Investor Abilities and Financial Contracting: Evidence from Venture Capital

Ola Bengtsson,
University of Illinois at Urbana-Champaign

Berk A. Sensoy,
Department of Finance, Fisher College of Business-Ohio State University

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by

Ola Bengtsson* and Berk A. Sensoy**

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Abstract

Using a large, new database of contractual provisions governing the allocation of cash flow rights between venture capitalists (VCs) and entrepreneurs, we investigate how contract design is impacted by VC abilities to monitor and provide value-added services to the entrepreneur. In doing so, this paper is the first to demonstrate that VC characteristics, in addition to portfolio company characteristics, have a significant impact on VC contract design in the U.S. We find that more experienced VCs, who have superior monitoring and value-added abilities and more frequently join the boards of their portfolio companies, obtain weaker downside-protecting contractual cash flow rights than less experienced VCs. This result is robust to extensive controls and several methods to account for endogenous selection effects. The relation between VC experience and downside protections is weaker when entrepreneurial agency problems are less severe and stronger when VC ownership is greater. The results, together with the existing literature, suggest that VCs with better governance abilities optimally focus less on obtaining downside protections, which are costly from a risk-sharing perspective, and more on upside payoffs and obtaining board representation during negotiations with entrepreneurs. The results also imply that previous estimates of the amount entrepreneurs pay for affiliation with high-quality VCs are overstated.

*University of Illinois and **Ohio State University. We thank Joseph Bartlett, Harry DeAngelo, Simon Gervais, Maureen O'Hara, Gordon Phillips, Manju Puri, David Robinson, Morten Sorensen, Per Strömberg, Mike Weisbach, and seminar participants at Cornell University, Duke University, University of Illinois, Syracuse University, NBER Entrepreneurship Group, University of Maryland, and Swedish Institute for Financial Research (SIFR) for helpful comments and discussions. We are grateful to *VCExperts* and Joseph Bartlett for access to the contract data, and to Anastasia Beglova, Sonali Das, Cathy Chenxi You, Vikas Patel, and Liheng Xu for valuable research assistance. This research was begun while Bengtsson was at Cornell University and Sensoy was at the University of Southern California. Contact information: ola@illinois.edu; bsensoy@fisher.osu.edu.

I. Introduction

Understanding the factors that impact contract design is a central issue in many areas of economics. In finance, contracting theories explore how agency and information problems can be mitigated by the contingent allocation of cash flow and control rights between managers and investors.[1] At the same time, investors often have access to other mechanisms to solve incentive problems. Investors may attempt to monitor managerial effort and actions directly, or may stage investments and terminate funding if interim performance is poor (Bolton and Scharfstein, 1990). While the theoretical importance of these mechanisms is clear, there is little evidence on their empirical relevance, and in particular whether and why investors' abilities to make effective use of these other governance mechanisms impacts the design of financial contracts.

In this paper we provide evidence on this question from the venture capital (VC) industry, which has several advantages as a setting to investigate the determinants of real-world financial contracts and their relation to theory. VCs are sophisticated investors who face substantial information and agency problems, have strong incentives to maximize value, and have considerable flexibility in designing contracts with the entrepreneurs they finance.[2]

Importantly for our purpose, VCs are actively involved in their portfolio companies and almost always stage investments, creating scope for mitigating financing problems through not only contractual contingencies, but also direct monitoring and intervention and the deterrent possibility of refusal to provide follow-on funding and withdrawal of value-added services. The greater a VC's monitoring and value-added abilities, the more effective the monitoring and deterrent channels will be at constraining the entrepreneur's behavior.

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[1] See, for example, Jensen and Meckling (1976), Holmstrom (1979), Aghion and Bolton (1992), and Dewatripont and Tirole (1994).

[2] Hart (2001) and Kaplan and Strömberg (2003, 2004) argue that VCs and the entrepreneurs they finance closely resemble the principals and agents of theory.

We study how VCs' abilities to mitigate agency problems through these monitoring and deterrent channels are related to the design of their contracts with entrepreneurs. In doing so, this paper is the first to demonstrate that VC characteristics, in addition to portfolio company characteristics, have a significant impact on VC contract design in the U.S. The analysis unites the literature examining U.S. VC contracts through an agency lens, which so far has implicitly treated VCs as a single uniform class (Gompers, 1998; Kaplan and Strömberg, 2003, 2004), with the growing literature documenting that VCs differ substantially in quality, behavior, and ability to add value to portfolio companies[3], thereby adding a contracting perspective to the implications of differing VC quality and abilities for entrepreneurial companies.

Our analysis uses a new dataset of contractual provisions governing the allocation of cash flow rights in U.S. investments by 646 private-partnership VCs in 1,266 startup companies over 1,534 investment rounds, which is several times larger than datasets used in previous work on VC contracts. These provisions – liquidation preference, anti-dilution rights, cumulative dividends, redemption rights, participation rights, and pay-to-play provisions – jointly determine the extent to which the VC receives a greater fraction of company cash flows if company performance is poor or mediocre.[4] We call them *downside protections.* The prevalence and magnitude of downside protections in VC contracts indicates that they are of first-order importance in these transactions (Sahlman, 1990; Kaplan and Strömberg, 2003, 2004).

We investigate the relation between the strength of downside protections in a VC contract and the monitoring and value-added abilities of the VC. On the one hand, because affiliation with better VCs is valuable to entrepreneurs (Hsu, 2004), it is possible that VCs with greater

[3] Notable work investigating differences in VC quality and behavior includes Hsu (2004), Kaplan and Schoar (2005), Chemmanur, Krishnan, and Nandy (2007), Bottazi, Da Rin, and Hellmann (2007), Sorensen (2007), Gompers, Kovner, Lerner, and Scharfstein (2008), and Zarutskie (2008).
[4] We explain these contractual provisions in detail in Section IV and Table II.

abilities could negotiate contracts with more downside protections. Consistent with this, Hsu (2004) finds that better VCs invest at lower pre-money valuations.

On the other hand, downside protections differ in an important way from pre-money valuations: their cash flow implications differ depending on whether company performance is good or bad. From an agency perspective, this property suggests a tradeoff. While downside protections provide incentives to the entrepreneur by penalizing him in bad states of the world (they give the VC a more “debt-like” claim), they are costly from a risk-sharing perspective (Holmstrom, 1979). To avoid these costs, it may be optimal for downside protections to be weaker when other mechanisms to contain agency problems are available. For this reason, VCs with greater abilities to monitor the entrepreneur, and with greater value-added abilities (which create a stronger deterrent threat of withdrawal of value-added services), may obtain weaker downside protections in exchange for more favorable terms elsewhere in the contract.

Our results strongly support this tradeoff view. To conduct our analysis, we code each cash flow provision based on the downside protection it offers the VC, and add the scores for each provision to create a downside protection index (DPI). We use the investment experience of the VC (i.e., number of historical investments) as our main empirical proxy for the VC’s abilities to monitor and add value to portfolio companies. This proxy is motivated by substantial evidence in the literature that more experienced VCs do in fact have superior such abilities (e.g. Chemmanur, Krishnan, and Nandy, 2007).

Our main finding is that more experienced VCs obtain significantly weaker downside protections. This result holds in univariate analysis and is robust to a battery of control variables for company and VC characteristics. In fact, VC firms in the top experience quartile are roughly twice as likely as VC firms in the bottom experience quartile to use contracts with below-median downside protections. These results also hold for all six cash flow provisions individually, and so are not sensitive to the choice of aggregation method. We obtain similar results using VC age and the success (IPO) rate of the VC's previous investments as a proxy for VC abilities. [5] [6]

These results imply that entrepreneurs pay less (in an expected value sense) for affiliation with high-quality VCs than previous literature suggests. In particular, Hsu's (2004) result that above-median quality VCs invest at a 10-14% lower pre-money valuation is an upward-biased estimate of the value of affiliation, because this estimate does not take into account the fact that more experienced (higher quality) VCs systematically obtain weaker downside protections. Simple estimates indicate that the value of the cumulative dividend and liquidation preference differences alone are on the order of 3.5%.[7]

We also find that more experienced VCs are more likely to join their portfolio companies' boards of directors, which implies they had negotiated the right to do so as part of the financing contract.[8] Baker and Gompers (2003) and Wongsunwai (2008) report similar results. This result suggests that board seats, which provide a channel for VCs to use their monitoring and value-added abilities, have greater value for VCs with superior abilities.

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[5] Our results are not driven by differences in the inclusion of contractual provisions that give VCs downside protections, but rather differences in their strength. Thus, our findings are not explained by more experienced VCs writing less complicated contracts (with fewer provisions) because they want to save on contracting costs (Tirole, 2008).

[6] Kaplan, Martel, and Strömberg (2007) find that VC contracts outside the U.S. are more likely to include cash flow and control right contingencies when the VC is more experienced or has previously syndicated with a U.S. VC, consistent with VCs outside the U.S. gradually learning about the benefits of contracts with such contingencies.

[7] Details are provided in Appendix B. A comprehensive valuation of all six cash flow provisions would entail a complex valuation model, incorporating an option pricing framework and explicitly modeling the complex interactions between various cash flow provisions. Deriving such a model, while interesting in its own right, is beyond the scope of this paper. See Metrick (2007) for a discussion of the issues involved.

[8] While we can observe whether a given VC joins the board, we do not have information on whether the VC controls a majority of the board seats.

Taken as a whole, our results combine with the existing literature to suggest that because of their better governance abilities, more experienced VCs have less need for downside protections, and optimally focus more on upside payoffs (obtained by investing at lower valuations) and obtaining board representation during negotiations with entrepreneurs.

An important potential concern with these interpretations is that our main findings may be driven by selection. Perhaps more experienced VCs obtain fewer downside protections because they invest in companies that are less prone to agency problems, making downside protections less relevant. In other words, perhaps VC experience proxies for unobserved aspects of company quality. We address this concern in two ways.

First, we provide evidence that the battery of control variables in our main specifications, some of which are hand-collected, do capture value-relevant aspects of company quality. These controls suffice to replicate Hsu's (2004) result that, among first-round investments in companies in high-tech industries, there is a negative relation between VC experience and the pre-money valuation of the company. If VC experience proxies for aspects of company quality that are missed by these controls, we would expect to instead find a positive relation, which we do not.

Second, we control for selection effects in an instrumental variables framework similar to that employed by Botazzi, Da Rin, and Hellmann (2008), who face similar potential selection issues. These specifications identify treatment effects of VC experience by assuming that the VC market is geographically segmented, which implies restrictions on the potential matches between VCs and portfolio companies. In particular, this assumption implies that matches are at least partially determined by geographic factors unrelated to company quality, thereby solving the endogeneity problem. The assumption of geographically segmented VC markets is motivated by considerable empirical evidence that VCs have a strong preference for geographically proximate investments (Sorenson and Stuart, 2001). Sorensen (2007) also relies on this assumption to identify a causal effect of VC experience on investment outcomes. Our main results are robust to these specifications.

Several additional pieces of evidence further buttress the interpretations offered above. In the cross-section, we find that the negative relation between DPI and VC experience is weaker when the entrepreneurial agency problem is likely to be less severe. In such cases, the ability of an experienced VC to mitigate agency problems in other ways is relatively less important. Furthermore, the relation between DPI and VC experience is stronger when the VCs collectively own a greater fraction of company equity, i.e. when VCs already have strong incentives to provide monitoring and value-added services. Also, in the subsample in which the VC joins the board, we find that the prior board experience of the VC partner who joins the board (a measure of monitoring ability) is negatively related to DPI. All of these results suggest that our main results are more likely due to the entrepreneur's incentive problem, and unlikely to reflect the need to provide the VC with incentives to provide monitoring and value-added services (the so-called dual moral hazard problem, e.g. Casamatta, 2003).

In a final step, we show that VCs that have stronger syndication networks obtain weaker downside protections. This result holds after controlling for VC experience, and is robust to different definitions of network strength. Hochberg, Ljungqvist, and Lu (2007) find that better networked VCs have better investment performance, suggesting networks may improve monitoring and value-added abilities. Moreover, VCs with stronger networks are likely to be more able to credibly transmit negative information about an entrepreneur to other VCs.[9]

[9] Robinson and Stuart (2007) make a similar argument in the context of strategic alliances, and find consistent evidence.

Our work adds to the literature examining how contracts are affected by the availability of other governance mechanisms in other contexts. Lerner and Schoar (2005) find that VCs outside the U.S. are more likely to use complex contracts when the legal system is more likely to enforce them. Robinson and Stuart (2007) examine contracts governing strategic alliances and find that reputational concerns are a substitute for explicit contractual control mechanisms in mitigating potential moral hazard problems. Corts and Singh (2004) find similar evidence in offshore oil-drilling contracts. Drucker and Puri (2007) examine bank loans, and find that loans sold to third-party investors contain more protective covenants than loans that are not sold.

This paper proceeds as follows. In Section II we develop our empirical predictions. Section III describes the sample. Section IV discusses the meaning of each contract term and how the downside protection index is computed. Section V presents our main empirical results. Section VI presents evidence on interaction effects and network strength as well as robustness tests. Section VII concludes.

II. Theoretical discussion and empirical predictions

A. Downside protection and investor abilities

In a frictionless Modigliani-Miller (1958) world, the use of downside protections in a financial contract is irrelevant in the sense that the combined payoff to VC investor and entrepreneur is unaffected by contract design. This irrelevance does not hold if the outcome of the start-up company depends on the entrepreneur's willingness to exert unobservable effort. As shown by Holmstrom (1979), the presence of this agency problem implies that the entrepreneur's payoff should optimally be higher when the company has a successful outcome. With limited liability, and in the absence of other contracting frictions, the optimal contract would then always give the entrepreneur a zero payoff if the company is not successful. This contract gives the investors the maximum possible downside protection.

In the real world, venture-backed entrepreneurs receive some positive payoff for a broad range of unsuccessful company outcomes, suggesting the existence of a contracting friction to explain why investor downside protections are used more moderately. Following Holmstrom (1979), one plausible friction is the difference in risk preferences between a risk-averse entrepreneur and a well-diversified investor who has more capacity to absorb risks. The presence of both a moral hazard problem and risk sharing costs implies that the optimal contract will include contractual terms that give investors some but not full downside protection, and the extent of downside protections will be negatively related to VC abilities to reduce agency costs through mechanisms that do not incur such costs.[10]

A distinguishing feature of the VC industry is that VCs actively monitor their portfolio companies and almost always stage investments. These abilities create scope for reducing moral hazard costs by observing the entrepreneur's effort and actions directly and imposing penalties if necessary, such as firing the entrepreneur, reducing his monetary compensation, withdrawing value-adding services to the company, or refusing to provide follow-up financing to the company. The logic above suggests that investors who have better such abilities will use contracts with weaker downside protection. Appendix A presents a stylized model to formalize this intuition.

B. VC Experience and investor abilities

In the context of venture capital, we argue that a good proxy for the investor's abilities to contain agency problems is the experience of the VC firm. More experienced VCs are on average

[10] This argument does not require differences in risk aversion. It simply requires the presence of any contracting friction that makes the use of maximum downside protections suboptimal.

better than less experienced VCs because of the survivorship bias that follows from the fact that poorly performing VCs find it hard to raise follow-up funds (Kaplan and Schoar, 2005), and because of the learning-by-doing nature of VC investing.

Consistent with this, recent empirical studies provide evidence that more experienced VCs have better abilities to monitor and intervene with their portfolio companies, or at least more opportunity to use these abilities. Baker and Gompers (2003), Wongsunwai (2008), and our results below, show that more experienced VCs are more likely to sit on the board of directors, which increases their ability to control agency problems by monitoring the entrepreneur and credibly threatening to replace or otherwise penalize her should she not take the desired actions.[11]

Moreover, VCs with greater value-added abilities may induce "good behavior" because of the value of a continuing relationship with them. Several studies suggest that more experienced VCs have greater value-added abilities. Sorensen (2007) shows that companies backed by experienced VCs are more likely to go public, even controlling for selection effects. Chemmanur, Krishnan, and Nandy (2008) show that companies backed by more reputable VCs grow faster and spend less. Hsu (2004) shows that entrepreneurs are more likely to accept financing offers from more experienced VCs even if such offers are financially less attractive.

As such, the refusal of an experienced, prominent VC to participate in a follow-up investment would be more costly to the company than the refusal of an inexperienced VC, both because of the loss of value-added services and because of the negative signal that would be sent to other potential VCs (Rajan, 1992). In unreported tests, we find additional evidence that

[11] Hellmann & Puri (2002) and Kaplan, Sensoy, and Strömberg (2009) show that founder CEOs are often replaced in venture-backed companies, and it is plausible to assume that experienced VCs can more easily find a good replacement CEO.

entrepreneurs prefer financing from more experienced VCs –more experienced VCs are more likely to be repeated investors in a company, i.e. invest in more than just one financing round.

For all of these reasons, we believe that VC experience is a good empirical proxy for VC abilities to lower moral hazard costs.

III. Sample

A. Sample description

Our sample of contractual terms comes from 3,394 U.S. private partnership VC investments in 1,534 financing rounds involving 1,266 unique U.S. companies, and so is roughly ten times larger than the sample studied by Kaplan and Strömberg (2003). We obtain the data from the Private Equity consulting firm VCExperts, who collect the data from publicly available (but difficult and costly to access) legal documents called Certificates of Incorporation which companies are required (by the state) to file with their states of incorporation when making changes to their outstanding equity (such as issuing preferred stock to VCs).[12]

The size of the sample comes at the cost of limitations on depth. Certificates of Incorporation provide detailed and comprehensive information on the downside-protecting cash flow rights to which VCs are entitled pursuant to the financing contract, and which are our main interest here, and which are a coherent set of provisions to analyze in light of our main hypotheses. However, they do not constitute or describe all the terms of the contracts between VCs and the companies they finance. In particular, the certificates do not provide comprehensive information about the exact allocation of control and voting rights, nor do they contain

[12] We are very grateful to VCExperts, and in particular to Joseph Bartlett, Cory Buecker, Justin Byers and Michael Ostendorff for all their help with obtaining and analyzing the data.

information on the valuation of the company (price paid for the preferred stock). As described below, however, we are able to infer (some of) this information from other sources.

For each investment we find the matching financing round in Venture Economics, extract data on company and round characteristics, and identify all the VCs that invested in the round. Venture Economics allows us to determine which if any VCs join the board of directors, from which we infer whether they had negotiated the right to do so as part of the financing contract. From Venture Economics and VCExperts we obtain valuation information for roughly half our sample. We supplement these data with hand-coded information on founder characteristics, specifically whether the founder is a repeat entrepreneur and if so whether the previous venture was a success (see Bengtsson, 2009 and Gompers et al., 2009a). We exclude companies that did not receive financing from at least one U.S. private partnership VC.

An important advantage of our sample is that there are no obvious selection issues. Our data are based on mandatory filings and therefore are not subject to any reporting biases. Moreover the data are random draws from the population within years; they were not selected based on company or VC characteristics.

Panel A of Table 1 provides an overview of the sample. The sample is recent; 39% of the financing rounds were completed in 2007, 44% in 2006, 15% in 2005, 2% in 2004, and only 1% before 2004. The concentration in 2006 and 2007 reflects the fact that VCExperts only began collecting the data in those years, and chose to focus on recent financing rounds.

Most of our sample involves investments in companies located in California (530 rounds, or 35%) or Massachusetts (247 rounds, or 16%). 425 (28%) of the financing rounds are first-round financings. 141 (9%) of our financing rounds involve companies in the biotech industries, 221 (14%) in the life-science industries, 228 (15%) in media industries, 793 (52%), and 151 (10%) in other industries.

Table 1 also shows that sample appears quite representative of the Venture Economics universe for the period 2005-2007 (97% of our sample) on the key dimensions of company location, round number, and industry group. The largest differences are that compared to Venture Economics, we slightly undersample California companies (35% compared to 41%) and slightly oversample Massachusetts companies (16% compared to 12%). We believe these slight differences are unlikely to bias our analysis, and in any case we control for company and VC location in our multivariate regression analyses.

B. Variables that measure VC abilities

Panel B of Table 1 displays summary statistics for VC characteristics for our sample of financing rounds. We use Venture Economics data to create proxies for each VC's monitoring and value-add abilities. "VC experience", the main independent variable in our empirical work, is the total number of unique companies in which the VC has invested up to the date of the investment in question. This is the most common measure of VC reputation or quality in the literature. "VC age" is the number of years since the founding of the VC firm. "VC IPO fraction" is the fraction of the VC's previous investments that subsequently went public in an IPO. "VC fund size" is the committed capital of the VC fund (not firm), which is again a measure of VC quality to the extent that successful VCs are able to raise larger funds (Kaplan and Schoar, 2005). At the time of a sample financing round, the average VC has invested in 118 companies, is 14.3 years old, and has a historical IPO rate of 11%. The average fund size is $307 million.

C. Control and other variables

Panel B of Table 1 also gives summary statistics for other variables we use as controls and dependent variables in various specifications. 49% of VCs are located in the same state as the companies they finance. 37% of VCs are located in California, and 19% in Massachussetts. 53% of VCs take a board seat in the company, of these the partner sitting on the board has previously sat on an average of 6.2 company boards.

The average company is about 5 years old at the time of financing. The average round consists of 4.3 VCs, 2.2 of which are private-partnership VCs. 91% of rounds are syndicated (involve more than one VC). The average amount invested in a round is $11.1 million, and the average pre-money valuation (for the roughly half of companies for which the data are available) is $47.8 million. We hand-collect data on founder background: 24% of companies are founded by a serial entrepreneur; of these 25% (or 6% of the total) previously founded another company that subsequently went public in an IPO, and 38% (or 9% of the total) previously founded another company that subsequently was acquired in an M&A transaction.

IV. Cash flow provisions and downside protection index

A. Description and economic function of cash flow provisions

The cash flow provisions in the Certificates of Incorporation apply identically to all investors in a given financing round. The provisions are cumulative dividend rights, liquidation preference, participation rights, anti-dilution rights, redemption rights, and pay-to-play requirements. The exact meaning and economic importance of each term is described in table 2 (see also Kaplan and Strömberg, 2003, and Metrick, 2007, for detailed descriptions). These six provisions all affect the cash flow rights that are attached to the preferred stock that VCs receive in exchange for their investment.

Because VC financing contracts call for the mandatory or automatic conversion of preferred stock to common stock if performance is sufficiently good (usually upon a successful IPO), these cash flow rights attached to preferred stock only affect actual cash flow allocations if company performance turns out to be poor or mediocre, and thereby are downside protections for the VC. (The equity ownership of the VC dictates his/her share of company value if the company is ultimately successful.) Moreover, if mandatory conversion does not occur, these cash flow rights have a relatively greater impact on the ultimate division of company cash flows when the selling price is lower. Therefore, the provisions have the greatest influence on the final allocation of cash flows when ultimate company performance is poor, and this influence weakens and eventually disappears altogether as performance improves.

To be more specific about the role of these provisions, cumulative dividends, liquidation preference and participation rights give the VC a higher fraction (up to 100%) of total cash flows when company performance is poor (total cash flows are smaller). Anti-dilution rights gives the VC more shares if the company secures a financing round at a lower valuation, which effectively increase the dollar payoff to the VC. Redemption rights, which give the VC the right to sell its shares back to the company, represent a valuable put option that is exercised if company performance is bad. Pay-to-play, which unlike the other terms is not favorable to the VC, forces a VC that chooses to not invest in follow-up financing rounds of the company to give up some or all of the control and cash flow rights that are attached to the preferred stock. Because pay-to-play not only affects the strength of the VC downside protection but can also affect the distribution of contractual rights between different VCs, we confirm that our main results are robust to specifications that exclude pay-to-play.

B. Coding of cash flow provisions

We code each provision based on the strength of the downside protection it offers the VC. Panel A of Table 2 reports summary statistics.

Redemption rights are coded as present (1) or not present (0). Redemption rights are not included in 39% of contracts (0) and are included in the other 61% (1).

The remaining five provisions are coded as 0, 1 or 2, where higher values denote stronger downside protections. 65% of our sample contracts include no cumulative dividends (0). The most common dividend rate is 8%. 28% of all contracts have a rate of 8% or less (1), and the remaining 7% of contracts have a dividend rate above 8% (2).

92% of our sample contracts have a 1X liquidation preference (0) and 6% have above 1X and up to 2X (1). Only 1%, or 22 contracts have a liquidation preference above 2X (2).

29% of contracts have (non-participating) convertible preferred stock (0). 25% have capped participating preferred stock (1). 46% of our contracts have uncapped participating preferred stock (2).

Anti-dilution in some form is almost always included in VC contracts. Only 2% of contracts in our sample have no anti-dilution (0). Weighted average is most common and found in 89% of all contracts (1), while only 10% of contracts have full ratchet anti-dilution (2).

Pay-to-play is not included in 82% of the sample contracts (2). Pay-to-play in which the VC loses some (but not all) contractual rights, typically anti-dilution, is found in 4% of contracts (1). Pay-to-play in which the VC loses all contractual rights and is forced to convert to common stock is found in 13% of the contracts (0).

Panel B of table 2 displays a cross-correlation matrix for the different contractual provisions. The contract terms are generally positively correlated with one another, indicating that they tend to be used together. The major exception is pay-to-play, which is not significantly positively correlated with any of the other contract terms.

C. Aggregation to downside protection index (DPI)

To study these downside-protecting cash flow provisions jointly, we aggregate the terms to an index that measures the overall downside protections the contract offers the VC. The ideal aggregation method would work as follows. First, for each financing round in our sample and for each outcome contingency, we would calculate the exact joint cash flow implications of the contract terms that we study. Second, we would calculate the expected value of these cash flows implications using the probability distribution of eventual company outcomes. This calculation is difficult because almost all input data is unavailable – we do not know the probability that the company will raise a follow-up financing round (which affects both anti-dilution and pay-to-play), the probability that VCs will use the redemption option, the probability distribution of sale or liquidation cash flows, or the timing of the liquidation event.

In light of these difficulties, we create our downside protection index (DPI) using the simplest and most transparent aggregation method available to us – adding the downside protection scores of each contract term together. Gompers, Ishii and Metrick (2004) similarly add together scores for various corporate governance provisions to arrive at a corporate governance index for firm, even though in reality the provisions interact in complex ways. Simple addition has the benefit of capturing the ordering of importance (the strength of downside protections) while maintaining simplicity and transparency. Our main results are qualitatively unaffected if we code each contract term as (0,1), which results in a DPI that ranges from 0-6 rather than 0-11, and Table 5 (described below) shows that our main results hold for each provision individually. For these reasons, it is unlikely that our results are sensitive to the choice of aggregation method.

Figure 1 shows the distribution and summary statistics of the resulting downside protection index (DPI). The index appears to be approximately normally distributed with mean 4.94 and standard deviation 1.65. 88% of all observations have a DPI between 4 and 8. One contract each has the minimum and maximum DPI scores of 0 and 11. 38% of contracts have DPI above the median (5).

V. Main results

A. Univariate results

Panel A of Table III presents the distribution of downside protection scores for each cash flow provision, and for aggregate DPI, by VC experience quartile. The negative relation between the extent of downside protections and VC experience is evident in the Panel. In fact, with one exception (liquidation preference from 4^{th} to 3^{rd} quartile), the relation is monotonic for every provision and for every quartile transition. The average DPI for the bottom quartile of VC experience is 5.31, compared to 4.36 for the top quartile.

Panel B of Table III shows that the differences between quartiles are almost all statistically significant. The differences between the top and bottom quartiles are all statistically significant.

B. Multivariate regressions

In Table IV we show that the negative relation between the strength of downside protections (DPI) and VC experience continues to hold in multivariate regressions and using different measures of VC quality or likely ability to monitor and add value to portfolio companies. For ease of interpretation, we report OLS regression results, but our conclusions continue to hold in untabulated ordered logit regressions.

The regressions include controls for whether the VC firm and company are located in the same state, the company's age, whether the founder is a serial founder, whether the founder is a serial founder whose previous company went public in an IPO, whether the founder is a serial founder whose previous company was acquired, the round number (a proxy for maturity), the amount invested in the round, and the total number of VCs investing in the round. The regressions also include fixed effects for VC firm location (California, Massachusetts, Texas, New York, and other states), company location (state), company industry (Venture Economics 10-industry classification), and year of investment round.

These controls are intended to capture aspects of the company, entrepreneur, and contracting environment that might affect downside protections, and thereby provide some confidence that coefficients on VC experience do not actually reflect selection effects. In particular, company maturity and founder background are likely to be related to the extent of agency problems faced by the VC (Kaplan and Strömberg, 2003). We address the adequacy of these controls, and other methods to deal with the selection issue, in subsection E below.

Two of these control variables, the number of VCs investing in the round, and the total amount invested in the round, require further discussion. Unlike the other control variables, these variables are endogenous, that is, they are codetermined along with the strength of downside protections as the financing round is negotiated. The advantage of including them is that they help hold constant as many factors across financing rounds as possible, and may be informative about the magnitude of agency problems. In particular, the size of the aggregate VC investment may be informative of the extent of agency problems because VCs may not be willing to commit large amounts to agency-prone companies. If so, including these endogenous regressors is likely to bias us away from finding the effects we do. Indeed, when we drop these controls, the coefficient on VC experience in Table IV increases in magnitude. This result is displayed in column 2 of Table IV.

Because all VCs investing in a round receive the same contract, we compute standard errors by clustering residuals by both VC firm and portfolio company using the two-way method of Petersen (2009). In Table VII, we show that our conclusions hold when we collapse the data to only one observation per investment round and cluster by lead VC firm.

The results in Table IV are easily summarized. Controlling for company and round characteristics, more experienced, older, larger, and more successful VCs use obtain significantly weaker downside protections. Doubling "VC number of investments" is associated with a 12 percentage point lower probability of DPI greater than 5 (the sample median), and VCs in the top experience quartile have a DPI score that is 0.50 lower than other VCs and 0.56 lower than VCs in the bottom experience quartile. These coefficients are substantial relative to the sample average DPI of 4.94 and correspond to about one third of a standard deviation.

Gompers et al. (2009b) show that VCs that focus their investments in fewer geographical areas or industries have higher successful rates than VCs that invest in many different areas and industries. Consistent with this, column 8 of Table IV shows that VCs with more industry focus (measured by the fraction of the VC's historical investments that are in the same industry as the current company) do obtain weaker downside protection. The same result does not hold for VCs with more geographic focus.

The coefficients on the control variables in table IV are generally insignificant, with three exceptions. Company age is significantly positively related to DPI, which may indicate a greater likelihood of a liquidation in which some assets are recoverable as the company ages. Round amount is significantly negatively related to DPI, consistent with VC willingness to invest more capital at one time in companies less prone to agency problems.

Serial entrepreneurs whose previous venture went public in an IPO are able to secure financing with weaker DPI; the same result does not hold serial entrepreneurs whose previous venture was unsuccessful. Kaplan and Strömberg (2003) find that serial founders receive better terms from VCs on a variety of dimensions, but do not distinguish between successful and unsuccessful serial founders. Our results suggest that the past success of a serial founder is an important indication of entrepreneur and company quality, and so is an important determinant of the downside protections provided in the financing contract. This result helps explain Gompers et al.'s (2009a) somewhat counterintuitive result that serial successful entrepreneurs do not receive more favorable valuations from VCs even though their subsequent companies are more likely to be successful. Our results suggest that serial successful entrepreneurs do in fact raise capital at more attractive terms, because the VCs obtain weaker downside protections.

Our results also imply that entrepreneurs pay less (in an expected value sense) for affiliation with high-quality VCs than previous literature suggests. In particular, Hsu's (2004) result that above-median quality VCs invest at a 10-14% lower pre-money valuation is an upward-biased estimate of the value of affiliation, because this estimate does not take into account the fact that more experienced (higher quality) VCs systematically obtain weaker downside protections. In Appendix B, we provide simple estimates indicating that the value of the cumulative dividend and liquidation preference differences alone are on the order of 3.5%.

C. Individual cash flow provisions

To address concerns that the results in Table IV may be driven by our choice of aggregation method, we run separate probit regressions for each individual cash flow provision. These regressions are displayed in Table V, in which the dependent variable takes the value 1 if cumulative dividends are present (specification 1), if the liquidation preference is above 1X (specification 2), if preferred stock has participation (specification 3), if full-ratchet anti-dilution is present (specification 4), if redemption rights are present (specification 5), and if pay-to-play is not present (specification 6), and 0 otherwise.

In Table V and subsequent tables we focus on VC experience. In untabulated regressions we use VC age and historical success (IPO) rate and obtain similar results. Consistent with the results in Table IV, the coefficient on "VC Experience" in table V is negative and significant for all six individual contract terms.

We are unable to cluster by both VC firm and portfolio company in the probit specifications in Table V because the resulting residual covariance matrices are not positive definite. Instead we cluster residuals by portfolio company (only). Linear probability models analogous to the specifications in Table V, in which we are able to cluster by both VC firm and portfolio company, yield similar results. These results suggest that the results in Table IV (and those that follow) are unlikely to be driven by our choice of aggregation method.[13]

D. Board representation and relation to Hsu (2004)

The fact that more experienced VCs obtain weaker downside protections, which all else equal imply a lower share of company value in expectation, raises the natural question of what concessions they obtain elsewhere in the contract to compensate. Part of the answer is provided

[13] As we note in Section IV. C., our results are qualitatively unaffected if we instead define DPI as the simple sum of a binary coding (0,1) of each cash flow provision.

by Hsu (2004), who finds that more experienced VCs invest at about a 10-14% lower pre-money valuation (or per-share purchase price) than their less experienced counterparts. A lower pre-money valuation translates into a greater equity ownership stake for a given investment amount and therefore a greater potential payoff if the company is eventually successful.

In addition, more experienced VCs appear to negotiate stronger control rights as part of the financing contract. While we do not have information on whether the VC or the entrepreneur controls the board of directors, Venture Economics reports whether a given VC sits on the board, which implies they had negotiated the right to do so as part of the financing contract.[14] Table VI shows that more experienced VCs are more likely to join the boards of directors of their portfolio companies. Similar results obtain using VC age, fund size, and historical success rate. As with Table V, the results continue to hold in OLS specifications which double cluster by both VC firm and portfolio company. Of course, sitting on the board provides a mechanism and authority to use monitoring and value-added abilities, and so should have greater value for VCs with superior abilities. In Table VI and all subsequent tables we do not report the coefficients on the control variables to conserve space and because signs and significance are similar to Table IV.

Overall, our results combine with the existing literature to suggest that by virtue of their abilities more experienced VCs have less need for downside protections, which are costly from a risk-sharing perspective, and consequently optimally focus more on upside payoffs (obtained by investing at lower valuations) and obtaining board representation during negotiations with entrepreneurs.

[14] Because the Venture Economics board data reflect self-reported or voluntarily disclosed information (from surveys, press releases, newspaper articles and web-pages), not all VC board seats are included in our sample. However, because the propensity to report a board seat is unlikely to be systematically related to VC experience, the cross-sectional results are unlikely to reflect a sample bias. Baker and Gompers (2003) and Wongsunwai (2008) find similar evidence using board data from IPO filings and other data sources.

E. Endogenous selection

In this subsection, we consider in detail whether selection biases are likely to be driving our main results. A potential concern is that the observed negative correlation between VC experience and contract DPI may simply reflect selection effects wherein more experienced VCs invest in better companies that are less prone to asymmetric information and agency problems, and for which downside protections are less important. In other words, the concern is that perhaps VC experience is related to aspects of company quality that are missed by our controls. We address this concern in several ways.

E.1 Replicating Hsu (2004)

Panel A of Table VII provides evidence that the battery of control variables in our main specifications do capture value-relevant aspects of company quality. Panel A shows that these controls suffice to replicate Hsu's (2004) result that, among first-round investments in companies in high-tech industries, there is a negative relation between VC experience and the pre-money valuation of the company. To mirror Hsu (2004), we collapse the data to one observation per financing round and estimate the relation between pre-money valuation and the experience (age, historical success rate) of the lead VC. If VC experience proxies for aspects of company quality that are missed by these controls, we would expect to instead find a positive relation, which we do not. Panel A also shows that the general negative relation between DPI and VC experience continues to hold in this subsample.

E. 2. Instrumental variables approach

We also adopt the methodology of Botazzi, Da Rin, and Hellmann (2008), who face essentially the same potential selection issues, and who offer three sets of tests to mitigate these concerns. The three sets of tests share the common feature that they identify treatment effects of

VC experience by assuming that the VC market is geographically segmented, which implies restrictions on the potential matches between VCs and portfolio companies. In particular, this assumption implies that matches are at least partially determined by geographic factors unrelated to company quality, thereby solving the endogeneity problem. The assumption of geographically segmented VC markets is motivated by considerable empirical evidence that VCs have a strong preference for geographically proximate investments (Sorenson and Stuart, 2001). Sorensen (2007) also relies on this assumption to identify a causal effect of VC experience on investment outcomes.

The first of the three approaches is based on instrumental variables. A good instrument in this setting is a variable that affects whether or not a company is financed by an experienced VC, but which does not affect the strength of downside protections except through the effect on whether the company is financed by an experienced VC. That is, the instrument must influence whether an experienced VC finances the company, but must not be correlated with other factors (such as company quality) that influence the strength of downside protections.

Botazzi, Da Rin, and Hellmann (2008) point out that if VC markets are geographically segmented, then while the exact VC with which a company is matched is endogenous to company quality, the availability of experienced VCs with which to potentially match is exogenous, i.e. unrelated to the quality of the company. That is, given geographic segmentation, and holding constant company quality, a company located in a region with more experienced VCs will be more likely to be financed by a more experienced VC. But because the local availability of experienced VCs is exogenous to company quality, this local availability will have no direct effect on the strength of downside protections obtained once the match occurs.

Following this logic, we instrument VC experience with the local availability of experienced VCs, which we define as the average experience of all VCs in the local market (state). This approach is very similar to Berger et al. (2005) who instrument an individual bank's size with the median size of banks in the local market.

The first three specifications of Panel B of Table VII report the results. We instrument for VC experience using the average experience at the time of investment of all VC firms located in the same state as the company receiving investment. From this average we exclude the actual VC investor because we do not want to contaminate our instrument by using an observation as its own instrument. The negative relation between VC experience and contract DPI is robust to these specifications. The results for the identical procedure using instead VC age and historical success rate (IPO ratio) are similar, though the coefficient on VC age is not quite significant.

A limitation of this approach is that it involves a somewhat restrictive specification of how endogenous selection takes place – specifically, that only VC experience is relevant to the selection problem. We next consider two additional approaches that allow for a richer selection model.

E. 3. Ackerman-Botticini (2002) approach

To allow for the possibility that matching may involve several different investor and company characteristics, we follow Botazzi, Da Rin, and Hellmann (2008) and also consider a variant of the rich identification strategy of Ackerman and Botticini (2002). In this approach, the matching of a VC and a company depends on all their potentially relevant characteristics, whether or not observed by the econometrician. Whether a particular company is matched with a particular VC depends on both characteristics of local VCs and characteristics of local companies, which given the assumption of geographic segmentation can be taken as exogenous to the quality of any particular company.

In this approach, a valid instrument for VC experience is a set of variables that capture exogenous local market characteristics (observed and unobserved), as well as exogenous company characteristics (company characteristics unrelated to company quality), that might influence the matching of a particular VC and a particular company. Ackerman and Botticini (2002) suggest a set of fixed effects: fixed effects for each local market, and fixed effects for each company type-local market pair.

Our data contain 50 local markets (50 states). Fixed effects for each of these states capture all aspects of the local market (observed and unobserved) that may influence whether a given VC matches with a given company. In particular, these fixed effects span and therefore subsume the average experience of local VCs used as an instrument in the previous subsection. It remains to specify fixed effects for company characteristics that may influence whether a company matches with an experienced VC, but are exogenous in the sense of being unrelated to company quality. We follow Botazzi, Da Rin, and Hellmann (2008) and use fixed effects for company industry (10 Venture Economics industries), which we interact with the state fixed effects (50 states) for a grand total of 500 fixed effects.[15] The intuition is that companies in some industries (e.g. high-tech) may have greater use for the better monitoring and value-added services of experienced VCs than companies in other industries (e.g. retail), but this is unrelated to the quality of the company within its industry. By interacting the fixed effects, the specification allows the extent to which industry and local market characteristics interact to vary across industries and local markets.

[15] Botazzi, Da Rin, and Hellmann (2008) also include fixed effects for investment round number, but we are unable to do so here because it would result in more fixed effects than observations.

We use all of these fixed effects to instrument for VC experience, and in separate specifications, VC age and historical success rate (IPO ratio). The fourth through sixth columns of Panel B of Table VII display the results, which confirm that our conclusions continue to hold.

E. 4. Sorensen-Heckman approach

Our final approach is what Botazzi, Da Rin, and Hellmann (2087) label the "Sorensen-Heckman" approach. This approach is based on combining the insight of Sorensen (2007) that there is information in all potential matches (including unrealized ones) in a market with the selection framework of Heckman (1979). Following Sorensen (2007), we form all potential matches between VC firms and companies in our sample and run a Heckman model in which the dependent variable in the selection equation takes the value 1 if the match is a realized match and 0 otherwise. The explanatory variables in the selection equation and outcome equation are VC experience and the controls in our main specifications in Table IV (in separate specifications we replace VC experience with VC age and historical success rate).

The indentifying variables included in the selection equation, but not the outcome equation, are interactions of fixed effects for both company and VC location (state). Thus, as before, the identifying assumption is that VC markets are at least partially geographically segmented, so that the likelihood of a match between a given VC and a company of given quality depends on their locations, but the strength of downside protections once a match is formed does not directly depend on locations. Due to computational limitations, we restrict the sample to VC firms and companies that are located in the five states that have the largest VC markets, which are California, Massachusetts, Texas, New York and North Carolina.

The results are displayed in the last three columns of Panel B of Table VII. In brief, the negative relations between VC experience, age, and historical success rate (IPO rate) continue to hold.

Taken as a whole, the results in Table VII suggest that it is unlikely that our main results are driven by selection.

VI. Further empirical evidence

A. Interactions with proxies for the entrepreneurial agency problem

Another potential alternative explanation for our main results is that they may reflect the need to provide VCs with incentives rather than the entrepreneur. More experienced VCs, whose monitoring and value-added services are more valuable, may require stronger incentives to provide those services. Downside protections, because they increase the VC's share of company cash flows in bad or mediocre states of the world, may actually dampen the VC's incentives. If so, the negative relation between VC experience and the strength of downside protections may reflect the VC's incentive problem rather than the entrepreneur's.

To address whether this is likely to be the case, we examine the relation between DPI and VC experience in the cross-section. Our theoretical discussion in Section II.A, and model given in Appendix A, suggest that, if the negative relation between VC experience and contract DPI we observe is driven by the entrepreneurial agency problem, the empirical relation should be weaker when agency problems are less severe. This is because when the entrepreneurial agency problem is less severe, weaker downside protections are required to solve it, so the costs of downside protections as a solution are lower relative to other mechanisms. In contrast, if our main results are driven by the need to provide incentives to the VC, we expect no such interaction effect.

To test these ideas, we interact VC experience with several proxies for the degree of entrepreneurial agency problems. Our first proxy is the background of the entrepreneur. Agency problems are likely to be less severe for serial founders, particularly when the founder has proven his quality with previous success. Gompers et al. (2009a) find that previously successful serial entrepreneurs are more likely to succeed in their subsequent ventures.

The first and second specifications of Panel A of Table VIII present evidence consistent with this idea. The relation between DPI and VC experience disappears when the company founder is a previously successful (IPO) serial founder. The point estimate is in the same direction but insignificant when we do not condition on whether the serial founder was previously successful.

The third specification of Panel A of Table VIII shows that the relation between VC experience and DPI is strongest for first round investments. In the first round, the probability that the company will eventually be successful is lower compared to subsequent rounds (see Metrick, 2006), and the importance of the entrepreneur's effort is highest. As a result, agency problems are likely more severe for first round investments compared to later rounds. Similarly, the point estimate in the fourth specification suggests that the relation between VC experience and DPI is stronger for younger companies, but the estimate is not statistically significant.

The fifth specification of Panel A of Table VIII includes an interaction between VC experience and the total amount invested in the round. Companies that are able to raise more VC financing may be more mature and thereby have lower agency problems. Consistent with this, we find that the relation between VC experience and DPI weakens with the round amount.

Overall, the evidence in Panel A of Table VIII suggests that the relation between VC experience and DPI is weaker when entrepreneurial agency problems are less severe, consistent with our main results being driven by the entrepreneur's agency problem rather than the VC's.

B. Interactions with VC Ownership

Another approach to examine whether our main results are likely to be driven by the VC's incentive problem rather than the entrepreneur's is to consider how the relation between DPI and VC experience varies with the ownership stake in the company's equity that the VC obtains in the financing round. If the negative relation between DPI and VC experience is due to the need to provide better VCs with stronger incentives, we would expect this relation to be weaker when the VC owns a greater fraction of the company's equity, because a larger equity ownership stake already gives the VC stronger incentives to provide value-adding services.

Panel B of Table VIII displays the results. In the Panel, the sample is limited to observations for which we have reliable data on VC ownership (roughly half the overall sample). We measure the ownership stake taken in the round by each individual VC and by all VCs in the round aggregated together, and construct dummy variables for whether these ownership stakes are above the respective sample mean. The table shows that, if anything, the relation between DPI and VC experience is stronger (more negative) when the individual or aggregate VC stake is above the median. This result holds whether we consider each VC individually or consider aggregate together all VCs in an investment round.

Overall, the evidence in both panels of Table VIII suggests that our main result is more likely due to entrepreneur's incentive problem rather than the VC's. This conclusion is consistent with Kaplan and Strömberg's (2003, 2004) findings that the use of downside protection varies the VC's assessment of management risk and other internal risks.

C. Network effects

We also investigate whether better-networked (as opposed to more experienced) VCs also use contracts with lower downside protection. In doing so, we are motivated by Hochberg, Ljungqvist, and Lu's (2007) findings that better-networked VCs have better investment performance, suggesting better monitoring ability and greater deterrent of the possibility of withdrawal of value-added services. In addition, VCs with stronger networks are likely to be more able to credibly transmit negative information about an entrepreneur to other VCs.

Table IX provides evidence consistent with this view. In Table IX, we measure network strength at the time of investment in two ways: as the total number of historical syndication partners, and as the total number of unique historical syndication partners (i.e. counting each partner only once, regardless of how many times syndication occurs with that partner). By all of these measures, we find that better-networked VCs obtain weaker DPI, even when we control for VC experience.

D. Robustness tests

Table X presents several specifications that explore the robustness of our main findings. In specifications 1 and 2 we show that the negative relation between contract DPI and VC is robust to controlling for the pre-money valuation of the company (recall that we have valuation data for slightly over half our sample). The fact that the control for pre-money valuation is not significant is another comforting indication that the battery of control variables in our main specifications suffice to capture value-relevant aspects of company quality.

Specifications 3-5 of Table X investigate whether the relation between VC experience and contract DPI is driven by the experience of the VC firm per se or rather by the abilities of specific VC partners. To address this question, we limit our sample to investments in which the

VC takes a board seat and control for the number of boards on which the specific VC partner on the board has previously sat. The fact that our main VC experience measure drives out the significance of this VC partner board experience measure suggests that the general abilities of the VC partnership as a whole are a more important determinant of DPI than the specific abilities of the partner on the board.

Specifications 6 and 7 of Table X collapse the data to one observation per investment round, using the experience of the lead VC and the average experience of all VCs in the round, respectively, as the measure of VC experience. The negative relation between VC experience and contract DPI continues to hold in these specifications. Finally, specification 8 of Table X restricts the sample to only one (the first) investment per company per VC firm. For example, if VC firm X invests in company Y's first and second rounds, we exclude the second round observation. Again, the negative relation between VC experience and contract DPI is robust. Furthermore, all of the conclusions from Table X continue to hold if we replace VC experience with VC age or historical success rate (IPO ratio).

VII. Conclusion

In this paper, we use a large, new database of contractual provisions governing the allocation of cash flow rights between venture capitalists (VCs) and entrepreneurs to investigate how contract design is impacted by VC abilities to monitor and provide value-added services to the entrepreneur. Our main result is that more experienced VCs, who likely have greater such abilities and more frequently join the boards of their portfolio companies, obtain weaker downside-protecting contractual cash flow rights than less experienced VCs. This result is robust to extensive controls as well as several methods to control for endogenous selection effects.

In the cross-section, the relation between VC experience and downside protections is weaker when entrepreneurial agency problems are less severe and stronger when VC ownership is greater, suggesting that the main result is more likely due to the entrepreneur's incentive problem rather than the VC's.

This paper makes several contributions. From a general contracting perspective, we provide empirical evidence consistent with the theoretical prediction that, to the extent contractual downside protections entail risk-sharing costs, the strength of such provisions in real-world contracts should be negatively related to investors' abilities to mitigate agency problems in other ways that do not entail these costs. Our work thereby adds to the literature that investigates how contractual and other governance mechanisms (such as the law) interact.

From a VC perspective, this paper is the first to provide evidence that U.S. VC contracts vary with characteristics of the VC, and do so in a manner consistent with theory. In doing so, we build on the seminal work of Gompers (1998) and Kaplan and Strömberg (2003, 2004), which investigates how U.S. VC contracts vary with the characteristics of entrepreneur and company to be financed. This paper unites that literature with the recent and growing literature that finds that VCs differ substantially in quality, behavior, and ability to add value to portfolio companies, and thereby provides a richer understanding of the implications of differing VC quality and abilities for entrepreneurial companies.

Our results also imply that existing estimates of the amount entrepreneurs "pay" for affiliation with high-quality VCs (Hsu, 2004) are overstated because they do not account for the fact that experienced (high-quality) VCs obtain systematically weaker downside protections. Our results combine with the existing literature to suggest that by virtue of their abilities more experienced VCs have less need for downside protections, which are costly from a risk-sharing perspective, and optimally focus more on upside payoffs and obtaining board representation during negotiations with entrepreneurs.

Our work also suggests several avenues for future research. Our data do not include detailed information on the various control-right covenants that VCs may obtain as part of the financing contract, such as the right to veto certain company activities. While our analysis of board representation offers some insight into the differences in control rights between experienced and inexperienced VCs, and how these interact with the cash flow rights that are our main focus, a comprehensive examination how and why of control rights differ in the cross-section of VCs awaits richer and more detailed data.

In addition, our sample period is concentrated in two years, 2006 and 2007. Gompers et al. (2008) find that public equity market valuations and activity have a significant effect on VC investment rates, particularly for experienced VCs. Future research should investigate how and why the results in this paper vary in different market environments, such as the extreme dislocation caused by the recent financial crisis.

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Appendix A

We present a stylized agency model that formalizes the theoretical argument outlined in Section II. A. The model demonstrates how the optimal financial contract gives the investor less downside protection if the investor has either better ability to monitor and, if deemed necessary, withdraw funding, or better ability to add value to the entrepreneur's company. The model also predicts that the association between these investor abilities and downside protection is weaker if the agency problem related to the entrepreneur's incentives is smaller.

A.1 Model assumptions

Consider an entrepreneur who owns a project that requires external financing. In the first period, the project needs funding of I_1 and the entrepreneur solicits financial contracts from a large number of identical investors. Conditional on financing in the first and second round, the project has a binary outcome so each financial contract is such that the entrepreneur receives S if the project fails and ($S + S \times q$) if the project is successful. Thus, q captures the investor's downside protection because because a higher q means a higher relative upside payoff to the entrepreneur. The entrepreneur has no initial wealth so $S \geq 0$ and $q \geq -1$. After the project receives the investment I_1 from the investor, the entrepreneur faces a binary decision of whether to put in effort, which incurs a cost of e, or not.

In the second period, the investor observes with a probability of m the effort level of the entrepreneur. The investor then chooses whether to continue funding the project, which means investing an additional I_2, or terminating the project at no cost. The investment I_2 could be interpreted as a follow-up financing round of effort put in by the investor (at cost I_2). Thus, the parameter m captures both the probability that the investor monitors the entrepreneur and withdraws funding from the project.

In the third period project cash flows, which are verifiable, are realized. Cash flows are C_F if it fails and ($C_F + C_S$) if the project is successful. If the entrepreneur has put in effort in the first period then the project has a positive probability of being successful, denoted p. If the entrepreneur has not put in effort then the project always fails. If the project is terminated by the investor in the second period, then cash flows are 0. We assume that $C_F < I_2$ so that the investor would want to terminate the project if low effort is observed.

The investor is risk neutral while the entrepreneur is risk averse. To capture risk aversion in a tractable way we define the entrepreneur's utility as

$$U_{entrepreneur} = S + S \times p \times q \times (1 - r) \quad (1)$$

The parameter r captures the degree of risk aversion and $0 < r < 1$. To simplify notation, we define F as profit of a failed project (excluding the effort cost), $F = C_F - I_1 - I_2$. To ensure that there is an internal solution to the model, we need to assume that effort costs are sufficiently high so that the agency problem cannot be solved only with monitoring/withdrawal, formally ($[F + C_S \times p] \times m < e$). Also, the entrepreneur's risk aversion r must be relatively small in relationship to the cost of effort, formally ($[F + C_S \times p] \times [1 - r] > e$).

A.2 Optimal contract

The only pure strategy equilibrium is such that the entrepreneur always puts in effort because no effort implies negative payoffs for the investor (by assumption is $C_F < I_2$). If the entrepreneur puts in effort then it is never optimal for the investor to terminate the project in the second period.

It can be shown that this is the only equilibrium because any contract that is implied by a mixed strategy equilibrium gives the entrepreneur lower utility than the contract of the pure strategy equilibrium.

In the pure strategy equilibrium, perfect competition between investors means that the investor participation (IR) constraint holds with equality.

$$U_{investor} = F + C_S \times p - S \times (1 + p \times q) = 0, \quad \text{if entrepreneur puts in effort.} \quad (2)$$

Solving for S gives:

$$S = (F + C_S \times p) / (1 + p \times q) \quad , \quad \text{if entrepreneur puts in effort.} \quad (3)$$

For the equilibrium to hold the entrepreneur's utility of effort needs to be higher than the utility of no effort. Thus, the following incentive (IC) constraint of the entrepreneur needs to hold

$$S \times (1 + p \times q \times [1 - r]) - e \geq S \times (1 - m). \quad (4)$$

Substituting (3) in (4) and solving for q gives

$$q \geq [e / (F + C_S \times p) - m] / [1 - r - e / (F + C_S \times p)] \times 1 / p. \quad (5)$$

Due to risk aversion, the entrepreneur chooses the contract that has the lowest possible q. To formally see this substitute in (2) in (1) and note how $U_{entrepreneur}$ is decreasing in q.

$$U_{entrepreneur} = (F + C_S \times p) / (1 + p \times q) \times [1 + p \times q \times (1 - r)]. \quad (6)$$

Thus, the optimal equilibrium contract $q^{\sim}$ is defined as

$$q^{\sim} = [e / (F + C_S \times p) - m] / [1 - r - e / (F + C_S \times p)] \times 1 / p. \quad (7)$$

We note that in (7) the numerator is decreasing in m, C_S and p, and the denominator is increasing in p and C_S.

A.3 Propositions relating the optimal contract to investor abilities

<u>Proposition 1</u>: The optimal contract gives the investor weaker downside protection if the investor has a better ability to monitor and withdraw funding to the project. <u>Proof:</u> The numerator of (7) is decreasing in m.

<u>Proposition 2</u>: The optimal contract gives the investor weaker downside protection if the investor

adds more value to the project, as measured by p or C_s. Proof: The numerator of (7) is decreasing in C_S and p and the denominator is increasing in p and C_S.

Lemma 1: The optimal contract gives the investor stronger downside protection if the cost of the entrepreneur's effort is higher. Proof: The derivative of $q^{\sim}$ with respect to e is positive.

$$\mathrm{d}q^{\sim} / \mathrm{d}e = 1 / (F+C_S\times p) \times (1 - r - m) / (1 - r - e / [F+C_S\times p - e])^2 \times 1 / p > 0. \quad (8)$$

Proposition 3: The sensitivity of investor downside protection and investor abilities (m, C_S and p) is weaker when the cost of the entrepreneur's effort is lower. Proof: Equation (8) is decreasing in m, C_S and p.

Appendix B

A higher DPI is associated with higher payoffs to the VC in bad or mediocre states of the world. Our univariate comparison of average DPI by VC experience quartile in Table III shows that DPI is on average 0.575 units higher for below-median VCs (5.235) than for above-median VCs (4.66). In this section we estimate how differences in two components of DPI, liquidation preferences and cumulative dividends, affect expected payoffs and thereby the effective transaction price (pre-money valuation) of the investment.

We focus on liquidation preferences and cumulative dividends because their cash flow consequences are relatively straightforward, and can be approximated with a simple, back-of-the-envelope calculation. A complete treatment of the valuation of all six cash flow provisions requires a complex valuation model, incorporating an option pricing framework and explicitly modeling the complex interactions between various cash flow provisions. Importantly, the complex model would require input data that we do not have: the probability that a company will raise more rounds of VC financing, the cash flow provisions given to investors in both previous and subsequent rounds, and the distribution of exit values. Deriving such model, while interesting in its own right, is beyond the scope of this paper. See Metrick (2007) for a detailed discussion of the relevant issues. Because we focus on only two of six cash flow provisions, our estimates likely understate the expected cash flow implications of DPI differences.

The incremental payoffs to VCs from cash flow provisions only apply to bad (other than total loss) or mediocre states of the world. This is because virtually all VC contracts include an “Automatic Conversion” provision, by which preferred stock automatically converts to common (and all special rights and privileges are forfeited) if the company goes public (i.e. is extremely successful). In addition, if the company is liquidated for a total loss, then there are no payoff implications associated with the cash flow provisions.

We begin by assuming that a company exits at a valuation that is sufficient to pay the VC all the cash flows to which he is entitled but not so high as to trigger either voluntary or automatic conversion to common stock. We then adjust the estimated payoffs to reflect the fact that only a fraction of VC investments will in fact exit in this range of value. In a final step, we adjust for the fact that the incremental payoffs from these cash flow provisions are only those payoffs that are above and beyond what the VC would otherwise be entitled to through his ownership of common stock (i.e. the VC takes some of the money from his own pocket).

VCs with above experience have a 0.13 lower DPI score for cumulative dividends. In the data, most of this difference reflects that some contracts do not have any cumulative dividends and others have cumulative dividends with an 8% annual rate. For this calculation, we assume this accounts for all of the difference. Over 5 years the compounded dividend rate is: $(1.08^5 – 1) = 0.47$. That is, an 8% annual dividend rate entitles the VC to dividends equal to 47% of his initial investment after 5 years.

VCs with above median experience have a 0.03 lower liquidation preference score. In the data, most of this difference reflects that most contracts have a liquidation preference of 1X whereas some have a liquidation preference of 2X. For this calculation, we assume this accounts for all of the difference.

We assume that the company exits either after 5 years or 10 years. Under these assumptions, after 5 years the sum of the payoff implications of these differences in cumulative dividend rate and liquidation preference is:

$$0.13 \times 0.47 \times \$Investment + 0.03 \times (2–1) \times \$Investment = 0.09 \times \$Investment. \quad (1)$$

After 10 years the difference is:

$$0.13 \times 1.16 \times \$Investment + 0.03 \times (2–1) \times \$Investment = 0.18 \times \$Investment. \quad (2)$$

We further assume that the company exits in the relevant range of value if and only if it exits in an acquisition (as opposed to bankruptcy or IPO). Metrick (2007, pp. 125, 132) reports that this outcome is realized after 5 years for approximately 20% of first round investments and 28% of later round investments. We use the average, 24% as an estimate of the ex ante probability of acquisition after 5 years. Metrick (2007) also reports that after 10 years another 18% of first round investments, and 14% of later round investments, are acquired. We use the average, 16%, as an estimate of the ex ante probability of acquisition after 10 years and not after 5 years. Therefore, the probability-weighted sum of payoff implications of cumulative dividends and liquidation preference is:

$$0.24 \times 0.09 \times \$Investment + 0.16 \times 0.18 \times \$Investment = 0.05 \times \$Investment. \quad (3)$$

Finally, we recognize that not all of the payoffs from cumulative dividends and liquidation preference are incremental payoffs. The median VC ownership stake in our sample is 29%, meaning that only 71% of the payoff associated with cash flow provisions are incremental payoffs. The incremental payoff is:

$$0.71 \times 0.05 \times \$Investment = 0.0355 \times \$Investment. \quad (4)$$

Put in words, equation (3) says that VCs with below median experience receive in expectation an additional 3.55% of their investment back because of higher cumulative dividends and liquidation preference. This is equivalent to paying a 3.55% lower pre-money valuation.

Figure I - Distribution of Downside Protection Index

See Table I for sample overview. One observation is one round (N=1,534). Table II details the coding of cash flow provisions that we aggregate to compute Downside Protection Index.

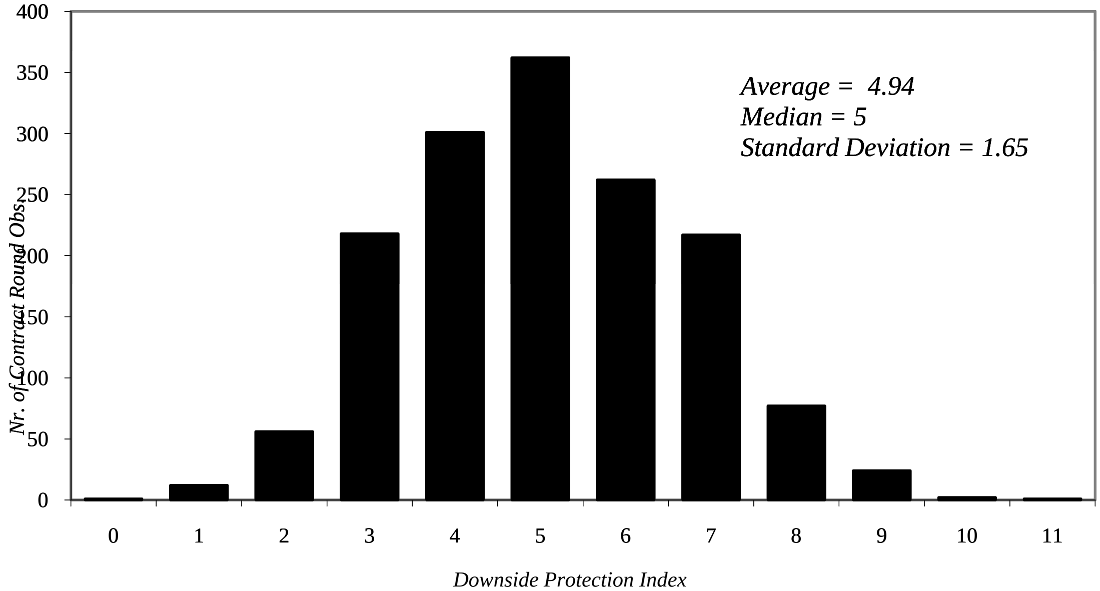

Table I - Sample Overview and Summary Statistics

The sample consists of venture capital (VC) financing contracts from U.S. companies that receive financing from (at least one) U.S. Private Partnership VC. Each contract is matched by company name and round date with an investment round listed in Venture Economics. All VC variables are updated to match the year of the contract. Venture Economics Percent is the fraction of the all U.S. VC investment rounds in the Venture Economics universe from the period 2005-2007 (which represents 97% of our contract sample).

Panel A: Sample Overview

	Unique VC Investment Rounds	Unique Rounds	First Round	Unique Companies	Unique VC Firms
	3,394	1,534	425	1,266	646
Year of Round	before 2004	2004	2005	2006	2007
# of Rounds	17	26	227	668	596
Percent	*1%*	*2%*	*15%*	*44%*	*39%*
Company Location	CA	MA	TX	NY	Other
# of Rounds	530	247	108	95	554
Percent	*35%*	*16%*	*7%*	*6%*	*36%*
Venture Economics Percent	*41%*	*12%*	*5%*	*5%*	*37%*
Round Number	1	2	3	4	5 or above
# of Rounds	425	277	229	207	396
Percent	*28%*	*18%*	*15%*	*13%*	*26%*
Venture Economics Percent	*27%*	*19%*	*14%*	*12%*	*28%*
Industry Group	Bio-Tech	Life-Science	Media	High Tech.	Other
# of Rounds	141	222	145	876	150
Percent	*9%*	*14%*	*9%*	*57%*	*10%*
Venture Economics Percent	*9%*	*14%*	*10%*	*54%*	*13%*

Panel B: Summary Statistics

	Obs.	Mean	Std. Dev.	Min	Max
VC Experience	3,394	118	144	0	779
VC Age	3,394	14.3	11.2	0.0	47.0
VC Fraction IPO	3,394	0.11	0.09	0.00	1.00
VC Fund Size ($ million)	2,581	307	361	0.2	5,000
VC and Company in Same State	3,394	0.49	0.50	0.00	1.00
VC in California	3,394	0.37	0.48	0.00	1.00
VC in Massachusetts	3,394	0.19	0.39	0.00	1.00
VC Board Seat	3,394	0.53	0.50	0.00	1.00
VC Partner Board Experience	1,808	6.2	5.1	0.0	31.0
Company Age	1,534	4.99	4.20	0.00	53.00
Number of VCs in Round	1,534	4.3	2.7	1.0	24.0
Number of private-partnership VCs in round	1,534	2.2	1.3	1.0	11.0
Syndicated Round	1,534	0.91	0.28	0.00	1.00
Total Round Amount ($ million)	1,534	11.1	12.7	0.0	110.0
Pre-Money Valuation ($ million)	786	47.8	56.4	0.6	458.4
Serial Founder	1,534	0.24	0.43	0.00	1.00
Serial Founder with IPO	1,534	0.06	0.24	0.00	1.00
Serial Founder with Merger	1,534	0.09	0.29	0.00	1.00

Table II - Cash Flow Provisions

See Table I for sample overview. Each cash flow provision contributes with 0, 1 or 2 to the Downside Protection Index, where 2 is the harshest to the entrepreneur / most favorable to the VC. In VC Contract Round, one observation is a unique investment by a VC in a round (N=3,364). In Contract Round, one observation is a unique round (N=1,534).

Panel A: Cash Flow Provision Descriptions and Frequency Distributions

Cumulative Dividends

Dividends that the investor earns annually until the company is sold or liquidated. Cumulative means that the dividends are not paid out annually but when the company is sold or liquidated. Cumulative dividends are senior to common stock. The dividend rights are expressed as a percentage of the VC's investment and are typically compounding, meaning that investors also earn dividends on accumulated, unpaid dividends. As an illustration, suppose the VC invests $2 million and receives 8% in compounding cumulative dividends. If the company is sold after 5 years for $10 million, then the VC receives (1.085 – 1) × $2 million =

	Above 8% = 2	8% or Below = 1	Not Included = 0
VC Contract Round	205 (6%)	925 (27%)	2,264 (67%)
Contract Round	108 (7%)	430 (28%)	996 (65%)

Liquidation Preference

The multiple of the investor's investment that is paid back to the investor when the company is sold or liquidated. Liquidation preference is senior to common stock. As an illustration,, for an investment of $2 million, a liquidation preference of 2X means that the VC gets the first $4 million of proceeds in liquidation. Unlike cumulative dividends, the amount of the VC's liquidation preference does not increase over time.

	Above 2X = 2	Above 1X, Up to 2X = 1	1X = 0
VC Contract Round	36 (1%)	193 (6%)	3,165 (93%)
Contract Round	19 (1%)	86 (6%)	1,429 (93%)

Participation

With participation the investor receives both a liquidation preference and a fraction of common stock when the company is sold or liquidated. With no participation the investor holds convertible preferred stock. As an illustration of convertible preferred stock, suppose the VC invests $2 million at a $10 million post-money valuation with a 1X liquidation preference. When the company is sold the VC can either claim $2 million in liquidation preference or 20% (2/10) of the common stock. The VC would choose to convert if and only if the proceeds from the company are above $10 million. If the preferred stock is instead participating, the VC does not have to choose between the liquidation preference and converting the preferred stock to common stock but instead receives both. Building on the example, participating preferred stock would give the VC both $2 million and 20% of the common equity. If the company is sold for $7 million then the VC receives $2 million in liquidation preference and $1 million in common stock (20% of the remaining $5 million). With "Capped" participation the investor only receives the liquidation preference if his investment IRR is below a certain hurdle.

	Not Capped = 2	Capped = 1	Not Included = 0
VC Contract Round	1,579 (47%)	855 (25%)	960 (28%)
Contract Round	711 (46%)	378 (25%)	445 (29%)

Anti-Dilution

The investor is issued additional shares if the company raises a new financing round at a lower valuation than what the investor paid (down round). "Full Ratchet" gives the investor more additional shares than "Weighted Average", especially if the new financing round is small.

	Full Ratchet = 2	Weighted Average = 1	Not Included = 0
VC Contract Round	301 (9%)	3,046 (90%)	47 (1%)
Contract Round	148 (10%)	1,358 (89%)	28 (2%)

Redemption

The investor has the right to sell his shares back to the company after a specified time period. A typical redemption right provision gives the investor the right to sell back 1/3 of his shares after 5 years, 1/3 after 6 years and the 1/3 after 7 years.

	Included = 1	Not Included = 0
VC Contract Round	2,034 (60%)	1,360 (40%)
Contract Round	931 (61%)	603 (39%)

Pay-To-Play

Pay-to-play provisions specify what contractual rights that the investor loses if he does not invest in a follow-up financing round of the company. With "Convert to Preferred" the investor loses some contractual rights that are attached to his preferred stock. With "Convert to Common" the investor loses all contractual rights that are attached to his preferred stock.

	Not Included = 2	Convert to Preferred = 1	Convert to Common = 0
VC Contract Round	2,671 (79%)	163 (5%)	560 (16%)
Contract Round	1,263 (82%)	68 (4%)	203 (13%)

Panel B: Correlations Between Cash Flow Provisions (Unit of Observation is Contract Round, N=1,534)

	Cumulative Dividends	Liquidation Preference	Participation	Anti-Dilution	Redemption
Liquidation Preference	0.063**				
Participation	0.137***	0.067***			
Anti-Dilution	0.110***	0.090***	0.149***		
Redemption	0.357***	0.0371	0.133***	0.118***	
Pay-To-Play	0.0100	0.0279	-0.0231	0.0174	-0.049*

Table III - Downside Protection Index, Individual Cash Flow Provisions and VC Experience, Univariate Comparison

See Table I for sample overview. One observation is one VC investment. VC Experience is updated to match the year of the contract. The 4th quartile represents the lowest VC experience and the 1st quartile represents the highest VC experience. Panel A shows for different quartiles of VC Experience sample means of the individual cash flow provisions. The definition and coding of these cash flow provisions is shown in Table II. Downside Protection Index (DPI) is the sum of the coding of the the individual cash flow provisions. Panel B shows the p-values of Kruskal-Wallis tests of equality of populations.

	Panel A: Individual Cash Flow Provisions and DPI				**Panel B: Kruskal-Wallis Tests of Equality of Populations**				
VC Experience Quartile	4th	3rd	2nd	1st	4th-3rd	3rd-2nd	2nd-1st	4th-1st	All
Variable	Sample Mean				P-Value				
Cumulative Dividends	0.48	0.44	0.41	0.24	0.286	0.210	0.000	0.000	0.000
Liquidation Preference	0.08	0.11	0.08	0.05	0.039	0.072	0.019	0.035	0.000
Participation	1.32	1.25	1.15	1.01	0.094	0.014	0.000	0.000	0.000
Anti-Dilution	1.10	1.09	1.09	1.02	0.632	0.960	0.000	0.000	0.000
Redemption	0.65	0.61	0.64	0.50	0.224	0.290	0.000	0.000	0.000
Pay-To-Play	1.70	1.66	1.59	1.54	0.138	0.065	0.192	0.000	0.000
Downside Protection Index (DPI)	5.31	5.16	4.96	4.36	0.038	0.005	0.000	0.000	0.000
Observations	852	852	847	843					

Table IV - Downside Protection Index and VC Experience

See Table I for sample overview. One observation is one VC investment. All VC variables are updated to match the year of the contract. Specifications 1-2 and 3-8 are OLS regressions with the Downside Protection Index (DPI) as the dependent variable. Table II details the coding of cash flow provisions that we aggregate to compute DPI. Specification 3 is a probit regression in which the dependent variable takes the value 1 if DPI is above 5 (sample median) and 0 otherwise. Coefficients in specification 3 reflect marginal effects. All specifications include fixed effects for VC firm location (California, Massachussets, Texas, New York, and other), company location (state), company industry (Venture Economics 10-level classification), and round year. Standard errors are clustered by both company and VC firm using the two-way method of Petersen (2009) and reported in brackets. Significance at 10% level is marked with *, 5% with ** and 1% with ***.

Specification	1	2	3	4	5	6	7	8
Dependent Variable	DPI	DPI	DPI>5	DPI	DPI	DPI	DPI	DPI
(log) VC Experience	-0.170***	-0.188***	-0.119***					-0.131***
	[0.029]	[0.030]	[0.023]					[0.032]
VC Experience Top Quartile (dummy)				-0.524***				
				[0.090]				
(log) VC Age					-0.197***			
					[0.044]			
(log) VC Fund Size						-0.103***		
						[0.033]		
VC IPO Ratio							-2.053***	-1.091***
							[0.393]	[0.406]
VC and Company in Same State	-0.032	0.024	-0.016	-0.031	0.001	0.072	-0.028	-0.047
	[0.073]	[0.076]	[0.060]	[0.073]	[0.074]	[0.087]	[0.074]	[0.073]
(log) Company Age	0.306***	0.304***	0.282***	0.304***	0.323***	0.285***	0.314***	0.308***
	[0.088]	[0.090]	[0.080]	[0.090]	[0.088]	[0.095]	[0.089]	[0.088]
Serial Founder	-0.028	-0.045	0.01	-0.056	-0.035	-0.061	-0.033	-0.03
	[0.138]	[0.141]	[0.126]	[0.143]	[0.141]	[0.151]	[0.141]	[0.138]
Serial Founder with IPO	-0.683***	-0.778***	-0.407*	-0.725***	-0.689***	-0.640***	-0.665***	-0.664***
	[0.216]	[0.221]	[0.210]	[0.218]	[0.216]	[0.218]	[0.215]	[0.215]
Serial Founder with Merger	0.007	-0.015	-0.015	0.034	0.012	0.051	0.023	0.019
	[0.176]	[0.183]	[0.175]	[0.183]	[0.177]	[0.185]	[0.177]	[0.175]
Round Number	0.038	0.001	0.001	0.032	0.037	0.041	0.037	0.041
	[0.042]	[0.037]	[0.038]	[0.042]	[0.042]	[0.045]	[0.042]	[0.042]
(log) Total Round Amount	-0.228***		-0.228***	-0.234***	-0.246***	-0.217***	-0.235***	-0.222***
	[0.058]		[0.049]	[0.057]	[0.058]	[0.063]	[0.058]	[0.058]
(log) Number of VCs in Round	-0.059		0.09	-0.041	-0.029	-0.147	-0.03	-0.058
	[0.143]		[0.119]	[0.142]	[0.142]	[0.154]	[0.142]	[0.143]
Observations	3,394	3,394	3,394	3,394	3,394	2,581	3,394	3,394
R-squared	0.22	0.21	0.16	0.23	0.22	0.22	0.22	0.23
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VC and Company Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table V - Individual Cash Flow Provisions and VC Experience

See Table I for sample overview. One observation is one VC investment. All VC variables are updated to match the year of the contract. This table presents probit regressions in which the dependent variable takes the value 1 if cumulative dividends are present (specification 1), if the liquidation preference is above 1X (specification 2), if the preferred stock has participation (specification 3), if full-ratchet anti-dilution is present (specification 4), if redemption rights are present (specification 5), and if pay-to-play is conversion to common equity (specification 6), and 0 otherwise. Coefficients reflect marginal effects. All specifications include fixed effects for VC firm location (California, Massachussets, Texas, New York, and other), company location (state), company industry (Venture Economics 10-level classification), and round year. Standard errors are clustered by company and reported in brackets. Significance at 10% level marked with *, 5% with ** and 1% with ***.

Specification	1	2	3	4	5	6
Dependent Variable	Dividend	Liq.Pref.	Particip.	Anti-Dil.	Redemp	Pay-Play
(log) VC Experience	-0.104***	-0.075**	-0.094***	-0.051*	-0.086***	-0.057**
	[0.023]	[0.030]	[0.022]	[0.031]	[0.024]	[0.023]
VC and Company in Same State	-0.067	-0.013	-0.044	0.072	0.03	0.024
	[0.070]	[0.091]	[0.065]	[0.084]	[0.067]	[0.064]
(log) Company Age	0.230***	0.427***	0.002	0.341***	0.152	0.117
	[0.084]	[0.127]	[0.086]	[0.108]	[0.093]	[0.082]
Serial Founder	0.075	0.203	-0.259*	-0.299	0.198	0.18
	[0.143]	[0.168]	[0.143]	[0.200]	[0.164]	[0.143]
Serial Founder with IPO	-0.475*	-0.137	-0.032	-0.074	-0.643***	-0.331
	[0.244]	[0.255]	[0.224]	[0.254]	[0.228]	[0.207]
Serial Founder with Merger	-0.389*	0.037	0.383*	0.052	-0.031	-0.082
	[0.215]	[0.236]	[0.199]	[0.251]	[0.210]	[0.186]
Round Number	-0.079**	0.098**	0.047	0.114**	-0.049	-0.001
	[0.039]	[0.050]	[0.040]	[0.046]	[0.043]	[0.039]
(log) Total Round Amount	-0.095*	-0.289***	-0.154***	-0.211***	0.114**	-0.079
	[0.049]	[0.071]	[0.050]	[0.060]	[0.054]	[0.051]
(log) Number of VCs in Round	0.085	0.163	0.213	-0.063	-0.494***	0.005
	[0.120]	[0.170]	[0.139]	[0.146]	[0.137]	[0.121]
Observations	3,394	3,394	3,394	3,394	3,394	3,394
R-squared	0.25	0.17	0.09	0.16	0.14	0.21
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
VC and Company Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Table VI - Board Seat and VC Experience

See Table I for sample overview. One observation is one VC investment. All VC variables are updated to match the year of the contract. Specifications 1-8 are probit regressions where the dependent variable takes the value 1 if the VC takes a board seat and 0 otherwise. Coefficients reflect marginal effects. Specifications 2-7 control for VC and Company in Same State, Serial Founder, Serial Founder with IPO, Serial Founder with Merger, Round Number, Company Age, Total Round Amount and Number of VCs in Round. Specifications 3-7 include fixed effects for VC firm location (California, Massachussets, Texas, New York, and other), company location (state), company industry (Venture Economics 10-level classification), and round year. Standard errors are clustered by company and reported in brackets. Significance at 10% level is marked with *, 5% with ** and 1% with ***.

Specification	1	2	3	4	5	6	7
Dependent Variable	VC Takes a Board Seat						
(log) VC Experience	0.100***	0.099***	0.100***				
	[0.007]	[0.009]	[0.009]				
VC Experience Top Quartile (dummy)				0.152***			
				[0.026]			
(log) VC Age					0.126***		
					[0.014]		
(log) VC Fund Size						0.114***	
						[0.010]	
VC IPO Ratio							0.597***
							[0.128]
Observations	3,394	3,394	3,394	3,394	3,394	3,394	3,394
R-squared	0.05	0.08	0.10	0.08	0.09	0.12	0.07
Industry Fixed Effects	No	No	Yes	Yes	Yes	Yes	Yes
VC and Company Location Fixed Effects	No	No	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes	Yes	Yes	Yes
Additional Controls	No	Yes	Yes	Yes	Yes	Yes	Yes

Table VII - Endogenous Selection - Panel A: Replication of Hsu (2004) Results

In Panel A the sample is restricted to first round investments in High-Tech companies for which we have valuation data. One observations is one round and VC characteristics capture characteristics of the lead VC. In specifications 1-3, the (log) pre-money valuation is the dependent variable. In specifications, 4-6 contract Downside Protection Index (DPI) is the dependent variable. Table II details the coding of cash flow provisions that we aggregate to compute DPI. All VC variables are updated to match the year of the contract. All specifications control for VC and Company in Same State, Serial Founder, Serial Founder with IPO, Serial Founder with Merger, Round Number, Company Age, Total Round Amount, Number of VCs in Round, VC firm location (California, Massachussets, Texas, New York, and other), company location (state), company industry (Venture Economics 10-level classification), and round year. Significance at 10% level marked with *, 5% with ** and 1% with ***.

Specification	1	2	3	4	5	6
Dependent Variable	Log (Pre-Money Valuation)			Downside Protection Index		
(log) VC Experience	-0.181**			-0.207*		
	[0.081]			[0.118]		
(log) VC Age		-0.217*			-0.340*	
		[0.120]			[0.172]	
VC IPO Ratio			-2.729*			-3.321
			[1.432]			[2.078]
Observations	85	85	85	85	85	85
R-squared	0.77	0.76	0.76	0.57	0.58	0.57
Sample	First Round in High-Tech Companies with Valuation Data			First Round in High-Tech Companies with Valuation Data		
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
VC and Company Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table VII - Endogenous Selection - Panel B: Instrumental Variable Regressions

See Table I for sample overview. One observation is one VC investment. All VC variables are updated to match the year of the contract. All specifications are regressions with the Downside Protection Index (DPI) as the dependent variable. Table II details the coding of cash flow provisions that we aggregate to compute DPI. In specifications 1-3 VC experience (age, IPO ratio) is instrumented with the average experience (age, IPO ratio) of all VCs (excluding the actual VC making the investment) in the same state as the company receiving investment. In specifications 4-6 VC experience, age, and IPO ratio are instrumented with a set of 500 dummy variables representing the interactions between company state (50 states) and industry (10 industries). In specifications 7-9, we run a Heckman model in which the indentifying variables (included in the selection equation but not the outcome equation) are interactions of company state and firm state dummies. The selection equation estimates the probability of a match as a function of the controls and identifying dummies; the reported coefficients are estimated treatment (outcome) effects. All specifications control for VC and Company in Same State, Serial Founder, Serial Founder with IPO, Serial Founder with Merger, Round Number, Company Age, Total Round Amount, Number of VCs in Round, VC firm location (California, Massachussets, Texas, New York, and other), company location (state), company industry (Venture Economics 10-level classification), and round year. Specifications 7-9 restrict the sample to observations where the VC and company location is California, Massachussets, Texas or New York. Significance at 10% level marked

Specification	1	2	3	4	5	6	7	8	9
Dependent Variable					Downside Protection Index				
(log) VC Experience	-0.352***			-0.429***			-0.369***		
	[0.119]			[0.100]			[0.090]		
(log) VC Age		-0.785			-0.472***			-0.395***	
		[0.529]			[0.136]			[0.107]	
VC IPO Ratio			-3.53**			-4.277***			-2.359***
			[1.663]			[1.536]			[0.512]
Observations	3,394	3,394	3,394	3,394	3,394	3,394	1,881	1,881	1,881
R-squared	0.21	0.15	0.22	0.2	0.21	0.21			
Sample		Full			Full			CA, MA, TX, NY, NC	
Instrument for VC experience (age, IPO ratio)		Average experience of VCs in same state as company (excluding actual VC)			Company State X Industry dummies				
Selection Equation								Company State X VC Firm State dummies	
Number of Potential Matches							887,680	887,680	887,680
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VC and Company Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table VIII - Downside Protection Index and VC Experience - Interaction Effects

See Table I for sample overview. One observation is one VC investment except in specifications 1-2 of panel B where one observation is one round. In specifications 3-4 of panel B sample is limited to observations with reliable data on VC ownership. All specifications are OLS regressions with the Downside Protection Index (DPI) as the dependent variable. Table II details the coding of cash flow provisions that we aggregate to compute DPI. All VC variables are updated to match the year of the contract. All specifications control for VC and Company in Same State, Serial Founder, Serial Founder with IPO, Serial Founder with Merger, Round Number, Company Age, Total Round Amount, Number of VCs in Round, VC firm location (California, Massachussets, Texas, New York, and other), company location (state), company industry (Venture Economics 10-level classification), and round year. Standard errors are clustered by both company and VC firm using the two-way method of Petersen (2009) and reported in brackets. Significance at 10% level marked with *, 5% with ** and 1% with ***.

Panel A: Interactions With Proxies For Entrepreneurial Agency Problems

Specification	1	2	3	4	5
Dependent Variable	Downside Protection Index				
(log) VC Experience	-0.181***	-0.183***	-0.268***	-0.246***	-0.995**
	[0.034]	[0.030]	[0.052]	[0.060]	[0.389]
(log) VC Experience X Serial	0.046				
	[0.052]				
(log) VC Experience X Serial Founder with IPO		0.192***			
		[0.069]			
(log) VC Experience X Round Number			0.030**		
			[0.014]		
(log) VC Experience X Company Age				0.046	
				[0.035]	
(log) VC Experience X Total Round Amount					0.051**
					[0.024]
Observations	3,394	3,394	3,394	3,394	3,394
R-squared	0.23	0.23	0.23	0.23	0.23
Industry and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
VC and Company Location Fixed Effects	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes

Panel B: Interactions With VC Ownership

Specification	1	2	3	4
Dependent Variable	Downside Protection Index			
(log) VC Experience	-0.146***	-0.082*		
	[0.031]	[0.049]		
(log) Average Experience of VCs			-0.260***	-0.214***
			[0.058]	[0.076]
Above Median Individual VC Ownership	0.096	0.596**		
	[0.114]	[0.287]		
Above Median Aggregate VC Ownership			0.253**	0.665*
			[0.110]	[.400]
(log) VC Experience X Above Median Individual VC Ownership		-0.121*		
		[0.065]		
(log) Average Experience of VCs X Above Median Aggregate VC Ownership				-0.092
				[0.091]
Observations	1,781	1,781	767	767
R-squared	0.25	0.26	0.28	0.28
Industry and Year Fixed Effects	Yes	Yes	Yes	Yes
VC and Company Location Fixed Effects	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes

Table IX - Downside Protection Index and VC Network Strength

See Table I for sample overview. One observation is one VC investment. All VC variables are updated to match the year of the contract. VC syndication variables reflect syndications with U.S. Private Partnership VCs only. All specifications are OLS regressions with the Downside Protection Index (DPI) as the dependent variable. Table II details the coding of cash flow provisions that we aggregate to compute DPI. VC Number of Syndications captures the number of syndications of the VC. VC Number of Unique Syndications captures the number of unique syndication partners of the VC. All specifications control for VC and Company in Same State, Serial Founder, Serial Founder with IPO, Serial Founder with Merger, Round Number, Company Age, Total Round Amount, Number of VCs in Round, VC firm location (California, Massachussets, Texas, New York, and other), company location (state), company industry (Venture Economics 10-level classification), and round year. Standard errors are clustered by both company and VC firm using the two-way method of Petersen (2009) and reported in brackets. Significance at 10% level is marked with *, 5% with ** and 1% with ***.

Specification	1	2	3	4
Dependent Variable	Downside Protection Index			
(log) VC Number of Syndications	-0.171***	-0.121***		
	[0.025]	[0.033]		
(log) VC Number of Unique Syndication Partners			-0.196***	-0.123***
			[0.032]	[0.039]
VC Experience Top Quartile (dummy)		-0.242**		-0.309***
		[0.115]		[0.109]
Observations	3,394	3,394	3,394	3,394
R-squared	0.24	0.24	0.23	0.24
Industry Fixed Effects	Yes	Yes	Yes	Yes
VC and Company Location Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes

Table X - Robustness Tests

See Table I for sample overview. One observation is one VC investment. All VC variables are updated to match the year of the contract. The table presents OLS regressions with Downside Protection Index (DPI) as the dependent variable. Table II details the coding of cash flow provisions that we aggregate to compute DPI. The sample is limited to observations for which valuation data is available in specifications 1 and 2, and in which the VC takes a board seat in specifications 3-5. Sample is limited to one observation per round in specifications 6-7, and one observation per VC in specification 8. All specifications control for VC and Company in Same State, Serial Founder, Serial Founder with IPO, Serial Founder with Merger, Round Number, Company Age, Total Round Amount, Number of VCs in Round, VC firm location (California, Massachussets, Texas, New York, and other), company location (state), company industry (Venture Economics 10-level classification), and round year. Standard errors are clustered by both company and VC firm using the two-way method of Petersen (2009) and reported in brackets. Significance at 10% level marked with *, 5% with ** and 1% with ***.

Specification	1	2	3	4	5	6	7	8
Dependent Variable	Downside Protection Index							
(log) VC Experience	-0.136***	-0.136***	-0.224***		-0.197***	-0.210***		-0.163***
	[0.031]	[0.031]	[0.040]		[0.047]	[0.044]		[0.029]
(log) VC Partner Board Experience				-0.248***	-0.07			
				[0.054]	[0.056]			
(log) Average Experience of VCs							-0.309***	
							[0.049]	
(log) Pre-Money Valuation	-0.147	-0.257						
	[0.105]	[1.407]						
(log) Total Round Amount Squared		-0.007						
		[0.033]						
(log) Pre-Money Valuation Squared		0.003						
		[0.041]						
Observations	1,827	1,827	1,808	1,808	1,808	1,534	1,534	2,849
R-squared	0.27	0.27	0.23	0.22	0.23	0.23	0.25	0.22
Sample	Valuation Data		VC has Board Seat			Unique Round		Uniq. VC
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VC and Company Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes