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# Exit Options in Corporate Finance: Liquidity versus Incentives ⋆

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**Abstract.** This paper provides a first study of the optimal design of active monitors' exit options in a problem involving a demand for liquidity and costly monitoring of the issuer. Optimal incentives to monitor the issuer may involve restricting the monitor's right to sell her claims on the firm's cash-flow early. But the monitor will then require a *liquidity premium* for holding such an illiquid claim. In general, therefore, there will be a trade off between incentives and liquidity. The paper highlights a fundamental complementarity between *speculative monitoring* in financial markets (which increases the informativeness of prices) and *active monitoring* inside the firm: in financial markets where price discovery is better and securities prices reflect the fundamentals of the issuer better, the incentive cost of greater liquidity may be smaller and active monitoring incentives may be preserved. The paper spells out the conditions under which more or less liquidity is warranted and applies the analysis to shed light on common exit provisions in venture capital financing.

## 1. Introduction

A large fraction of the most successful US firms in the last decade have grown out of venture capital financing. This is most evident in the high-technology, computer software, and biotechnology sectors. Venture capital (VC) is generally described as short to medium term investment by specialized funds in "high-growth, high-risk, firms that need equity capital to finance product development" (Black and Gilson 1998). VC funds also provide firms with managerial or marketing advice and intensive monitoring: "the professional manager of a venture capital partnership holds himself out as someone with expertise to "add value" to the investments under his control. The notion is that the typical founder is an incomplete businessman, with gaps in experience in matters such as financial management and marketing. An active board of directors, staffed by representatives of the investors, is expected to help fill these gaps" (Bartlett 1996). It is the nature of their investments and the active role they play in firms they invest in that sets VC funds apart from other financial intermediaries like banks.

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But VC funds also differ in important ways in how they are funded and in the time horizon of their investments. Typically, a VCs' involvement is limited to the start-up phase of a firm even for the successful ventures. The average holding period for VC investors' shares in a portfolio firm is under 5 years (Sahlman 1990). This is due to a number of considerations. First, the limited partners in a fund, who are generally wealthy individuals, pension funds or investment trusts, usually require repayment of their investment after a few years. Second, successful start-ups generally require new capital to grow and most VC funds only have limited capital available to invest in any individual firm. Third, when successful ventures grow to become more mature, VC managers usually do not have any special expertise in managing such firms (Kaplan and Stromberg 2003, 2004; Gompers and Lerner 1999). For these reasons it is generally desirable to move away from VC financing past the start-up phase by going public, switching to straight bank financing, or merging with another firm.

Since VC financing is a temporary form of financing in a firm's life-cycle, an important aspect of the contracting relationship between VC funds and firms is the regulation of the VC's exit: "Securities sold in venture capital transactions are almost always subject to restrictions upon resale. *Registration rights*[1] are an important means of providing investors with eventual liquidity for their investments through a registered offering of shares to the public. Registration rights provisions are often some of the more heatedly debated provisions contained in venture capital transactions" (Gunderson and Benton 1993).

There is often a basic conflict of interest between the founder of the start-up and VC investors concerning 'exit': there are issues of control; there are the obvious difficulties in valuing the potential of a start-up at an early stage; there are concerns about dilution; and there are issues relating to VC managers' incentives to promote the long-term value of the firm: "some founders are proud that they have turned down entreaties from investment bankers to take their companies public. They claim that public shareholders might cramp their style and interfere with their ability to run the company according to their own tastes. Well and good for the founder, but not so comforting to a minority investor locked into the founder's company. Even if the investors as a group are in control of the company, there may be differences of opinion as to when an exit strategy should be implemented; indeed, each investor may have a different sense of timing on the issue, based on facts peculiar to that investor" (Bartlett 1996).

This conflict of interest concerning 'exit' is a central focus of our paper. We provide a formal analysis of this exit problem using the methodology of mechanism design theory. Our main aim is to spell out the fundamental economic variables affecting the optimal VC 'exit' decision from an ex-ante perspective and to pro-

[1] Registration rights give an investor or VC the right to have his shares included in an IPO (so called *piggyback rights*) or the right to request that an IPO or private placement of shares take place (so called *demand rights*). Bartlett (1996) provides a detailed discussion of these financial clauses in VC contracts.

pose a stripped-down formal model as a benchmark for the efficient evaluation of the liquidity-incentive tradeoff facing VC general partners, or more generally, any investor actively monitoring the firms he invests in.

A related goal is to highlight the special role played by primary securities markets. These markets serve not only a role as liquidity providers but also a critical role of valuation of new ventures, which facilitates the provision of incentives for company founders and their investors who wish to 'exit' before the full potential of their investments is realized.

The basic contracting framework we consider to address this exit problem involves a principal acting on behalf of uninformed investors, an entrepreneur, an active monitor (or VC general partner) who can monitor the entrepreneur's conduct, and a speculative monitor (an underwriter or new shareholders) who can acquire information about the firm's future performance. The active monitor is subject to liquidity shocks, and therefore may value contractual arrangements that provide him with an exit option prior to the payback stage where the firm's revenues are realized.

Although our leading application is VC financing and IPOs, we believe that the liquidity-incentive tradeoff underlined in this paper is of broader relevance and arises in most corporate finance situations involving active and speculative monitoring. Indeed, corporations can enter agreements with large block holders that mimic some of the incentive and exit possibilities designed for a venture capitalist.

Our model also provides a framework for assessing the impact of proposed regulations to check insiders' exit. A popular view on Wall Street and elsewhere is that controlling shareholders' ability to unwind their positions at any time must be restricted to ensure efficient monitoring. Otherwise, the argument goes, (controlling) shareholders will be tempted to "exit" before "voicing" their disapproval of management's actions. According to this view there is a tradeoff between the liquidity of a controlling shareholder's stake and effective shareholder control.[2] Our model characterizes an efficiency benchmark against which these proposals can be evaluated.

To our knowledge, our paper is the first in the growing theoretical literature on VC financing to focus on the design of exit clauses. Outside the VC literature, the most closely related models to ours are by Kahn and Winton (1998) and Maug (1998). They are also concerned with the general link between stock market liquidity and monitoring by large investors or block-holders, but in their models the liquidity demand comes from small investors and not from the block-holders,

[2] In particular, see Coffee (1991); other authors such as Mayer (1988), Bhide (1993), Roe (1994) and Kojima (1995), further suggest that a strength of Japanese and German corporate governance systems is that they ensure better involvement in firms of large (institutional) shareholders by restricting their ability to trade controlling blocks in secondary markets. They argue that shareholder activism in the US and the UK can only work effectively when similar trading restrictions on active institutional investors are set up. Accordingly, they advocate the reversal of US stock market regulations which, they argue, have systematically pursued secondary market liquidity over effective shareholder control.

who do the active monitoring. Moreover, these papers do not take a mechanism design approach to the optimal design of liquidity. The models of Faure-Grimaud and Gromb (1999) and Fulghieri and Lukin (2001) tie in more closely with our analysis and study similar issues but their analyses do not take a mechanism design approach and do not aim to determine the optimal level of liquidity to be granted to investors actively monitoring the firm.

The remainder of the paper is organized as follows. Section 2 develops the general framework. Section 3 first characterizes the optimal contract for the active monitor and provides sufficient conditions under which this contract is liquid and allows her to sell her claims whenever she faces a liquidity shock. It then characterizes the optimal contract for the speculative monitor and analyzes how the two monitoring problems interact. Finally, Section 4 discusses various extensions and robustness checks, and derives some implications of our analysis for the design of venture capital agreements.

## 2. Basic Model

The model sets up a general long-term multilateral contracting problem between an entrepreneur and multiple investors. All parties are assumed to be risk-neutral but some parties have limited wealth and therefore exhibit a form of 'risk-aversion'. Some contracting parties also have a demand for liquidity, which gives rise to yet another form of 'risk-aversion'.

We divide time into three main phases or periods:

- a start-up stage (date $t = 0$) where contracts are structured and investments made,
- a trading stage (date $t = 1$) where the firm's initial investors may sell their stake to new investors and
- a pay-back stage (date $t = 2$) where the firm's revenues are realized.

Our analysis focuses mainly on date $t = 1$: whether and how stakes can be sold to new investors and more generally how the liquidity of initial investments should be designed. Before we turn to a description of the mechanism design problem, we need to specify the firm's technology, preferences of participants (entrepreneur and investors) and their information structures.

### 2.1. THE FIRM'S TECHNOLOGY

At date $t = 0$ an entrepreneur, who has no wealth, seeks outside funding to set up a new venture requiring an investment $I > 0$. The project generates a random verifiable cash flow at date $t = 2$ of

$$\widetilde{R} = \begin{cases} r & \text{with probability } 1 - p, \\ r + \Delta & \text{with probability } p, \end{cases} \tag{1}$$

where $r > 0$ and $\Delta > 0$. The entrepreneur can affect the cash flow outcome. This is modeled by letting the probability $p$ be an endogenous variable. It can take two values, $p \in \{p_L, p_H\}$ where:

- $p = p_L = 0$ if the entrepreneur shirks and
- $p = p_H > 0$ if she is diligent.

The entrepreneur's choice of $p$ is not observable and when she shirks she gets a private benefit denoted by $\beta > 0$. This gives rise to a classic incentive problem. We shall allow for both financial incentives and monitoring to overcome this problem.

## 2.2. INVESTORS

Besides the entrepreneur, there are potentially three types of investors involved in the firm:

- uninformed investors, e.g. limited partners in a venture capital fund, who limit their involvement to a passive financial investment,
- an active monitor, e.g. the general partner in a venture capital fund, who takes a more active role and monitors the entrepreneur, and
- a speculative monitor, e.g. a buyer, an underwriter, or a speculator, who may gather information on the firm's performance from the outside and make speculative investments at date $t = 1$ if shares are issued or sold.

Uninformed investors and the speculative monitor have no binding wealth constraint. In contrast, the active monitor faces a unit opportunity cost of funds $\mu_0 > 1$. His investment $I^a$ is therefore generally less than the set-up cost $I$, and the residual $(I - I^a)$ is provided by uninformed investors.[3]

1. *The Active Monitor.* The core economic issue in our model relating to active monitoring arises from the tension between two objectives: i) providing the active monitor with efficient financial incentives to monitor, and ii) letting the active monitor hold as liquid a stake as possible.

   The active monitor can reduce the entrepreneur's private benefits from shirking by supervising her actions. When the entrepreneur is not monitored, her private benefits are $\beta = B$. But when she is, her private benefits are reduced to $\beta = b < B$. The interpretation is that by supervising the entrepreneur, the active monitor can reduce her scope for diversion of funds.

   Active monitoring, however, involves a private cost $c > 0$ for the monitor. It will only take place if the monitor has a financial incentive, which compensates him for incurring these costs. We suppose that the monitor's decision to supervise or not is observed by the entrepreneur before she chooses her action. Thus, if the active monitor decides not to supervise the entrepreneur, she will simply

[3] Holmstrom and Tirole (1997) first introduced this notion of opportunity cost of funds for large investors. It is meant to reflect the idea that professional investors have access to better investment opportunities than small retail investors. But even very wealthy professional investors do not have enough personal wealth to be able to invest in all better investment opportunities that are open to them.

shirk. We restrict the analysis to parameter values for which the entrepreneur cannot get financing if left unmonitored.[4]

We model the monitor's demand for liquidity by assuming that he is subject to a privately observed liquidity shock: with probability $\lambda$ the monitor would prefer to unwind his investment in the firm at date $t = 1$ in order to reinvest the proceeds in a more profitable investment opportunity. More formally, the active monitor's date $t = 1$ utility function is given by:

$$u(c_1, c_2) = \begin{cases} \mu_1 c_1 + c_2 & \text{with probability } \lambda, \\ c_1 + c_2 & \text{with probability } (1 - \lambda), \end{cases} \tag{2}$$

where $\mu_1 > 1$ is the scarcity value of funds for the active monitor at date $t = 1$ if an alternative and more profitable investment opportunity arises at that date. We assume that $\mu_1$ is not too large:

$$\mu_0 \geq \lambda\mu_1 + (1 - \lambda).$$

This is to eliminate a potential arbitrage opportunity between uninformed investors and the active monitor, where the latter borrows an unlimited amount from uninformed investors at date $t = 0$ and makes unbounded investments in the new more profitable investment opportunities at date $t = 1$.

The problem with unwinding the active monitor's investment early is that at date $t = 1$ the final realized value of cash flows $\tilde{R}$ is not known perfectly. As a result, it is more difficult or more expensive to provide adequate financial incentives to the active monitor to supervise the entrepreneur. To see this, imagine that nothing is known about realized cash flows at date $t = 1$. Then, if the active monitor is allowed to sell his stake in that period at its expected present value, he gets no financial reward for actively monitoring the entrepreneur whenever he quits at date $t = 1$. To preserve incentives for active monitoring, it is thus essential to bring the information about realized cash flows at date $t = 2$ forward to period $t = 1$. This can be done by "speculative investors" who monitor the firm from the outside.

2. *The Speculative Monitor*. His role is to assess the value of the firm at date $t = 1$. At that date all actions have already been chosen and the probability distribution over future cash flows is determined. When he monitors, he receives a signal about future cash flows, $s \in \{r + \Delta, r\}$. We denote by $q_H$ (respectively $q_L$) the probability of receiving a signal $(r + \Delta)$, when the entrepreneur has chosen $p_H$ (respectively $p_L = 0$). The cost of generating these signals is $\psi > 0$.

   For simplicity, we assume that realized cash flows are a sufficient statistic for managerial effort; in other words, that the speculative monitor's signal conveys no new information beyond that contained in the final return. This implies that

[4] These assumptions, which again are borrowed from Holmstrom ad Tirole (1997), considerably simplify the strategic interaction between the active monitor and entrepreneur.

the only role of speculative monitoring is to bring information forward in time. Let $\sigma \in (1/2, 1)$ denote the conditional probability that the signal matches the return. Then we have:

$$q_i = p_i\sigma + (1 - p_i)(1 - \sigma). \tag{3}$$

Our assumption that cash flows are a sufficient statistic for managerial effort implies that the likelihood ratios on observing respectively a high final cash flow realization and a high signal at date $t = 1$ are ranked as follows:

$$\frac{p_H - p_L}{p_H} > \frac{q_H - q_L}{q_H}. \tag{4}$$

We denote the likelihood ratios at respective dates $t = 1$ and $t = 2$ by

$$\Lambda_q = \frac{q_H - q_L}{q_H} \text{ and } \Lambda_p = \frac{p_H - p_L}{p_H} = 1.$$

The closer $\Lambda_q$ gets to $\Lambda_p = 1$, the better the quality of the signal generated by speculative monitoring.

We shall analyze the optimal contract for the active monitor in a first stage and take the existence of a signal at date $t = 1$ as given. We only consider the endogenous production of this signal by speculative monitors in a second stage.

### 2.3. INFORMATION STRUCTURES AND THE TIMING OF MOVES

There are three incentive problems in our model. First, the entrepreneur's problem, which results from the unobservability of her choice of effort. Second, the active monitor's problem. His decision about whether to supervise the entrepreneur is observable by the entrepreneur but by no one else. Furthermore, the active monitor has private information about his liquidity need. Third, the speculative monitor's problem: his decision to monitor and the signal he observes are private information, so that he must be given financial rewards to induce him both to monitor and reveal his information truthfully.

The timing of moves of the different participants is as follows:

- At date $t = 0$, the uninformed investors, the entrepreneur and the active monitor sign a comprehensive contract specifying how the contracting parties are compensated as a function of the revenue outcome at date $t = 2$, the reported liquidity shock (if any) of the active monitor, and the reported signal obtained by the speculative monitor at date $t = 1$. We assume that the principal, acting on behalf of uninformed investors, makes the ex ante contractual proposals to the other parties (entrepreneur, active and speculative monitors).[5]
- Once the contract is signed and the investment project set up, the active monitor chooses whether to supervise the entrepreneur.

[5] No change would arise if, as is sometimes done in the existing literature, we assumed instead that the entrepreneur is the contract designer.

- Following the active monitor's choice, the entrepreneur decides whether to shirk. She observes the active monitor's choice before taking that decision.
- Following these action choices, the active monitor learns (privately) at date $t = 1$ whether he faces a liquidity shock. In case he announces a liquidity shock, the contract may call for the services of a speculative monitor to value the active monitor's claims and specify a compensation for the active monitor at date $t = 1$ on the basis of the speculative monitor's report $\hat{s}$.[6]
- Finally, at date $t = 2$ returns are realized and all parties are compensated as a function of the publicly observable realized returns and (when available) the previous period's reports of the active and speculative monitors.

We restrict our analysis to parameter values such that the net pledgeable income to uninformed investors is positive when the entrepreneur is actively monitored and chooses $p = p_H$, but is negative when no active monitoring takes place and the entrepreneur shirks.[7]

## 2.4. FEASIBLE CONTRACTS

Throughout most of the paper we shall assume that the contracting parties can commit to a long-term contract. In Section 4 we briefly discuss how the possibility of contract renegotiation at date $t = 1$ affects the efficient outcome. There is no loss of generality in considering optimal compensation contracts for each agent separately. We begin with the entrepreneur and the active monitor:

1. *The Entrepreneur's Compensation Contract.* Since the speculative monitor's report at date $t = 1$ is less informative about the entrepreneur's choice of action than cash flow realizations at date $t = 2$, it is optimal to defer the entrepreneur's compensation entirely to date $t = 2$. The entrepreneur's payment at date $t = 2$ then depends on the cash flow realization. The entrepreneur is induced to choose $p_H$ if she is rewarded sufficiently for high cash flow realizations and punished for low cash flow realizations. As she is wealth-constrained, the maximum punishment in the event of a low return is to pay her 0. Thus, the entrepreneur's compensation boils down to a single, strictly positive payment $R^e$ received in the event of a high cash-flow outcome.
2. *The Active Monitor's Compensation Contract.* To insure the active monitor against liquidity shocks it may be optimal to pay him a positive transfer at date $t = 1$ on the basis of the speculative signal. Again, to have incentives to monitor he should be rewarded only when a high signal at date $t = 1$ or a high cash flow at date $t = 2$ is realized and he should be punished in the event of a low signal or a low cash flow outcome. We assume that the active monitor is protected by limited liability, so that the maximum punishment is

6 Although for reasons of convenience the contracting problem is set up so that the conditional services of a speculative monitor are already committed at date $t = 0$, the problem could easily be modified to allow for contracting with a speculative monitor only as of date $t = 1$.

7 See footnote 13 below for a formal statement of this assumption.

to receive a zero transfer.[8] Thus, his compensation contract has at most four strictly positive transfers[9] $\{r^a(\mu_1), R^a(\mu_1), r^a(1), R^a(1)\}$, where:

(a) $r^a(\mu_1)$ denotes the active monitor's payoff at date $t = 1$ contingent on a high signal when he reports a liquidity shock;
(b) $R^a(\mu_1)$ denotes the date$-2$ transfer contingent on a high cash flow realization when he reports a liquidity shock;
(c) $r^a(1)$ denotes the active monitor's payoff at date $t = 1$ contingent on a high signal when he reports no liquidity shock; as we shall argue below (see footnote 12), it is (weakly) optimal to set $r^a(1) = 0$ since signals at date $t = 1$ are less informative than cash flows; hence, we shall use the less cumbersome notation $r^a$ to denote the active monitor's date$-1$ payoff when he reports a liquidity shock, that is: $r^a = r^a(\mu_1)$;
(d) $R^a(1)$ denotes the date$-2$ transfer contingent on a high cash flow realization when he reports no liquidity shock.

## 3. The Liquidity-Monitoring Tradeoff

Before turning to a characterization of the active monitor's optimal contract, consider briefly the entrepreneur's incentive problem. Given that he has been actively monitored, the entrepreneur is better off working than shirking if and only if:

$$p_H R^e \geq p_L R^e + b. \tag{5}$$

This incentive constraint ties down exactly the required minimum transfer that induces the entrepreneur to work:

$$R^e \geq \frac{b}{p_H - p_L} = \frac{b}{p_H}. \tag{6}$$

### 3.1. THE ACTIVE MONITOR'S CONTRACT

The active monitor's incentive problem is a non-standard dynamic moral hazard problem because it has a stochastically evolving opportunity cost of funds and the realized value at date $t = 1$ is private information. Viewed from another perspective the active monitor's problem here is a combination of a Diamond and Dybvig (1983) type liquidity problem and a moral hazard problem.

[8] Limited liability is the rule for most investment contracts. Explaining why this is the case is beyond the scope of this paper. The form of the optimal contract and our main results would be qualitatively the same if we relaxed the limited liability constraint to allow for positive but finite punishments.

[9] Arguably it might be desirable not to punish the active monitor at all in the event of a liquidity shock, as a way of providing better insurance. It is easy to check, however, that this is not the case. Under our assumptions it is always better to punish the active monitor as much as possible in the event of a low signal. The ex-ante incentive benefits of this punishment outweigh the insurance costs.

#### 3.1.1. *The Active Monitor's Incentive Problem*

The optimization problem with respect to transfers to the active monitor can be set up as a cost minimization problem subject to an individual rationality constraint and to two incentive constraints. The individual rationality constraint guarantees that the amount $I^a$ initially invested by the active monitor times the scarcity value $\mu_0$ is less than or equal to his expected utility $U^a$ under the contract. The first incentive constraint guarantees that the monitor actively monitors the entrepreneur. The second that he truthfully reports his liquidity shock.

More formally, using the fact that the individual rationality constraint of the active monitor is binding in equilibrium[10], and letting $P^a$ denote the expected monetary payment to the active monitor, an optimal contract for the active monitor is one that minimizes the net expected cost of active monitoring, namely:

$$P^a - I^a,$$

where $I^a$ is the active monitor's investment in the project. The individual rationality constraint of the active monitor is binding when $I^a = \frac{1}{\mu_0}U^a$, where $\mu_0$ is the scarcity value of venture capital funds and $U^a$ is the expected gross utility of the active monitor if he signs the contract. We have:

$$U^a = \lambda(q_H\mu_1 r^a + p_H R^a(\mu_1)) + (1-\lambda)p_H R^a(1) - c$$

and

$$P^a = \lambda(q_H r^a + p_H R^a(\mu_1)) + (1-\lambda)p_H R^a(1).$$

Therefore, we can express the optimal contracting problem for the active monitor as the following minimization problem:

$$\min_{\{r^a, R^a(\mu_1), R^a(1)\}} \left\{\lambda\left[q_H\left(1-\frac{\mu_1}{\mu_0}\right)r^a + p_H\left(1-\frac{1}{\mu_0}\right)R^a(\mu_1)\right]\right.$$
$$\left. + (1-\lambda)\left(1-\frac{1}{\mu_0}\right)p_H R^a(1)\right\},$$

subject to:

$$\lambda[q_H\mu_1 r^a + p_H R^a(\mu_1)] + (1-\lambda)p_H R^a(1) - c \geq \lambda q_L\mu_1 r^a + (1-\lambda)q_L r^a, \tag{7}$$

[10] If this constraint were not binding, then the Principal could increase his net expected value by slightly reducing $r^a$, $R^a(1)$, and $R^a(\mu_1)$ in such a way that both the individual rationality constraint and the two incentive constraints of the active monitor remain satisfied.

and

$$\left\{\begin{array}{ll} q_H\mu_1 r^a + p_H R^a(\mu_1) \geq p_H R^a(1) & (a) \\ p_H R^a(1) \geq q_H r^a + p_H R^a(\mu_1) & (b) \end{array}\right\}. \tag{8}$$

Constraint (7) is the active monitor's *ex ante* incentive constraint with respect to monitoring effort. The RHS of this constraint reflects the fact that a shirking monitor has the option to exit at date $t = 1$ in order to avoid the negative consequences from shirking by getting out before anyone is aware of his misconduct. He chooses to exercise this option whenever $r^a > 0$ since in that case his payoff from exiting $q_L r^a$ is greater than his payoff from staying, which is just equal to zero when he shirks and chooses $p_L$.[11] Constraints (8) ensure truthful reporting of the liquidity shock conditional on not shirking.[12]

It is easy to see that at the optimum, constraint (7) is always binding. Indeed, if it were not then the obvious solution to the subconstrained program in which (7) is ignored is $r^a = R^a(\mu_1) = R^a(1) = 0$. But this solution clearly violates constraint (7).

### 3.1.2. *Optimal Liquidity Design*

Using the fact that (7) is binding at the optimum, and then substituting for $(1-\lambda)p_H R^a(1)$ from (7) into the principal's objective function, we can reformulate the above program as:

$$\min_{\{r^a\geq 0, R^a(\mu_1)\geq 0\}} \left\{\left[\lambda\left(1-\frac{\mu_1}{\mu_0}\right)q_H - \lambda\left(1-\frac{1}{\mu_0}\right)\mu_1(q_H-q_L) + (1-\lambda)\left(1-\frac{1}{\mu_0}\right)q_L\right]r^a + \frac{c}{\mu_0}\right\},$$

subject to:

$$\left\{\begin{array}{ll} q_H\mu_1 r^a + p_H R^a(\mu_1) \geq p_H R^a(1) & (a) \\ p_H R^a(1) \geq q_H r^a + p_H R^a(\mu_1) & (b) \end{array}\right\}. \tag{9}$$

[11] The assumption $p_L = 0$ ensures that the active monitor always wants to exit at date $t = 1$ when he has shirked. Our results extend with minor modifications to the general case where $p_L > 0$, but since in this case it is possible that the active monitor may prefer not to exit at date $t = 1$ when he shirks, the derivation of the optimal contract is slightly more involved.

[12] Assuming that the active monitor's reward $r^a(1)$ in the absence of a liquidity shock is equal to zero, involves no loss of optimality. To see this, note that since $\frac{q_H-q_L}{q_H} < \frac{p_H-p_L}{p_H}$ a move from a contract with $r^a(1) > 0$ to a contract with $r^a(1) = 0$, keeping the expected transfer to the active monitor conditional upon not shirking constant, relaxes both incentive constraints. Therefore the optimal contract is such that $r^a(1) = 0$.

Now, define the cut-off $\mu^*$ for the active monitor's scarcity value of funds at date $t = 1$:

$$\mu^* = \frac{\lambda q_H + \left(1 - \dfrac{1}{\mu_0}\right)(1-\lambda)q_L}{\lambda\left[\dfrac{q_H}{\mu_0} + \left(1 - \dfrac{1}{\mu_0}\right)(q_H - q_L)\right]}.$$

When $\mu_1 < \mu^*$, it is straightforward to verify that the term in square brackets in the objective function is positive, so that it is optimal to set $r^a = 0$ and $R^a(1) = R^a(\mu_1)$. On the other hand, if $\mu_1 \geq \mu^*$, it is optimal to set $r^a$ as large as possible, subject to (9). This in turn implies that the second constraint in (9) is binding at the optimum. We shall refer to a contract where $r^a = 0$ as an *illiquid contract*, and a contract with $r^a > 0$ as a *liquid contract* giving the active monitor an *exit option* at date $t = 1$.

To understand why it is optimal to give the active monitor an exit option if and only if $\mu_1 \geq \mu^*$, observe that when $\mu_1$ is close to 1 the active monitor is essentially indifferent as to when he gets paid. Giving him an exit option by offering him a liquid contract with $r^a > 0$ would then only worsen his incentive to monitor and would not yield any substantial liquidity benefits. More formally, when $\mu_1$ is close to 1, we have

$$\mu_1\left(\frac{q_H - q_L}{q_H}\right) < \frac{p_H - p_L}{p_H}. \tag{10}$$

Then, any contract with $r^a > 0$ can be improved upon by lowering $q_H r^a$ by some amount $dr$, while at the same time increasing $p_H R^a(\mu_1)$ by $\mu_1(\frac{q_H - q_L}{q_H})dr < dr$. This change would not violate the active monitor' s effort incentive and participation constraints and it would lower the expected cost of raising capital from the active monitor.

When $\mu_1$ is large instead, an exit option would give the active monitor significant liquidity benefits and thus could lower the cost of raising capital from the active monitor. Less obviously, it could also increase his monitoring incentives. Indeed, when $\mu_1$ is large enough the inequality (10) is reversed:

$$\mu_1\left(\frac{q_H - q_L}{q_H}\right) > \frac{p_H - p_L}{p_H},$$

so that the speculative signal at date $t = 1$ can provide higher powered incentives to the active monitor than date $t = 2$ returns, despite the fact that the speculative signal is less informative than cash flow.

We now provide a complete characterization of the active monitor's optimal contract:

1. **Patient Monitor Case:** $\mu_1 < \mu^*$. We have seen that, in this case, the optimal contract is illiquid, with $r^a = 0$ and $R^a(1) = R^a(\mu_1)$. From the active monitor's incentive constraint (7) one then easily observes that $R^a(\mu_1) = R^a(1) = \frac{c}{p_H}$. The principal's expected cost from hiring and raising capital $I^a$ from an active monitor is then:

$$C_A^{IL} = \left(1 - \frac{1}{\mu_0}\right) c + \frac{c}{\mu_0} = c,$$

where the superscript *IL* stands for *Illiquid*.

2. **Impatient Monitor Case:** $\mu_1 > \mu^*$. In this case we know that constraint (8b) is binding, that is:

$$R^a(1) = \frac{q_H}{p_H} r^a + R^a(\mu_1).$$

Using this together with the active monitor's effort incentive constraint, which we can rewrite as:

$$(q_H - q_L)(\lambda\mu_1 + 1 - \lambda) r^a + p_H R^a(\mu_1) = c, \tag{11}$$

one can substitute for $R^a(1)$ and $r^a$ in the principal's objective function, so that the above minimization program reduces to:

$$\min_{R^a(\mu_1)} \left\{ F R^a(\mu_1) + \frac{c}{\mu_0} \right\},$$

where

$$F = \left(1 - \frac{1}{\mu_0}\right) - \frac{\left[\lambda\left(1 - \frac{\mu_1}{\mu_0}\right) + (1-\lambda)\left(1 - \frac{1}{\mu_0}\right)\right] q_H}{(q_H - q_L)(\lambda\mu_1 + 1 - \lambda)}.$$

It is easy to check that $F$ is positive whenever $\mu_1 > \mu^*$. It is thus optimal to set

$$R^a(\mu_1) = 0,\ r^a = \frac{c}{(q_H - q_L)(\lambda\mu_1 + 1 - \lambda)} \text{ and } R^a(1) = \frac{q_H}{p_H} r^a,$$

with a resulting cost for the principal – including the expected cost of acquiring the speculative signal $\lambda\psi$ at date $t = 1$- equal to:

$$C_A^L = \frac{\left[\lambda\left(1 - \frac{\mu_1}{\mu_0}\right) + (1-\lambda)\left(1 - \frac{1}{\mu_0}\right)\right] c}{[\lambda\mu_1 + (1-\lambda)]\Lambda_q} + \frac{c}{\mu_0} + \lambda\psi, \tag{12}$$

where the superscript $L$ stands for *liquid*.[13,14]

Now, if we rewrite the cut-off level of impatience $\mu^*$ as:

$$\mu^* = \frac{\lambda + (1-\lambda)\left(1 - \dfrac{1}{\mu_0}\right)(1-\Lambda_q)}{\lambda\left[\Lambda_q\left(1 - \dfrac{1}{\mu_0}\right) + \dfrac{1}{\mu_0}\right]},$$

one can immediately verify that when $\psi = 0$, $C_A^L \leq C_A^{IL}$ if and only if $\mu_1 \geq \mu^*$. More generally, combining our analyses of the patient and the impatient active monitor cases, we obtain the following central result:

PROPOSITION 1. There exists a cut-off opportunity cost $\widehat{\mu} \geq \mu^*$ such that:

(a) It is optimal to offer a **liquid** contract with $r^a = \frac{c}{(q_H - q_L)(\lambda\mu_1 + 1 - \lambda)}$ and $R^a(\mu_1) = 0$ when $\mu_1 > \widehat{\mu}$, and to offer an **illiquid** contract with $r^a = 0$ and $R^a(\mu_1) = R^a(1) = \frac{c}{p_H}$ otherwise.

(b) The cut-off opportunity cost $\widehat{\mu}$ decreases with both $\lambda$ and $\Lambda_q$ and increases with $\mu_0$ and $\psi$.

(c) The payment $r^a$ in the **liquid** contract decreases with both $\lambda$, $\Lambda_q$ and $\mu_1$.

*Proof.* see the discussion above.

The optimal contract trades off liquidity and incentives by providing an early exit option to the active monitor only if his demand for liquidity, as measured by his opportunity cost of financing $\mu_1$, is high enough. Only then does it pay to obtain a costly speculative signal about the entrepreneur's action choice, and only then does the liquidity benefit of the exit option outweigh the incentive cost. Indeed, when $\mu_1$ rises, early exit not only provides a higher liquidity benefit but also results in a lower disincentive effect to monitor.

When the contract provides an early exit, it lets the active monitor entirely unwind his stake if he chooses to do so (given that $R^a(\mu_1) = 0$). This *bang-bang* outcome is unlikely to be general and is driven by the linear structure of the parties' payoffs. Interestingly, conditional on offering an early exit option the optimal contract provides for a lower transfer $r^a$ the higher is $\mu_1$. The reason is that any dollar the active monitor can take out early is then worth more. A similar logic explains why $r^a$ decreases with $\lambda$. The decrease in $r^a$ with $\Lambda_q$, on the other hand, is explained by the fact that when $\Lambda_q$ rises the disincentive effect of an early exit is

13 The assumption that the firm's pledgeable income is positive if and only if the entrepreneur is actively monitored, can now formally be expressed by the inequalities:

$$r + p_H\Delta - \psi - \min\{C_A^{IL}, C_A^L\} - b > I > r.$$

14 Note that if the assumption $\mu_0 > \lambda\mu_1 + (1-\lambda)$ is violated then it is optimal to set $r^a = \frac{\Lambda_q p_H R^a(1)}{q_H} = +\infty$, so that $C_A^L = -\infty$ !

reduced, as the speculative signal is then more informative about the entrepreneur's action choice.

The intuition behind our comparative statics results with respect to the cut-off opportunity cost $\widehat{\mu}$ is similar. With a higher $\lambda$ it is more likely that the contract will be liquid, as the active monitor's ex-ante preference for liquidity increases. With a higher $\Lambda_q$ the liquid contract is also relatively more attractive, as the disincentive effect of an early exit is lessened.

The comparative statics result with respect to $\mu_0$ is less straightforward. To understand why an increase in the active monitor's opportunity cost of funds at date $t = 0$ reduces the relative attractiveness of the liquid contract (i.e. results in an increase in $\widehat{\mu}$), it is helpful to observe that a switch from an illiquid to a liquid contract at the cutoff $\widehat{\mu}$ actually worsens the active monitor's incentive problem as

$$\widehat{\mu}\left(\frac{q_H - q_L}{q_H}\right) < \frac{p_H - p_L}{p_H}.$$

Therefore, to preserve the active monitor's incentives to monitor, the contract has to strengthen his monetary return from monitoring and this, in turn, requires an increase in the active monitor's investment $I^a$. Now, for a higher $\mu_0$ such an increase in the active monitor's investment costs more. Therefore, the principal is less willing to offer the liquid contract for higher $\mu_0$.

Our comparative statics results with respect to $\mu_0$ may thus provide an explanation for the observed reduction in the average age of technology start-ups before they go public as well as the increase in general partners' investments during the NASDAQ technology boom (see Black and Gilson (1998)). Our explanation would be that as more money flows into the venture capital industry the terms demanded by Venture Capital funds go down (in terms of our model $\mu_0$ goes down) and therefore the relative costs of offering a more liquid contract go down. This is an alternative explanation to the one that is commonly given that firms tend to go public sooner because the market for IPOs is currently very hot. Note that these two explanations are not inconsistent. Also, unfortunately, disentangling the two effects empirically appears to be very difficult.

### 3.2. THE SPECULATIVE MONITOR'S CONTRACT

The principal must design a contract with the speculative monitor that induces him to both gather and truthfully reveal his information. When designing this contract, the principal has to evaluate the speculative monitor's incentives in response to all possible action choices by the active monitor. We begin by characterizing the optimal contract in response to the choice of action $p_H$ by the active monitor. We then consider the effects of a deviation by the active monitor to $p_L$ on the speculative monitor's incentives, keeping the speculative monitor's contract unchanged, and show that multiple equilibria may obtain under that contract for the speculative monitor and under the contract characterized in Proposition 1 for the active monitor. Finally, we show how the active monitor's contract must be modified to ensure unique implementation of the second best outcome.

### 3.2.1. *An Optimal Contract*

The speculative monitor's contract can take a very simple form. The principal can offer the speculative monitor a call option (expiring at date $t = 1$) allowing him to purchase a fraction $\theta$ of the firm's shares (that entitles him to a fraction $\theta$ of the firm's cash-flow) at an exercise price $\xi$. As we show below, there is a range of values $\{\theta, \xi\}$ such that: i) the speculative monitor is induced to monitor and reveal truthfully his observed signal and ii) his individual rationality constraint is binding.

The exercise price $\xi$ should be set so that the speculative monitor prefers not to exercise if he gets a low signal $(r)$, but exercises the option if the signal is high $(r + \Delta)$. In other words, the exercise price $\xi$ must satisfy the condition:

$$m_H^H \geq \frac{\xi - r}{\Delta} \geq m_H^L, \tag{13}$$

where

$$m_H^H = \frac{\sigma p_H}{\sigma p_H + (1 - p_H)(1 - \sigma)}$$

and

$$m_H^L = \frac{p_H(1 - \sigma)}{p_H(1 - \sigma) + (1 - p_H)\sigma},$$

are the probabilities of a high date$-2$ cash flow conditional on observing, respectively, signals $(r + \Delta)$ and $r$. Since $\sigma > 1/2$, the conditional probabilities are such that $m_H^H > m_H^L$. It is therefore possible to find an exercise price $\xi$ satisfying condition (13). Under this contract, exercising the option is tantamount to (truthfully) revealing the signal $(r + \Delta)$ and not exercising to revealing $r$.

Having obtained the option, the speculative monitor has an incentive to pay the acquisition cost $\psi$ in order to obtain an informative signal if and only if:

$$q_H(m_H^H \Delta + r - \xi)\theta - \psi \geq \max\{0, p_H \Delta + r - \xi\}\theta. \tag{14}$$

Finally, his individual rationality constraint is given by

$$q_H(m_H^H \Delta + r - \xi)\theta - \psi \geq 0. \tag{15}$$

As long as $p_H \Delta + r > \xi$, the incentive constraint (14) can be relaxed by increasing the exercise price $\xi$. Therefore, the exercise price that minimizes the required fraction $\theta$ of shares pledged to the speculative monitor is obtained by setting $\xi = p_H\Delta + r$. Substituting this value in (14) and solving:[15]

$$q_H(m_H^H - p_H)\Delta\theta = \psi.$$

Thus, under this contract the speculative monitor makes zero net expected profits and the principal pays an expected cost $\psi$ to obtain the date $t = 1$ signal. We summarize this discussion in the following proposition.

PROPOSITION 2. An optimal incentive contract for the speculative monitor is a call option maturing at date $t = 1$ with exercise price: $\xi = p_H\Delta + r$, in exchange for a fraction of the firm's shares: $\theta = \frac{\psi}{q_H(m_H^H - p_H)\Delta}$.

*Proof.* See the discussion above.

Although this proposition is very simple, important implications derive from it, especially concerning firms' decisions to go public and the IPO process. The proposition establishes that it is (weakly) optimal to provide the speculative monitor with options to purchase *equity* at date $t = 1$. This conclusion bears implications both for issuers and underwriters.

First, the proposition suggests that it is weakly optimal for the firm to issue equity, even though the firm has private information about its future cash flow. Although this conclusion is broadly consistent with firms' decision in practice to go public by first issuing equity it goes against the classical prescription of Myers and Majluf (1984) that firms, which have private information about their underlying value, should issue debt. The reason why the Myers and Majluf logic does not apply here is that they, unlike us, do not allow for valuable information acquisition by prospective buyers of the firm's securities. Once it is understood that prospective buyers should be given incentives to acquire information about the firm's underlying value it is easier to see why it might be preferable for the firm to issue equity. Issuing debt instead of equity in a public offering at date $t = 1$ is suboptimal if it does not provide the buyers of the issue with sufficient incentives to acquire information about the future value of the firm. Thus, for example, going public by issuing safe debt would deprive the firm of valuable signals, which would improve the incentive contract with the active monitor.

Second, if the underwriter must be given incentives to acquire and truthfully disclose information then the proposition implies first that underwriters' ability to underprice an issue should be limited. Indeed, the exercise price $\xi$ can be interpreted as the price set by the underwriter in an IPO. Under that interpretation, the proposition suggests that the IPO price should be set at the long-run expected value of the firm. Second, the proposition suggests that to align incentives, the underwriter should be required to hold at least a fraction of the equity issued. This

[15] Intuitively, any option with exercise price such that $p_H\Delta + r > \xi$ would give a free gift to the speculative monitor if he does no monitoring. To maximize incentives it is best to eliminate this gift.

clearly goes against existing practice, but the IPO scandals in recent years suggest that underwriters' incentives under existing practice may not be adequately aligned.

### 3.2.2. *Multiple Equilibria and Unique Implementation*

Unfortunately, the optimal contracts for the active and speculative monitor derived above do not always uniquely implement the second-best outcome. Indeed, multiple equilibria may obtain under these contracts. Specifically, an inefficient equilibrium in which the active monitor chooses low effort, and the speculative monitor does not invest in information may exist along with the efficient equilibrium. To see this, observe that if the active monitor is expected to induce $p_L = 0$, it is optimal for the speculative monitor never to exercise the call option and therefore not to acquire any information. Conversely, if the speculative monitor is not expected to exercise the call option then the active monitor's best response may be to induce $p_L = 0$ instead of $p_H$. This is the case whenever:[16]

$$p_H R^a(1) < c. \tag{16}$$

Note that this condition is consistent with the active monitor's effort incentive constraint (11). Both conditions can hold in particular when $\lambda$ and/or $\mu_1$ are large. Thus, if conditions (11) and (16) both hold there exists an inefficient equilibrium along with the efficient equilibrium characterized above.

The principal could stop here and hope for the best, or he could modify the active monitor's contract to ensure unique implementation of the efficient equilibrium.

Unique implementation requires that the active monitor's effort incentive constraint (7) as well as

$$p_H R^a(1)) \geq c \tag{17}$$

be satisfied under the optimal contract.[17]

When

$$\Lambda_q(\lambda\mu_1 + 1 - \lambda) \leq 1,$$

[16] The LHS of this condition, reflects the fact that an active monitor who anticipates no speculative monitoring to take place, will systematically announce no liquidity shock; this, in turn, follows from the fact that $R^a(\mu_1) = 0$ if the contract is liquid, as shown in Section 3.1 above.

[17] When both constraints are satisfied it is a dominant strategy for the active monitor to induce $p_H$ so that the inefficient equilibrium is eliminated. An alternative potential way of achieving unique implementation could be to make information acquisition and truthful revelation by the speculative monitor a dominant strategy. But this is not possible when $p_L = 0$, for then there is no valuable information to be collected by the speculative monitor. If, however, $p_L > 0$ then it is possible and desirable to achieve unique implementation by selling a put (instead of a call) option on the firm to the speculative monitor under which it is a dominant strategy for the speculator to acquire the date $t = 1$ signal.

constraint (17) is automatically satisfied by the optimal contract for the active monitor derived in Proposition 1, so that there is a unique efficient equilibrium under this contract. However, when the opposite inequality holds,

$$\Lambda_q(\lambda\mu_1 + 1 - \lambda) > 1,$$

then the active monitor's contract must be derived under the additional constraint (17), which of course will be binding in this case.

As we show in the Appendix, under unique implementation the optimal contract is less likely to be liquid. The reason is that, when constraint (17) is binding, the weighting of the active monitor's compensation contract must shift towards more long-term compensation, to maintain incentives to monitor even when the speculative monitor does not acquire any information. Therefore, since long-term compensation alone provides adequate incentives to monitor, the only purpose for the early exit option is to provide insurance against liquidity shocks. When constraint (17) is not binding, on the other hand, the early exit option provides both more insurance (as the compensation contract is less weighted towards long-term performance) and possibly even more efficient incentives. For both of these reasons, an early exit option is then generally more efficient.

Interestingly, as $\lambda$ increases there may be a shift from liquid to illiquid contracts under unique implementation, which seems counterintuitive. Formally, we show in Proposition 3 (in the Appendix) that the contract is liquid for low values of $\lambda$. That is when, either:

(i) $\mu_1 > \mu^*$ and $\Lambda_q(\lambda\mu_1 + 1 - \lambda) \leq 1$ or

(ii) $\Lambda_q(\lambda\mu_1 + 1 - \lambda) > 1$ and $\mu_1 \geq \dfrac{q_H + \dfrac{\lambda}{1-\lambda} q_L}{q_H - q_L} > \mu^*$.

But, the contract is illiquid for higher values of $\lambda$: when

$$\frac{q_H + \dfrac{\lambda}{1-\lambda} q_L}{q_H - q_L} > \mu_1 > \mu^* \text{ and } \Lambda_q(\lambda\mu_1 + 1 - \lambda) > 1.$$

This is counterintuitive, as a higher $\lambda$ means a higher demand for liquidity. But, there is a countervailing effect here arising from the need to preserve incentives for the active monitor. If short-term performance is expected to be uninformative (because the speculative monitor is not acquiring any information) and if exit at date $t = 1$ is likely ($\lambda$ is high) then, to preserve incentives, more and more weight must be put on long-term performance. There then comes a point where it is no longer worth offering an early exit option.

## 4. Discussion

We begin by discussing informally a number of directions in which the theory can be extended.

### 4.1. EXTENSIONS

(a) *Hot-Issue Markets.* Decisions to go public are influenced by the ease of fund-raising; indeed the vast majority of IPOs occur at market peaks (Lerner 1994). IPOs do well in hot-issue markets presumably because they create stores of value in states in which loanable funds are plentiful and stores of value scarce.

Formally, the macroeconomic shock determining whether the market is hot or cold, can be introduced into our model by letting the price that uninformed investors are willing to pay at date $t = 1$ for a share yielding a unit expected income at date $t = 2$ vary across states of nature. We can then consider two cases. In the first case, contracts contingent on the macroeconomic shock can be written at date $t = 0$. The analysis is then a straightforward extension of that in Section 3. The new insight is that the liquidity of the active monitor's claim may now be contingent on the macroeconomic shock: An IPO being more profitable in a hot market, it may be optimal to make the active monitor's claim be liquid in the event of a hot market at date $t = 1$ and illiquid in the event of a cold market. Note that in contrast to the predictions of a standard moral hazard incentive problem the active monitor's expected payoff may then depend on a (macroeconomic) variable he has no control over.

When the macroeconomic shock is observable but not directly verifiable, it is still the case that some information about this shock can be recovered from the price that shares fetch at the IPO. For example, one can let the active monitor decide whether to go public at date $t = 1$, and if he chooses so, reward him only if the sale price is sufficiently high, meaning that he is likely to have monitored *and* the market is hot. This makes the active monitor's reward in case of exit even more nonlinear (although not more risky).

(b) *Renegotiation.* We have assumed that the initial plan is always implemented and that there is no renegotiation. Established VCs may be able to build a reputation for abiding by the initial plan or create an underlying situation where they have no alternative but to stick to the plan by choosing not to line up prospective future buyers at the time of contracting. In general, however, renegotiation cannot be ruled out.

Renegotiation has no impact if the optimal contract is a liquid one since the allocation is then ex post efficient. In contrast, the illiquid contract is ex post inefficient since the active monitor keeps his stake until date $t = 2$ even when he faces a liquidity shock. As is often the case in optimal contracting, ex ante incentives are created by an ex post distortion that the parties will want to renegotiate away at date $t = 1$. The parties here have an incentive to agree to let the active monitor exit at a discount relative to the value of his long term claim. The possibility of such renegotiation would then bring about more liquidity than would be desirable from an ex-ante perspective.[18] It is conceivable that adequately balanced regulatory intervention limiting exit at date $t = 1$, perhaps of the kind envisioned by Coffee (1991) and others,[19] might then provide an efficiency improving countervailing force.

(c) *IPO Underpricing.* Our model has not made any assumption as to how the sale of shares proceeds. In particular, underpricing may occur if the IPO auction exhibits rationing as in Rock (1986). The level of underpricing will in general depend on the asymmetry of information between investors and the speculative monitor. If this asymmetry of information covaries with the uncertainty about the quality of active monitoring (a covariation that can easily be built into the theoretical framework), then underpricing is less pronounced when the active monitor is more reputable, as the evidence for the venture capital industry by Barry, Muscarella, Peavy and Vetsuypens (1990) suggests.

### 4.2. EXIT DESIGN IN VENTURE CAPITAL AGREEMENTS

Our model can be interpreted in several different ways. One interpretation is that the active monitor is a CEO of a publicly traded firm. The CEO is expected to remain a limited time on the job, but his decisions and monitoring activities may have long-run effects on the performance of the corporation. In designing the CEO's compensation package the board of directors must then determine how liquid the CEO's stake should be in terms similar to those outlined in this paper.[20] Another interpretation is that the active monitor is some large pension or mutual fund engaging in some form of shareholder activism. As Coffee (1991) has suggested, the investment fund would then face a tradeoff between liquidity and incentives. However, contrary to his claims our analysis suggests that a highly liquid secondary

[18] See Fudenberg and Tirole (1990), Ma (1991) and Matthews (1995) for an analysis of renegotiation in a dynamic optimal contracting problem with moral hazard. Their analyses apply to our problem with small modifications (to include liquidity shocks). One might expect from their analyses that the anticipation of renegotiation at date $t = 1$ might lead to an equilibrium outcome where the active monitor mixes between $p_H$ and $p_L$, and as a result renegotiation leads to only partial liquidity provision at date $t = 1$.

[19] Coffee (1991) discusses a number of regulations governing exit, most notably: (i) the Securities Act of 1933, which restricts the ability of an "affiliate" (person or group in control) to unwind its share ownership; (ii) Section 16(b) of the Securities Exchange Act of 1934, which requires disgorgement of capital gains realized within a six month period by large owners.

[20] Our analysis suggests that a more liquid CEO compensation contract, while undermining CEO incentives to some extent may still be beneficial if it provides a valuable exit option to the CEO. Interestingly, Morellec (2003) reverses part of our logic and argues that long-term compensation contracts with no early exit option may create new agency problems. In his model a less liquid stake of the CEO results in a premature exercise of a real option.

market providing potentially large speculative gains to speculators could actually induce more, not less active monitoring.

We believe, however, that our model fits best the interpretation that the active monitor is either a bank engaged in a long-term relation with the firm or a venture capitalist. In the remainder of this section we discuss in greater detail common exit clauses in venture capital contracts and how they can be rationalized on the basis of our analysis.

(a) *Planning of Exit.* Venture Capital (VC) contracts reveal that VCs carefully plan their exit. Indeed, one of the most important issues for VC investors in negotiations with the entrepreneur concerns the allocation of registration rights. If VC investors hold a minority stake their exit will depend on decisions reached by majority shareholders. Therefore VC investors often require a registration rights agreement giving them the right either to have their shares included in an IPO (so-called "piggyback rights") or to request that an IPO or private placement of shares take place (so-called "demand rights") (see Bartlett (1994)). Venture capitalists may also hold warrants, which the company must repurchase at an attractive price for the venture capitalist if the company does not go public within, say, five years (see Lerner (1999, p. 339)). In return for granting such rights, however, the entrepreneur often insists on a right to veto proposals to go public in the first three years (see Levin (1995)).[21] Another important limitation on VC exit is that following an IPO there is usually a six-month lock-up period contracted with underwriters, during which the VC investor must retain a majority of their shares after the IPO.

Most VC agreements usually specify that the private equity or VC fund will dissolve after a period of no more than 10 to 13 years (see Gompers and Lerner (1999, p. 240)). But there is evidence suggesting that VC investors generally do not seem to hold their shares for such a long period. The average holding period is under 5 years (Sahlman 1990).

To be sure, the exact date of exit is generally not specified at the outset. Neither does the theory predict that it should. For one thing, under the liquid contract, the date of liquidation depends on the realization of the active monitor's liquidity needs. Furthermore, as discussed in Section 4.1, the exact date of liquidation may depend on the state of the placements market.

(b) *Speculative Monitoring and Equity-Based Exit.* General partners in venture capital funds hold fairly risky claims (usually convertibles and warrants, and sometimes common stocks). There are two main avenues for exit. One is a private placement or sale of the firm to a (usually larger) buyer. The other is an IPO. The consequences of these two modes of exit for the venture capitalist are largely

[21] Alternatively, the entrepreneur may have the right to preempt by purchasing all shares of the venture capitalist at a price specified by a formula.

similar.[22] The "speculative monitor" of the model is the buyer in case of a sale and the underwriter and the stock analysts in case of an IPO. It is widely accepted in the venture capital community that equity-based exit, whether through an IPO or a sale, is key to the measurement of the performance of the entrepreneur-venture capitalist team. Indeed, a precondition for a sale is often that all convertible debt be converted prior to putting the company up for sale or an IPO (see Bartlett (1994)). To facilitate the sale of the company the general partner sometimes requests the right to *drag along* the other investors when he finds one or several buyers. A drag-along covenant allows the general partner to force exit by the entrepreneur and by limited partners in case he finds a buyer. Similarly, a necessary condition for a successful IPO is that enough stocks be traded in order to attract enough attention by investors and induce speculative monitoring. Such requirements can be viewed as ways of providing speculative monitors with enhanced incentives to acquire information, thereby facilitating the exit of the venture capitalist.

(c) *Determinants of the Intensity of Liquidity Needs.* Our theory predicts that the VC contract should facilitate early exit more, the more intense and the more frequent the liquidity shock (the higher $\mu_1$ and $\lambda$[23]). Factors that may have an impact on the active monitor's liquidity needs include:

- *Reputation.* Well-established VCs can raise large sums of money on short notice. The certification provided by the exit mechanism is less important for them than for less reputable VCs. Our theory is therefore consistent with the observation of "grandstanding" (see Gompers 1996). The evidence shows that firms backed by young VC firms are also younger at the IPO stage. This finding is inconsistent with the alternative plausible theory linking reputation and liquidity, according to which a reputable venture capitalist could be allowed to exit earlier as he has a larger reputational capital at stake and therefore is less likely to bring bad firms to the market. It is, however, consistent with the explanation that more experienced VCs do not need to liquidate their stakes in order to levy money for new investments (their "$\mu_1$" is lower).
- *Credit Crunch.* Investment opportunities are particularly attractive when other large investors such as banks and insurance companies suffer a credit crunch or are imposed tighter restrictions on risky investments. One would therefore identify a credit crunch episode as one in which $\mu_1$ is large for VCs.[24]
- *Hot-Issue Markets*. One would expect VCs to have a high willingness to exit in a hot-issue market as they may then have more alternative investments to bring to the market (that is, they may then have either a higher $\lambda$ or a higher $\mu_1$).

[22] This is not so for the entrepreneur, who may be able to reassume some of her control rights in case of an IPO, but not in case of a sale. Berglof (1994) builds a theoretical model of the distributional conflicts associated with the sale of a company.

[23] It is hard to distinguish empirically between $\mu_1$ and $\lambda$. Our two-point distribution is a special case of a general distribution over the realization of $\mu_1$.

[24] See Lerner (1999, p. 337).

## 5. Conclusion

This paper provides a first study of the optimal design of active monitors' exit option. An active monitor's claim is more likely to be liquid, the more intense and frequent his liquidity needs; the more informative the speculative monitoring (in a sale, IPO or secondary market); and the scarcer the active monitor's loanable funds at the date of the initial outlay. In particular, we have argued that claims of active monitors should be more liquid when more money flows into the venture capital industry. The reason is that the returns demanded by VC Funds are then lower and therefore the relative cost of offering a more efficient liquid contract is reduced.

Turning to the optimal contract for the speculative monitor, we have shown that it is (weakly) optimal for a venture capital firm to go public by issuing (options to purchase) equity rather than safe debt in order to provide the buyers or underwriters with the appropriate incentives to acquire information, which in turn can help improve the incentive contract with the active monitor.

While we argue that our theory is basically consistent with existing evidence on venture capital, further empirical validation is called for. Also, the theory should be extended in a number of directions, both to build a richer account of venture capital agreements (e.g. relative to the choice of exit through a sale or an IPO, and to the allocation of control rights among the general partners, the limited partners, and the entrepreneur) and to analyze the aggregate dynamics of venture capital loanable funds and investment. We hope research in these directions and others will develop in the near future.

## Appendix

When $\Lambda_q(\lambda\mu_1 + 1 - \lambda) > 1$ the optimal contract for the active monitor which uniquely implements the second best outcome must satisfy the new incentive constraints:

$$\lambda[q_H\mu_1 r^a + p_H R^a(\mu_1)] - \lambda c \geq \lambda q_L \mu_1 r^a + (1-\lambda) q_L r^a, \tag{18}$$

and

$$\left\{\begin{array}{ll} q_H\mu_1 r^a + p_H R^a(\mu_1) \geq c & (a) \\ c \geq q_H r^a + p_H R^a(\mu_1) & (b) \end{array}\right\}. \tag{19}$$

These constraints are obtained by substituting for $R^a(1) = \frac{c}{p_H}$ into the incentive constraints (7) and (8). Recall that unique implementation requires that constraint (17) be binding when $\Lambda_q(\lambda\mu_1 + 1 - \lambda) > 1$.

Hence, when constraint (17) is binding the active monitor's optimal contract solves:

$$\min_{\{r^a, R^a(\mu_1)\}} \left\{\lambda\left[q_H\left(1 - \frac{\mu_1}{\mu_0}\right) r^a + p_H\left(1 - \frac{1}{\mu_0}\right) R^a(\mu_1)\right]\right\} + \lambda\psi, \tag{20}$$

subject to constraints (18) and (19).

Solving this problem we obtain the following proposition characterizing the optimal contract that uniquely implements the second best outcome:

PROPOSITION 3. Under the unique implementation requirement,

(a) If either $\mu_1 \leq \mu^*$ or $\mu^* < \mu_1 < \frac{q_H + \frac{\lambda}{1-\lambda} q_L}{q_H - q_L}$ and $\Lambda_q(\lambda\mu_1 + 1 - \lambda) > 1$, then the optimal contract is **illiquid** and given by

$$r^a = 0 \text{ and } R^a(\mu_1) = R^a(1) = \frac{c}{p_H}.$$

(b) If $\mu_1 > \mu^*$ and $\Lambda_q(\lambda\mu_1 + 1 - \lambda) < 1$, the optimal contract is **liquid** and given by

$$r^a = \frac{c}{(q_H - q_L)(\lambda\mu_1 + 1 - \lambda)}, \; R^a(\mu_1) = 0 \text{ and } R^a(1) = \frac{q_H}{p_H} r^a.$$

(c) If $\mu_1 \geq \frac{q_H + \frac{\lambda}{1-\lambda} q_L}{q_H - q_L}$ and $\Lambda_q(\lambda\mu_1 + 1 - \lambda) > 1$, the optimal contract for the active monitor is **liquid** and given by:

$$r^{a*} = \frac{c}{\mu_1(q_H - q_L) - \frac{1-\lambda}{\lambda} q_L}; \; R^{a*}(\mu_1) = 0 \text{ and } R^{a*}(1) = \frac{c}{p_H}.$$

*Proof.* It only remains to show that the optimal contract characterized in the proposition is indeed the solution to the new constrained optimization problem. As before, constraint (18) must be binding at the optimum, so that

$$\lambda p_H R^a(\mu_1) = \lambda[c - (q_H - q_L)\mu_1 r^a] + (1 - \lambda) q_L r^a.$$

Substituting for $\lambda p_H R^a(\mu_1)$ in the objective function and constraints (19) we then obtain the same objective function as before,

$$\min_{r^a} \left\{ r^a \left[ \lambda q_H \left(1 - \frac{\mu_1}{\mu_0}\right) - \lambda \left(1 - \frac{1}{\mu_0}\right) \mu_1 (q_H - q_L) \right. \right.$$
$$\left. \left. + (1 - \lambda) \left(1 - \frac{1}{\mu_0}\right) q_L \right] \right\} \tag{21}$$

but a different incentive constraint:

$$0 \geq \left[ q_H - \mu_1(q_H - q_L) + \frac{1 - \lambda}{\lambda} q_L \right] r^a.$$

Note that constraint (19) (a) is always satisfied. The optimal contract now is liquid if and only if

$$\mu_1 \geq \frac{q_H + \dfrac{\lambda}{1 - \lambda} q_L}{q_H - q_L}$$

and given by

$$r^a = \frac{c}{\mu_1(q_H - q_L) - \dfrac{1-\lambda}{\lambda} q_L}; \; R^a(\mu_1) = 0 \text{ and } R^a(1) = \frac{c}{p_H}.$$

This establishes the proposition. □

Thus, when

$$\Lambda_q(\lambda\mu_1 + 1 - \lambda) > 1$$

and the principal wants to guarantee unique implementation of the second best outcome, he will have to restrict exit at date $t = 1$ more than before if $\widehat{\mu} < \frac{q_H + \frac{\lambda}{1-\lambda} q_L}{q_H - q_L} = (\Lambda_q(1 + \frac{\lambda}{1-\lambda}\frac{1}{1-\Lambda_q}))^{-1}$, which is the case for example if $\mu_0$ is sufficiently close to one.

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