THE JOURNAL OF FINANCE • VOL. LVI, NO. 2 • APRIL 2001

Valuation and Control in Venture Finance

ANDREI A. KIRILENKO*

ABSTRACT

This paper presents the model of a relationship between a venture capitalist and an entrepreneur engaged in the formation of a new firm. I assume that the entrepreneur derives private nonpecuniary benefits from having some control over the firm. I show that to separate the entrepreneur's value of control from the firm's expected payoff, the venture capitalist demands disproportionately higher control rights than the size of his equity investment. The entrepreneur is compensated for a greater loss of control through better terms of financing, ability to extract higher rents from asymmetric information, and improved risk sharing.

VENTURE CAPITAL FIRMS often finance projects which, at the time of funding, have neither revenues nor even a product in existence. However, by using an intricate system of control rights, venture capitalists can overcome many failures inevitable in a complex task of converting entrepreneurial talent into companies, products, and markets.

There are three main facts about the allocation of control rights between venture capitalists and entrepreneurs. First, the degree of control acquired by venture capitalists is disproportionately large compared to what they would have received under the "one share one vote rule" (see Sahlman (1990), Gompers (1997), and Black and Gilson (1998)). Second, control is not an indivisible right held at any one time by either an investor or an entrepreneur, but rather a continuous variable that is adjusted and fine-tuned through a multitude of contingent provisions (see, e.g., Kaplan and Stromberg (1999); see also Halloran et al. (1995) and Bartlett (1999)). Finally, Gompers (1997) finds that venture capital contracts "explicitly assign greater control rights to the venture capitalist" in cases "with greater potential asymmetric information."

The theoretical model that I present in this paper reconciles these facts. The model describes the relationship between a venture capitalist and an entrepreneur engaged in the formation of a new company. The counterparties bargain over financing, share valuation, and profit distribution in an incomplete contracting environment.

* International Monetary Fund. I thank Michael Barclay, Matthias Kahl, George Kanatas, Josh Lerner, Leslie Marx, René Stulz, the editor, an anonymous referee, and seminar participants at the FOURTH Maryland Finance Symposium (2000), the 2000 *Journal of Financial Intermediation* Symposium at Boston College, 1999 Financial Management Association meetings, 1998 Northern Finance Association meetings, and Simon Business School of the University of Rochester for helpful suggestions. The views expressed in the paper are my own and do not necessarily constitute an official position of the International Monetary Fund. I remain responsible for all errors.

I argue that the disproportionate distribution of control rights in venture-capital-financed deals arises in response to an adverse selection problem. I model the source of the problem as a privately observed variable that represents the sum of net nonpecuniary benefits that an entrepreneur derives from control, access, and other noncontractible aspects of managing the venture. Because only the entrepreneur knows the value of control, contractual clauses contingent on the value's actual realization cannot be credibly enforced.

A number of studies introduced contractual incompleteness in a similar way. Grossman and Hart (1986) and Hart and Moore (1988) use an analogous form of contractual incompleteness to develop a theory of vertical integration and ownership. Aghion and Bolton (1992) and Dewatripont and Tirole (1994) study the firm's capital structure choice and security design.

I demonstrate that in situations in which the parties to a contract would wish to include contingent clauses, but are prevented from doing so because the state of nature cannot be verified, a reallocation of control rights can alleviate commitment and incentives problems and lead to an improved outcome.[1]

In contrast to earlier theoretical studies, I model control as a continuous, rather than a binary, variable. The venture capitalist requires an appropriate share of control rights to separate the "noise" associated with the entrepreneur's value of control from the "signal" about the venture's expected payoff. As one venture capitalist explained: " . . . you put it [contractual clauses including control rights] down on paper . . . that's when you really begin to know each other . . . the things that they [the entrepreneurs] think are important to them tell you a lot about them . . . it's a way to figure out what the other person is all about, not just what they say they are all about" (Landstrom et al. (1998), p. 9).

I show that in equilibrium, the higher the degree of adverse selection, the more control rights are allocated to a venture capitalist. I also show that the distribution of control rights affects the size of investment, the informativeness of share prices, and the distribution of risk between parties. Finally, I prove that an optimal allocation of control rights can be implemented via a variety of mechanisms.

Earlier theoretical literature on the distribution of control rights in venture finance is limited to three studies: Chan, Siegel, and Thakor (1990), Berglof (1994), and Hellmann (1998). Counter to the available empirical evidence, all three studies specify control as an indivisible right that can be held at any given time by only one party. These studies define the distribution of control rights as a function that can take values of either zero or one. Allocation of control rights depends on the realizations of random variables, actions of participants, and parameters of each model.[2]

[1] This result has been previously conjectured by Hart and Moore (1999) and Maskin and Tirole (1999).

[2] Studies of venture capital contracts also assume that the distribution of control rights is a binary function (see, for example, Marx (1998)).

In their study, Chan et al. (1990) view control as a unilateral ability to make production decisions. They define the value of control as the utility from terminal cash flow less the disutility of effort that has to be expended by the party in control.

According to Berglof (1994), control is an ability to bargain with an outside buyer of a venture. He defines the value of control as the amount of compensation captured by the party that is in control of the venture prior to its sale, plus the amount extracted from a potential buyer during the sale. Parameters describing project financing needs, private benefits from managing the firm, and nonverifiable assets seized at liquidation determine the optimal financing mix and the associated value of control.

Finally, Hellmann (1998) specifies control as an ability to replace the entrepreneur with a professional manager. He defines the value of control as a utility from a private benefit that an entrepreneur derives from managing the firm. The private benefit is noncontractible, and is lost if the venture capitalist replaces the entrepreneur with a professional manager. However, the entrepreneur relinquishes control voluntarily, if the value of her stake in the venture under professional management (including transfers for not renegotiating the contract) outweighs the cumulative losses of any financial and private benefits associated with the replacement. Hellmann (1998) also argues that because an entrepreneur cannot derive extra utility from the ability to replace herself, the distribution of control rights is a binary function.

I present a more comprehensive theoretical depiction of venture finance. I do this by relaxing a number of restrictive assumptions made in previous studies. I do not assume that control is a binary variable that is either allocated to the venture capitalist or the entrepreneur, but model it as a continuous variable. I assume that the allocation of control rights and the valuation of a venture are determined simultaneously during negotiations on the sale of private equity, but I do not restrict control rights to be proportional to the number of acquired shares. I also do not require that the value of control or the bargaining process depend on the presence of a third party.[3] Instead, I model the optimal allocation of control rights as an outcome of a two-agent game of incomplete information.

Finally, I should note that my model focuses on the allocation of control rights only in the initial financing round, and thus does not belong to the class of dynamic agency models such as Admati and Pfleiderer (1994) and Bergemann and Hege (1998). Both studies examine a multiperiod financial contracting problem. In every period, a venture capitalist must decide whether or not to continue financing a project initially owned by an entrepreneur. In return for financing, the venture capitalist demands a fraction of the project's

[3] Contracts with third parties are a successful device for eliminating unwanted outcomes or converting unwanted outcomes into desirable ones. See, for example, Palfrey and Srivastava (1993) on how the introduction of a third agent can ensure incentive compatibility and facilitate implementation.

payoff. Admati and Pfleiderer (1994) find that the only contract that assures optimal continuation and investment decisions is an equity contract "in which the venture capitalist owns the same fraction of the payoff independent of the continuation decision, and also finances that same fraction of any future investment." (p. 395) Bergemann and Hege (1998) also find that an equity contract ensures optimal continuation decision, but argue that to allow for intertemporal risk sharing, the fraction held by the venture capitalist must be time-varying.

The paper is organized as follows. Section I presents the model. Section II contains the derivation of the equilibrium investment. Section III discusses the optimal allocation of control rights. Section IV summarizes conclusions on control rights and efficiency. Section V discusses the implementation of control rights. Section VI concludes the paper. Lengthy proofs are in the Appendix.

I. Model

I consider a two-period economy populated by competitive, risk-neutral, venture investors and risk-averse entrepreneurs. In the first period, a wealth-constrained entrepreneur forms a venture with a profit-maximizing investor. The entrepreneur's contribution to the venture consists of a risky investment project with a payoff of $\tilde{x}$ (a random variable) realized in the second period. As the project's owner, the entrepreneur receives a private valuation of the project's payoff, s.

The investor's contribution to the venture is a capital injection, pq, where q is the number of shares acquired and p is the price per share. In practice, venture capitalists typically use equity-linked securities to finance new ventures (see Fenn, Liang, and Prowse (1997) and Fenn and Liang (1998)).

The value of the venture to the entrepreneur consists of two components, the project's future payoff, $\tilde{x}$, and the net nonpecuniary private benefits derived from control, access, and other noncontractible aspects of managing the venture denoted by T. T is a function of two variables, v and λ. v is the entrepreneur's private value of control and λ is the amount of control that is lost when a share is sold. I assume that $T(v, \lambda)$ is continuous in both arguments and becomes zero whenever either v or λ is equal to zero. Thus, I allow the extent to which an entrepreneur relinquishes control to a venture capitalist to vary continuously. The rationale for a transfer of control rights is provided by a combination of two assumptions. On the one hand, because the entrepreneur's private benefits are not observed by the investor, they cannot be covered by enforceable contractual clauses. On the other hand, because the entrepreneur is wealth constrained, she cannot be charged a sufficient penalty for deviating from an agreement. Control rights mitigate incentives problems and allow for financing to take place.

I define the contract as a triple (p, q, λ) agreed upon at the beginning of period one. I assume that there exists a competitive market for control in which the size of equilibrium λ is determined. I later relax this assumption and show that the equilibrium allocation of control rights can be implemented via bilateral bargaining procedures.

I also assume that the contract does not include a credibly enforceable commitment not to renegotiate. Hart and Moore (1999) argue that if such a commitment were to exist, then contractual incompleteness would not matter, because the counterparties could credibly agree in the initial period to contribute agreed-upon allocations, regardless of the noncontractibility of some variables. Consequently, all control rights should remain with the entrepreneur under all possible contingencies. In practice, contracts between entrepreneurs and venture capitalists contain clauses that specify settlement of disputes, but not clauses that prohibit renegotiation (see Landstrom et al. (1998)).

The "no commitment" assumption is consistent with the earlier assumption that the entrepreneur has limited wealth. If the risk averse entrepreneur were to have enough wealth to repay the investors regardless of the outcome, then she should retain all control over the venture in return for a state-independent fraction of the payoff. I assume that the wealth constraint is sufficiently tight so that the ex ante financing decision does not lead to an allocation of control rights in which one party has all control and the other has none. Evans and Jovanovic (1989) support this assumption by reporting that entrepreneurs face a "binding liquidity constraint."

The formal description of the game, agents, and the definition of equilibrium is as follows. At the start of the game, the entrepreneur receives an endowment of a risk-free asset, c, with gross intertemporal return equal to one, and a risky project with a payoff $\tilde{x}$. I assume that $\tilde{x}$ is distributed normally with mean μ and variance σ_x^2. Empirically, the distribution of returns on investments into new companies is not normal, but highly skewed toward a small number of very valuable projects (see, e.g., Sahlman (1990)). Later in the paper, I argue that the results are robust with respect to the assumption of normally distributed returns.

The entrepreneur's first- and second-period wealth must satisfy the budget constraints,

$$W_0 = pq + c \tag{1}$$

and

$$W_1 = (\tilde{x} + T(v, \lambda))q + c, \tag{2}$$

respectively. Equations (1) and (2) imply that the entrepreneur's intertemporal budget constraint is given by

$$W_1 = W_0 + (\tilde{x} - p)q + T(v, \lambda)q. \tag{3}$$

Without loss of generality, I assume that the function T is the product of λ and v, that is, $T(v, \lambda) = \lambda v$. I assume that the loss of control, λ, is a constant between zero and one, independent of both $\tilde{x}$ and q. By convention, $\lambda = 0$ means that a sale of shares does not result in any loss of control. In practice, venture capitalists gradually adjust control rights through the staged infusion of capital, board representation, voting rights, and veto power over main operating decisions (see Lerner (1995), Black and Gilson (1998), and Hellmann (1998)).

I assume that the entrepreneur knows the value of control, but the investor does not. To the investor, the value of control, v, is a normally distributed random variable with mean zero and variance σ_v^2. I assume that the value of control is orthogonal to the payoff on the project, $\tilde{x}$. The rationale for this assumption is that entrepreneurs may prefer to run projects that have high private value of control, but yield low or even negative monetary returns to investors (see, e.g., Gompers (1995)). Later in the paper I relax this assumption and show that as long as the correlation between the value of control and the payoff on the project is not perfect, all results remain valid. The assumption only helps to derive a tractable closed-form solution for the equilibrium allocation of control rights.

Because her terminal period wealth is derived from a nondiversified portfolio consisting of a stake in the risky project and cash, I assume that the entrepreneur is risk averse. I further assume that the entrepreneur has a negative exponential utility function with a parameter $\rho > 0$,

$$u(W_1) = -\exp(-\rho W_1). \tag{4}$$

In addition to assets, the entrepreneur receives a private signal of the project's value, s, which is not known to the investor. I assume that the entrepreneur's noisy private signal about $\tilde{x}$ is of the following form: $s = \tilde{x} + \epsilon$, where $\epsilon \sim N(0, \sigma_\epsilon^2)$, independently of $\tilde{x}$ and v.

The entrepreneur determines the optimal stake offered to an investor, q, by maximizing the expected utility of the liquidation period wealth

$$\max_q E\{-\exp(-\rho(W_0 + (\tilde{x} - p)q + \lambda v q)) | s, v, \lambda\}. \tag{5}$$

The information set of the entrepreneur contains the signal, s, the value of control, v, and all publicly available information.

The investor is a competitive, expected profit maximizer. Empirical evidence suggests that the venture capital investment market is competitive. For example, according to Venture Economics Information Services, during 1998, over 3,300 venture capital funds disbursed over 16 billion dollars to nearly 2,700 venture-capital-backed companies (around one-third of them in early stages) (see Gannon (1999)). However, it must also be acknowledged that venture capital firms are greatly differentiated by reputation. In addition, there is some evidence of collaboration among venture capital firms in the form of the syndication of their investments (see Lerner (1994)). For the purposes of this paper, I treat a syndicate of venture capitalists as one venture capitalist competing with other investors who are not members of the syndicate.

The investor is also risk neutral, because he already holds a diversified portfolio of projects.[4] Investors compete for ownership in the venture by offering a price schedule, $p(q)$, given the entrepreneur's offer, q, and all available information. The investor's expected profit maximization problem is of the following form:

$$\max_p E\{(\tilde{x} - p(q))(-q) | q(\lambda), \lambda\}, \tag{6}$$

where $q(\lambda)$ is the demand schedule of the entrepreneur for a given value of λ. The value of λ specifies the reallocation of control associated with each transaction. In practice, funds are disbursed in stages. Each financing round is covered by separate contractual agreements that specify the timing of capital injections, the valuation of the company, and the distribution of control rights.

I assume that the investor maximizes the return on his portfolio by maximizing the return on each project. In practice, aside from a fixed fee to cover operational expenses (typically, 2 to 2.5 percent of assets under management), the main source of a venture capitalist's compensation is a share of capital gains from the sale or distribution of controlled equity.

All negotiations and transactions take place in the first period. In the second period the payoff, $\tilde{x}$, is realized and the venture is liquidated. In practice, returns are realized through a variety of exit or liquidation strategies. Profitable ventures typically exit through an initial public offering, a merger or acquisition by another company, or a share buyback.

The investor agrees to finance the venture only if the expected profit from buying a number of shares, q, for a price, p, is nonnegative. Consequently, the investor prefers to offer the entrepreneur the lowest possible price for the highest number of shares. The entrepreneur, on the other hand, prefers to sell the smallest number of shares for the highest possible price.

A strategy for the entrepreneur is a rule that specifies an offer, $q(p)$, given the investor's price and the available private and public information.

A strategy for the venture investor is a rule that specifies a price offered to the entrepreneur, $p(q)$, based on the entrepreneur's offer and all publicly available information.[5]

The distributional and functional assumptions, objective functions of all participants, and the structure of the game are common knowledge.

[4] The occurrence of grandstanding documented by Gompers (1996) might be a sign that risk aversion is an issue for some, especially less-established, venture capitalists.

[5] The description of strategies is without the loss of generality. In Section V, the strategies are significantly modified, but only in the context of implementing an optimal allocation of control rights.

I define a Bayesian–Nash equilibrium of this game as a strategy function, q, for the entrepreneur, a strategy function, $p(q)$, for the investor, and a constant, λ, such that the following conditions hold. First, the agents' strategies yield the best outcomes, conditional on the available information. Second, the agents' strategies are mutually consistent in the sense of Bayesian updating. Third, the investor who offers the lowest loss of control rights gets to finance the venture.

II. Equilibrium Investment

In this section, I show that there exists a unique linear equilibrium in the asset market. For the equilibrium to exist, a sufficient condition that describes the permissible extent of information asymmetry must hold. Consider the following proposition.

PROPOSITION 1: *If*

$$\lambda^2 > \frac{\sigma_x^2}{\sigma_v^2}\left(\frac{\dfrac{\sigma_x^2}{\sigma_\epsilon^2}}{\left(\dfrac{\sigma_x^2}{\sigma_\epsilon^2}+1\right)}\right),$$

then there exists a unique linear equilibrium of the following form:

$$q^\star = \frac{E(\tilde{x}|s) - p + \lambda v}{\rho \operatorname{Var}(\tilde{x}|s) + \phi_\lambda} \tag{7}$$

$$p^\star(q) = \mu + \phi_\lambda q, \tag{8}$$

where $\phi_\lambda > 0$ is a constant.

The proof is given in the Appendix.

Proposition (1) states that in equilibrium, the entrepreneur willingly dilutes her ownership in the venture if the share price offered by the investor is high enough to compensate for the loss of the expected payoff on the project and private benefits of control. Equilibrium in the asset market does not exist if all control rights remain with the entrepreneur. This result follows from an observation that when λ is equal to zero, the strict inequality condition is violated.

For a given nonzero λ, the equilibrium trade size depends on the entrepreneur's appetite for risk and the degree of information asymmetry. The appetite for risk is summarized by the product of risk aversion and the conditional variance of the project's payoff, $\rho \operatorname{Var}(\tilde{x}|s)$. The degree of information asymmetry is characterized by the "signal-to-noise" ratio, $\sigma_x^2/\sigma_\epsilon^2$. An increase in risk aversion decreases the size of a transaction, but does not affect the distribution of control rights. An increase in the signal-to-noise ratio, $\sigma_x^2/\sigma_\epsilon^2$, leads to a dilution of the entrepreneur's ownership in the venture and results in a reallocation of control rights from the entrepreneur to the investor.

The investor's equilibrium price rule, $p^\star$, is an upward-sloping function of quantity: The higher the sale offer of the entrepreneur, the lower the price offer of the investor. The slope, ϕ_λ increases in the signal-to-noise ratio. The result follows from a differentiation of ϕ_λ with respect to the signal-to-noise ratio, $\sigma_x^2/\sigma_\epsilon^2$.

Sahlman (1990) documents the prices paid and capital raised in multiple investment rounds for eight venture-backed companies. The data and discussion suggest that a company's share price is determined by the number of shares offered and the company's current and future performance. Sahlman (1990) also finds that "increased capital requirements invariably dilute management's [i.e., the entrepreneur's] equity share at an increasingly punitive rate." (p. 507)

III. Equilibrium Control Rights

This section consists of two parts. First, I present a proposition and three corollaries that characterize the equilibrium distribution of control rights. Second, I prove that the model's results are robust with respect to the assumption that the value of control is orthogonal to the payoff on the project.

Proposition (2) describes the equilibrium distribution of control rights, $\lambda^\star$.

PROPOSITION 2: *In equilibrium, the distribution of control rights is given by*

$$\lambda^\star = \min\left\{\lambda \in [0,1] \,|\, \lambda^2 > \frac{\sigma_x^2}{\sigma_v^2}\left(\frac{\dfrac{\sigma_x^2}{\sigma_\epsilon^2}}{\left(\dfrac{\sigma_x^2}{\sigma_\epsilon^2}+1\right)}\right)\right\}. \tag{9}$$

The proof is given in the Appendix.

Interviews with venture capitalists support the "minimum" equilibrium approach to control rights. For example, Landstrom et al. (1998) quote a venture capitalist: "We [the venture capitalists] spell out pretty clearly that we want them [the entrepreneurs] to run the company, and that we don't want to run the company. We are investing in *them* [italics original], and they are going to run the company." (p. 9) Sahlman (1990) also concludes that "venture capitalists who abuse their power will find it hard to approach the best entrepreneurs, who have the option of approaching other venture capitalists or sources other than venture capital." (p. 513)

The equilibrium distribution of control rights depends on three parameter values, σ_x^2, σ_ϵ^2, and σ_v^2, which describe the variances of signal, noise, and the value of control, respectively. The following three corollaries describe the precise nature of this dependence.

COROLLARY 1: *Equilibrium in the market for control does not exist if either of the following two conditions holds:*

$$\sigma_v^2 = 0; \tag{10}$$

$$\frac{\sigma_x^2}{\sigma_\epsilon^2} = \infty. \tag{11}$$

Conditions presented in Corollary 1 have an intuitive interpretation. Condition (10) means that the investor knows with certainty the private value of the entrepreneur's value of control, v. Consequently, the investor can deduce the entrepreneur's private signal, s, from the offer schedule. This eliminates the informational advantage of the entrepreneur, but leaves intact the investor's monopoly over funds. Knowing s, the investor offers such prices that the entrepreneur's terminal period wealth is equal to her initial cash holdings. This eliminates the entrepreneur's incentives to engage in a venture and leads to no trade.

Condition (11) means that the common prior on $\tilde{x}$ relative to the entrepreneur's signal is completely uninformative. Faced with so much uncertainty, the venture capitalist cannot expect to earn nonnegative expected profits and refuses to trade.

COROLLARY 2: *In equilibrium, the higher the degree of adverse selection, the more control rights are allocated to a venture capitalist.*

Corollary 2 links the equilibrium distribution of control rights with the degree of adverse selection. The corollary is proved by observing that in equilibrium, higher adverse selection, which is characterized by a higher signal-to-noise ratio, $\sigma_x^2/\sigma_\epsilon^2$, leads to a greater loss of control by the entrepreneur to the investor.

Empirical observations support this result. For example, Gompers (1997) finds that contracts allocate greater control rights to venture capitalists investing in early-stage companies, companies in industries with high R&D intensities, or companies with significant growth options.

The importance of adverse selection in the determination of control rights is likely to be even stronger if the distribution of $\tilde{x}$ is not normal, but highly skewed in favor of a few very valuable projects as is the case empirically. For example, Sahlman (1990) reports that according to one survey, more than one-third of nearly 400 investments made by 13 venture capital firms resulted in an absolute loss. Another 30 percent of the same investments had returns which were relatively low, given their levels of risk. At the same time, less than 7 percent of investments yielded more than 10 times their original cost and accounted for nearly 50 percent of the ending value of the entire investment portfolio. Faced with such a skewed distribution of returns, a venture capitalist would be even more vigilant in trying to resolve the adverse selection problem. Thus, the results achieved under the assumption of normality of $\tilde{x}$ constitute a lower bound on the distribution of control rights associated with particular levels of adverse selection.

COROLLARY 3: *In equilibrium, the higher the uncertainty about the value of control, the more control rights are allocated to the entrepreneur.*

Corollary 3 states that higher uncertainty about the value of control, manifested by higher σ_v^2, leads to a lower equilibrium $\lambda^\star$. This means that the entrepreneur retains a higher fraction of private benefits of control from running the venture. Note that this reinforces the entrepreneur's incentive to never reveal her private value of control to investors.

To derive a tractable closed-form solution for the equilibrium allocation of control rights presented in Proposition 2, I assume that the value of control is orthogonal to the payoff on the project. However, this technical assumption can be relaxed. Proposition 3 states that as long as v and $\tilde{x}$ are not perfectly correlated, the logic of the proofs of Propositions 1 and 2 does not change.

PROPOSITION 3: *If v and $\tilde{x}$ are not perfectly correlated, then the proofs to Propositions* 1 *and* 2 *remain valid.*

The proof is given in the Appendix.

The intuition is as follows. The assumption that the value of control is orthogonal to the payoff on the project affects the informational content of a descriptive statistic of the risky payoff. The investor constructs the descriptive statistic, z, by using the entrepreneur's offer, q, and publicly available information.

Even if I assume that $\tilde{x}$ and v are correlated, as long as the correlation is not perfect, the investor is not able to invert the statistic and obtain the entrepreneur's private signal, s.

To take the correlation between $\tilde{x}$ and v into account, the investor can construct a modified statistic, $\hat{z}$. However, that does not change the signal extraction problem underlying the proof to Proposition 1, nor does it change the logic of the proof to Proposition 2.

This technical assumption only helps to derive a closed-form solution to the equilibrium condition

$$\lambda^2 > \frac{\sigma_x^2}{\sigma_v^2}\left(\frac{\dfrac{\sigma_x^2}{\sigma_\epsilon^2}}{\left(\dfrac{\sigma_x^2}{\sigma_\epsilon^2}+1\right)}\right).$$

Having a closed-form solution makes it much easier to analyze the equilibrium distribution of control rights, $\lambda^\star$, without compromising the generality of results.

IV. Control and Efficiency

In this section I summarize the model's conclusions on control rights and efficiency.

PROPOSITION 4: *If there does not exist a mechanism to distribute control rights, then investment does not take place, information relevant to the project's payoff is not revealed, and risks are not shifted from a risk-averse entrepreneur to a risk-neutral investor.*

The proof is given in the Appendix.

Proposition 4 states that the lack of a mechanism to distribute control rights results in welfare losses and allocational, informational, and risk inefficiencies. Thus, there are possible efficiency and welfare gains associated with the introduction of such a mechanism.

Suppose that there exists a mechanism to distribute control rights. What effect would changes in the equilibrium distribution of control rights have on investment, the informativeness of prices, and the distribution of risks? Consider the following proposition.

PROPOSITION 5: *Allocation of more control rights to the investor results in: (1) a smaller dilution of the entrepreneur's ownership in the venture at higher share prices, (2) less informationally efficient prices, and (3) a higher share of risks allocated to the least risk averse party.*

Proposition 5 states that the entrepreneur is compensated for a greater loss of control through better terms of financing, ability to extract higher rents from asymmetric information, and better risk sharing.

The proof is as follows. Parts (1) and (2) follow from the analysis of equations (A17) and (A7) in the Appendix, respectively. Part (3) follows from observing that, by being willing to pay proportionally higher prices for any given number of shares, as shown in part (1), the investor assumes more risks associated with the risky project.

In Corollaries 4 and 5, I describe how control affects the equilibrium valuation of a risky venture.

COROLLARY 4: *The presence of a private value of control prevents securities' prices from being sufficient statistics for the valuation of a venture.*

In other words, prices that solve problems (5) and (6) are not fully revealing. Prices become more informative as more control is allocated to the venture capitalist. In practice, valuations of new companies tend to reflect both the projects' payoffs and private views of contracting parties. For example, Bartlett (1999) reflects that "there are almost as many methods of calculating value [of a new company], as there are world religions, since the questions are metaphysical in part and depend on the appetites of the observer." (p. 28)

COROLLARY 5: *A private value of control introduces a premium into the equilibrium valuation of the venture and makes the equilibrium value of the venture more volatile.*

The value of the venture to the entrepreneur consists of two components: the share of the project's future payoff and the private value of control. In other words, the private value of control represents an additional source of value for the entrepreneur, separate from a claim on the share of the future payoff. Because the entrepreneur values control, she demands that the prices that solve problems (5) and (6) include a component that compensates her for the loss of control. The investors do not value control. They are only interested in the future payoff of the project. However, they are willing to pay a "premium" over a price that includes only information relevant to the project's payoff. In return, they get an assurance that the incentives of the entrepreneur are compatible with theirs. In equilibrium, both parties agree to include into the value of the venture an amount of the entrepreneur's private value of control proportional to $\lambda^\star$.

Although all agents are fully rational, incentive compatibility requires that the equilibrium value of the risky venture include an "idiosyncratic" component due to the entrepreneur's private value of control. Moreover, because the investors do not know the value that the entrepreneur places on control, this idiosyncratic component makes the equilibrium value of the risky venture more volatile than it would have been without it. Lacker, Levy, and Weinberg (1990) derive a similar result.

V. Implementation of Control Rights

Because the value of control is the entrepreneur's private information, it cannot be verified in a public court. Thus, it is not possible to credibly enforce explicit contractual clauses that specify particular allocations of control rights. Therefore, to implement an optimal allocation of control rights, the venture capitalist and the entrepreneur must use an indirect mechanism that takes into account their incentives and bargaining power (see Hart and Moore (1999) and Maskin and Moore (1999) for details). In this section, I show that an optimal allocation of control rights can be implemented via a variety of indirect mechanisms.

In Proposition 6, I prove that an optimal allocation of control rights can be implemented via a competitive market for control.

PROPOSITION 6: *The equilibrium allocation of control rights achieved in a competitive market is Pareto optimal.*

Proposition 6 states that, in a model economy, there is no other mechanism, including any bilateral bargaining scheme or contract, that can improve upon the allocation of control rights achieved in a competitive market.

The proof is as follows. When the entrepreneur loses control rights and the associated utility, the investor does not correspondingly gain in profits. All the investor wants is to separate the "noise" associated with the private value of control from the payoff on the project. By using control rights, the investor can evaluate the project better and price the deal more efficiently.

However, the loss of control results in expected utility losses for the entrepreneur. A mechanism that allocates control rights to minimize the associated deadweight loss is Pareto optimal. By construction, the distribution of control rights achieved in a competitive market satisfies the conditions for Pareto optimality. It guarantees the smallest utility loss to an entrepreneur, while at the same time allowing an investor to complete the venture financing deal. This completes the proof.

This result depends on the assumption that there exists a competitive market for control rights. However, the contracting parties can also implement their objectives through other mechanisms.

In Proposition 7, I show that the optimal allocation of control rights can be implemented via two bilateral bargaining procedures, a "take-it-or-leave-it" offer and a multistage bargaining game.

PROPOSITION 7: *The optimal allocation of control results can be implemented via bilateral bargaining procedures.*

The proof is as follows. Consider a mechanism in which the entrepreneur has a right to make a take-it-or-leave-it offer to the investor after the payoff, $\tilde{x}$, is realized. The offer includes new prices, share distributions, and a new allocation of control rights. If the investor agrees, the original contract is pronounced invalid in favor of the new contract. If the investor refuses, the allocation specified by the original contract remains valid.

Given the assumption that the original contract does not include a credibly enforceable commitment not to renegotiate, the take-it-or-leave-it offer cannot be enforced. Therefore, the entrepreneur's right to make a take-it-or-leave-it offer after the payoff is realized does not give her any additional leverage in the bargaining process.

However, the investor will accept the entrepreneur's offer if it enables him to solve his signal extraction problem and earn nonnegative expected profits. Therefore, the entrepreneur chooses $\lambda^\star$, the minimum acceptable loss of control rights. The entrepreneur agrees and the optimal allocation of control rights is implemented through a take-it-or-leave-it mechanism.

Consider also the following three-stage mechanism. The three stages take place in the first period. In Stage 1, the entrepreneur offers the investor either $(p^\star,q^\star)$ or, without the loss of generality, $\hat{q} < q^\star$ at $p^\star$. If she offers $(p^\star,q^\star)$, then the investor accepts on the condition that $\lambda = \lambda^\star$, and the bargaining process ends. Otherwise, the bargaining proceeds to Stage 2.

In Stage 2, the investor can either agree to or challenge the offer. If the investor agrees to the offer, then he contributes $p^\star\hat{q}$ to the venture and the bargaining ends. If he challenges the offer, then the bargaining process proceeds to Stage 3.

In Stage 3, the entrepreneur must choose between two values of λ, $\lambda = 1$ or $\lambda^\star$, following which the bargaining process ends. I assume that all announcements are nonverifiable.

The entrepreneur prefers to offer $\hat{q}$ in Stage 1. However, if the investor does not accept this offer, the process continues to Stage 2. At Stage 2, the investor promptly challenges and the process proceeds to Stage 3. At Stage 3, the entrepreneur must choose between losing all of her control rights or only enough of them to obtain the capital injection $p^\star q^\star$. Because the entrepreneur and the investor both prefer the latter outcome, the optimal allocation of control rights is implemented.

Although in all of the above mechanisms, the entrepreneur makes the first move, the venture capitalist can also start the bargaining process. The venture capitalist can offer an allocation of control rights and let the entrepreneur accept or reject the offer. If the entrepreneur rejects the offer, then the bargaining process ends. If she accepts the offer, then the bargaining process continues in the same way as, for example, in the three-stage mechanism.

In practice, optimal control rights are implemented during negotiations between the venture capitalist and the entrepreneur. For example, Shaheen (1999) gives the following advice to lawyers counseling their clients on venture capital financing: "Be as tough as possible on negotiations of terms for the initial contracts because they affect the structure of the company and its ability to expand for many years. . . . Your negotiations will center on (i) valuation of the company, (ii) composition of securities sold, (iii) equity to be retained by founders, (iv) representations, warranties, and covenants, (v) change of control in the event that certain performance benchmarks are not met, (vi) registration rights, (vii) conversion and antidilution provisions, among others." (p. 6)

VI. Conclusions

I present a model in which a venture capitalist and an entrepreneur are engaged in the complex and risky task of forming a new company. I show that a reallocation of control rights can alleviate some commitment and incentives problems and lead to an improved outcome.

In contrast to earlier studies, I assume that control is a continuous, rather than a binary variable. I show that the equilibrium distribution of control rights depends on the degree of adverse selection. In equilibrium, the higher the degree of adverse selection, the more control rights are allocated to the venture capitalist. This explains why, in practice, venture capitalists receive control levers that are significantly higher than the size of their equity investment.

I also show that allocating more control rights to the investor results in a smaller dilution of the entrepreneur's ownership in the venture at higher share prices, less informationally efficient prices, and a higher share of risks shifted to the investor. In other words, the entrepreneur is compensated for a greater loss of control through better terms of financing, ability to extract higher rents from asymmetric information, and better risk sharing. Finally, because contractual provisions conditional on the entrepreneur's private value of control cannot be enforced, I investigate how an optimal allocation of control rights can be implemented through indirect mechanisms. I prove that an optimal allocation of control rights can be implemented via a competitive market for control or bilateral bargaining procedures.

The fit and predictive power of the model can be improved in several ways. First, the two-period model can be extended to a multiperiod setting. A multiperiod model can be used to analyze the allocation of control conditional on performance in prior stages. Second, a broader choice of available financial instruments can be considered. Finally, the optimal exit and postexit strategies can be explicitly incorporated into the model. These issues and the analysis of fundraising, compensation, and the optimal mix of shareholders can be explored in future studies.

Appendix A

Proof of Proposition 1: Given the available information, the entrepreneur offers a schedule $q(p)$ to the investor (venture capitalist). The functional and distributional assumptions jointly imply that a solution to the entrepreneur's expected utility maximization problem (5) must satisfy the following first-order,

$$E\{\tilde{x}|s\} - \rho\,\mathrm{Var}\{\tilde{x}|s\}q - p'(q)q - p(q) + \lambda v = 0, \tag{A1}$$

and second-order optimality conditions,

$$-\rho\,\mathrm{Var}\{\tilde{x}|s\} - 2p'(q) - p''(q) < 0. \tag{A2}$$

Applying the result on conjugate families for samples from a normal distribution (DeGroot (1970)), the entrepreneur's posterior distribution of $\tilde{x}$ given the normal prior and the signal s, is also normal with mean

$$E\{\tilde{x}|s\} = \frac{\dfrac{s}{\sigma_\epsilon^2} + \dfrac{\mu}{\sigma_x^2}}{\dfrac{1}{\sigma_\epsilon^2} + \dfrac{1}{\sigma_x^2}} \tag{A3}$$

and variance

$$\mathrm{Var}\{\tilde{x}|s\} = \frac{1}{\dfrac{1}{\sigma_\epsilon^2} + \dfrac{1}{\sigma_x^2}}. \tag{A4}$$

The investor does not observe s and v separately, and therefore cannot distinguish whether the entrepreneur's decision to offer q is motivated by the information about the project's expected payoff or the value of control. However, he can use the entrepreneur's offer schedule to update his information set, construct a posterior distribution of $\tilde{x}$, and then bid for shares using the posterior.

Define

$$R(q) \equiv \rho \operatorname{Var}\{\tilde{x}|s\}q + p(q) + p'(q)q, \tag{A5}$$

and

$$z(q) \equiv \left(R(q)\left(\frac{1}{\sigma_\epsilon^2} + \frac{1}{\sigma_x^2}\right) - \frac{\mu}{\sigma_x^2}\right)\sigma_\epsilon^2. \tag{A6}$$

By construction, $R(q) = E\{\tilde{x}|s\} + \lambda v$. Substituting R into z results in

$$z(q) = s + \left(1 + \frac{\sigma_\epsilon^2}{\sigma_x^2}\right)\lambda v = \tilde{x} + \epsilon + \left(1 + \frac{\sigma_\epsilon^2}{\sigma_x^2}\right)\lambda v. \tag{A7}$$

Thus, $z(q)$ is a descriptive statistic of the risky payoff, $\tilde{x}$, that contains private information embedded in the entrepreneur's offer, q, and publicly available information.

Note that a higher λ magnifies the level of payoff-irrelevant noise in the descriptive statistic, $z(q)$. Thus, an increase in λ results in a lower informational efficiency of equilibrium prices.

From the investor's point of view, because $\tilde{x}$, v, and ϵ are independently normally distributed variables, $z \sim N(\tilde{x}, \sigma_\omega^2)$, where $\sigma_\omega^2 = \sigma_\epsilon^2 + (1 + \sigma_\epsilon^2/\sigma_x^2)^2\lambda^2\sigma_v^2$.

The mean and variance of the posterior distribution of $\tilde{x}$ are

$$E\{\tilde{x}|q\} = \frac{\dfrac{z}{\sigma_\omega^2} + \dfrac{\mu}{\sigma_x^2}}{\dfrac{1}{\sigma_\omega^2} + \dfrac{1}{\sigma_x^2}} \tag{A8}$$

and

$$\operatorname{Var}\{\tilde{x}|q\} = \frac{1}{\sigma_\omega^2} + \frac{1}{\sigma_x^2}, \tag{A9}$$

respectively.

Investor competition implies that in equilibrium

$$p = E\{\tilde{x}|q\}. \tag{A10}$$

Substituting equations (A5) and (A6) into equation (A8) and using condition (A10) yields

$$p'(q)q = \alpha(p(q) - \mu) - \beta q, \tag{A11}$$

where

$$\alpha = \frac{\sigma_\omega^2 - \sigma_\epsilon^2}{\sigma_x^2 + \sigma_\epsilon^2} \tag{A12}$$

and

$$\beta = \frac{\rho\sigma_x^2\sigma_\epsilon^2}{\sigma_x^2 + \sigma_\epsilon^2} \tag{A13}$$

are constants. The solution to the above first-order differential equation is of the form

$$p(q) = \mu + \frac{\beta}{\alpha - 1}q - C|q|^\alpha, \tag{A14}$$

for $\alpha \neq 1$, and

$$p(q) = \mu + Cq - \beta\ln(|q|)q, \tag{A15}$$

for $\alpha = 1$, where C is some constant of integration.

There are nine possible combinations of α and C, corresponding to the values of α greater, less than, or equal to 1 and values of C greater, less than, or equal to 0. When $C < 0$ and $\alpha \leq 1$, the investor pays more per share if he buys more shares. This means that the more shares the entrepreneur offers, the higher per share equilibrium price she can demand. This represents an arbitrage opportunity that cannot be sustained in equilibrium. When $C < 0$ and $\alpha > 1$, the second-order optimality condition (A2) is violated. The condition (A2) is also violated when $C \geq 0$ and $\alpha \leq 1$. Finally, when $C > 0$ and $\alpha > 1$, an investor who offers to finance the venture at the same $\alpha > 1$, but $C = 0$ should be preferred to any investor offering $C > 0$. This leaves us with a unique combination of α and C that can support an equilibrium, $C = 0$ and $\alpha > 1$.

This implies that the equilibrium price rule is unique and linear in q,

$$p(q) = \mu + \frac{\beta}{\alpha - 1} q = \mu + \phi_\lambda q, \tag{A16}$$

where

$$\phi_\lambda = \frac{\rho \sigma_\epsilon^2 \sigma_x^2}{\left(1 + \dfrac{\sigma_\epsilon^2}{\sigma_x^2}\right)(\lambda^2 \sigma_v^2 - \sigma_x^2)} > 0. \tag{A17}$$

Note that a higher value of λ decreases ϕ_λ, the slope of the equilibrium price rule. This leads to a lower decline in prices and a smaller dilution of shares.

The equilibrium of the form

$$q^\star = \frac{E(\tilde{x}|s) - p + \lambda v}{\rho \operatorname{Var}(\tilde{x}|s) + \phi_\lambda} \tag{A18}$$

$$p^\star = \mu + \phi_\lambda q, \tag{A19}$$

exists if $\alpha > 1$, or, in terms of parameter values, if the following inequality holds:

$$\lambda^2 > \frac{\sigma_x^2}{\sigma_v^2} \left(\frac{\dfrac{\sigma_x^2}{\sigma_\epsilon^2}}{\left(\dfrac{\sigma_x^2}{\sigma_\epsilon^2} + 1\right)} \right). \tag{A20}$$

Q.E.D.

Proof of Proposition 2: Competition in the market for control rights implies that the investor who offers to leave the most control with the entrepreneur gets the deal. The most control an investor could leave with the entrepreneur is specified by the inequality (A20). If an entrepreneur asks for control rights beyond that, the investor refuses to trade. Thus, the equilibrium allocation of control rights is defined by

$$\lambda^\star = \min \left\{ \lambda \in [0,1] \,\middle|\, \lambda^2 > \frac{\sigma_x^2}{\sigma_v^2} \left(\frac{\dfrac{\sigma_x^2}{\sigma_\epsilon^2}}{\left(\dfrac{\sigma_x^2}{\sigma_\epsilon^2} + 1\right)} \right) \right\}. \tag{A21}$$

Q.E.D.

Proof of Proposition 3: Suppose that, without the loss of generality,

$$\hat{v} \equiv \gamma(s - \mu) + \eta, \tag{A22}$$

where η is distributed independently normally with mean zero and variance σ_η^2 and γ is some constant different from zero. By construction, $\hat{v}$ is correlated with $\tilde{x}$.

As in the proof of Proposition 1, the investor uses the entrepreneur's offer, q, to update his information set and construct a posterior distribution of $\tilde{x}$. Define

$$\hat{R}(q) \equiv \rho \operatorname{Var}\{\tilde{x}|s\}q + p(q) + p'(q)q \tag{A23}$$

and

$$\hat{z}(q) \equiv \frac{\hat{R}(q)\left(\dfrac{1}{\sigma_\epsilon^2} + \dfrac{1}{\sigma_x^2}\right) - \mu\left(\dfrac{1}{\sigma_x^2} - \lambda\gamma\left(\dfrac{1}{\sigma_\epsilon^2} + \dfrac{1}{\sigma_x^2}\right)\right)}{\dfrac{1}{\sigma_\epsilon^2} + \lambda\gamma\left(\dfrac{1}{\sigma_\epsilon^2} + \dfrac{1}{\sigma_x^2}\right)}. \tag{A24}$$

By construction, $\hat{R}(q) = E\{\tilde{x}|s\} + \lambda\hat{v}$. Substituting equation (A23) into equation (A24) results in

$$\hat{z}(q) = s + \frac{\lambda}{\lambda\gamma + \dfrac{\sigma_x^2}{\sigma_\epsilon^2 + \sigma_x^2}}\eta = \tilde{x} + \epsilon + \frac{\lambda}{\lambda\gamma + \dfrac{\sigma_x^2}{\sigma_\epsilon^2 + \sigma_x^2}}\eta. \tag{A25}$$

Thus, $\hat{z}$ is a descriptive statistic that takes into account the correlation between $\tilde{x}$ and $\hat{v}$. Note that, when γ equals zero and σ_η^2 is equal to σ_v^2, $\hat{z}$ simplifies to z in equation (A7).

Because $\tilde{x}$, η, and ϵ are independently normally distributed variables, $\hat{z} \sim N(\tilde{x}, \sigma_{\hat{\omega}}^2)$, where

$$\sigma_{\hat{\omega}}^2 = \sigma_\epsilon^2 + \left(\frac{\lambda}{\lambda\gamma + \dfrac{\sigma_x^2}{\sigma_\epsilon^2 + \sigma_x^2}}\right)^2 \sigma_\eta^2. \tag{A26}$$

The mean and variance of the posterior distribution of $\tilde{x}$ are

$$E\{\tilde{x}|q\} = \frac{\dfrac{\hat{z}}{\sigma_{\hat{\omega}}^2} + \dfrac{\mu}{\sigma_x^2}}{\dfrac{1}{\sigma_{\hat{\omega}}^2} + \dfrac{1}{\sigma_x^2}} \tag{A27}$$

and

$$\mathrm{Var}\{\tilde{x}\,|\,q\} = \frac{1}{\sigma_{\hat{\omega}}^2} + \frac{1}{\sigma_x^2}, \tag{A28}$$

respectively.

Because equations (A27) and (A8) and equations (A9) and (A28) have identical functional forms, the remainder of the investor's signal extraction problem is the same as in Proposition 1. This establishes that as long as v and $\tilde{x}$ are not perfectly correlated, the proof of Proposition 1 remains valid.

The logic of the proof of Proposition 2 also remains valid. The only technical modification is that the inequality (A20) that characterizes the distribution of control rights must be replaced by the following general condition:

$$\lambda\gamma\left(1 + \frac{\sigma_\epsilon^2}{\sigma_x^2} + \frac{\lambda^2}{\sigma_x^2\left(\lambda\gamma + \dfrac{\sigma_x^2}{\sigma_\epsilon^2 + \sigma_x^2}\right)^2}\right) + \frac{\lambda^2(\sigma_\epsilon^2 + \sigma_x^2)\sigma_\eta^2}{(\lambda\gamma(\sigma_\epsilon^2 + \sigma_x^2) + \sigma_x^2)^2} > 1. \tag{A29}$$

The meaning of condition (A29) is the same as that of the inequality (A20). It describes the set of control rights for which there exists an equilibrium in the asset market. Moreover, when γ equals zero and σ_η^2 is equal to σ_v^2, condition (A29) simplifies to the inequality (A20).

However, unlike the inequality (A20), condition (A29) does not have a tractable closed-form solution. Q.E.D.

Proof of Proposition 4: If a mechanism to distribute control rights does not exist, then λ is always equal to zero. If the value of λ is zero, then there is no trade between an entrepreneur and an investor in equilibrium.

Suppose that there is a mechanism that produces an allocation of control rights $\lambda' \geq \lambda^\star$. Then, according to Proposition 1, the sufficient condition for existence is satisfied and voluntary trading takes place in equilibrium. Because the trading is voluntary, at least one of the agents must experience a welfare gain without making the other agents suffer. By definition, that signifies efficiency improvement in the allocation of resources.

The act of trading generates prices that partially aggregate valuable information. That signifies an improvement in informational efficiency compared to the "no trade" outcome.

Finally, trading enables the entrepreneur to achieve a preferable risk-return trade-off by shifting to the investor some of the risks associated with the project. That signifies a more efficient allocation of risks among agents. Q.E.D.

REFERENCES

Admati, Anat R., and Paul Pfleiderer, 1994, Robust financial contracting and the role of venture capitalists, *Journal of Finance* 69, 371–402.

Aghion, Philippe, and Patrick Bolton, 1992, An incomplete contract approach to financial contracting, *Review of Economic Studies* 59, 473–494.

Bartlett, Joseph W., 1999, *Fundamentals of Venture Capital* (Madison Books, New York, NY).

Bergemann, Dirk, and Ulrich Hege, 1998, Venture capital financing, learning, and moral hazard, *Journal of Banking and Finance* 22, 703–735.

Berglof, Erik, 1994, A control theory of venture finance, *Journal of Law, Economics, and Organization* 10, 247–267.

Black, Bernard S., and Ronald J. Gilson, 1998, Venture capital and the structure of capital markets: Banks versus stock markets, *Journal of Financial Economics* 47, 243–277.

Chan, Yuk-Shee, Daniel Siegel, and Anjan V. Thakor, 1990, Learning, corporate control, and performance requirements in venture capital contracts, *International Economic Review* 31, 365–381.

DeGroot, Morris H., 1970, *Optimal Statistical Decisions* (McGraw-Hill, New York, NY).

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

Evans, David S., and Boyan Jovanovic, 1989, An estimated model of entrepreneurial choice under liquidity constraints, *Journal of Political Economy* 97, 808–827.

Fenn, George W., and Nellie Liang, 1998, New resources and new ideas: Private equity for small businesses, *Journal of Banking and Finance* 22, 1077–1084.

Fenn, George W., Nellie Liang, and Stephen Prowse, 1997, The private equity market: An overview, *Financial Markets, Institutions, and Instruments* 6, 1–105.

Gannon, Michael, 1999, Size does matter, *Venture Capital Journal,* March, 39–43.

Gompers, Paul A., 1995, Optimal investment, monitoring, and the staging of venture capital, *Journal of Finance* 50, 1461–1489.

Gompers, Paul A., 1996, Grandstanding in the venture capital industry, *Journal of Financial Economics* 42, 133–156.

Gompers, Paul A., 1997, Ownership and control in entrepreneurial firms: An examination of convertible securities in venture capital investments, Working paper, Harvard University.

Grossman, Sanford J., and Oliver Hart, 1986, The costs and benefits of ownership, *Journal of Political Economy* 94, 691–719.

Halloran, Michael J., Lee F. Benton, Robert V. Gunderson, Keith L. Kearney, and Jorge del Calvo, 1995, *Venture Capital and Public Offering Negotiation* (Aspen Law and Business, Englewood Cliffs, NJ).

Hart, Oliver, and John Moore, 1988, Incomplete contracts and renegotiation, *Econometrica* 56, 755–785.

Hart, Oliver, and John Moore, 1999, Foundations of incomplete contracts, *Review of Economic Studies* 66, 115–138.

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

Kaplan, Steven N., and Per Stromberg, 1999, Financial contracting theory meets the real world: An empirical analysis of venture capital projects, Working paper, University of Chicago.

Lacker, Jeffrey M., Robert J. Levy, and John A. Weinberg, 1990, Incentive compatible financial contracts, asset prices, and the value of control, *Journal of Financial Intermediation* 1, 31–56.

Landstrom, Hans, Sophie Manigart, Cohn M. Mason, and Harry J. Sapienza, 1998, Contracts between entrepreneurs and investors: Terms and negotiation processes, in *Frontiers of Entrepreneurship Research* (Babson College, Wellesley, MA).

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

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

Marx, Leslie M., 1998, Contract renegotiation for venture capital projects, Working paper, University of Rochester.

Maskin, Eric, and John Moore, 1999, Implementation and renegotiation, *Review of Economic Studies* 66, 39–56.

Maskin, Eric, and Jean Tirole, 1999, Unforeseen contingencies and incomplete contracts, *Review of Economic Studies* 66, 83–114.

Palfrey, Thomas R., and Sanjay Srivastava, 1993, *Bayesian Implementation* (Harwood Academic Publishers, Chur, Switzerland).

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

Shaheen, David T., 1999, The venture capital process, *Bar Association of the District of Columbia Newsletter,* March-April.