supportive of theories that predict shifts of control to investors in different states, such as Aghion and Bolton (1992) and Dewatripont and Tirole (1994).

Fourth, the widespread use of non-compete and vesting provisions indicates that VCs care about the hold-up problem explored in Hart and Moore (1994).

Finally, we think our descriptive results suggest fruitful avenues for future theoretical research.

The paper proceeds as follows. Section 2 describes our sample. Section 3 describes the VC contracts. Section 4 compares the empirical results in Section 3 and additional cross-sectional analyses to the assumptions and predictions of financial contracting theories. Section 5 presents additional descriptive information regarding the contracts that should be of use to future theory. Section 6 summarizes and discusses our results.

2. SAMPLE

We analyse 213 VC investments in 119 portfolio companies by 14 VC partnerships.

2.1. *Description*

To obtain this sample, we asked each VC to provide detailed information on as many of their portfolio company investments as they were willing to provide. For each of these companies, the VCs provided the documents that include all the financing terms, the firm's equity ownership—investors, founders, management, etc.—and any contingencies to future financing. The VCs also provided (if available) the portfolio company's business plan at the time of the financing, the VC's internal analysis of the investment, and the subsequent portfolio company financial performance.

Before we present our results, it is worth pointing out that while we have a great deal of data, we do not have complete data on every financing round. As a result, the number of observations varies across our analyses according to the availability of the relevant information.

Table 1 presents summary information. Panel A indicates that we have 213 investments in 119 portfolio companies by 14 VC firms. Ninety-eight of the 213 investments are the first VC financing rounds.

The VCs commit a median of $4·5 million in equity in each financing round. Not all of the committed financing is released to the company immediately, however. The VCs disburse a median $3·6 million at the time the round closed. The difference between committed financing and the amount that is released at the closing is particularly large for first VC financing rounds.[4]

The financing amount is the total for all VCs investing in the round. For the remainder of this paper, we aggregate the holdings of all the VCs investing in the same portfolio company, treating them as one. As seen from panel A, the median number of VCs involved in each investment is four, although it is lower for first and second financing rounds.[5]

Panel B shows that 166 of the financing rounds were completed between 1996 and early 1999, and that 79 of our 119 portfolio companies received their first round of VC financing within this period. This sample, therefore, largely reflects financings completed before the large increase in VC financing in 1999 and 2000.

Panel C shows that each VC firm provided at most 22 portfolio companies. The average VC firm age is about 13 years (median of 11). According to Venture Economics' (VE) rankings, seven of our VC firms rank among the 100 largest VCs in the U.S. in funds managed in 1999.[6] The median amount of funds managed is $525 million. The VC firms in our sample, therefore, seem representative of U.S. VCs, with perhaps a bias towards larger, more established funds.

Panel D presents the industry distribution of the portfolio companies in our sample. Consistent with the VC industry, the greatest percentage of companies, 42%, are in the information technology and software industries. An additional 13% are in telecommunications. Both of these industries include a number of Internet related investments. This concentration is roughly consistent with the industry distributions reported in VE.

Panel E presents the geographical distribution of the portfolio companies in our sample. The distribution is fairly uniform across California (28%), the Midwest (19%), the North-east (28%), and elsewhere. Relative to the VC industry as a whole, California firms are slightly underrepresented and Midwest firms are somewhat overrepresented. According to VE, 41% of overall VC investments were in California firms and only 14% in Midwest firms.[7]

2.2. *Sample selection issues*

In this section, we discuss potential selection issues concerning our sample. Our companies and financings are not a random sample in that we obtained the data from 14 VC firms with whom we have a relationship. In addition, only five of our 14 VC funds, representing 59% of the sample

4. We consider a financing round as a set of contracts agreed to on a particular date that determines the disbursement of funds from a VC to a company. A new financing round differs from the contingent release of funds in that the price and terms of the financing are not set in advance.

5. In a typical financing, one VC leads the round by negotiating the terms. If the VC chooses to syndicate the round, other VCs typically invest on the same terms as the lead VC. It is common for a VC to syndicate financings with the same group of VCs over time. See Sorensen and Stuart (2001). It is beyond the scope of this paper to consider agency problems among VC syndicates. Given the repeated nature of syndications, we believe it is reasonable to aggregate holdings and assume that the VCs in each round act to maximize value.

6. VE is one of the two major data services for the VC industry. Venture one is the other. VE provides databases on VC investments in portfolio companies and fundraising by VC partnerships. Two of our VC firms do not disclose the amount of funds under management and are not ranked in VE.

7. These figures are for the period between 1996 and 1999.

TABLE 1

Summary information

A. VC financing round statistics	All	1st	2nd	3rd	4th	5th	6th	7th +
Number of rounds in sample								
By all companies	213	98	50	31	17	7	5	5
By companies going public by 31 December 1999	73	29	18	13	6	2	2	3
By companies acquired by 31 December 1999	32	13	10	5	2	1	1	0
By companies private/liquidated by 31 December 1999	108	56	22	13	9	4	2	2
# Rounds in sample/# rounds reported by 1 May 1999:								
All rounds completed by 1 May 1999	59%	82%	60%	48%	42%	39%	56%	23%
By companies going public by 31 December 1999	53%	74%	58%	50%	38%	22%	40%	23%
By companies acquired by 31 December 1999	70%	76%	83%	56%	40%	50%	100%	—
By companies private/liquidated by 31 December 1999	62%	89%	54%	43%	45%	57%	67%	22%
VC financing amounts ($ millions):								
Total financing committed, Mean	6·8	6·8	6·3	7·4	6·4	11·1	3·3	8·6
Median	4·5	3·6	5·4	6·2	3·0	7·5	2·0	11·1
Financing provided up front, Mean	5·2	3·8	5·7	6·9	6·4	9·0	3·3	8·1
Median	3·6	3·0	4·7	6·2	3·0	6·6	2·0	9·4
Number of VCs in syndicate: Mean	4·3	2·7	4·8	6·4	5·6	6·7	6·6	10·2
Median	4·0	2·0	4·5	6·0	5·0	7·0	5·0	9·0

B. Year of VC financing

	Pre92	92	93	94	95	96	97	98	99	Total
Number of rounds in sample	13	2	3	12	17	53	53	57	3	213
Year company first received VC financing	10	2	1	13	14	33	21	23	2	119

C. VC firm characteristics

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
# Rounds	19	47	3	42	16	6	4	2	22	5	13	14	19	1	213
# Portfolio comp.	9	20	3	22	9	6	4	2	10	4	11	10	8	1	119
Main location	CA	MW	NE	MW	CA	NE	MW	CA	DIV	NE	MW	DIV	DIV	CA	
														Mean	Med
VC is younger than (yrs)	5	15	20	20	5	5	10	15	25	5	20	30	10	20	12·6	11·0
VC size rank in terms of managed funds, is top	100	100	25	250	250	—	—	250	25	250	250	25	100	100	123·2	90·5

D. Industry distribution of companies

	Biotech/Medical	IT/Software	Telecom	Healthcare	Retail	Other
Companies	18	50	15	11	11	14
Financing rounds	33	86	21	15	23	35

E. Geographical distribution of companies

	California	Midwest	North-east	Other
Companies	35	25	27	32
Financing rounds	59	40	60	64

F. Securities	Financing rounds	Percentage of rounds
Convertible preferred stock	170	79·8%
Convertible zero-coupon debt	4	1·9
Convertible preferred stock and convertible zero-coupon debt	4	1·9
Multiple classes of common stock	3	1·4
Convertible preferred stock and common stock	16	7·5
Convertible debt and common stock	1	0·5
Straight preferred stock and common stock	3	1·4
Convertible preferred stock and straight preferred stock	8	3·8
Convertible preferred stock, straight preferred stock, and common stock	4	1·9
Common stock	1	0·5
Convertible preferred is participating	82	38·5

TABLE 1—*Continued*

G. Other characteristics of the sample

	All rounds			First observed round for each company		
	Mean	Median	*N*	Mean	Median	*N*
Pre-revenue rounds, %	38·5	—	208	45·7	—	116
Repeat entrepreneur, %	16·9	—	213	16·0	—	119
Volatility of ind. log returns	6·05	5·94	213	6·13	5·99	119
Industry R&D/sales	0·063	0·090	212	0·063	0·090	118
Log industry sales ($M)	10·0	10·3	205	10·1	10·4	115
Industry fixed/total assets	0·273	0·260	213	0·277	0·270	119
Ind. long-term debt/assets	0·046	0·00	212	0·049	0·00	118

Summary information for 213 investments in 119 portfolio companies by 14 venture capital partnerships. Investments were made between December 1986 and April 1999. Reported rounds are the number of rounds completed before 1 May 1999, based on data from VE combined with contract information. Total financing committed is the amount of equity financing committed to by the VCs in each round. Financing provided up front is the amount of equity financing actually provided to the portfolio company at the round closing. The main location of the VC firms is either California (CA), Midwest U.S. (MW), North-east U.S. (NE), or diverse (DIV), *i.e.* the VC has several offices and no clear main location. The VC rank is in terms of funds managed in 1999 and was obtained from VE. Pre-revenue rounds are rounds where the venture has no revenues at the time of the closing. Repeat entrepreneurs are founders whose previous ventures were able to go public or were sold to a public company. Industry volatility is the value-weighted volatility of the log stock return for the venture's industry according to the Fama and French (1997) industry classification. 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. Industry log sales, in millions, are for the venture's four-digit SIC industry according to the 1997 U.S. census. Long-term debt to assets is the median ratio of long-term debt to assets for public firms in the venture's three-digit SIC industry according to COMPUSTAT.

portfolio companies, gave us either all of the deals from their recent fund or all of the deals of a particular partner.

It is possible that our sample is biased towards more successful investments. By the end of 1999, 25% of our sample companies had gone public, and another 13% had been acquired. This is slightly higher than the rates for all firms funded over all time periods by the VCs in our sample according to VE (16% IPOs and 15% acquisitions). The higher IPO rate in our sample, however, largely reflects the 1996–1999 period when VC investments were unusually successful. For the five VCs for whom we know no selection bias exists, the IPO rates in our sample were higher than for their overall historical portfolio, 20% compared to 17%. This suggests that there is at most only a modest bias towards more successful investments in our sample.

Another potential source of selection bias is that we have missing information on some of the financing rounds that our portfolio companies completed. Combining our data with information from VE, we were able to infer that our 119 portfolio companies completed a total of 358 VC financing rounds before May 1999 (the last financing round in our sample occurred in April 1999).[8] Hence, only 59% of the financing rounds completed are included in the sample. Panel A shows that we have data on 82% of the first financing rounds, and a smaller percentage for ensuing rounds. It does not seem that the coverage is correlated with performance, however. While we have a somewhat lower fraction of rounds from firms that are still private or were liquidated compared to the ones that were acquired, it is still higher than the fraction for firms that eventually went public.

Even if some performance selection biases exist in our sample, we do not think they are of much concern to our results because we do not attempt to measure performance. Rather, we try to characterize what contracts look like in general and, perhaps more importantly, what contracts

8. It also is worth pointing out that the VE data are not completely reliable. We found, significant inaccuracies in 95 of the 213 financing rounds we have. Lerner (1994) also acknowledges this problem.

are possible. Moreover, in our regression results, we control for VC firm fixed effects, which will pick up systematic differences in the data from the different VCs.

As mentioned above, the 14 VC firms that provided data appear to be largely representative of the overall U.S. VC industry. In addition, because the VC investments are syndicated, the 119 companies in our current sample received VC financing from more than 90 additional VC firms either in the financing round in our sample or in earlier financing rounds. A total of more than 100 different VC firms, therefore, invested under the terms of the contracts in our sample. This suggests that the financings in our sample are likely to be representative of VC contracts in general.

To conclude, the likely bias in our sample is that we have selected VC firms that are better than average. If this is so, we believe this strengthens our results because we are more likely to have identified sophisticated, value maximizing principals.

3. DESCRIPTIVE RESULTS

In this section, we describe the contracts between the portfolio companies/entrepreneurs and the VCs in great detail. We first describe the securities issued. We then describe how these contracts allocate cash flow rights, voting rights, board rights, and liquidation rights. Last, we consider in more detail the contingencies involved in allocating those rights. In the analysis, we report results for the whole sample as well as for the (98) financing rounds in which the company utilizes VC funding for the first time.

3.1. *Securities*

Panel F of Table 1 reports the types of securities used in the 213 financing rounds. Consistent with Sahlman (1990) and Gompers (1998), convertible preferred stock is the most commonly used security, appearing in 204 of 213 financing rounds. The panel also indicates, however, that VC financings (1) do not always use convertible preferred stock; and (2) frequently include securities in addition to convertible preferred stock. Only 170 of the rounds are financed solely by convertible preferred stock. Seven of the 213 financing rounds do not use any form of convertible security. Instead, they use multiple classes of common stock or a combination of straight preferred and common stock.

Panel F also reports that the VCs use a variant of convertible preferred called participating preferred in 82 of the financings. Upon the liquidation or exit of a participating convertible preferred, investors receive both the principal amount of the preferred—as they would in an investment of straight preferred—and the common stock promised under the conversion terms. As a result, participating convertible preferred is better categorized as a position of straight preferred stock and common stock than as a position of convertible preferred. In some instances, the participating preferred does not receive a return of principal if the company return is sufficiently high. This creates a payoff for the VC that looks like straight preferred and common over some valuation range and then convertible preferred above that range.

While the VC financings utilize different types of securities, the financings are similar in that they allow for different allocations of cash flow, voting, board, and liquidation rights. In the financings that use multiple classes of common stock, the VCs receive a different class of common stock than the founders who receive two or more classes of common stock. The VC class of common stock has voting, board, and liquidation rights that are different from those of the founders' classes of common stock. The cash flow rights of the classes of common stock also differ in that the founders' stock classes vest under different conditions from those of the VC class (which vests immediately).

3.2. *Residual cash flow rights*

Panel A of Table 2 presents our results on cash flow rights. By cash flow rights, we mean the fraction of a portfolio company's equity value that different investors and management have a claim to. Measuring cash flow rights is not trivial, however, because many of the cash flow rights accorded to founders and management are contingent either on subsequent performance (performance vesting) or on remaining with the company (time vesting). Panel A, therefore, presents three measures of cash flow rights. The first—minimum VC ownership—measures cash flow rights assuming management meets all performance and time vesting milestones or contingencies. The second—maximum founders and employee vesting—measures cash flow rights assuming all time vesting stock and options vest. The third—maximum VC ownership—measures cash flow rights if management does not meet any performance or time vesting milestones. Under each of the three measures, VC%, founders% and other% are, respectively, the percentage of cash flow rights owned by the VCs, the founders, and others. Founders include the founding management team. Others include employees and non-VC investors.

The ownership numbers are imperfect because we do not always have complete information on the vesting terms for issued options. When we do not have such information, we assume that the issued options are vested. Our results, therefore, understate the true extent of state contingent cash flow rights.

Panel A indicates that the VC typically controls roughly 50% of the cash flow rights; founders, 30%; and others, 20%. This suggests that substantial equity ownership on the part of founders is desirable. On the other hand, it also indicates that founders give up a large fraction of ownership.

Panel A also indicates that there are state-contingencies built into the cash flow rights. The VC stake is a median of 4·2% (average of 8·8%) lower under full vesting and good performance compared to the minimum vesting, bad performance state. State-contingencies are significantly greater in first VC rounds compared to subsequent ones, with a median of 8·0% (average 12·6%).

3.3. *Board and voting rights*

The rights to control or make corporate decisions are provided in board rights and in voting rights. The board is generally responsible for (1) hiring, evaluating, and firing top management; and (2) advising and ratifying general corporate strategies and decisions. Certain corporate actions are governed or subject to shareholder votes. These vary across firms, but sometimes include large acquisitions, asset sales, subsequent financings, election of directors, or any other actions stipulated by contract.

Board rights and voting rights can be different from cash flow rights and from each other. The difference is achieved in a number of ways including unvested stock options (which do not have votes), non-voting stock, contracts specifying a change in equity ownership at the IPO (*i.e.* at the point when the VC has pre-committed to giving up most control rights), or explicit contracting on the right to exercise votes depending on performance targets. Board rights, in turn, can be separated from voting rights through explicit agreements on the election of directors. Different securities also can have different rights to elect directors. Panels B and C of Table 1 describe board and voting rights in our sample.

3.3.1. Board rights. We distinguish between three kinds of board members—VCs, founders, and outsiders. VC seats are board seats that are reserved for or controlled by VCs. Founder seats are board seats that are reserved for or controlled by the founders/entrepreneurs. Outsider seats are board seats that are to be filled by individuals mutually agreed upon by the VCs and the founders/entrepreneurs.

TABLE 2

Distribution of cash flow, control, and liquidation rights

A. Residual cash flow rights

	Minimum VC ownership contingency		Max. founder and employee vesting contingency		Maximum VC ownership		Difference, min. and max. VC ownership	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
All rounds, N = 212								
VC%	46·7	47·3	47·9	47·9	55·5	57·5	−8·8	−4·2
Founders%	31·1	29·8	30·0	27·1	24·3	20·1	6·8	0·0
Others%	22·2	20·4	22·1	20·4	20·2	17·2	2·0	0·0
First VC rounds only, N = 98								
VC%	40·4	41·0***	42·4	43·1***	53·0	50·5*	−12·6	−8·0***
Founders%	39·5	38·7***	37·7	37·6***	29·6	29·5***	9·9	3·7***
Others%	20·31	18·8**	19·9	18·8**	17·4	13·2***	2·7	0·0

B. Board rights

Mean (median)	*All rounds, N = 201*		*First VC rounds, N = 95*	
	Normal	Adverse state	Normal	Adverse state
Number of board seats	6·0 (6·0)	6·3 (6·0)	5·7 (5·0)***	6·0 (5·0)***
% VC seats	41·4 (40·0)	46·0 (42·9)	37·0 (40·0)***	42·6 (40·0)***
% Founder seats	35·4 (37·5)	32·9 (33·3)	38·5 (40·0)***	35·4 (40·0)*
% Outsider seats	23·2 (20·0)	21·0 (20·0)	24·5 (20·0)	22·0 (20·0)
% VC board majority	25·4	35·8	11·6***	27·4**
% Founder majority	13·9	12·4	20·0**	16·8*
% Neither board majority	60·7	51·7	68·4**	55·8
% of cases with adverse state board provisions	18·4		21·1	
% Seats to cash flow rights, VC	1·00 (0·89)		1·09 (0·92)	
% Seats to cash flow rights, founder	1·77 (1·12)		1·27 (0·99)	
Signed rank test Z-stat [P-value] VC vs. F	−5·50***		−0·59	

C. Voting rights

Mean (median)	*All rounds, N = 212*			*First VC rounds, N = 98*		
	Minimum VC votes	Maximum VC votes	Difference min. − max.	Minimum VC votes	Maximum VC votes	Difference min. − max.
% VC votes	53·6 (52·9)	62·3 (64·3)	−8·7 (−1·6)	46·3 (45·4)***	58·9 (59·6)*	−12·6 (−6·4)***
% Founder votes	33·7 (31·1)	24·5 (20·1)	9·2 (1·5)	42·9 (42·5)***	29·8 (29·5)**	13·0 (6·2)***
% Others votes	12·6 (7·1)	13·1 (9·1)	−0·5 (0·0)	10·9 (5·4)**	11·3 (5·5)***	−0·4 (0·0)
% VC control	52·8	68·9		40·8***	61·2**	
% Founder control	23·6	12·3		37·8***	21·4***	
% Neither control	23·6	18·9		21·4	17·3	
% Switch in control	17·8			24·5**		
% Votes to cash flow:						
VC	1·16 (1·13)	1·15 (1·09)		1·16 (1·13)	1·16 (1·07)**	
Founder	1·08 (1·09)	1·02 (1·04)		1·06 (1·08)	0·98 (1·00)*	
Others	0·49 (0·49)	0·61 (0·64)		0·47 (0·43)	0·66 (0·72)	
Signed rank Z, VC vs. F	4·26***	5·01***		3·14***	3·00***	

D. Liquidation rights and redemption rights

	All rounds, N = 213			*First VC rounds only, N = 98*	
	% of obs.	Mean	(Med.)	% of obs.	Mean (Med.)
VC liq. rights < cumulative investment	1·5%			1·1%	
VC liq. rights = cum. investment	27·3%			29·0%	
VC liquidation rights > cum. investment	71·2%			69·9%	
Cumulative accruing dividend rate	43·8%	0·081	(0·080)	48·9%	0·079 (0·080)
Participating preferred stock	40·5%			30·8%***	
Common/conv. plus straight preferred	7·5%			10·2%	
Other cases with liq. rights > inv.	2·4%			2·1%	

TABLE 2—*Continued*

	All rounds, N = 213			*First VC rounds only, N = 98*		
	% of obs.	Mean	(Med.)	% of obs.	Mean	(Med.)
Non-VC liq. rights senior or par to VC/VC cumulative investment	49·8%	0·167	(0·000)	38·9%***	0·116	(0·000)**
Founder claims sen. or par to VC/cum. inv.	34·3%	0·059	(0·000)	24·5%***	0·092	(0·000)**
VC has redemption/put rights	78·7%			81·7%		
Among firms with redemption/put rights only:						
Maturity, years		4·87	(5·00)		5·28	(5·00)***
Redemption includes cum. div.	54·0%			59·2%		
Redemption at fair market value	12·9%			18·4%**		
Other redemption > cum. investment	9·8%			6·6%		
VC gets board control and/or right to sell company upon failed redemption	31·9%			38·2%		

E. Other terms

	All rounds, N = 213			*First VC rounds only, N = 98*		
	% of cases	Mean	(Med.)	% of cases	Mean	(Med.)
Automatic conversion provisions	95·2			92·6		
Auto. conv. price/round price		3·6	(3·0)		4·4	(3·0)%***
Any anti-dilution protection	94·7			91·0**		
Full ratchet	21·9			24·7		
Weighted average	78·1			75·3		
Founder vesting	41·2			48·0*		
Founder non-compete clauses	70·4			71·2		
Founder non-compete, excl. California	73·5			78·4		

Post-round allocations of rights for 213 investments in 119 portfolio companies by 14 venture capital partnerships. Investments were made between 1987 and 1999. VC allocations are aggregated over all claims from VCs present in a particular round. Founders include the founding management team. Others include employees and non-VC investors. In *Panel A*, VC%, founders% and other% are, respectively, the percentage of residual cash flow rights (*i.e.* fully diluted equity) owned by the VCs, the founders, and others. Minimum VC ownership if management meets all performance and vesting milestones or contingencies. Max. founders and employees vesting occurs if non-performance based management stock and options vest. Maximum VC ownership occurs if management does not meet performance milestones and stock and options do not vest. In *Panel B*, normal board is the board at the completion of the financing. Adverse state board is the board that will result if the portfolio company performs poorly or reaches an adverse state. VC seats are board seats that are reserved for VCs. Founder seats are board seats that are reserved for or controlled by the founders/entrepreneurs. Outsider seats are board seats that are to be filled by individuals mutually agreed upon by the VCs and the founders/entrepreneurs. % seats to cash flow is the fraction of board seats divided by the fraction of residual cash flow rights held by the VCs, founders and others. The % seats to cash flow excludes observations where cash flow rights are zero. In *Panel C*, minimum (maximum) VC votes represents the minimum (maximum) votes the VCs control based on subsequent management performance and vesting milestones or contingencies. % VC, % Founder and % Neither control are, respectively, the percentage of instances in which voting control is held by the VCs, the founders, or neither. % Votes to cash flow is the fraction of votes divided by the fraction of residual cash flow rights held by the VCs, Founders and Others. The % Votes to cash flow excludes observations where cash flow rights are zero. In *Panel D* liquidation rights are the proceeds accruing to the party upon a liquidation or bankruptcy. The mean and median dividend rates are over observations that have cumulative accruing dividends, while mean and median fractions of non-VC senior or par claims are over all observations. In *Panel E*, conversion price is the IPO or sale price per share of common stock at which the venture capital securities automatically convert into common stock. Round price is the price per share of common stock at which the securities issued in the current round convert or are priced. If a company subsequently issues equity at a lower price per share than the current round: under a full ratchet provision, the conversion price on the current round drops to the new issue price; under a weighted-average provision, the conversion price of the current round declines to a value between the current round and the new issue price. First VC rounds differ from subsequent rounds at the 1%***, 5%**, and 10%* levels.

We also distinguish between normal board rights that reflect the board rights or composition at the completion of the financing from adverse state board rights that reflect board rights or composition if the portfolio company performs poorly or reaches an adverse state.

Panel B reports that boards have an average of and a median of six members. These boards are appreciably smaller than those of public companies. Overall, the VC has the majority of the

board seats in 25% of the cases, the founders in 14% of the cases, and neither in 61% of the cases. VC board control is less common for first VC rounds.

State-contingent board provisions (*i.e.* the VC gets control of the board in the bad state) are present in 18% of the cases. This provides an important example of state-contingent control rights that do not occur simply in case of default on a debt payment. This state-contingency result and those that follow are important in light of several of the financial contracting theories we describe in Section 4.

3.3.2. Voting rights. Panel C of Table 2 reports post-round voting rights. Voting rights measure the percentage of votes that investors and management have to effect corporate decisions.

In panel C, minimum (maximum) VC votes represents the minimum (maximum) votes the VCs control based on subsequent management performance and stock vesting milestones or contingencies. VC%, Founder%, and Neither% control are, respectively, the percentage of instances in which voting control is held by the VCs, the founders, or neither. Switch in control indicates the percentage of instances in which voting control can switch based on subsequent performance.

Panel C indicates that VCs have a voting majority in 53% of all financings in the minimum contingency case and in 41% of first VC rounds. In the maximum VC vote contingency cases, VCs control a voting majority in 69% of all financings and 61% of first VC rounds.

Voting control also is commonly state-contingent. In 18% of all financings and 25% of first VC financings, voting control switches depending on state-contingencies.

We also measure the degree to which voting and cash flow rights are separated by the fraction of votes to cash flow. VCs hold a significantly higher fraction of votes to cash flow rights than the founder, while both VCs and founders hold a higher fraction of votes than others, such as employees.

3.4. *Liquidation cash flow rights*

The residual cash flow rights discussed in the previous section describe how the cash flow rights of the company are divided in the good state of the world, when the value of the venture is sufficiently high and after senior claims have been paid off. In contrast, when the value of the venture is low, the cash flow rights go to the senior claims, which we call the liquidation cash flow rights. In this subsection and in panel D of Table 2, we describe the liquidation cash flow rights in VC financings.

First, VCs have claims that in liquidation are senior to the common stock claims of the founders. This is true in all but one of the financings. In that financing, the VC bought common stock.

Second, the claims of the VCs in liquidation are typically at least as large as the original investments. Panel B indicates that this is true in more than 98% of the financings.

Even though most of the financings give liquidation claims to the VCs, there are some cross-sectional differences in how strong these are for different deals. One common way of making the liquidation rights stronger is to make the preferred dividends cumulative (rather than non-cumulative). Even though these are dividends that do not have to be paid out, they accumulate and are added to the liquidation claim. Cumulative preferred dividends are present in 43·8% of our financings.

Another common way that VCs strengthen liquidation rights is to use either participating convertible preferred stock or a combination of common and straight preferred stock. These are present in 48% of our deals. In both of these cases, the VC receives not only a senior liquidation

claim up to the face value of the preferred (plus the accumulated dividend, if present) but also shares whatever value is left after the senior claim has been paid off with the common stock.

3.5. *Redemption rights*

Optional redemption and put provisions also are commonly used to strengthen the liquidation rights of the VC's investment. After some period of time, these provisions give the VC the right to demand that the firm redeem the VC's claim, typically at liquidation value (or occasionally, at the maximum of the liquidation value and "fair market value"). This is very similar to the required repayment of principal at the maturity of a debt claim. Without this provision, the liquidation right loses much of its bite because there are no other contracted payments for the firm to default on. Unlike a debt claim, however, the company cannot force the VC to exercise the redemption right. Panel D indicates that redemption provisions are present in 78·7% of our financings with a typical maturity of 5 years.

3.6. *Other terms*

VC financings include a number of additional terms and conditions. Sahlman (1990), Bartlett (1995), Gompers (1998) and Levin (1998) detail many of these. In this section, we describe several of the terms and conditions that we believe are relevant to the financial contracting theories.

3.6.1. Automatic conversion. Securities in VC financings often include automatic conversion provisions in which the security held by the VCs automatically converts into common stock under certain conditions. These conditions relate almost exclusively to an initial public offering (IPO) and require a minimum common stock price, dollar amount of proceeds, and/or market capitalization for the company.[9]

As Black and Gilson (1998) argue, the effect of these provisions is to require the VCs to give up their superior control, board, voting, and liquidation rights if the company attains a desired level of performance. Upon such performance, the VCs retain only those rights associated with their ownership of common stock. If the company does not deliver that performance, the VCs retain their superior control rights. This provides the entrepreneur an incentive to perform in addition to the monetary incentive.

Panel E of Table 2 indicates that an automatic conversion provision is present in 95% of the financing rounds. The financing rounds that included an automatic conversion provision required that the company complete an IPO at an IPO stock price a median 3·0 times greater than the stock price of the financing round. The ratio is significantly higher in first VC rounds.

It is worth emphasizing that at the median ratio of 3·0, the VCs are not willing to give up control unless they triple their money. Over a 4-year horizon, this works out to a return of 31% per year.

3.6.2. Anti-dilution protection. VC financings also frequently include anti-dilution protection that protects the VC against future financing rounds at a lower valuation than the valuation of the current (protected) round. In the extreme case, known as full ratchet protection, the protected security receives a claim to enough additional shares in the subsequent financing to reduce the price of the protected issue to the price of the new issue. In a convertible issue, this is accomplished by decreasing the conversion price on the protected issue to the conversion price

9. Unlike Gompers (1998), who analysed 50 contracts for one specific VC firm, we never observed automatic conversion contingent on profit or sales benchmarks, and conclude that these are probably quite rare.

of the new issue. The other common type of anti-dilution protection is the weighted average ratchet. Under a weighted average ratchet, the reduction in the conversion price (or common stock price) of the protected issue is a function of the existing shares, the new shares issued and the conversion price of the new issue.

Panel E indicates that almost 95% of the financings include anti-dilution protection. About 78% of these financings utilize the weighted average method rather than the full ratchet method.

3.6.3. Vesting and non-compete clauses. The inalienability of human capital theories of Hart and Moore (1994) assume that the entrepreneur cannot contractually commit to stay with the firm. Even though it is not possible to write enforceable contracts that compel the entrepreneur to stay with a firm, there are contractual provisions that make it more costly for the entrepreneur to leave. In real-world contracts, two methods are commonly used to make it costly for the entrepreneur to leave the firm.

First, the entrepreneur's shares can vest over time. This means that the company receives or can buy back any unvested shares for some low value if the entrepreneur leaves. The earlier the entrepreneur leaves, the more shares are unvested. Second, the VCs can require the entrepreneur to sign a non-compete contract that prohibits him from working for another firm in the same industry for some period of time if he leaves. Both of these provisions improve the bargaining power of the VCs if the entrepreneur tries to hold up the VCs.

Panel E shows that the VC financings commonly utilize both founder vesting and non-compete clauses. Founder vesting is used in almost 41% of financing rounds. Such vesting is more frequent in first VC financings (48%). Non-compete clauses are used in approximately 70% of the financings.

3.7. *Contingencies*

Different theories make different assumptions concerning what it is and is not possible to write contracts on. For example, some financial contracting theories—see Hart and Moore (1998)—assume that the entrepreneur and outside investors can observe firm output, but cannot write contracts on that output because output cannot be verified in court.

Panel A of Table 3 reports the extent and nature of contracts between VCs and entrepreneurs that are contingent. Contracts may be contingent on subsequent financial performance, non-financial performance, actions, dividend payments, future security offerings, or continued employment. Contingencies may affect cash flow rights, voting rights, board rights, sale rights, liquidation rights, redemption rights, or future funding. Panel B reports specific examples of these contingencies.

Panel A indicates that almost 73% of the financings explicitly include some type of contingency. In particular, over 17% of financings are contingent on financial performance; almost 9% on non-financial performance; and 11% on actions. The panel also shows that in almost 15% of the financings, the VCs provide only a portion of the total funding commitment at the closing or signing of the financing. Additional funding is contingent on subsequent performance and actions. For example, in two financings, the VC provided only 5% of its total commitment at closing with the rest being contingent.[10]

Panel B reports specific examples of contingencies. In one financing round, the VCs contractually obtain voting control from the entrepreneur if the firm's EBIT—earnings before interest and taxes—falls below a mutually agreed upon amount. In another financing round, VCs

10. About 55% of these contingencies (excluding vesting) specify a specific time horizon, which is typically 12–18 months from the initial closing, but in a few cases 5 years or more.

TABLE 3

Contingencies and the contracting space

A. Percentage of rounds with contingent contracts

	Cash flow rights	Voting rights	Board rights	Right to force sale	Liquidation, or dividend amount	Redempt. rights	Release of committed funds	Any rights
Contingent on financial performance	8·0% [11·2]*	5·6% [7·1]	0·5% [1·0]	1·4% [2·0]	3·3% [2·0]	0·5% [1·0]	4·2% [7·1]*	17·4% [22·4]*
Contingent on non-financial performance	6·1 [6·1]	4·2 [3·1]	0·0 [0·0]	0·0 [0·0]	0·0 [0·0]	0·0 [0·0]	3·3 [5·1]	8·9 [11·2]
Contingent on actions	1·9 [2·0]	0·5 [0·0]	0·5 [1·0]	0·0 [0·0]	0·0 [0·0]	0·5 [0·0]	8·9 [12·2]	11·3 [14·3]
Contingent on default on dividend or redemption payment	5·2 [6·1]	5·2 [6·1]	19·2 [21·4]	1·4 [2·0]	2·8 [1·0]	0·5 [0·0]	0·0 [0·0]	27·7 [29·6]
Contingent on future securities offerings or "fair market value"	8·9 [13·3]**	7·5 [9·2]	0·0 [0·0]	3·8 [5·1]	11·7 [16·3]*	0·9 [1·0]	0·9 [1·0]	21·1 [27·6]**
Any of the above	18·8 [23·5]*	15·5 [16·3]	19·2 [22·4]	6·1 [8·2]	15·5 [19·4]	2·3 [2·0]	14·6 [20·4]**	52·6 [60·2]**
Contingent on founder remaining with firm	44·6 [51·0]*	40·4 [48·0]**	— —	0·0 [0·0]	0·0 [0·0]	0·0 [0·0]	0·9 [1·0]	40·8 [51·0]*
Any contingent contracting	52·6 [61·2]**	50·7 [58·2]**	19·2 [22·4]	6·1 [8·2]	15·5 [19·4]	2·3 [2·0]	14·6 [20·4]**	72·8 [79·6]**

Contingencies for 213 investments in 119 portfolio companies by 14 venture capital partnerships. Investments were made between 1987 and 1999. Table measures the extent to which venture capital contracts include contingencies based on observable and verifiable characteristics or states. The numbers in the table are the percentage of all rounds that exhibit a certain type of contingent contracting. The numbers in brackets are the corresponding percentages of first VC financings only. The "Contingent on future securities offerings or 'fair market value'" group excludes anti-dilution and automatic conversion provisions. First VC rounds differ from subsequent rounds at the 1% ***, 5% **, and 10% * levels.

B. Examples of contingencies

Type of contingency	Examples
1. Contract contingent on financial measures of performance	• VC dividend on preferred shares, payable in common stock, is suspended if revenue and operating profit goals attained (CF, VO) • Founder (VC) receives options if revenue/earnings goal (not) attained (CF) • VC can only vote for all owned shares if realized EBIT below threshold value, in which case VC gets voting control (VO) • If net worth below threshold, VC will get three more board seats (BD) • Founder has veto power against sale of company for 3 years, as long as company achieves at least 80% of revenues and profits before tax relative to business plan (FS) • VC liquidation value multiple of net operating cash flow or net earnings (LI) • If earnings are below threshold, VC is allowed to redeem shares (RD) • Committed funds paid out when achieves projected net revenue (ST)
2. Contract contingent on non-financial measures of performance	• Employee shares vest when release of second major version of the product that incorporates significant new functionality, FDA approval of new drug, new corporate partnership found, or patents approved (CF, VO) • VC gets fewer shares if secures distribution agreement within 3 months (CF, VO) • Founder gets options when company secures threshold number of customers who have purchased the product and give positive feedback (CF) • Committed funding paid out when new clinical tests completed, new strategic partnership completed, or patent approved (ST)
3. Contract contingent on meeting dividend or redemption payment	• If company cannot pay dividend in cash, it has to be paid in common stock (CF, VO) • If company fails to redeem preferred stock, VC elects majority of board (BD)

TABLE 3—*Continued*

Type of contingency	Examples
	• If company fails to pay out certain fraction of revenue as a dividend, VC elects majority of board (BD) • If company fails to redeem preferred stock, VC has the right to select an investment banker to assist in the sale of the business (FS) • If company fails to redeem preferred stock, cumulative dividend will be increased (LI)
4. Contract contingent on certain actions being taken	• Founder gets equity when VP of sales and marketing hired, or acquires certain technology (CF, VO) • VC gets board majority if company fails to recruit a CEO within 9 months (BD) • VC has option to redeem preferred stock until new CEO hired acceptable to VC (RD) • Committed funding paid out subject to new business plan for entering new markets completed and approved by board, new key executives or CEO hired, certain company acquired, or company starts to develop new facilities (ST)
5. Contract contingent on offering of securities	• Founder ownership increasing non-linear function of share price obtained in sale or IPO (CF) • VC receives dividend in stock, cancelled upon IPO of minimum value, or if company manages to raise minimum amount of new funding above minimum price per share (CF, VO) • VC warrants expire if company manages to raise alternative funds where proceeds and price of securities exceed threshold (CF) • If no IPO has occurred within 5 years, VC has right to force a sale of company (FS) • VC can redeem preferred shares after IPO at a value that increases the later the IPO date (LI) • VC can redeem shares at fair market value (LI)
6. Contract contingent on founder staying with firm	• Founder loses unvested shares if employment terminated (CF, VO) • Founder loses voting rights (but keeps cash flow rights) for shares if terminated for cause (VO) • Committed funding paid out under the condition that founder still employed (ST)

Contingencies for 213 investments in 119 portfolio companies by 14 venture capital partnerships. Investments were made between 1987 and 1999. Table gives examples of contingencies based on observable and verifiable characteristics or states. Examples include contingent residual cash flow rights (CF), voting majority (VO), board control (BD), right to force a sale (FS), liquidation or dividend cash flow rights (LI), redemption rights (RD), and release of committed financing (ST).

obtain board control if a firm's net worth falls below a threshold. These examples indicate that VCs are able to write (and presumably enforce) contracts in which control rights are contingent on subsequent financial performance independently of cash flow rights.

Panel B.2 shows that financing rounds include contingencies based on subsequent non-financial performance. In one instance, share vesting is contingent on product functionality or performance. In several others, vesting is contingent on FDA or patent approvals.

Panel B.4 describes financing rounds that include contingencies based on certain actions being taken. For example, in different rounds, the disbursal of committed funding is contingent on hiring new executives, developing new facilities, and completing a new business plan. Presumably, these actions are both observable and verifiable.

Overall, Table 3 generates two strong results. First, investors (VCs) commonly write contracts in which control rights are contingent on subsequent measures of financial performance, non-financial performance, and actions. Second, there is a great deal of variation in the contingencies in these contracts. By looking at the contingencies, we also obtain examples of managerial actions that the VC is trying to induce or avoid. We discuss these issues in more detail in Kaplan and Strömberg (2002).

3.8. *Summary*

We make several general observations concerning the descriptive results in this section.

First, VC financings allow VCs to separately allocate cash flow rights, board rights, voting rights, liquidation rights, and other control rights.

Second, while VCs use convertible securities most frequently, they also implement the same allocation of rights using combinations of multiple classes of common stock and straight preferred stock. Furthermore, VCs make frequent use of participating convertible preferred which is the equivalent of a position of preferred stock and common stock rather than a position of convertible preferred.

Third, rights are allocated such that if the company performs poorly, the VCs obtain full control. As company performance improves, the entrepreneur retains/obtains more cash flow rights and control rights. If the company performs very well, the VCs relinquish most of their control and liquidation rights.

Fourth, it is common for VCs to include non-compete and vesting provisions aimed at mitigating the potential hold-up problem between the entrepreneur and the investor. The vesting provisions are more common in early stage financings where it is more likely that the hold-up problem is more severe.

Finally, cash flow rights, control rights, voting rights, and future financings are frequently contingent on observable measures of financial and non-financial performance. These state contingent rights are more common in first VC and early stage financings.

4. RELATION TO FINANCIAL CONTRACTING THEORIES

In this section, we interpret our results relative to financial contracting theories. We focus on three general classes of theories: (1) classical principal–agent; (2) control theories; and (3) debt theories. We consider the extent to which the contract provisions we have examined are consistent with the assumptions and predictions of the theories. We augment this discussion and analysis with cross-sectional regressions when appropriate. We conclude this section by discussing the results for the general classes of theories in relation to more recent VC specific theories.

4.1. *Allocation of cash flow rights and pay performance incentives*

4.1.1. Theoretical predictions. The first set of theories deals with the allocation of cash flow rights between the VC and entrepreneur. The classical principal–agency approach, pioneered by Holmström (1979), assumes that the agent's effort is unobservable to the principal. Signals, such as firm output or profits, however, are correlated with effort and can be contracted on. The optimal incentive contract ensures that the agent puts in enough effort by making the agent's compensation dependent on the outcome of the signals. In the basic model, and in the absence of risk aversion, the investor maximizes the sensitivity of the agent's compensation to the signal. Moreover, it is in the investor's interest to make the entrepreneur's compensation contingent on as many verifiable signals correlated with effort as possible (the "Informativeness Principle" of Holmström (1979); see also Harris and Raviv (1979), Innes (1990)).

The result that the entrepreneur's pay performance sensitivity should be maximized may not hold if the entrepreneur is risk averse or if multi-tasking problems exist. Compensation contingent on performance is costly because a risk-averse entrepreneur requires a higher level of compensation to offset the extra risk. Prendergast (1999) mentions several potentially testable predictions: (1) entrepreneurs who are more risk averse will have less pay performance sensitivity. (2) Noisier performance signals impose more risk on the entrepreneur, making

pay performance sensitive compensation more expensive. Less noisy performance measures should be given relatively higher weight in compensation. (3) The higher the positive effect on performance for a given effort by the entrepreneur, the higher the pay performance sensitivity should be. (4) If entrepreneurs differ in ability, performance sensitive contracts will be relatively more attractive to better entrepreneurs (holding risk aversion constant). This gives rise to selection effects (see Lazear, 1986). Investors can screen out entrepreneurs by offering high-powered compensation contracts because only high-ability entrepreneurs will accept such contracts. Hence, the higher the asymmetric information regarding the ability of the entrepreneurs, the higher the pay performance sensitivity in the contracts offered by the investor.

Multi-tasking models (Holmström and Milgrom (1991), Baker (1992)) assume that there are several activities for which the entrepreneur needs to exert effort. This leads to a problem of potential "gaming", where the entrepreneur will only exert effort in the activity whose signal is most rewarded in the compensation contract. As a result, overall incentives have to be muted in the optimal compensation contract, and the principal will tend to rely more on subjective performance evaluation. This suggests that compensation should be less dependent on performance and more dependent on subjective performance measures in situations with gaming potential.

4.1.2. Empirical results. The descriptive analysis of cash flow rights in Table 2 seems largely consistent with both the assumptions and predictions of the classical principal–agent approach. In our financings, the entrepreneur gets a large fraction of equity in the firm and the entrepreneur's equity stake increases with performance. Moreover, Table 3 shows that the contracts often condition the entrepreneur's equity compensation on a multitude of financial and non-financial signals, consistent with the "Informativeness Principle".

To test the models, we would ideally plot the entrepreneur's compensation as a function of the venture's value, and examine what independent variables determine the shape of this function. The pay performance sensitivity of the founder's compensation is increasing both in the function's slope—the fraction of the value promised to the entrepreneur at a given value—and its convexity—the increase in the fraction of the value given to the entrepreneur as value increases.

Because it is hard to capture these aspects in one single measure and no measure is perfect, we examine several. First, we look at the percentage of the residual cash flow rights allocated to the founder (FRCFs). This captures the compensation function slope given that the venture is worth more than the liquidation claims. This percentage, unfortunately, is not ideal, because it is also potentially a function of the (unobservable) quality of the entrepreneur.

Second, we look at the change in the fraction of FRCFs as a function of vesting. As this fraction becomes more state-contingent, the compensation function becomes more convex and the pay performance sensitivity increases. We separate contingencies into the sensitivity due to performance vesting—financial or non-financial—and the sensitivity due to time vesting of the founders' shares. This is a relevant separation in theory as time vesting can be interpreted as a form of subjective performance evaluation. With time vesting, the founder's compensation is contingent on the board's decision to retain the founder, rather than on explicit benchmarks. This might be expected to be more likely when multi-tasking is present.[11] We measure the change in FRCFs both on an absolute scale and relative to the level of the FRCF. We think the relative

11. This also is a prediction from the control theory of Hart and Moore (1994) that we describe in the following section. Vesting makes it more costly for the founder to leave the company which mitigates a potential hold-up problem.

change in FRCF is more indicative of incentives because it measures the fraction of the founders' equity that is at risk, therefore, controlling for unobservable quality.

Third, we look at the degree to which the founder has claims to the liquidation proceeds. Giving the founder part of the liquidation cash flow rights lowers the convexity of the compensation function and leads to lower pay performance sensitivity.

The key independent variables in our analyses are pre-revenue, repeat entrepreneur, and months since the first VC round. Pre-revenue equals one if the company had no revenues at the time of financing, and zero otherwise. It seems likely that uncertainty and asymmetric information are greater for pre-revenue firms. It also is arguable that incentive problems are more severe for early stage ventures since the entrepreneur's effort is relatively more important. As Myers (2000) assumes, this likely would be the case of the development of a new technology or concept. Once the technology or concept has been created or validated, the founders are more replaceable with outsiders.

Repeat entrepreneur takes the value of one if the founders previously founded a company that was either taken public or acquired by a public company, and zero otherwise. This provides a measure of the extent to which VC may have prior information on the quality of the founders. Such information reduces the likelihood of adverse selection and the uncertainty of the venture.[12] If this is important, we would expect repeat entrepreneurs to have lower powered incentives. On the other hand, repeat entrepreneur also is likely to be correlated with higher outside wealth and lower risk aversion. If repeat entrepreneur measures differences in risk aversion, we would expect repeat entrepreneurs to have higher powered incentives.

Months since the first VC financing round is another measure of asymmetric information. VC uncertainty about management quality and asymmetric information should be highest in the first VC financing round and should decrease thereafter.

Table 4 presents the results of our cross-sectional regression analyses. The regressions include controls for industry volatility, industry research and development (R&D), industry size, company location, and VC.[13] We also control for the amount of funds invested by the VC by including in the accumulated VC investment as a control variable.[14] Finally, we attempt to include a control for performance. Although we have incomplete data on accounting performance, we have more complete data on financing terms. Accordingly, we measure performance based on the annual return on the securities since the initial investment. When the company performs poorly, the VCs will pay less for the securities acquired in the round. A problem with using this return as an independent variable is that the round price is endogenous and related to the percentage of equity allocated to the VC in the round. To address this, we include dummies for whether the return is in the upper or lower quartile rather than including the return directly.

The first regression in Table 4 examines the determinants of the fraction of equity (cash flow rights) allocated to the entrepreneur. The only significant result is that as the VC–entrepreneur relationship progresses, the founder's equity stake declines. This is consistent with classical principal–agent theory—lower powered incentives are required as asymmetric information declines. This also may be a function of the need to provide newly hired managers with equity incentives as the company grows.

The second and third regressions of Table 4 analyse the determinants of absolute and relative sensitivity to explicit performance benchmarks. Explicit performance-based equity compensation is used more in pre-revenue ventures, less for repeat entrepreneurs, and earlier in

12. We use the company business plan, the VC analysis, and company web sites to obtain this information.

13. The table provides a more detailed description of the control variables in the regressions.

14. Because this is potentially endogenous, we instrument this variable with median industry capital expenditures and yearly time fixed effects using two-stage least squares.

TABLE 4

Determinants of founder cash flow incentives

	% Founder residual cash flow rights (FRCF), best case	% FRCF sensitivity, performance benchmarks	Relative % FRCF sensitivity, performance benchmarks	% FRCF sensitivity, vesting	Relative % FRCF sensitivity, vesting	Founder has liquidation CF rights (logit)
Sample	All, $N = 189$	All, $N = 189$	All, $N = 188$	All, $N = 189$	All, $N = 188$	All, $N = 163$
Constant	—	—	—	—	—	—
Pre-revenue	−3·68 (3·17)	1·61 (0·63)**	4·74 (1·69)***	8·47 (2·33)***	23·62 (6·04)***	0·06 (0·56)
Repeat entrepr.	6·14 (3·76)	−0·67 (0·47)	−2·20 (1·24)*	−0·06 (2·30)	1·96 (7·09)	1·78 (0·62)***
Months since 1st VC round	−0·70 (0·12)***	−0·06 (0·03)**	−0·13 (0·06)**	−0·063 (0·06)	−0·37 (0·20)*	0·028 (0·013)**
VC cum. invest (instrumented)	3·67 (2·79)	1·13 (0·67)*	3·20 (1·72)*	−0·37 (1·76)	3·51 (5·38)	—
Return	−1·35 (2·44)	−0·81 (0·36)**	−2·34 (1·02)**	0·08 (1·01)	1·86 (3·36)	0·25 (0·44)
Ind. volatility	−2·57 (2·36)	−0·45 (0·38)	−2·03 (0·93)**	4·16 (1·69)**	10·76 (4·19)**	0·012 (0·38)
Ind. R&D/sales	35·0 (37·6)	−20·1 (11·2)*	−69·4 (31·4)**	23·4 (21·7)	17·48 (67·66)	−6·74 (5·76)
Industry size	1·53 (1·20)	0·68 (0·28)**	2·43 (0·81)***	−0·72 (0·75)	−0·34 (2·42)	−0·094 (0·20)
California	1·86 (3·55)	−2·02 (0·70)***	−6·61 (1·91)***	−1·82 (2·36)	−19·01 (7·01)***	−0·99 (0·58)*
Midwest	12·9 (4·30)***	−0·44 (0·89)	−0·55 (2·17)	−2·40 (2·06)	−20·91 (6·89)***	−0·67 (0·58)
North-east	4·67 (4·00)	−1·21 (0·93)	−4·78 (2·29)**	−1·42 (2·09)	−10·16 (7·13)	−1·63 (0·60)***
χ^2/F-test, location [P-value]	3·70 [0·03]**	6·18 [0·002]***	6·23 [0·002]***	0·08 [0·92]	0·95 [0·38]	2·49 [0·29]
VC dummies	Yes	Yes	Yes	Yes	Yes	Yes
χ^2/F-test, VC [P-value]	2·30 [0·02]**	2·72 [0·008]***	2·94 [0·004]***	1·67 [0·11]	0·84 [0·57]	8·94 [0·18]
Adj. / Ps. R2	0·31	0·33	0·40	0·27	0·30	0·22

OLS and two-stage least squares regressions of founder cash flow incentives on various independent variables for 213 investments in 119 portfolio companies by 14 venture capital partnerships. Investments were made between 1987 and 1999. % Founder residual cash flow rights (FRCF), best case is the % of cash flow rights owned by founders if they meet all time and performance vesting milestones. % FRCF sensitivity, performance (time vesting) benchmarks is the difference in founder's equity if they meet performance (time vesting) benchmarks. Relative % FRCF sensitivity, performance (time vesting) benchmarks are the corresponding measures as a percentage of the founder's equity stake in the best case. Pre-revenue takes the value of one if the venture has no revenues at the time of financing, and zero otherwise. Repeat entrepr. takes the value of one if the founder's previous venture was able to go public or was sold to a public company. Industry volatility is the value-weighted volatility of the log stock return for the venture's industry according to the Fama and French (1997) industry classification. 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. Industry size is equal to log sales, in millions, in the venture's four-digit SIC industry according to the 1997 U.S. census. VC cumulative investment is instrumented using two-stage least squares with industry capital expenditures to sales as well as year dummies. Return takes the value of minus one if the ratio of per share round price to first round price is in the lowest quartile, one if it is in the highest quartile, and zero otherwise. White (1980) robust standard errors are in parentheses. Asterisks indicate statistical significance at the 1%***, 5%**, and 10%* levels. In the fourth regression, 29 observations (corresponding to two specific VCs) had to be dropped due to collinearity.

VC–founder relationships. All three of these results are consistent with asymmetric information and moral hazard models where pay performance sensitivity increases when uncertainty about venture quality is higher. The negative coefficient on repeat entrepreneur suggests that repeat entrepreneur picks up information effects rather than risk aversion effects. Also, the negative coefficient on the return variable indicates that the use of explicit performance benchmarks increases with poor performance.

The results imply economically meaningful effects. The relative (absolute) sensitivity to explicit performance benchmarks is 4·7% (1·6%) greater in pre-revenue companies and 2·2% (0·7%) lower when repeat entrepreneurs are present. These compare to mean values for relative and absolute sensitivities of 3·5 and 1·1%, respectively.

The fourth and fifth regressions analyse the determinants of absolute and relative pay performance sensitivity due to time vesting. Time vesting is significantly higher for pre-revenue ventures and, in the relative regressions, for early VC–founder relationships. The relative and absolute sensitivities to time vesting for pre-revenue companies are large at 23·6 and 8·5%, respectively. Again, this is supportive of asymmetric information and moral hazard models.

Interestingly, the signs on the industry ratios are opposite the ones in the performance benchmark regressions. The contracts in high volatility, high R&D, and smaller, presumably less established industries seem to use time vesting rather than explicit performance benchmarks to induce pay performance sensitivity. One interpretation, consistent with theory, is that these are environments where explicit performance signals are noisier measures of true performance. Because of this, explicit performance benchmarking will be more costly, both because of managerial risk aversion as well as multi-tasking or gaming problems.

Finally, in the sixth regression, we use a logit specification to analyse the determinants of founder liquidation rights.[15] While pre-revenue is not significant, both repeat entrepreneur and months since first VC round are positive and significant. Hence, when the founder has been successful in the past, and as the VC learns more about the firm over time, the founder has more liquidation rights. Again, this is consistent with less pay-for-performance as asymmetric information declines. Again, this result is not consistent with repeat entrepreneur as a measure of (less) risk aversion.

The results in Table 4 control for VC and location fixed effects. The use of performance benchmarks varies significantly among VCs. Also, explicit performance benchmarks are used significantly less in California ventures. Hence, contract design may be affected by different contracting "styles" for different VCs and markets.

To sum up, the regressions in Table 4 are largely supportive of classical principal–agent theories and their screening implications. As uncertainty about the quality of the venture and the founder increases, the VC increases the pay performance sensitivity by making the founder's cash flow compensation increasingly convex in performance through more explicit performance compensation, more time vesting, and fewer liquidation cash flow rights. Also, as explicit performance signals become noisier measures of true performance, the contracts substitute explicit performance benchmarks with more vesting and lower liquidation cash flow rights.

4.2. *Control theories: cash flow verifiable but not actions*

4.2.1. Theoretical predictions. Board rights and voting rights give the controlling party the right to decide on any action that is not pre-specified in the original contract. Such rights are valuable in an incomplete contracting world, when it is not feasible or credible to specify

15. The logit regression excludes observations for VCs that did not allocate founder liquidation rights in any of their investments. The results are qualitatively similar when we exclude the VC dummies and include all observations.

all possible actions and contingencies in an *ex ante* contract. Incomplete contracting and control rights were introduced by Grossman and Hart (1986) and Hart and Moore (1990).[16] These theories change the traditional principal–agent model assumptions by assuming that actions are observable, but not verifiable. Output and monetary benefits may or may not be contractible. As a result, control rights that determine who chooses which action to take will be important.

Two important papers that take this approach are Aghion and Bolton (1992) and Dewatripont and Tirole (1994). In Aghion and Bolton (1992), the project yields both monetary benefits that are verifiable and transferable to outside investors, and private benefits or actions that are non-verifiable and go only to the entrepreneur. The magnitude of these benefits, in turn, depends on what (non-verifiable) action is taken with respect to the project. This introduces a conflict of interest. Aghion and Bolton (1992) show that as the external financing capacity of the project increases (*i.e.* the higher the profitability of the project and the lower the conflicts of interest), control moves from more investor control to more entrepreneur control. In particular, for projects with high external financing capacity, the entrepreneur should always have control. As external financing capacity decreases, there should be state-contingent control similar to a debt contract that transfers control to investors only in bad states of the world. Finally, for projects with low external financing capacity, the investor should always be allocated control.

Dewatripont and Tirole (1994) build on Aghion and Bolton (1992) by focusing on the optimal correlation between control rights and cash flow rights. In their model, the entrepreneur always prefers to take the riskier action (*e.g.* continuing the project), even though it will be *ex post* optimal to take the less risky action (*e.g.* liquidate the project) when the project is doing badly. They show that when performance is poor, the party in control should have a cash flow claim that is concave in performance (such as debt), while when performance improves more control should be transferred to a holder of a convex cash flow claim (such as equity).

4.2.2. Empirical results. The extensive use of control rights in our sample is broadly consistent with the assumptions and predictions of these theories. State-contingent board and voting control rights also are common features in our contracts. This contracting is more elaborate than that in ordinary debt contracts that only give liquidation rights in case of default on a promised payment. As Table 3 shows, control can be made contingent on financial performance or on non-financial events independently of the division of cash flow rights. These results are broadly consistent with Aghion and Bolton (1992). We now examine the predictions of these theories in more detail by analysing the cross-section.

The control theories predict that as agency problems and financial constraints become more severe, the contracts should change from entrepreneur control to state-contingent control to full VC control. We interpret the situation where neither the VC nor the founder is in control as similar to state-contingent control. For example, in boards where outside, jointly appointed, board members are pivotal, it seems plausible that these members will vote with the VC as founder performance declines. On the other hand, we assume that when the VC explicitly gets control in the bad state, through a default board provision or state-contingent voting control, the VC has relatively more control compared to cases where the outsiders are pivotal. Therefore, for a given financing round, we let the board/voting control variables equal zero if the founder always controls a majority of the seats/votes, one if neither the VC nor the founder has a majority

16. Also, see Hart (1995, 2001) for an overview of these theories.

TABLE 5

Determinants of control allocations

	Degree of VC board control (ordered logit)	Degree of VC voting control (ordered logit)	Ln auto. conv. price/round price (2SLS)
Observations	All rounds $N = 182$	All rounds $N = 192$	All rounds $N = 158$
Constant	—	—	—
Pre-revenue	0·81 (0·39)**	1·27 (0·43)***	0·24 (0·10)**
Repeat entrepr.	0·07 (0·50)	−0·83 (0·47)*	−0·25 (0·12)**
Months since 1st VC round	0·066 (0·012)***	0·066 (0·014)***	−0·005 (0·005)
VC cum. invest (instrumented)	—	—	−0·084 (0·088)
Return	0·58 (0·35)*	0·24 (0·32)	−0·36 (0·12)***
Ind. volatility	0·63 (0·29)**	0·87 (0·35)**	0·071 (0·074)
Ind. fixed assets	6·25 (2·51)**	5·54 (3·18)*	−0·67 (0·81)
Industry size	−0·08 (0·17)	−0·29 (0·19)	−0·090 (0·049)*
California	−0·45 (0·48)	−0·74 (0·52)	−0·24 (0·13)*
Midwest	0·44 (0·49)	−1·36 (0·53)**	−0·27 (0·12)**
North-east	1·14 (0·47)**	−1·35 (0·50)**	−0·20 (0·14)
χ^2/F-test, location	$\chi^2(2) = 9·6$***	$\chi^2(2) = 1·8$	$F(2, 138) = 0·12$
[P-value]	[0·01]	[0·42]	[0·89]
VC dummies?	Yes	Yes	Yes
χ^2/F-test,	$\chi^2(7) = 20·1$***	$\chi^2(7) = 11·8$*	$F(8, 138) = 1·26$
VC [P-value]	[0·01]	[0·11]	[0·27]
Adj. / Ps. R2	0·17	0·17	0·57
Ord. logit cut-offs:			
Cut-off group 1	2·91	1·19	
Cut-off group 2	6·12	2·72	
Cut-off group 3	6·90	3·53	

Two-stage least squares and ordered logit regressions of VC board control, voting control, and automatic conversion provisions on various independent variables for 213 investments in 119 portfolio companies by 14 VC partnerships. Investments were made between 1987 and 1999. The degree of board and voting control variables take the value of 0 if the founder always has control, 1 if neither the VC nor the founder has control, 2 if the VCs have control only in the bad state, and 3 if the VCs always have control. Pre-revenue takes the value of one if the venture has no revenues at the time of financing, and zero otherwise. Repeat entrepr. takes the value of one if the founder's previous venture was able to go public or was sold to a public company. Industry volatility is the value-weighted volatility of the log stock return for the firm's industry according to the Fama and French (1997) industry classification. Industry fixed assets is the median fixed to total assets for all (public as well as closely held) firms in the venture's four-digit SIC industry according to Onesource. Industry size is equal to log sales, in millions, in the venture's four-digit SIC industry according to the 1997 U.S. census. VC cumulative investment is instrumented using two-stage least squares with industry capital expenditures to sales as well as year dummies. Return takes the value of minus one if the ratio of per share round price to first round price is in the lowest quartile, one if it is in the highest quartile, and zero otherwise. White (1980) robust standard errors are in parentheses. Asterisks indicate statistical significance at the 1%***, 5%**, and 10%* levels.

of the seats/votes in the bad state, two if the VC controls a majority in the bad state only, and three if the VC controls a majority of the seats/votes in the good and bad states.[17]

The first two regressions presented in Table 5 use ordered logits to analyse board rights and voting rights, respectively. VCs are more likely to have board and voting control in pre-revenue ventures, as the time since the first financing round increases, and in industries with higher volatility and more fixed assets. VCs are more likely to have board control when returns are high and less likely to have voting control with repeat entrepreneurs.

The coefficients are economically as well as statistically significant. For example, VC voting control (group 3) is almost 30% more likely in pre-revenue companies while the other three states

17. The classification of the situation in which neither party is in control in the bad state is arguably ambiguous. We have run alternative regressions (not in the table) in which we classify these situations as entrepreneur control (0) or with the VC control in the bad state (2). Our results are qualitatively identical.

are each roughly 10% less likely. VC voting control is 20% less likely in companies with a repeat entrepreneur while neither control in the bad state (group one) is 10% more likely.

These results indicate that when the uncertainty about the venture and the quality of the founder is higher, the VC is allocated more control. In contrast, VC control increases as the VC–entrepreneur relationship progresses. Although the uncertainty about the venture should decrease over time, the VC also invests more funds. The founder's stake declines over time as the VC receives more control and cash flow rights in exchange for the additional funds invested.[18] This is consistent with Aghion and Bolton (1992) who predict that the investor should be allocated more control as the financing constraint becomes more binding.

Of the other industry characteristics, the amount of fixed to total assets is significantly positively related to VC voting control.[19] One explanation for this is that such companies are less reliant on the intangible human capital of the original founder, making intervention by the VC more efficient.

The last regression uses the price at which the VC's securities are automatically converted into common equity as a measure of VC control. The lower this price is, the more states in which the VC has pre-committed to give up its control and liquidation rights. As a dependent variable, we normalize the automatic conversion price by dividing by the round price and then taking logs.

The automatic conversion price is higher for pre-revenue ventures and lower for repeat entrepreneurs. Again, this is supportive of the prediction that as uncertainty about the quality of venture increases, the VC demands more control. Among the other industry controls, the automatic conversion price is lower for ventures in larger, more established industries. Finally, as one might expect almost by construction, the relative automatic conversion price decreases as the round price increases (as measured by return). As with cash flow rights, the degree of board and voting control varies significantly across different VCs. Also, the degree of board control is higher in the companies based in the North-east U.S.

Together, the results imply that for ventures with greater initial uncertainty about viability, the VC receives more board and voting control, and demands stronger performance (through the automatic conversion price) before ceding control. This is broadly consistent with Aghion and Bolton (1992). When uncertainty is high, conflicts are more likely to arise between the VC and the founder regarding issues whether the manager should be replaced or the business should be continued. Hence, the VCs need to be allocated control in more states in order for their investment to be *ex ante* profitable.

4.3. *Debt theories and the allocation of liquidation rights*

4.3.1. Theoretical predictions. Many financial contracting theories predict that the investor should hold a debt-like claim. As mentioned in Section 4.1.1, the security design theories based on classical principal–agent theory (such as Innes, 1990) show that giving investors a senior claim is useful for incentive purposes as it makes the manager's residual claim more sensitive to performance. Similarly, signalling theories such as Myers and Majluf (1984) and Duffie and Demarzo (1999), show that in an asymmetric information setting, the manager can

18. When we include the log accumulated VC financing in the ordered logit regression, it is strongly positive and significant. The months since first VC round variable is still significant. The amount of financing is endogenous, and cannot be instrumented in an ordered logit framework, hence, we do not include this specification in the table. We have also run 2SLS regressions on the difference between the fraction of VC and founder votes or board seats, instrumenting log VC investment with year dummies. Log VC financing is positive and all other results are similar.

19. When we replace fixed to total assets with R&D to sales, the coefficient is negative. Because the two variables are highly negatively correlated, we do not include both simultaneously in the regressions. The result does not change when we include cumulative VC investment. We do not include it in the reported regression because it is endogenous to VC control and cannot be instrumented in the ordered logit framework.

signal that success is more likely by offering the investor a senior claim that receives all of the value in case of failure. According to these models, VC liquidation rights should be stronger when there is greater uncertainty about venture quality and founder ability.

Apart from seniority, however, the other important characteristic of debt is the ability to take control and liquidate the firm when performance is bad. This can be interpreted as another way of allocating the investor state-contingent control. One criticism, however, of this explanation for debt—see Hart (1995)—is that changes in control in Aghion and Bolton (1992) do not necessarily coincide with default on a contracted payment, which is a central feature of real-world debt contracts. This feature of debt can be derived in a model where not only actions, but also profits and cash flows are non-observable or non-verifiable. In this world, there is no way to stop the entrepreneur from stealing the firm's profits.

There are two main strands to this literature, which we denote "stealing models". Costly state verification (CSV) models—*e.g.* Townsend (1979) and Gale and Hellwig (1985)—assume that profits are completely unobservable, unless a verification cost is paid. The other strand—*e.g.* Bolton and Scharfstein (1990), Fluck (1998) and Hart and Moore (1998)—assumes that profits are observable but not verifiable to outsiders and courts. The optimal financial claim in both approaches is a debt-like claim in which (1) the entrepreneur promises a fixed payment to the investor; and (2) the investor takes control of the project and liquidates the assets if the payment is not made. Hence, these theories are consistent both with the seniority and the default aspects of debt contracts. Bolton and Scharfstein (1990) also show that withholding future funding can play a role similar to demanding repayment in forcing liquidation.

In these models, the value investors can realize when they seize assets limits the liquidation claim that can be promised to outside investors. Hence, liquidation claims should be greater when assets are more tangible and when the founder's human capital is less crucial. Because the liquidation threat always exists in the stealing models, there are no cross-sectional predictions regarding the investor's ability to force liquidation in the bad state. Given that the models rely on the assumption of non-verifiability of cash flow, however, one possible prediction would be where cash flow is harder to verify, the ability to liquidate should be more important and we should observe stronger VC liquidation rights.

4.3.2. Empirical approach. In Section 3, we showed that the allocation of liquidation rights is an important feature of the venture contracts. First, in all of our observations but one, the VC is senior to common equity in liquidation. The seniority of the VC claim is consistent with classical moral hazard theories, signalling and screening theories, as well as the "stealing" theories. Second, consistent with the "stealing theories", the VCs do have some power to liquidate upon default on a contracted payment.

We note, however, that "stealing" theories do not explain a number of our results including the allocation of residual cash flow rights and the frequent contingent contracting on financial performance measures. Such features are ruled out by assumption because cash flow is not verifiable.[20,21]

In Table 6 we analyse the cross-sectional determinants of VC liquidation rights in more detail. In the first regression, we analyse the determinants of the size of the VC's liquidation

20. They are still consistent with the control theory of Aghion and Bolton (1992). See Hart (2001).

21. There are "stealing" models that explain the use of outside equity. In the models of outside equity financing in Fluck (1998) and Myers (2000), the liquidation right is replaced by the right to fire management. This occurs if dividends are too low. Here it is essential, that outside equity investors have this right, which in turn implies that they need to control a majority of the board/votes. Moreover, in these models, the firm has to pay out dividends. Both of these assumptions are frequently violated in our venture capital financings. In a significant fraction, the VC lacks board/voting control. Moreover, few ventures pay any cash dividends.

claim. We use a dummy variable that equals one if the liquidation claim exceeds the VC's cumulative investment (through cumulative dividends, participating preferred, etc.) and zero otherwise.[22] Because the VC's liquidation claim varies little between rounds, we report results using the first financing round for each firm. The results with the full sample are almost identical. Overall, the results are weak. There is no evidence that the VC's liquidation claim is larger when asymmetric information problems are more severe, because volatility, pre-revenue, and repeat entrepreneur are not significant. Collateral value, measured as fixed to total assets, is not significant either. Only the debt capacity of the venture, measured as the industry median long-term debt ratio, is related to the VC liquidation claim.

The remaining regressions of Table 6 analyse the VC's ability to liquidate. We first analyse whether redemption rights are present in the VC contracts. Again the results are weak. In the second regression, redemption rights are unrelated to the pre-revenue and the repeat entrepreneur variables.

Even though redemption rights are the part of the VC contracts that most resemble debt, there are other ways that a VC can force a liquidation of badly performing firms. The most important mechanism is through staging of the investment.[23] We distinguish between two different forms of staging: *ex ante* (or within-round) and *ex post* (or between-round) staging.

In an *ex ante* staged deal, part of the VC's committed funding is contingent on financial or non-financial performance milestones. This essentially gives the VC the right to liquidate the venture in the bad state of the world. Even many VC financings are not explicitly staged *ex ante*, most of them are implicitly staged *ex post*, in the sense that even when all the funding in the round is released immediately, future financing will be needed to support the firm until the IPO. By providing less funding in a given round, and hence shortening the time until the next financing round, the VC increases the ability to liquidate the venture if performance is unsatisfactory.[24] *Ex ante* staging within a given round, however, arguably makes this liquidation right stronger and more explicitly related to performance.

The fourth and fifth regressions in Table 6 analyse between-round staging by explaining the time until the next financing round. The repeat entrepreneur dummy is positively related to the time between rounds, indicating that previously successful founders receive more funding in a given round, reducing the VC's liquidation threat. In contrast with Gompers (1995), most of our industry variables are insignificant.[25] The exception is the industry long-term debt ratio, which is negative and significant. Hence, the use of between-round staging seems to be complementary with the use of debt in the industry.

The three final regressions address *ex ante* staging by analysing the fraction of funds committed in a given round that are provided up front. Repeat entrepreneurs receive more of their funding up front, although the variable is not significant when VC dummies are included. Again, the use of *ex ante* staging is positively related to industry debt. In addition, when the round return is higher, more funds are provided up front and are less contingent on performance. The coefficient on the time since the first VC round is negative, showing that *ex ante* staging is more common in earlier rounds.

To sum up, our results on liquidation rights and claims are mixed. The results on redemption rights and staging, although somewhat weak, at least suggest that the VCs increase their ability to liquidate when dealing with less proven entrepreneurs. There does not seem to be any strong

22. Separate regressions on cumulative dividends and participating preferred stock generate similar results.

23. See Bolton and Scharfstein (1990). Neher (1999) provides a model of staging based on Hart and Moore (1998).

24. Gompers (1995) analyses *ex post* staging, using VE data. Time between financing rounds decreases with industry R&D intensity and market-to-book ratios; it increases with industry tangible asset ratios.

25. None of the measures Gompers (1995) uses—the fixed asset ratio, R&D to sales, or market-to-book ratio—are significant in our regressions. Part of this could be an issue of power, however, since Gompers has a larger sample.

TABLE 6

Determinants of VC redemption rights, staging, and liquidation claims

	VC liq. claim> cum. invest. (logit)	VC has redemption rights (logit)	Months until next fin. round (2SLS)	Months until next fin. round (OLS)	% of funds up front (2SLS)	% of funds up front (2SLS)	% of funds up front (OLS)
Observations	1st firm observ. $N = 108$	1st firm observ. $N = 106$	All observ. $N = 164$	1st firm obs. $N = 98$	All observ. $N = 191$	All observ. $N = 191$	1st firm obs. $N = 98$
Constant	—	—	—	14·7 (7·8)*	—	103·9 (20·8)***	92·6 (30·4)***
Pre-revenue	−0·20 (0·75)	−0·32 (0·63)	−0·10 (1·10)	−1·81 (1·23)	−0·30 (3·87)	−3·69 (3·62)	−4·50 (5·19)
Repeat entrepreneur	0·28 (0·98)	−0·83 (0·81)	4·39 (1·86)**	2·36 (1·39)*	3·58 (3·69)	7·69 (3·50)**	9·83 (5·91)*
Months since 1st VC round	—	—	−0·003 (0·034)	—	0·21 (0·08)**	0·28 (0·11)**	—
Investment in round (instr.)	—	—	1·86 (1·85)	—	−3·37 (3·33)	−4·24 (4·22)	—
Return	—	—	−0·30 (1·11)	—	6·36 (3·25)*	6·55 (3·14)**	—
Ind. volatility	−0·06 (0·52)	−0·20 (0·62)	−0·37 (0·89)	−1·39 (0·86)	−1·72 (2·72)	−3·65 (2·83)	−4·56 (4·37)
Ind. fixed assets	−3·75 (4·94)	−3·80 (5·08)	5·87 (9·98)	—	−17·1 (30·4)	−56·7 (33·4)*	−24·8 (44·4)
Ind. LT debt to assets	11·84 (5·29)**	5·14 (4·33)	−20·8 (7·1)***	−10·7 (4·9)**	−68·2 (32·4)**	−69·2 (30·9)**	−107·2 (33·9)***
Industry size	−0·33 (0·31)	−0·20 (0·35)	0·91 (0·57)	0·62 (0·66)	1·47 (1·75)	2·59 (2·02)	0·65 (0·79)
California	−2·41 (1·06)**	−1·93 (0·91)**	1·50 (1·43)	—	7·23 (4·39)	—	—
Midwest	−1·04 (0·87)	−0·50 (1·21)	−0·90 (1·61)	—	4·67 (6·16)	—	—
North-east	−3·41 (1·18)***	−2·66 (0·92)***	1·77 (1·78)	—	5·56 (5·01)	—	—
χ^2/F-test, location	$\chi^2(3) = 9.59$** [0·02]	$\chi^2(3) = 11.36$*** [0·01]	$F(2, 143) = 1.56$ [0·21]	—	$F(2, 170) = 0.37$ [0·90]	—	—
VC dummies	Yes	Yes	Yes	No	Yes	No	No
χ^2/F-test, VC dummies	$\chi^2(8) = 6.32$ [0·61]	$\chi^2(8) = 9.85$ [0·28]	$F(8, 143) = 1.57$ [0·14]	—	$F(8, 170) = 3.50$ [0·00]***	—	—
Adj. / Ps. R2	0·25	0·23	0·19	0·10	0·39	0·29	0·24

Regressions of degree of VC liquidation rights on various independent variables for 213 investments in 119 portfolio companies by 14 VC partnerships. Industry LT debt to assets is the median ratio of long-term debt to assets for public firms in the venture's three-digit SIC industry according to COMPUSTAT. For remaining variable definitions, see Table 5, above. Investments were made between 1987 and 1999. White (1980) robust standard errors are in parentheses. Asterisks indicate statistical significance at the 1%***, 5%**, and 10%* levels.

relation between liquidation rights and the tangibility of assets or with the degree to which cash flows are uncertain and hard to verify. However, the strength of VC liquidation rights and claims increases with industry debt. To the extent that industry debt is a better measure of collateral than tangible assets, this result is consistent with the stealing theories.

4.4. *Venture-capital specific theories*

While the theories analysed above are general financial contracting models, a number of recent theoretical papers focus specifically on venture capital contracts. Most of these papers try to explain the use of convertible securities in venture capital financings (based on the results in Sahlman, 1990).

The first group of theories is motivated by empirical evidence that, apart from the mere provision of funds, VCs exert substantial effort in monitoring and aiding their portfolio companies.[26] Motivated by this observation, these theories, including Repullo and Suarez (1999), Schmidt (1999), Casamatta (2000), Renucci (2000), Dessi (2001) and Inderst and Müller (2001), model the VC–entrepreneur relationship as a double moral-hazard problem, where both the entrepreneur and the VC have to be given incentives to provide costly effort.

Consistent with our empirical evidence, these models predict that both the entrepreneur and the VC should be allocated residual cash flow rights.

These theories have more mixed success in explaining the liquidation cash flow rights that come with the convertible preferred securities. In Repullo and Suarez (1999) the optimal contract calls for giving the initial VC investors a warrant-like claim. This avoids inefficient liquidations for projects that turn out to be marginally profitable after the first round of financing. This intuition is inconsistent with our findings because the liquidation rights that come with a convertible or participating preferred in practice would worsen the inefficient liquidation problem in their model.

In the models of Casamatta (2000), Renucci (2000), Dessi (2001) and Inderst and Müller (2001), VC liquidation rights emerge as part of the optimal contract, but only for parts of the parameter space. For example, in Casamatta (2000), only as the external financing constraint becomes more binding does the VC's claim resemble a convertible and the entrepreneur's resemble common stock. For low levels of external financing need, the entrepreneur gets a convertible and the VC common stock.[27] Given that (1) VCs are allocated liquidation cash flow rights in our sample (212 out of 213 financings), and (2) that liquidation claims do not vary much with our proxies for the severity of the agency problem (see Table 6), the cross-sectional predictions do not seem consistent with the data.[28]

Schmidt's (1999) theory relies heavily on the VC contract being a standard convertible security, rather than participating preferred or a combination of straight preferred and common. Given the widespread use of participating preferred in particular (39% of our sample), this is a serious shortcoming of Schmidt's model.

A second theoretical approach, represented by Cornelli and Yosha (1998), motivates convertible securities as a way of stopping the entrepreneur from manipulating interim

26. See Kaplan and Strömberg (2001, 2002) and Hellman and Puri (2002).

27. Similarly, in Inderst and Müller (2001) VCs only get convertibles when there is low competition among VC funds, and in Dessi (2001) convertibles are only optimal under very specific assumptions regarding collusion between the VC and entrepreneur against uninformed third-party investors.

28. Still, there are two observations that give some support to Casamatta's (2000) model. First, as we show in Table 8, below, the strength of the VC's liquidation claim increases in later financing rounds, *i.e.* as the VC invests additional funds. Second, empirical evidence on angel financings (see *e.g.* Wong, 2001) shows that angel investments are smaller in magnitude and more likely to involve common stock.

performance.[29] In their model, entrepreneurs have the incentive to manipulate interim performance signals upward to secure additional rounds of VC financing. A properly designed convertible contract avoids this problem by making conversion undesirable for the entrepreneur (*i.e.* by setting a low conversion price). Because a high performance signal increases the probability of a VC conversion that dilutes the entrepreneur's equity stake, the entrepreneur will refrain from such manipulation. Although the use of convertibles is consistent with our evidence, the model relies on the convertible contract maturing before the true performance of the venture is revealed. Because the real-world convertibles we observe have infinite maturity (in the sense that they cannot be called by the company), and typically only convert at a successful IPO or sale, this explanation does not seem consistent with our data. Moreover, our observation that VC residual cash flow rights decrease with interim performance signals goes against the model's predictions.

A third theoretical approach, represented by Berglöf (1994) and Hellman (2001), derives convertibles as a way to avoid inefficient venture exit decisions. In Berglöf's model, convertibles enable VCs and entrepreneurs to capture a maximum amount of rents when selling the venture to third-party buyers. The convertibles give control rights to the entrepreneur in the good state which enables him to get fully compensated for his private benefits, and control to the VC in the bad state which compensates the VC from being expropriated by the new majority owners after the sale. Although Berglöf's prediction of the allocation of control rights is consistent with our evidence, the allocation of cash flow rights is not. His model predicts that all cash flow rights are allocated to the VC, and hence does not capture the fact that cash flow rights are also allocated based on firm performance. Moreover, the expropriation assumption is questionable in that it relies on the VC staying as a minority shareholder after a trade sale.

Building on Aghion and Bolton (1992), Hellman (2001) argues that convertibles solve a conflict between the VC and the entrepreneur regarding exit choice. The conflict arises because a minimum amount of equity has to be given up to the entrepreneur in the case of an IPO, while no such restriction exists in a trade sale, making VCs prefer trade sales *ceteris paribus*. The optimal contract calls for leaving control with the entrepreneur as long as the VC breaks even, and allocating cash flow rights to the VC, subject to leaving the minimum stake to the entrepreneur in the case of an IPO. The model is successful in explaining a number of features of VC contracts, such as participating preferred (which will be optimal when the financing constraint is tight), automatic conversion at an IPO (which is necessary to guarantee the entrepreneur's minimum IPO share), and transfer of control from the entrepreneur to the VC as the financing constraint tightens (as in Aghion and Bolton). Moreover, if we assume that the financing constraint tightens in later financing rounds (as more funds are invested), the finding in Table 2 that both the use of participating preferred and VC control increase in later rounds is consistent with Hellman's predictions. One shortcoming, however, similar to that of the double moral-hazard models, is that VCs are predicted to hold only common stock for parts of the parameter space. Still, Hellman (2001) shows that by augmenting Aghion and Bolton with a role for cash flow incentives (which Hellman models in reduced form by the minimum entrepreneur IPO stake), a number of features of the VC contracts can be explained simultaneously.

5. COMPLEXITY OF REAL-WORLD CONTRACTS: COMPLEMENTARITY AND DYNAMICS

In the previous section, we examined venture capital contracts in the light of standard financial contracting theories. It appears that real-world contracts are more complex than

29. The intuition of their model is somewhat similar to the risk-shifting motivation for convertibles of Brennan and Schwartz (1982) and Green (1984).

the theories predict. First, control rights, cash flow incentives and liquidation rights are all used simultaneously. Moreover, control rights are multi-dimensional, with several different types of control being allocated between VCs and entrepreneurs, and switching gradually with performance. Second, the contractual relationship between the VCs and the entrepreneurs evolves; each new round involves a new set of contract terms with previous contracts potentially being renegotiated. In this section, we describe these features in more detail in order to provide stylized facts for future theoretical work.

5.1. *Complementarity and substitutability of contract provisions*

We use cluster analysis to divide the contracts into five generic groups to analyse the simultaneous use of different governance mechanisms—pay performance compensation, board and voting control, and liquidation rights. The hierarchical cluster method[30] we use forms groups that maximize the Euclidian distance between matrices of dummy variables measuring 12 main contractual characteristics for the companies in each group. Although cluster analysis is a somewhat subjective methodology because it depends on the number of groups and input variables used, the results using different specifications are qualitatively similar. We restrict the sample to first VC financing rounds when available (89 cases) or, otherwise, from second round investments when available (seven cases) in order to purge the comparison from effects due to the subsequent evolution of the contracts.

Table 7 reports the results. The order of the five clusters increases in the degree of residual cash flow rights given up by the founder. The ordering also corresponds roughly to the degree of board and voting control allocated to the VC, with cluster 1 (5) being the firms with the most (least) VC control. The first three clusters exhibit the highest degree of VC control and also contain a significantly higher fraction of pre-revenue firms. Hence, the first three clusters are presumably associated with a higher degree of uncertainty regarding the viability of the venture.

We make a number of observations regarding the interplay among the different rights. First, voting and board control are positively correlated. When VCs control the board (cluster 1), they typically also have a voting majority; when founders control the board (cluster 5), the founder group tends to control a voting majority. Not surprisingly, these two control mechanisms are more complements than substitutes. Also, cash flow rights and control rights largely go together. The fraction of equity held by the founder is significantly higher for cluster 5 compared to cluster 1.

Second, although voting, board and residual cash flow rights are correlated, the correlation is far from perfect. Cluster 2 firms have VC voting control, but no or only state-contingent board control; cluster 4 firms exhibit a high fraction of founder voting control without board control. This further supports the result that control is more multi-dimensional and continuous than most financial contracting theories assume.[31] Moreover, the fraction of votes and board seats relative to cash flow rights vary between clusters and are typically different from one. In general, the VC and founder hold more control rights relative to their residual cash flow rights, at the expense of third parties such as employees.

Third, the founder's pay performance sensitivity, measured by the convexity induced by performance benchmarks and vesting, is lower when the founder controls the venture. In cluster 1, the founder's cash flow rights are reduced by roughly 20% if performance benchmarks are not met, and by another 20% upon leaving the firm; in contrast, the pay performance convexity of clusters 4 and 5 is close to zero.[32] Hence, high-powered cash flow compensation and

30. See Aldenderfer and Blashfield (1984) for details on this procedure.

31. One exception is Kirilenko (2001).

32. In clusters 4 and 5, the sensitivity to vesting is even slightly negative. This is due to vesting of employee and other managers. If these do not vest the founder ends up with a higher fraction of the residual cash flow rights.

TABLE 7

Complementarity and substitutability of contractual provisions

Cluster:	1—max. VC control	2	3—no party in control	4	5—max. fndr control	Kruskal–Wallis χ^2
Founder residual cash flow rights, %:	$N = 14$	$N = 29$	$N = 17$	$N = 20$	$N = 16$	statistic (4 df)
Total equity in best case	24·4 (24·0)	25·8 (24·9)	44·6 (45·5)	46·3 (42·1)	52·0 (55·1)	39·2***
Sensitivity, benchmarks	4·54 (0·00)	1·12 (0·00)	0·90 (0·00)	0·36 (0·00)	2·49 (0·00)	12·2**
Sensitivity, vesting	5·61 (4·64)	6·36 (2·35)	23·6 (25·0)	−2·23 (0·00)	−2·67 (−0·69)	40·5***
Voting control (% of cases):						
VC always in control	92·9	89·7	0·0	5·0	12·5	69·6***
Fndr always in control	0·0	0·0	0·0	60·0	50·0	42·2***
Control state-contingent	0·0	3·5	100·0	0·0	18·8	75·3***
VC votes/CF, best case	1·14 (1·12)	1·14 (1·12)	1·15 (1·12)	1·18 (1·16)	1·17 (1·17)	1·6
Fndr votes/CF, best case	1·12 (1·15)	0·96 (1·04)	1·13 (1·12)	1·16 (1·13)	1·12 (1·09)	10·9**
Board control (% of cases):						
VC always in control	100·0	0·0	5·9	5·0	0·0	81·5***
Fndr always in control	0·0	3·5	0·0	0·0	93·8	81·4***
Outside directors pivotal	0·0	65·5	88·2	70·0	6·2	41·7***
Control state-contingent	0·0	31·0	5·9	25·0	0·0	13·2**
VC seats/CF, best case	1·13 (1·05)	0·67 (0·65)	1·21 (1·08)	1·32 (1·12)	1·23 (1·10)	40·2***
Fndr seats/CF, best case	1·07 (0·92)	1·85 (1·28)	1·14 (0·85)	0·92 (0·92)	1·34 (1·12)	16·1***
VC liquidation rights (% of cases):						
Redemption rights	85·6	89·7	76·5	80·0	75·0	2·2
liq. claim > cum. investment	71·4	89·7	52·9	45·0	81·2	14·4***
Investment of VC funds:						
Investment commitment,	20·1 (12·4)	7·09 (6·00)	2·95 (2·30)	3·21 (2·24)	3·77 (3·00)	25·1***
$m % of funds released up front	54·6 (50·0)	73·3 (70·0)	97·6 (100)	97·6 (100·0)	90·6 (100·0)	29·9***
Number of VCs in syndicate	3·6 (3·0)	3·7 (4·0)	3·0 (2·0)	1·8 (2·0)	1·9 (2·0)	21·8***
Relative auto. conv. price:	3·14 (3·00)	5·30 (4·32)	5·13 (5·00)	3·8 (3·0)	3·30 (3·00)	5·7
Contingent contracting on (% of cases):						
Financial performance	28·6	34·5	23·5	0·0	37·5	9·4*
Non-financial performance	14·3	20·7	17·6	0·0	0·0	7·8*
Actions	35·7	24·1	5·9	0·0	0·0	14·9***
Default on redemp./dividend	28·6	41·4	11·8	40·0	18·8	6·3
Securities issues/valuations	50·0	17·2	29·4	20·0	37·5	6·3
Founder staying with firm	57·1	55·2	94·1	5·0	6·2	41·0***
% Pre-revenue ventures	64·3	58·6	62·5	35·0	25·0	8·7*

Table compares mean (median) frequencies and values of various contract provisions and firm characteristics between five clusters of portfolio companies. Data are taken from first VC financing rounds when available (89 cases) otherwise from second round investments (seven cases). Twenty-three firms where data on first or second round investments were not available were excluded from the sample. Clusters are obtained from a hierarchical cluster analysis maximizing between-group variation measured by Euclidian distance with respect to the following 12 dummy variables: (1) founder cash flow rights depend on performance benchmarks; (2) founder cash flow rights depend on vesting; (3) VC has voting majority; (4) founder has voting majority; (5) voting majority is state-contingent; (6) VC controls board; (7) founder controls board; (8) neither VC nor founder controls board; (9) board majority is state-contingent; (10) VC has redemption rights; (11) VC financing commitment is staged *ex ante*; (12) VC liquidation claim is larger than investment commitment. Asterisks indicate jointly statistically significant differences between clusters at the 1% ***, 5% **, and 10% * levels, using a Kruskal–Wallis χ^2 test.

VC control are largely complementary.[33] The firms in cluster 3 represent an intermediate case,

33. See also Baker and Gompers (1999) who analyse equity ownership of IPO firms. They find that CEOs of VC-backed firms hold a smaller fraction of total equity but have a higher elasticity to performance due to options.

TABLE 8

Evolution of contracts over time

Mean (median)	*Round 1* Ex ante *staging*	*Round 1* *No* ex ante *staging*	*Round 2*	*Round 3*	*Round 4+*	*Average change between two consecutive rounds*
	$N = 34$	$N = 64$	$N = 50$	$N = 31$	$N = 34$	$N = 90$
Founder residual cash flow rights, %:						
Total equity in best case	30·8 (30·3)[1]	44·0 (41·1)[1]	25·7 (21·1)	23·6 (21·3)	21·5 (16·0)	−10·2 (−7·7)***
Sensitivity, benchmarks	2·81 (0·00)	1·21 (0·00)	0·42 (0·00)	0·43 (0·00)	0·63 (0·00)	−0·38 (0·00)
Sensitivity, vesting	7·02 (3·21)	8·68 (0·00)	4·12 (0·00)	2·31 (0·00)	4·24 (0·00)	−3·69 (0·00)***
Voting control (% of cases):						
VC always in control	64·7[1]	28·1[1]	61·2	61·3	70·6	19·1 (0·00)***
Fndr always in control	8·82[5]	28·1[5]	8·2	3·2	0·0	−9·00 (0·00)***
Control state-contingent	17·6	28·1	14·0	9·7	8·8	−11·1 (0·00)**
VC votes/CF, best case	1·13 (1·09)	1·16 (1·13)	1·16 (1·14)	1·13 (1·10)	1·18 (1·14)	0·00 (0·01)
Fndr votes/CF, best case	0·98 (1·05)[5]	1·20 (0·99)[5]	1·09 (1·10)	1·13 (1·10)	1·09 (1·10)	0·01 (−0·01)
Board control (% of cases):						
VC always in control	23·5[1]	4·76[1]	27·3	34·5	54·6	11·0 (0·00)***
Fndr always in control	8·8	21·3	11·4	6·9	6·1	−8·75 (0·00)**
Outside directors pivotal	41·2[5]	63·9[5]	54·6	55·2	33·3	2·50 (0·00)
Control state-contingent	26·5[5]	9·68[5]	6·8	3·5	6·1	−4·94 (0·00)**
VC seats/CF, best case	1·00 (0·87)[5]	1·13 (1·00)[5]	0·88 (0·84)	0·91 (0·78)	0·97 (0·90)	−0·11 (−0·07)***
Fndr seats/CF, best case	1·41 (0·96)	1·20 (0·99)	1·90 (1·29)	2·17 (1·52)	2·69 (1·13)	0·49 (0·27)***
VC liquidation rights (% of cases):						
Redemption rights	84·4	80·3	71·4	71·0	88·2	−1·11 (0·00)
Liq. claim > cum. investment	72·7	67·2	62·5	69·0	87·9	4·71 (0·00)**

TABLE 8—*Continued*

Mean (median)	*Round 1* Ex ante *staging*	*Round 1* *No* ex ante *staging*	*Round 2*	*Round 3*	*Round 4+*	*Average change between two consecutive rounds*
	$N = 34$	$N = 64$	$N = 50$	$N = 31$	$N = 34$	$N = 90$
Investment of VC funds:						
Investment commitment, $m	12·5 (6·7)[1]	3·69 (3·0)[1]	6·3 (5·4)	7·4 (6·2)	7·2 (5·3)	2·01 (1·17)***
% of funds released up front	50·1 (51·8)[1]	100·0 (100)[1]	88·4 (83·9)	90·0 (100)	95·6 (100)	0·75 (0·00)
Number of VCs in syndicate	3·0 (2·0)	2·6 (2·0)	4·8 (4·5)	6·4 (6·0)	6·6 (5·0)	1·59 (1·00)***
Relative auto. conv. price:	5·1 (4·1)	4·0 (3·0)	3·3 (2·8)	2·7 (2·5)	9·7 (2·2)	2·03 (−0·43)***
Contingent contracting on (% of cases):						
Financial performance	41·2[1]	12·5[1]	14·0	6·5	17·6	−5·56 (0·00)
Non-financial performance	23·5[1]	4·7[1]	8·0	6·5	5·9	−2·22 (0·00)
Actions	32·4[1]	4·7[1]	14·0	6·5	2·9	1·11 (0·00)
Default on redemp./dividend	35·3	26·6	30·0	12·9	32·3	−3·33 (0·00)***
Securities issues/valuations	38·2[10]	21·9[10]	16·0	16·1	14·7	2·22 (0·00)
Founder staying with firm	58·8	42·2	42·0	29·0	29·4	0·00 (0·00)
Round involves renegotiation of prev. terms (% of cases):	—	—	30·0	29·0	26·5	—

Contract terms by financing round for 213 investments in 119 portfolio companies by 14 venture capital partnerships. Investments were made between 1987 and 1999. For first financing rounds, we distinguish rounds where part of the committed financing is contingent (*ex ante* staging) from rounds where all funds are released upon the initial closing (no *ex ante* staging). Significant differences between *ex ante* and no *ex ante* staging are indicated at the 1%[1], 5%[5], and 10%[10] levels, using a Mann–Whitney test. The last column shows changes in allocations between two consecutive rounds using the sample of observations where this information is available. Significant changes between rounds are indicated at the 1% ***, 5% **, and 10% * levels, using a Wilcoxon test.

with founder residual cash flow rights dependent on vesting, but not on explicit performance benchmarks. In addition, neither the VC nor the entrepreneur has control, with state-contingent voting control and outside directors pivotal in the board. This type of contract turns out to be particularly common in pre-revenue, R&D ventures.[34] One potential explanation could be that these ventures are particularly dependent on the skills of the original founder, increasing potential hold-up problems along the lines of Hart and Moore (1994). The high degree of vesting makes it costly for the founder to leave the firm prematurely, mitigating the hold-up threat during the time the venture is most dependent on his or her skills. The open control, in turn, protects the entrepreneur from being held up by the VC, since outside board members are unlikely to vote to replace the founder unless performance is truly inferior.

Fourth, liquidation claims and redemption rights are largely independent and not systematically related to control rights and residual cash flow rights.

Fifth, the size of the VC commitment and the release of funds are related to control. For firms in clusters 1 and 2, where the VCs have the most control, the total commitment of VC funds is higher, with a large fraction contingent on milestones. Hence, VC control is complementary with *ex ante* staged, longer-term contracts that give the VC a greater ability to force the firm into liquidation by withholding funds.

Sixth, the degree to which contracts are written contingent on actions and performance differs across clusters. Non-financial performance, actions, and founder employment contingencies are more common in the clusters where the VC is in control. Moreover, these ventures are more often pre-revenue, where the future performance uncertainty is the highest. Hence, in the ventures where observability and verifiability problems might be expected to be particularly severe, we observe the highest degree of contracting on events that the incomplete contracting literature describes as non-verifiable. The examples in Table 3 suggest, however, that some of these actions and non-financial performance measures might indeed be difficult to verify objectively.

There are two possible explanations for the complementarity between VC control and contingencies. Because the contingencies may be difficult to verify, the VC will only be comfortable using them when the VC has control and, therefore, a greater ability to decide whether the contingency is met.[35] An alternative interpretation is that because of the large uncertainty and difficulty in writing all contingencies, control is given to the VC. To keep the VC from taking too much advantage of that control, some contingencies are written that protect the entrepreneur.

5.2. *Dynamic evolution of contracts*

So far we have largely ignored the fact that different financing rounds for the same company are related. Accordingly, in Table 8, we report cash flow rights, voting rights, board rights, liquidation rights, and other terms as a function of the financing round. We distinguish between financings in which future financing is contingent on performance (*ex ante* staging) and those that are not. Finally, to control for the fact that we do not have complete observations of all financing rounds for every firm, the last column shows changes in terms between rounds where we have observations for two consecutive VC financings.

Table 8 indicates that founders' cash flow, voting, and board rights decline over financing rounds while VC rights increase. The degree of state-contingent control also decreases over

34. The R&D to sales ratio is significantly higher for this group compared to the others (significant at the 5% level using a Mann–Whitney test). We have omitted R&D to sales from the table due to space considerations.

35. This suggests that there is the possibility of the VC behaving opportunistically towards the founder in interpreting the contracts. It is likely that the reputational concerns of the VC mitigate such problems.

time in favour of more VC control. The results for board rights are similar, although the rate at which VCs increase their board control is slower. The increase in VC cash flow and control rights over financing rounds is consistent with the VC demanding more equity and control as compensation for providing additional funding. Hence, a less successful venture will see control being transferred from the founder to the VC through two mechanisms: through explicit state-contingent control, specified *ex ante* in the contracts in a given round, and through dilution of control as the VC has to provide additional subsequent financing. The table also shows that while the use redemption rights does not change much over time, the size of the VC liquidation claims (relative to VC investment) does increase somewhat between rounds.

Comparing the *ex ante* staged rounds with the other first round observations, we observe some interesting differences. Naturally, these contracts commit a significantly larger amount of financing, of which on average half is released subject to future performance. Consistent with the cluster analysis, the VCs are significantly more often in control, both in terms of votes and board seats, and more future contingencies are specified in advance. We believe that the choice between *ex ante* staged, longer-term contracts, vs. short-term, "*ex post*" staged contracts, is an interesting issue for future research.

Finally, we also provide evidence that contract terms are sometimes renegotiated. In about 30% of subsequent financing rounds (34 cases), some contractual rights from a previous financing round are renegotiated as a part of the new contract. The most commonly renegotiated terms are the automatic conversion price (typically increasing it; 11 cases) and the VC liquidation claim (changing dividends or participation; 10 cases). Other renegotiated terms include changing the redemption maturity, waiving funding milestones, or changing vesting provisions and performance benchmarks (each present in five cases).[36] Since our data are incomplete, these numbers likely underestimate the frequency of renegotiation.[37] This gives additional support to the incomplete contracting theories which rely heavily on the presence of bargaining and renegotiation (see *e.g.* Hart, 1995). The fact that contractual provisions are not always enforced does not necessarily imply that they are irrelevant. Even in those instances, the initial contracts are likely to be important in determining the outside options for any subsequent bargaining over rights in later rounds.

6. CONCLUSION

In this paper, we have compared the characteristics of real-world financial contracts between VCs and entrepreneurs to their counterparts in financial contracting theory. The distinguishing characteristic of VC financings is that they allow VCs to separately allocate cash flow rights, board rights, voting rights, liquidation rights, and other control rights. We describe and measure these rights. We then interpret our results in relation to existing financial contracting theories. Overall, the theories do rather well, particularly, the classical principal–agent theories (*e.g.* Holmström, 1979) and control theories (*e.g.* Aghion and Bolton, 1992).

Still the results suggest there is room for additional theory. Our results clearly show that real-world contracts are more complex than existing theories predict. For example, Section 5 indicates that the allocations of cash flow and control rights and the use of contingencies are related in systematic ways. We hope that these results and others in the paper provide stylized facts for future theory.

36. Note that a renegotiation may involve several different provisions.

37. In particular, for the *ex ante* staged financings, we usually have data from the initial contracting stage only and do not know whether some terms were subsequently renegotiated.

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