Participating convertible preferred stock in venture capital exits☆

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1. Executive summary

Venture capital is an important source of equity financing for innovative ventures. Venture capitalists typically use convertible preferred equity to finance such ventures. Investors of convertible preferred equity have the option of either holding a debt-like claim—preferred equity, or converting into common equity. The literature has analyzed the main trade-offs affecting the two alternatives. However, convertible preferred equity can come with special features. With a few exceptions, scholars have not delved into the specific details of these securities. This paper examines one such convertible preferred equity with distinct features—participating convertible preferred (PCP) stock.

Participating convertible preferred stock gives its holders preference in dividend payments and at the same time allows them to participate in excess earnings (i.e. the cash flows to which equity is entitled to after all debt and preferred claims have been satisfied) along with the common stockholder. PCP holders thus concurrently hold both a debt-like claim (preferred equity) as well as an equity claim (participation rights). However, PCP holders lose their preferred rights if they convert into common stock. The specific question that I address in this paper is why are venture capitalists willing to convert their PCP stock into common equity and give up their preferred rights?

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To answer this question, I propose a signaling model for PCP stock based on its role in venture capital exits. The two major forms of exits observed in venture capital are the initial public offerings (IPOs) and the trade sale (TS). Typically, a PCP stake is converted into common equity during an IPO exit but is not converted in a TS exit. My model shows that VCs can signal the quality of their venture in an IPO, by converting their PCP stake into common equity and giving up some of their cash flow rights. Signaling is of particular importance in an IPO because new investors are relatively uninformed about the venture. In contrast, potential trade buyers are more likely to be well-informed since they are usually industry peers.

When exit is through an IPO, the entrepreneur retains control of the firm. Thus, when the firm value is high, an IPO exit rewards the entrepreneur and should be the preferred exit route. However, the VC may be reluctant to take that route given that investors in an IPO are less informed and the VC may not get the full value for his stake. So it is precisely when the firm value is high that the VC may prefer to target investors who are more informed and thus less costly—in other words to exit through a trade sale. However, the interests of VCs and entrepreneurs are more easily aligned when the latter convert their PCP stakes into common shares and exit through an IPO.

With the help of the model, I confirm some well-known empirical observations. The model first predicts that, the greater a market's informational efficiency, the greater the possibility of signaling. There is empirical evidence to suggest that the US and UK markets are informationally more efficient compared to all other markets. Hence we are more likely to observe exits through IPOs in US and UK than in other markets, which is borne out by the evidence. Secondly, the higher the value of reputational benefits that a VC derives by exiting a venture through an IPO, the higher is the probability of such an exit. This has been empirically confirmed by Gompers (1996).

Venture capitalists investing in start-ups use sophisticated financial instruments to structure their investments. This paper provides a rationale, for the use of one such financial instrument—PCP stock, based on the venture capitalist's exit decision. In doing so, it makes a connection between the exit route and entrepreneurial effort. The paper thus highlights factors that have direct implications for the incentives of venture capitalists to invest in ventures and entrepreneurs to exert effort to make them a success.

2. Introduction

Venture capitalists’ (VCs) investment in a new venture typically takes the form of convertible preferred stock. Investors in convertible preferred (CP) either hold debt-like preferred equity or have the option of converting into common equity. The literature has documented the extensive use of convertible securities in venture capital contracting (Kaplan and Stromberg (2003)). While analyzing the use of CP stock the theoretical work has focused mostly on the plain-vanilla form of these securities and concludes that it is an optimal incentive structure between the entrepreneur and the VC (Da Rin et al. (2011)). In practice, convertibles do not always have this simple structure and come in many different flavors (Metrick and Yasuda (2011)). This paper analyzes one such variant, observed frequently in venture capital contracting, participating convertible preferred (PCP) stock which is a CP stock with participation rights.

Participation rights entitle the VC, in the event of sale or liquidation, to a liquidation preference plus a pro rata share of what remains to be paid to common shareholders. Thus, upon sale or liquidation, participating preferred shareholders have a debt-like claim equal to their liquidation preference plus a common shareholder’s claim. In contrast, holders of nonparticipating convertible preferred shares either receive the liquidation preference payable on the preferred stock or they convert their shares to common stock and share pro rata with common shareholders. I give a simple numerical example to illustrate these features. Assume that a VC's investment entitles him to $5 million from a given venture in the form of a CP stock, that is convertible into 50% of the common equity. Now suppose the company is liquidated for $12 m. The VC can then either (a) convert his stake to common equity and receive 50% of the proceeds (i.e. $6 m) or (b) not convert and receive his preferred proceeds (i.e. $5 m). Let us further assume now that the VC holds a PCP with participation rights on an as-converted basis (50% in this case). If the VC converts his CP stock to common equity then he is entitled to $6 m (i.e. 50% of $12 m), but if he chooses not to convert then he is entitled to receive $5 m (his preferred claim) plus shares to the extent of 50% in the remaining equity pool of $7 m ($12 m minus $5 m), thus giving him a total of $8.5 m (i.e. $3.5 m plus $5 m) rather than $6 m from converting CP stock. Thus the stockholders cash flow rights vary depending on whether or not the stake is converted. In this example, the VC’s payoff is higher in case of nonconversion (conversion) in the presence (absence) of the participation feature.

PCP stock is routinely used in venture capital contracts. Kaplan and Strömberg (2003) report that nearly 80% of all venture contracts use convertible preferred stock and that in nearly half of those cases the stock is participating. In venture capital contracts, PCPs are structured in such a way that the allocation of cash flow rights varies depending on the type of exit. The two most common types of exit observed in venture capital are an initial public offering (IPO) or a trade sale (TS)—in which the company is sold either to a trade buyer or acquired by another company. Most venture capital investment agreements explicitly treat TS as a liquidation event, in which case the VCs retain both their participation and preferred rights whereas the same agreements usually stipulate automatic conversion of the convertible stake into common equity if exit is via an IPO. By giving up their preferred rights during an IPO, the VCs are forsaking a substantial portion of their cash flows. The question that I address in this paper is: why are the VCs willing to give up their preferred rights in the case of an IPO but not in the case of a TS?

I propose that VCs use PCP stock conversion as a signal of the firm’s quality. My assumption is that signaling is especially important in a public offering since the new shareholders are relatively uninformed about the venture's value. In contrast, the firms that are bidding in a TS have the opportunity to conduct due diligence and also tend to be peers from the same industry; this gives them in-depth knowledge, which makes them relatively well informed. I argue that the VCs convert their stake into common equity—and accept a lower stake when exit is through a IPO—to signal the quality of the venture to investors. However, for a TS exit, such a costly signal is not required because target buyers are relatively well informed about the venture's value. Hence the relative costs (versus the TS scenario) of exiting through an IPO create the possibility of a signaling equilibrium, which good firms can use by converting their
PCP stake. Such an ex-post equilibrium can also give the entrepreneur ex ante incentives given that she typically is in control of the venture after a IPO. In contrast, the entrepreneur loses control of her venture after a trade sale. Therefore, provided it occurs when firm value is high, exit via IPO has the desirable property of rewarding the good entrepreneur with continued control of the venture.

My model works as follows. In the presence of PCP, the VC investing in a good firm would prefer not to convert. Although the IPO exit route suffers from greater informational asymmetry than the TS route, the latter does have the advantage of allowing VC not to convert. This means that a IPO is costly to the VC (because of conversion) which provides a role for PCP as a signaling mechanism.

The role of VCs in certifying IPOs has been well documented. Megginson and Weiss (1991) provide empirical evidence for the certification role of venture capitalists in bringing new issues to market. They show that the support by VCs of the offering firm certifies the issue’s quality through its investment of financial and reputational capital. By comparing the costs of going public (including underpricing, underwriting spreads, etc.) for a group of VC-backed IPOs with a control sample of non-VC-backed offers, these authors find that the costs of going public are significantly lower for the VC-backed IPOs. Megginson and Weiss also contend that the mere presence of the VC is enough to certify the venture. I take this a step further and argue that VCs use their stake conversion as a further signal of the venture’s quality.

Black and Gilson (1998) endorse the view that relinquishing control to entrepreneurs is a means of rewarding good entrepreneurs. These authors argue that in a US style stock market-based system (unlike a German, bank-based system)—there is an implicit contract between the VC and the entrepreneur by which, if the venture does well the VC cedes control back to the entrepreneur by exiting through an IPO. In the case of a TS control of the venture is transferred to the acquirer. Black and Gilson argue that the opportunity to acquire control incentivizes the entrepreneur much beyond the purely financial gain arising out of an appreciation of her stake. My model formalizes this argument and in addition confirms the signaling role of PCP stock in the exit decisions of venture capitalists.

To the best of my knowledge, Hellmann (2006) is the only paper that deals explicitly with the use of convertible preferred stock (and its variants) in venture capital contracts. Hellmann, shows that pure equity is the optimal security for resolving the double moral hazard problem. Convertible preferred equity preserves balanced incentives if the venture remains independent (after an IPO) yet allows the VC to extract additional rents if it is acquired (in a TS), thus helping to satisfy his financing constraint. Hellmann’s paper thus focuses on the early-stage investor whereas I focus on the late-stage investor: the strategic buyer or IPO investor. My model therefore analyzes the “buy” side of the venture market in the presence of asymmetric information, so it complements Hellmann’s work by suggesting an additional reason for the use of these securities—namely, their role in signaling the venture’s quality at the time of VC exit.

This paper also contributes to the literature on venture capital exits. Berglöf (1994) and Bascha and Walz (2001) model the trade-offs between IPO and TS exit routes. In both these papers and also in the paper by Hellmann (2006) there are conflicts between the entrepreneur and VC on the most appropriate method of exit from a venture. Convertible securities can help the parties select an optimal exit strategy by suitably allocating control rights. In the model I abstract from this conflict and instead address the question of how convertibles help resolve information asymmetry and provide ex ante incentives to the entrepreneur. Other research on VC exits includes the papers by Bienz and Leite (2008), who focus on control issues related to exit and specifically on the post-IPO monitoring of the entrepreneur and Tykvova (2003), who analyzes the optimal timing of exit.

This paper is also related to the work of Faure-Grimaud and Gromb (2004) and Aghion et al. (2000) who explore how liquidity shocks affect a VC’s desire to exit an investment. Faure-Grimaud and Gromb (2004) emphasize the effect of stock price informativeness on exit decisions and incentives. Some of my comparative statics deal with the stock market’s ability to price IPOs accurately and in this sense complements their study.

The rest of the paper proceeds as follows. In Section 3, I describe the model set-up. Section 4 sets out the entrepreneur’s first-best incentives and the venture capitalist’s choices. In Section 5, I analyze the various signaling equilibria. Section 6 discusses alternative explanations and suggests avenues for further research. Section 7 examines the empirical implications and Section 8 concludes.

3. The model

Consider a model with three dates, universal risk neutrality and no discounting. An entrepreneur (“she”) has a project that needs an investment $K$. Lacking, the financial means to put up this amount she approaches a competitive venture capitalist (“he”) to fund this project.

Contracts: The VC receives a proportion $f$ of the cash flows. For now, view the security held by the VC as convertible preferred equity. This stake also comes with participation rights, and the VC can convert his stake at a cost (as described previously) into a fraction $q$ ($\leq f$) of common equity. The entrepreneur is the residual claimant.

The proportion $f$ of PCP comprises two components, the preferred dividend $D$, and a share $q$ of the remaining cash flows. If the value of the venture at exit is $V$ then the total payoff to PCP holders without conversion is

$$f = \frac{(D + (V-D)q)}{V} = \frac{(1-q)D}{V} + q$$

Upon conversion the PCP stockholder receives $qV$.

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1 See Section 3 for the distinction between “good” and “mediocre” ventures.

2 The issue of security design is much discussed in the theoretical VC literature. Most conclude (albeit for different reasons) that convertible equity is the optimal security for VC contracting. This paper approached the issue from a different perspective: we take the equity claim as given and focus our analysis on the participating and convertible features associated with it.
For all values of $D > 0$ and $0 < q \leq 1$ we obtain $f > q$, which justifies our assumption. This analysis suggests that the proportion of cash flows $f$ is not fixed and instead will depend on the venture’s value $V$ at the time of exit. However, in the analysis I will maintain the assumption of constant proportions for ease of exposition.\footnote{In maintaining this assumption I sacrifice some features of the security for the sake of simplicity. However, this modeling choice has no effect on the main trade-off and hence none on the equilibrium.}

### 3.1. Project

After the investment is made at $t = 1$ the venture proves to be either a good firm with a value of $V_H$ with probability $p$ or mediocre firm with value $V_x$ (naturally $V_H > V_x$). The entrepreneur provides effort $e$ that affects the venture’s likelihood of success. If she exerts effort then the probability of the venture being good is $p$ (and is 0 otherwise). The effort provided is both unobservable and costly. The value realization ($V_H$ or $V_x$) is observed by the VC and entrepreneur but not by outsiders.

After the venture’s value is realized, an investment of $I$ is needed to move the venture forward. This investment is valuable, and its constant rate of return is $x$. Thus the firm’s overall value after investment is either $V_H(1 + x)$ or $V_x(1 + x)$ as applies. I assume that absent investment $I$, the venture is of no value. Both the good project and the mediocre one exhibit a positive net present value (i.e. $V_x(1 + x) \geq K + I$), so by this criterion they are worthy of investment. However, neither the entrepreneur nor the VC can invest in the project at this stage. The reasoning is as follows. The entrepreneur cannot invest because she is wealth-constrained. The VC does not invest because he is an early-stage investor. We can think of $K$ and $I$ as (respectively) start-up and late-stage investments respectively. The start-up investment could actually be a series of smaller amounts $k_1$, $k_2$, ..., $k_n$ which is typically provided in stages upon the entrepreneur’s achievement of certain milestones. In most cases investors who provide start-up financing are distinct from those who invest at later stages. Note also that VCs may have liquidity needs that force them to exit the investment and leave them with no funds to inject. Venture capitalists tend to invest in firms through a limited partnership. Such arrangements have a finite life (typically 10–12 years) before they are dissolved. For this reason VCs thus tend to invest in the first 5–6 years of a partnership; thereafter, they seek to exit their investments so that the partnership can be dissolved.

### 3.2. Exits

There are only two methods of raising $I$: through a trade sale or an initial public offering. In the case of a trade sale (TS), buyers know $V$ with probability $r = 1$ whereas in an initial public offering (IPO), investors know $V$ with probability $r < 1$.

We shall assume that buyers in a TS are more informed (and to simplify the exposition, analyze the case where they are fully informed) than the buyers in an IPO. From an informational point of view it is well known that shares in an IPO are typically provided in stages upon the entrepreneur’s achievement of certain milestones. Poulsen and Stegemoller (2008) provide empirical evidence that firms with higher asymmetric information exit through trade sales (as compared to public offerings) because other companies operating in the same industry have extensive knowledge of that industry. Poulsen and Stegemoller (2008) provide empirical evidence that firms with higher asymmetric information exit through trade sales (as compared to public offerings) because other companies operating in the same industry have extensive knowledge of that industry.

Finally, our assumption that exit occurs only via IPO or TS implies assuming that the venture is successful and that its value exceeds the PCP stock’s liquidation value (i.e. $V > D$).

### 3.3. Control

The model presented here assumes that the VC is in control and makes the exit decision consistent with the empirical evidence in Bienz and Walz (2007) who analyze 464 German VC–entrepreneur contracts and find that, over time the VC acquires more exit rights while relinquishing operational rights.

### 3.4. Preferences

Both the VC and the entrepreneur may derive private benefits from the project.

The entrepreneur derives a private benefit if she is in control of the project. This is usually the case when the VC exits after an IPO. I therefore assume that the entrepreneur receives private benefit of control $B$ if the VC exits through an IPO (and receives zero otherwise). That private benefits of control exist is a well-documented empirical fact, one widely used in the control literature (see Zingales, 1995). Empirical evidence suggests that entrepreneurs continue to be involved with the firm even after an IPO. Kaplan, Sensoy and Strömberg (2009) find that at the time of the IPO, 92% of the firms continue to have the founder either as a top executive or director. Even, practitioners acknowledge the existence of private benefits of control. According to a note by the law firm Baker and McKenzie on venture capital exit routes: “An exit through the stock market seems to be favored by management, since it allows them to remain in place and in control.”

\[^1\] In maintaining this assumption I sacrifice some features of the security for the sake of simplicity. However, this modeling choice has no effect on the main trade-off and hence none on the equilibrium.  
\[^4\] www.bakernet.com/BakerNet/Practice/Corporate
I similarly assume that the VC derives a private benefit if the firm is good and the exit is through an IPO. We can conceive of this private benefit as a reputation effect. Amit et al. (1998) show that VCs might try to acquire a reputation for sponsoring IPOs only for high quality ventures. It is therefore reasonable to assume that IPOs are associated with a greater reputation effect for VCs than trade sales. I therefore assume that the VC’s private benefits from a successful IPO are higher than those from a trade sale. The VC receives a private benefit \( Z \) if the venture is good and exit is via an IPO (and zero otherwise).

3.5. Timeline

<table>
<thead>
<tr>
<th>( t = 0 )</th>
<th>( t=1 )</th>
<th>( t=1.5 )</th>
<th>( t=1.75 )</th>
<th>( t=2 )</th>
<th>( t=3 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrepreneur approaches the VC who invests ( X ) in return for a PCP stake; the entrepreneur provides effort.</td>
<td>Value of the venture is realized and is observed by the VC and the entrepreneur</td>
<td>VC can decide whether or not to convert his stake into common.</td>
<td>Investment / raised by selling stake either through a TS or an IPO.</td>
<td>Investors observes value of firm’s true with probability ( r ) (if IPO) or with probability ( 1-r ) (if TS).</td>
<td>The VC exits by selling his remaining stake.</td>
</tr>
</tbody>
</table>

The model's timeline is summarized as follows:

It is usual for VC to exit from a venture in multiple stages. A small fraction of VC holdings is sold during the IPO and the bulk of those holdings is sold sometime thereafter. Venture capitalists typically retain a substantial portion of their equity holdings after an IPO. Megginson and Weiss (1991) report that, on average, venture capitalists own 36.6% (resp. 26.3%) of the firm prior to (resp. immediately after) the IPO. The timeline aims to reflect these observations.

4. First-best incentives

4.1. Entrepreneur incentives

Assume that the entrepreneur gets a portion of the cash flows, \( C^H \), if the venture is good and valued at \( V^H \) and \( C^L \) if the venture is mediocre and is valued at \( V^L \). As discussed above besides share of the cash flows the entrepreneur also receives private benefits if exit is through an IPO. Then the entrepreneur’s incentives to create a venture and exert effort is given by

\[
p \mu (C^H + B) + (1-p) \gamma (C^L + B) \geq e + \gamma (C^L + B)
\]

here \( p \) is the probability that the venture is good if the entrepreneur exerts effort, \( \mu \) (resp. \( \gamma \)) is the probability of an IPO given that the venture is good (resp. mediocre), \( B \) is the entrepreneur’s private benefit when the exit is through an IPO and \( e \) is the disutility of effort incurred by the entrepreneur.

The left-hand side of Eq. (2) states that, if the entrepreneur exerts effort, then with probability \( p \) the venture is good and with probability \( 1-p \) it is not. The probability \( \mu \) is the probability of an IPO given that the venture is good and \( \gamma \) is the probability that the venture is mediocre.

The foregoing clearly indicates that an entrepreneur’s incentives to exert effort increases (decreases) with \( \mu \) (\( \gamma \)), the probability of an IPO when the venture’s performance is good (mediocre), respectively.
4.2. VC’s choices

Like the entrepreneur the VC also values both cash flows and private benefits. The VC chooses his method of exit. Although IPOs maximize the entrepreneur’s incentives, they are informationally disadvantageous in comparison with a trade sale. One consequence of the informational asymmetry between the insiders and the investors is that the VC of a good venture might not get a fair price.

If there were no information asymmetries between the VC and the investors, then the venture would need to offer the following stakes in return for the investment \( I \). If the venture’s value were \( V^H \), then the investor would demand a share

\[
S_H = \frac{I}{V^H(1 + x)} \tag{4}
\]

if the venture’s value is \( V^d \) then the investor’s stake in the venture would be

\[
S_L = \frac{I}{V^d(1 + x)} \tag{5}
\]

Assume instead that the outside investors hold some prior beliefs \( \alpha \) that the quality of the venture is good. Given these beliefs, an investor’s stake would have to be:

\[
S_A = \frac{I}{[\alpha V^H + (1 - \alpha)V^d](1 + x)} \tag{6}
\]

Now consider the situation from the perspective of a VC who holds a stake of \( f \), that may be converted prior to raising new capital into \( q \). If the venture is successful (and so has value \( V^H \)), then the VC has the following choices. The VC can sell his stake as it is to investors with the most optimistic beliefs (i.e. the highest \( \alpha \)). Because we consider the strategic choice faced by a VC who knows \( V^H \), this amounts to choosing the form of exit involving the best-informed buyers—namely, a trade sale. Another option available to the VC is to use the exit mode as a means of signaling additional information to the market.

When \( V = V^d \) it seems appropriate for the VC to exit via IPO because doing so efficiently rewards the entrepreneur. However, the VC may be reluctant to exit that way if IPO investors are less informed. So it is therefore precisely in cases of high firm value that the VC will prefer to target a more informed audience—and thus prefer to exit via a trade sale.

Yet it may be possible to reconcile the parties’ preferences if the VC can somehow signal the firm’s type to potential investors. In the next Section I explore the various possibilities of signaling.

5. Conversion as a signal

I propose that one way for the VC to signal the market is by converting his PCP stake. To be effective in conveying additional information to the market the signaling action should exhibit two features; first the signal must be costly; second it must be more costly for the mediocre type than for the good type. When converting PCP to common stock the VC’s resulting stake is less than his original stake \( f \). Clearly, then conversion qualifies as a signal in terms of the first criterion. Next we examine the conditions under which the second criterion is also satisfied.

5.1. Conversion without exit choice

I begin by investigating whether a signaling equilibrium exists if there is only one method of exit available. In that case, VCs cannot choose their exit route but can still convert their PCP stake as a signal to the market. Denote by \( r_b \in \{0, 1\} \) the probability that a given investor discovers the true value of \( V \) after investing.

The VC may seek to signal his type by converting his preferred stake \( f \) to common equity \( q \). I look for a separating equilibrium in which the VC of a good firm converts whereas the VC of a mediocre one does not. The analysis of this equilibrium is constructive that is a set of investor beliefs is specified and then a program is constructed that assures that the firms behave accordingly. I begin by assuming that investors believe that the VC of a good firm converts his stake to common equity in order to signal the type. Therefore the investors believe the venture is a good if they observe conversion (and otherwise believe it is mediocre). Based on these beliefs, investors demand a suitable stake in return for their investment. Denote by \( Z_r \in \{0, 2\} \) the VC’s private benefits, where \( Z_r = Z \) if the exit is through an IPO.

In order for such an equilibrium to exist, the following incentive compatibility conditions must be satisfied.

\[
q[1-S_H]V^H(1 + x) + Z_r \geq f(1-S_L)\alpha V^H(1 + x) + Z_r
\]

\[
f(1-S_L)V^d(1 + x) \geq q(1-S_H)\alpha V^H(1 + x) + Z_r
\]

If the venture is good the investors accept a stake \( S_H \) (Eq. (4)) in return for their investment. Condition (7) simply states that the VC’s utility from the good venture after conversion of his stake into common equity is greater than not converting and being

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In contrast, in case of an IPO investors pay a fair price only with probability $r_B$. In line with our assumption, the VC of the good venture derives private benefit $Z$, in the event of a successful exit.

Similarly, the condition (8) states that there is no advantage to a mediocre firm’s VC mimicking a good firm. By converting his stake (to mimic the good-venture behavior), the VC of a mediocre venture can secure investment $I$ with a “good venture” purchase price. After buying a stake in this firm the investor discovers its true value with probability $r_B$. Together, then conditions (7 and 8) lead to the following statement:

**Proposition 1.** If the VCs of good and mediocre ventures have only one available exit strategy, then there is no separating equilibrium in which the good venture’s VC can signal its type by converting his PCP stake into common equity.

**Proof.** See the Appendix A.

Therefore, a VC who cannot choose his exit mode will be unable to signal the venture’s type through preferred stock conversion. The reason is that even though the good venture’s VC is prepared to bear (via conversion) the cost of signaling, the mediocre venture’s VC can easily convert and mimic that behavior and thereby render such signals less informative. Converting costs a VC to lose $(f-q)\%$ of his shares but this is less costly when the company is mediocre; hence such ventures will always mimic.

If therefore no separating equilibrium exists then the VC of a good firm will not convert because doing so is not a credible signal and also results in a lower stake. The proposition clearly depends on the existence of only one available exit strategy and on the investors’ post-investment knowledge (with probability $r_B$) of the venture’s true value.

Finally, observe that it is difficult to satisfy the entrepreneur’s incentive compatibility condition. The entrepreneur’s IC (3) can be satisfied provided there is a difference in IPO exit probability, between the good and mediocre ventures (i.e. when $\mu > \gamma$). But in this case since there is only one VC exit route there is no way to satisfy the entrepreneur’s IC and thus no way to motivate her to exert effort.

### 5.2. Exit choice without conversion

Consider now the converse situation, where the VC’s share $f$ has no conversion rights but he can choose whether to exit via IPO or TS. In this case, a VC’s method of exit can serve to signal the type of his venture to the market.

I analyze whether a separating equilibrium is possible in which the good firm’s VC exits through an IPO and the mediocre firm’s VC through a TS. If so, then investors would believe that a firm whose VC exited via IPO (resp. TS) is good (resp. mediocre). The incentive compatibility conditions for such an equilibrium are:

$$f(1-S_H)V_H^{\mu}(1+x) + Zf(1-S_J)V_H^{\mu}(1+x)$$

$$f(1-S_J)V_J^{\mu}(1+x) \geq f(1-S_H)(1+x)[rV_J^{\mu} + (1-r)V_H^{\mu}]$$

Inequality (9) is the IC condition for the good venture’s VC; it simply states that his overall payoff when exiting through an IPO is greater than when exiting through a TS. When the good venture’s VC exits via IPO he also secures the additional private benefit $Z$—the reputation effect described previously. Note that the VC forgoes that benefit $Z$ if he exits via TS.

Similarly, (10) is the IC condition for the mediocre venture’s VC. It states that the VC of a mediocre venture does better by exiting through a TS than through an IPO. A TS exit signifies that the venture is mediocre, so investors pay a price $S_J$ for their stake. In contrast, in case of an IPO investors pay a fair price only with a probability $r < 1$.

The IC condition of a good venture’s VC (inequality (9) will always be satisfied but that of the mediocre venture’s VC (inequality (10) will never be satisfied. Since $V_J^{\mu} > V_H^{\mu}$, it follows that, for all values of $r < 1$, the sum $[rV_J^{\mu} + (1-r)V_H^{\mu}]$ will exceed $V_J^{\mu}$. And since $(1 - S_H) > (1 - S_J)$ by definition, it follows that the right-hand side of Eq. (10) will always exceed the left-hand side; and hence the IC condition of mediocre venture’s VC can never be satisfied. Consequently, when VCs hold common equity stakes there is no separating equilibrium whereby VCs of good ventures exit through IPOs while those of mediocre ventures exit through trade sales. It can likewise be shown that there exists no separating equilibrium in which VCs hold common equity and the good exit via TS while the mediocre exit via IPO. This result is formalized in our next proposition.

**Proposition 2.** If VCs hold only common equity, then there is no separating equilibrium in which a VC can signal his venture’s type via choice of exit strategy (either IPO or TS).

**Proof.** Refer to preceding discussion.
VCs of both venture types will choose the same exit strategy; this has a negative effect on the entrepreneur’s incentives to exert effort.

5.3. Exit choice with conversion

Here I explore the possibility of a separating equilibrium when (a) the VC can exit via IPO or TS and (b) the VC’s stake is convertible. Once again I look for a separating equilibrium in which the good venture’s VC converts (and exits via IPO) while the mediocre venture’s VC does not convert (and exits via TS). In this case potential investors would believe that the venture is good only if the VC has converted his stake and exited through an IPO; otherwise the venture is believed to be mediocre. Recall that, with an IPO exit, investors do not discover the venture’s true value even after investment; they observe the true value only with probability $r$.

The incentive compatibility conditions for such an equilibrium are as follows:

$$q(1-S_H)V^H(1+x) + Zf(1-S_L)V^L(1+x)$$

$$f(1-S_L)V^L(1+x) \geq q(1-S_H)[rV^L + (1-r)V^H](1+x)$$

For a separating equilibrium to exist the investors must believe that the converting VC’s venture is good and will naturally accept a stake $S_H$ in that venture. Condition (11) simply states that the VC of a good venture does better by converting (and thus accepting a stake $q$) and paying a price $f$ for the investment than by not converting (i.e. retaining the stake $f$), having his venture be mistaken for a mediocre one and exiting through a TS. Recall that the VC derives private benefit $Z$ when a good firm holds a successful IPO for a good firm. It should be clear from Eq. (11) that the conversion signal will be credible only if $q < f$.

Condition (12) states that it is not worthwhile for the mediocre to mimic the good by exiting through an IPO. The VC of a mediocre venture is better-off not converting (and then exiting through a TS). The reason is that conversion does not guarantee high valuation of the VC’s remaining stake in a mediocre firm. Investors in an IPO realize the venture’s true value with probability $r$, so it is only with probability $(1-r)$ that the mediocre venture is mistaken for the good. These IC conditions yield the following proposition

**Proposition 3.** There exists a fully separating equilibrium—in which the VC of the good venture converts his stake into common equity and then exits through an IPO—provided that

$$q \equiv \left\{ \frac{f(1-S_L)V^L(1+x) - Z}{(1-S_H)V^H(1+x) - (1-S_L)[rV^L + (1-r)V^H]} \right\}$$

$$Z \geq Z_{min} = fV^L \left[ V^L(1+x) - x \right] \left[ \frac{rV^L}{V^L + (1-r)V^H} \right]$$

The VC of the mediocre venture does not convert and exits through a trade sale.

**Proof.** See Appendix A

I define the range in which a fully separating equilibrium exists as $q \equiv (q_{FS}, q_{US})$. The upper bound of the range i.e. $q_{US}$ defines the threshold above which the mediocre venture’s VC no longer finds it worthwhile to exit through a TS. Similarly, below the lower bound $q_{FS}$ the payoff for a good venture’s VC is greater via TS via IPO. Thus it is only when $q$ lies within the range that there can exist a fully separating equilibria in which the good firm’s VC converts his stock (and then exits through an IPO) while a mediocre firm’s VC does not convert (and then exits through a TS). Note that condition (i) of the proposition implies that $q < f$ hence conversion must be costly (see Appendix A for proof).

The other necessary condition for a separating equilibria to exist is that the private benefits $Z$ can be no less than $Z_{min}$ as in condition (ii) where $\Delta V = (V^H - V^L)$. Separation is not possible with $Z = 0$ because the combination of converting and choosing an IPO exit imposes a costs on both types of venture. However, the cost is higher for the good ventures than for the mediocre one. Hence a separating equilibrium can occur only if good firms are more willing than mediocre firms to pay (cf: Allen and Faulhaber, 1989). Yet that can happen only when $Z$ is sufficiently large. The VC of the good firm thus accepts (through conversion) a reduced stake, and then exits though an IPO because of the reputation (private benefit $Z$) he gains from bringing a good venture to the market. This is crucial because—in light of our assumption that trade sales are informationally more efficient than IPOs—the venture is valued less accurately in the later.

Could there be a separating equilibrium with $q = f$? Without conversion, the VC of the mediocre firm will be tempted by an IPO because it would make the venture’s true value less detectable than would sticking to his postulated equilibrium strategy of exiting through a trade sale. Forcing conversion to a lower stake prior to an IPO is one way to deter the mediocre from mimicking the good.
The results reported here confirm that exiting through an IPO increases the entrepreneur’s incentives. Compers and Lerner (1999) point out, IPOs are the most successful of all venture exits and fetch the highest returns to the venture investors. Moreover, most venture agreements require that—prior to an IPO—convertible stakes be automatically converted into common equity.

5.4. Semi-separating equilibria

In this Section I explore the possibility that a good venture’s VC exits via IPO with probability \(\mu\) and exits via a TS with probability \(1 - \mu\) that is a semi-separating equilibrium. The conditions for the existence of such a hybrid equilibrium are as follows:

\[
\begin{align*}
q(1 - S_H^Q) V^H(1 + x) & + Z \geq f\left(1 - S^H \right) V^H(1 + x) \\
\left(1 - S^H \right) V^I(1 + x) & \geq q(1 - S_H^Q) \left[rV^I + (1 - r)V^H\right](1 + x)
\end{align*}
\]  

These conditions are similar to those for the fully separating equilibrium; the only difference is that in this case a TS no longer allows investors to conclude that the venture is mediocre. The investors know that a venture holding an IPO is good, but a venture raising funds through a TS could be either good or mediocre. Investors update their prior probabilities of good and mediocre i.e. \(\alpha\) and \((1 - \alpha)\) with the additional information about the probability \(\mu\) of a good venture undertaking an IPO. After Bayesian updating the investors estimate a revised share \(\hat{S}\) for ventures that seek funding via trade sales. This share is given by the following relationship:

\[
\hat{S} = \left[\frac{(1 - \mu)\alpha}{(1 - \mu)\alpha + (1 - \alpha)} V^H(1 + x) + \frac{(1 - \alpha)\mu}{(1 - \mu)\alpha + (1 - \alpha)} V^I(1 + x)\right] = I
\]

Proposition 4. There exists a semi-separating equilibrium in which the VCs of the good firms randomize between converting their PCP stakes (and exiting through an IPO) and not converting (and exiting through a Trade Sale)—provided

\[
q = \frac{f\left(1 - S^H \right) V^I(1 + x) - Z}{(1 - S_H^Q) V^H(1 + x) - f\left(1 - S^H \right) V^I} \tag{1}
\]

\[
Z \geq Z_{\text{min}} = f\frac{V^H}{VT} \left[ V^I(1 + x) - I \right] \left[ \frac{\Delta V(1 - r)}{V^I + (1 - r)V^H} \right] \tag{2}
\]

The VCs of the mediocre ventures do not a trade convert and exit only through sale.

Proof. See Appendix A

Much as with the condition on \(q\) for a fully separating equilibria, we may define the range of \(q\) over which a semi-separating equilibrium is supported as \(q \in (q_{SS}, q_{IS})\). Note that the value of \(Z_{\text{min}}\) that supports an equilibrium is the same for both the fully separating and the semi-separating equilibrium. \(Z_{\text{min}}\) is the minimum reputation gain required for the good venture’s VC to exit through an IPO. The two types of equilibria differ only in terms of the probability \(\mu\) of an IPO exit by a good venture. The VCs payoffs from the IPO exit is the same for both fully separating and semi-separating equilibria, which is why the value of \(Z_{\text{min}}\) is the same for both.

If a good venture’s VC does not exit through an IPO then his payoff is higher in a semi-separating equilibrium than in a fully separating equilibrium. This difference is reflected in the upper bound of \(q\) which is lower in the semi-separating equilibrium than in a fully separating equilibrium. Comparing the range of \(q\) for a fully separating and semi-separating equilibrium reveals that \(q_{IS} > q_{SS} > q_{TS} > q_{IS}\). In sum; values of \(q\) that are low in the range support fully separating equilibrium, medium values support both fully separating and semi-separating equilibria, and high values support only semi-separating equilibria.

A natural question is whether the expressions so derived are feasible—in other words do they lead to reasonable values of \(D, f\) and \(q\)? To illustrate the answer, a numerical example will prove useful. Assume the following parameters, \(I = 100, V^H = 300, V^I = 150, x = 25\%\) and \(r = 60\%\). If we assume that \(Z = Z_{\text{min}} = 50\) then using the respective expressions from Proposition 3 yields \(q_{IS} = 0.4545\) and \(q_{SS} = 0.4545\). Combining \(q_{IS}\) and Eq. (1) we have \(D = \frac{40450}{4545}\). Thus \(q_{IS} = 4.55\%\) and \(D = 21.43\) when \(f = 10\%\) and so on. This shows that there exist feasible sets of values for the relevant parameters of our model.

More formally using Eq. (1) and the expressions for \(q_{IS}\), we can easily derive an expression for \(D\) in terms of \(f\) and show that indeed \(D > 0\) and \(q > 0\) for values of \(f > 0\).

Finally, which separating equilibrium does the VC prefer for medium values of \(q\)? Given \(V^H\), the probability of exiting through an IPO is lower in the semi-separating than in the fully separating case. So in terms of incentivizing the entrepreneur, it is optimal—all else being equal—when VCs commit to exiting through an IPO.

\[5\] In the above example the value of \(D\) varies between 21.43 and 132.35 for values of \(f\) between 10\% and 50\% respectively.
5.5. Out of equilibrium behavior

In this Section I investigate whether the hypothesized actions taken by the VCs of the good or mediocre ventures dominate the other actions open to them. To perform this analysis I list below the payoffs to the good and the mediocre VCs under all possible scenarios i.e. conversion, non-conversion each under the two possible exit routes—IPO and TS.

5.5.1. Good venture

I list below the payoffs to the VC of the good venture taking into account both conversion as well as exit choices.

<table>
<thead>
<tr>
<th>Venture Payoff</th>
<th>Conversion</th>
<th>Non-conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPO</td>
<td>[q(1 - S_H)VL(1 + x) + Z]</td>
<td>[f(1 - S_H)(1 + x)[rV_H + (1 - r)V_L]]</td>
</tr>
<tr>
<td>TS</td>
<td>[q(1 - S_H)V_L(1 + x)]</td>
<td>[f(1 - S_H)V_L(1 + x)]</td>
</tr>
</tbody>
</table>

From the above table it is clear that in case of conversion the VC of the good venture prefers exiting via IPO compared to TS. Similarly in case of non-conversion he prefers TS to IPO, since if \(r < 1\), then \(rV_H + (1 - r)V_L\) is less than \(V_H(1 + x)\). In the analysis of the separating equilibrium (Section 5.3) we have derived parameter values such that the VC prefers conversion and exit via IPO as compared to non-conversion and exit via TS.

5.5.2. Mediocre venture

The payoffs to the VC of the mediocre venture are:

<table>
<thead>
<tr>
<th>Venture Payoff</th>
<th>Conversion</th>
<th>Non-conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPO</td>
<td>[q(1 - S_H)(1 + x)[rV_H + (1 - r)V_L]]</td>
<td>[f(1 - S_H)V_L(1 + x)]</td>
</tr>
<tr>
<td>TS</td>
<td>[q(1 - S_H)V_L(1 + x)]</td>
<td>[f(1 - S_H)V_L(1 + x)]</td>
</tr>
</tbody>
</table>

The VC of the mediocre venture in case of conversion prefers IPO to TS and in case of non-conversion he is indifferent. In proposition 3 we have derived parameter values such that the VC prefers non-conversion and exit via TS to conversion and exit via IPO.

The analysis in this section thus allows us to conclude that for both good and mediocre ventures, the VC’s equilibrium choice (of exit via IPO and TS respectively) is guaranteed not only by their equilibrium behavior but also by some out-of-equilibrium behavior. Both satisfy standard refinements—including the intuitive criterion of Cho and Kreps (1987), which ensures that the equilibrium choices dominate the other available options.

6. Discussion

The preceding sections clearly demonstrate that there exist separating equilibria in which the good venture’s VC converts and exits through an IPO while the mediocre venture’s VC does not convert and exits through a TS. Given that the entrepreneur’s cash flows as well as private benefits are maximized in an IPO that mode of exit can be used to motivate and reward her efforts, upon which the venture’s success depends. In contrast, the VC of a mediocre venture exits through a trade sale, in which case the entrepreneur receives no private benefits. The following table summarizes the total payoffs to the VC and entrepreneur in case of a separating equilibrium.

<table>
<thead>
<tr>
<th>Exit</th>
<th>Venture Value</th>
<th>Payoff</th>
<th>Entrepreneur Payoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPO</td>
<td>(V_L(1 + x))</td>
<td>[q(1 - S_H)VL(1 + x) + Z]</td>
<td>[(1 - q)(1 - S_H)V_L(1 + x) + B]</td>
</tr>
<tr>
<td>TS</td>
<td>(V_L(1 + x))</td>
<td>[f(1 - S_H)V_L(1 + x)]</td>
<td>[(1 - f)(1 - S_H)V_L(1 + x)]</td>
</tr>
</tbody>
</table>

The entrepreneur’s payoffs are higher when exit is through an IPO. She is rewarded with higher cash flows as well as private benefits of control, \(B\). In contrast, when exit is through a trade sale her share is lower, since \(f > q\) it follows that \((1 - f) < (1 - q)\) and moreover she does not get any private benefits of control.

From the VCs viewpoint, even though his share of cash flows realized in an IPO is lower he additionally gets a private benefit \(Z\). In fact the private benefit should compensate the VC for his loss of cash flow rights upon conversion. The higher is the value of these private benefits, the lower is the (post-conversion) value of the VC is willing to accept.

The entrepreneur will always prefer exit via IPO and conversion, since this choice maximizes her cash flows as well as private benefits. On the other hand, the VCs payoffs are maximized in a trade sale, so his preference will depend crucially on the level of private benefits \(Z\), he gets in a successful IPO. To signal the venture’s value the VC forgives his higher share \(f\) in case of exit via IPO, which has the effect of incentivizing the entrepreneur. Note that since the VC takes this action only when firm value is high, it has a lower impact on the VC’s overall payoff.

The ex ante optimal values of \(f\) and \(q\) can be determined based on the expected payoff to the VC, which should be equal to \(K\), the initial funding requirement of the project.

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6.1. Conversion

PCP holders face automatic conversion in a qualified public offering (QPO) which is an initial public offering (IPO) of securities valued at or above a total amount specified in the financing agreement. This amount is usually specified to be sufficiently large enough to guarantee that the IPO shares will trade on a major exchange. Kaplan and Strömberg (2003), document that this automatic conversion rule typically applies only if the company completes an IPO at a share price that exceeds that of the previous financing round by a factor (on average) of 3. This 3:1 ratio is significantly higher if the share price at prior investment rounds is also considered. Thus the VC is not prepared to give up both control and participation/preferred rights unless he is assured of a high exit value.

Most VC financing agreements explicitly indicate what conditions lead to conversion of the VC stake, but this paper models the decision to convert as a choice made by the VC at the time of his exit. Modeling that choice as an ex ante decision would not alter the implications of the signaling equilibria described here, since in either case the VC forgoes his participation rights in a public offering but not in a trade sale. The VC’s agreeing ex ante to give up those rights is essentially a commitment device to avoid ex post conflicts.

6.2. Alternative explanations and securities

Our model focuses on one reason for the use of participating convertible preferred stock in venture capital contracts and their conversion prior to a public offering. Of course, there may be other reasons for the presence of PCP stock in this context. Some of these reasons are discussed in this subsection.

A major reason for use of PCP stock is the protection it affords VCs from unscrupulous entrepreneurs. This motivation is evidenced in the Hotmail Corporation case study (Mukherjee (1999)). During negotiations with the VC the entrepreneurs were concerned that the investors were receiving participating preferred stock in their first round of investment. The entrepreneurs felt that this was unfair for the investors to thus “double-dip”—which means that they recovered their original investment and shared in the remaining equity pool. The VCs in this case study countered that the arrangement was necessary so that entrepreneurs would not have an incentive to sell the company (at a low price) early in its life.

Practitioners offer another reason for the forced conversion of PCPs in an IPO. Venture capitalists convert their preferred holdings to common shares in order to clean up the company’s capital structure before it goes public. Otherwise that structure would be so complicated that potential IPO investors would find it too costly to perform their due diligence. These concerns do not arise in a trade sale because the investor acquires the entire company; the VC and the entrepreneur are then left to distribute the proceeds among themselves.

In many cases the preferred shares have a cap; these are known as participating convertible preferred with cap (PCPC) shares. With such shares, the total of the liquidation preference and participation in excess earnings is capped at a pre-specified level. The cap is usually stipulated as a multiple of the liquidation preference value. In order to receive a payout in excess of the specified cap the PCPC shareholder would have to convert that stake into common equity. How does this class of stock affect our model? The cap plays a role similar to that of a QPO. A VC will not convert unless he is assured of a high return—irrespective of the mode of exit. When that exit is via TS, however, there is no signaling role for the preferred shares. Even so, the basic point remains that a high valuation has been achieved, which is probably why the VC is willing to forgo his participation rights.

The analysis presented in this paper brings up one additional question: Can we use a simple convertible preferred (CP) stock instead of the PCP shares described here—to achieve the same results? It is certainly true that for exit valuations below a certain threshold, CP and PCP securities would yield similar results. This claim can be illustrated using numbers from my example in the Introduction. For an exit valuation below $10 million (say $9 m), CP holders would be entitled to their preferred dividend of $5 m when not converting or to $4.5 m (50% of $9 m) upon conversion. However, this generalization applies only for low exit valuations. The focus in this paper is on excess IPOs and trade sales, transactions that almost always feature extremely high valuations. Moreover, even with low valuations it costs more to signal using CP than PC stock; this means that the former security type supports a separating equilibrium over a greater range of q values. The empirical evidence indicates that in about half of all cases, convertible preferred stock is nonparticipating. One possible occasion for the use of nonparticipating stock is because of uncertainty about the entrepreneur’s effort. Nevertheless, the choice between participating and nonparticipating convertible preferred stock raises interesting issues worth exploring.

Almost all preferred securities issued to VCs (including CP, PCP and PCPC) are subject to clauses that require conversion into common prior to an IPO. However, preferred securities differ from other securities in that converting the latter is a decision that simply involves comparing payoffs and then choosing the highest one. In contrast, a VC who converts a PCP stake is giving up his participation rights—which can happen only with PCP stock and is the cost of signaling in our model.

6.3. Optimal security design

In the model I have abstracted from the issue of optimal security design. We have seen that, for a separating equilibrium to exist it is necessary that \( q < f \). One way to ensure this outcome is through the participating and convertibility features of PCP stock. However, I have not addressed the question of how best to design the initial stake.

Given our model’s two point support \( (V^H, V^L) \) our focus on equity is without loss of generality. A combination of equity and risky debt can replicate the payoffs from any optimal security. It should therefore be straightforward to extend our
argument to the case where a VC holds both debt and equity and could convert (at some cost) one or both securities in the event of an IPO.

A more general conclusion that can be drawn from my analysis is that the informed party (in our case the VC) should hold a claim that is sufficiently information sensitive that converting it to a lower stake conveys some information. I posit the existence of a trade-off between this claim’s information sensitivity and how much a VC must forgo in order for such action to be viewed as a credible signal. In a more inclusive model, the issues of security design and convertibility would be considered jointly. The key point here is simply that the optimal security should be convertible otherwise it cannot be used to signal value.

Unlike many other models in the literature, my model does not incorporate the double moral-hazard setting. In that setting, not only does the entrepreneur typically faces some moral hazard problem (as in this paper), but also the VCs must be given incentives because their actions, too are non-contractible. Although model details vary, most theoretical work reaches the conclusion: that convertible preferred equity enables the optimal incentives for both entrepreneur and VC.6

Finally, recent VC literature has analyzed how behavioral factors influence the VC-entrepreneur relationship. For example Fairchild (2011), develops a game-theoretic model with both economic and behavioral factors in a double-sided moral hazard setting. The entrepreneur in his model—when choosing between “angel” and venture capital financing—weighs her empathy with the angel against the VC’s value adding abilities. We can reasonably conclude that including behavioral factors would affect the contracts and thus the results discussed in this paper. Such factors thus provide an interesting avenue for extending our work.

7. Empirical implications

The first question that comes to mind is; Under what circumstances are we likely to observe to financing that involves PCP shares? A general feature of such stock (one that our model does not exploit) is that their participation rights facilitate overcoming financial constraints and thereby help support higher investments. This means that PCP issues are more likely to be used in relatively larger projects. More specifically; although the model developed here does not explicitly compare the use of PCPs and other securities, however I do show that participating stock can be used to signal value when a firm’s VC exits through an IPO. As a result, PCP stock is likely to be used whenever an IPO exit is possible. For this reason, their use is more likely when the venture’s success is uncertain and contingent on entrepreneurial effort.

In what follows I use comparative statics to analyze how changes in different parameter values affect the range of q-values that support a separating equilibrium. Then the results of the analysis are used to make empirical predictions based on those. I focus on two parameters Zmin and q that define the equilibrium.

Lemma 5. The minimum private benefit Zmin required to sustain a separating equilibrium (i) increases with (1-r), with the difference ΔV between the values of the good and mediocre ventures, with the value VH of the good firm, and with the VC’s stake q after conversion and (ii) decreases with value Vf of the mediocre venture and with the amount I of investment raised.

Proof. Rearranging the definition of Zmin in Proposition 3(ii) yields Zmin = hi(VH(1 + x) − f)(1−r)ΔV. From this equality, the comparative statics follow.

The interpretation offered by this paper is that a VC’s private benefits Z are reputation effects that help the VC establish himself among investors. The range of q that supports a separating equilibrium is wider if the distribution of Z is higher in the sense of first-order stochastic dominance. In the dominant distribution it is more likely that Z ≥ Zmin, which makes it easier to give entrepreneurs the incentive of a future IPO. In practice, Z is likely to be higher for younger VCs (who have yet to establish their reputations) and lower for older, more established VCs. Hence the model predicts that we will observe more exits through IPO exits by younger than by older venture capitalists. This prediction is confirmed empirically by Gompers (1996), who observes “grandstanding” by younger VCs. Gompers finds that younger VCs are more likely to exit a venture through an IPO than are older VCs.

Lemma 6. In a fully separating equilibrium the range of q (or f) supporting the equilibria (i) increases as r increases; (ii) increases as Z increases; (iii) decreases as Vf increases; and (iv) decreases as Vf increases.

Proof. See the Appendix A

With increasing probability r that a venture’s true value is known, the range supporting a separating equilibrium also increases. It is safe to assume that r is high for informationally efficient markets (e.g. the US and UK markets) and lower for less efficient ones (as in, for example, much of Continental Europe). In informationally efficient markets there are many analysts

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6 There is an extensive literature on double moral hazard in the venture capital context. Notable contributions include Casamatta (2003) and Repullo and Suarez (2004), for double-sided moral hazard combined with doubles sided asymmetric information see Houben (2003). Excellent reviews are offered by Da Rin et al. (2011)) and Fairchild(2011).

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following stocks and so the probability of correctly valuing a post-IPO stock is relatively high, implying a high \( r \). In fact, the cross-listing literature provides evidence that this is indeed the case. Baker, Nofsinger and Weaver (2002) find that firms listing their shares on both the New York Stock Exchange (NYSE) or the London Stock Exchange (LSE) and their home country experience a significant increase in visibility, as proxied by both analyst coverage and print media attention. Other studies analyzing cross-country differences in, cost of capital (Hail and Leuz (2006)), and IPO underpricing (Banerjee et al. (2011)) reach similar conclusions about the US and other equity markets. We are thus likely to observe more IPO exits in such markets (and conversely, fewer IPO exits in less visible markets). Such correlations might account for more IPO exits being observed in the US than in any other market. Also for extremely low values of \( r \) (i.e. \( r \to 0 \)) a separating equilibrium cannot be sustained at all. In that case the use of convertible securities is redundant. This claim also is borne out by empirical and anecdotal evidence. Note that there is limited use of such securities outside of the United States, especially in Europe (Schwienbacher (2008)). An increase in \( r \) means that the probability that investors know the venture’s true value, has the effect of “loosening” the incentive compatibility condition of the mediocre venture’s VC. In the limit when \( r = 1 \) investors are certain of the mediocre venture’s true value. In effect, this certainty increases the range over which a separating equilibrium is supported.

In sum; our analysis suggests that we are more likely to observe the use of participating shares in well-developed capital markets and for larger projects whose success is both uncertain and contingent on entrepreneurial effort.

8. Conclusion

This paper presents a signaling model of exits by venture capitalists. I argue that participating convertible preferred securities, a sophisticated contracting device, can be used by a VC to signal the venture’s quality at the time of exit. Exit through an IPO has the advantage of incentivizing entrepreneurs, who are usually rewarded with control after the exit. In contrast, the entrepreneur normally loses control of her venture when the VC exits through a trade sale. However, the VC views an IPO as having an informational disadvantage when compared with a TS. Hence a VC may well be reluctant to exit via IPO.

That mismatch of preferences can be resolved with the aid of PCP stock. The VCs conversion of his PCP stake into common equity serves to signal the quality of his venture. In this paper I show that there exists a separating equilibrium in which the VC of a good venture converts his stake (and exits through an IPO) while the VC of a mediocre venture does not convert (and exits through a TS). This equilibrium rewards the entrepreneur with control if the venture is a good one. I thus explain a commonly observed phenomenon in venture capital exits; conversion of VC’s stake prior to an IPO.

The model’s parameters can also be used to explain some commonly observed differences between the United States and other VC markets. In particular, given that U.S. markets feature less informational asymmetry, our model predicts that the United States witnesses more exits through IPOs than do other markets. Finally, we have seen that reputation effects lead to IPO exits being chosen more frequently by younger than by older venture capitalists.

Appendix A

**Proof of Proposition 1.** The incentive compatibility condition (7) for the good can be simplified and rewritten as follows

\[
\frac{q(1-S_H)}{f(1-S_L)} \geq \frac{r_B V_H + (1-r_B)V_L}{V_H^H}
\]

Similarly the IC (8) for the mediocre can be rewritten as

\[
\frac{q(1-S_H)}{f(1-S_L)} \leq \frac{V_L}{r_B V_L + (1-r_B)V_H^H}
\]

The above conditions will be satisfied only if

\[
\frac{V_L}{r_B V_L + (1-r_B)V_H^H} \geq \frac{r_B V_H^H + (1-r_B)V_L}{V_H^H}
\]

Simplifying the above leads us to the following condition

\[
0 \geq (V_H^L - V_L)^2
\]

which can never be satisfied for any values of \( V_H^L \) and \( V_L \), which means that there exists no separating equilibrium.
Proof of Proposition 3. The condition (11) for the good can be simplified and rewritten as

$$q \geq \frac{f(1-S_L) V^H (1+x)}{1-S_H} - Z$$

(16)

Similarly Eq. (12) can be rewritten as

$$q \geq \frac{f(1-S_L) V^L}{1-S_H} - \frac{f(1-S_L) V^H (1+x)}{1-S_H}$$

(17)

Thus a fully separating equilibrium exists if $q$ lies within the values shown above. This gives the first condition for the existence of the fully separating equilibria. We derive below the minimum value of $Z$, $Z_{min}$ which ensures that $q$ lies in the range described by Eqs. (16) and (17). The above conditions imply that

$$\frac{f(1-S_L) V^L}{1-S_H} \geq \frac{f(1-S_L) V^H (1+x)}{1-S_H} - Z$$

(18)

Rearranging and simplifying Eq. (18) gives us the minimum value of $Z$, $Z_{min}$ above which the fully separating equilibria exists.

I now show that $f > q$ in the above equilibrium. Rearranging Eq. (17) I have

$$f \geq \frac{q(1-S_H)}{1-S_L} \left[ \frac{rV^L + (1-r)V^H}{V^H} \right]$$

(19)

From the above $f > q$ if $\frac{(1-S_L)(rV^L + (1-r)V^H)}{1-S_H} > 1$, which I can rewrite as $\frac{(1-S_L)}{1-S_H} + \frac{[rV^L + (1-r)V^H]}{V^H} > 1$.

$\frac{(1-S_L)}{1-S_H}$ is greater than 1 since by definition $S_L > S_H$.

Also, $\frac{rV^L + (1-r)V^H}{V^H} > 1$, since $rV^L + (1-r)V^H > V^H$. Therefore $f > q$.

Proof of Proposition 4. I can arrive at the range which supports the semi-separating equilibrium using a similar method used above for the fully separating equilibrium. The condition (13) for the good can be simplified and rewritten as

$$q \geq \frac{f(1-S_L) V^H (1+x)}{1-S_H} - Z$$

(20)

Similarly Eq. (14) can be rewritten as

$$q \leq \frac{f(1-S_L) V^L}{1-S_H} - \frac{f(1-S_L) V^H (1+x)}{1-S_H}$$

(21)

Thus a semi-separating equilibrium exists if $f$ lies within the values shown above. This gives the first condition for the existence of the semi-separating equilibria. Similarly I derive below the minimum value of $Z$, $Z_{min}$ which ensures that $f$ lies in the range described by Eqs. (20) and (21). The above conditions imply that

$$\frac{f(1-S_L) V^L}{1-S_H} \geq \frac{f(1-S_L) V^H (1+x)}{1-S_H} - Z$$

(22)

Rearranging and simplifying Eq. (22) gives us the minimum value of $Z$, $Z_{min}$ above which the semi-separating equilibria exists.

Proof of Lemma 7. The comparative statics of the various parameters supporting the fully separating equilibrium is arrived at by differentiating the upper and lower bounds with the respective parameters. For ease of exposition I calculate the impact on the range by restating and differentiating the upper and lower bounds w.r.t. $f$. The results hold if the effects are calculated w.r.t. $q$.

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(i) With respect to $r$
Differentiating the lower and upper bound of $f$ with respect to $r$ I have $rac{df_{FS}}{dr} = \frac{q(1-S_h)\left(V^H(1-x)\right)^2}{(1-S_L)^2\left[V^L(1+x)\right]^2}$ which can be further simplified as
$$
\frac{df_{FS}}{dr} = \frac{q(1-S_h)(V^H - V^L)}{(1-S_L)^2\left[V^L(1+x)\right]^2}.
$$
Thus $\frac{df_{FS}}{dr} < 0$. Also the upper bound $F_{FS}$ does not depend on $r$ and hence does not change with $r$. Thus an increase in $r$ results in the lower bound $f_{FS}$ decreasing which causes the entire range to increase.

(ii) With respect to $Z$
Only the upper bound $F_{FS}$ depends on $Z$. On inspecting the value $F_{FS} = \frac{q(1-S_h)(V^H + V^L)}{(1-S_L)^2\left[V^L(1+x)\right]^2}$, I can immediately see that an increase in $Z$ increases $F_{FS}$. The value of $f_{FS}$ does not depend on $Z$ and thus is not affected by it. Therefore an increase in $Z$ results in an increase in the range of $f$ supporting the equilibria.

(iii) With respect to $V^H$
Differentiating the upper and lower bounds of $f$ with respect to $V^H$ I have the following:
$$
\frac{df_{FS}}{dV^H} = \frac{q}{(1-S_h)} \left[ \frac{I}{(1-S_L)^2\left[V^L(1+x)\right]^2} \left[ r + (1-r) \frac{V^H}{V^L} \right] - \frac{(1-r)\left(V^H\right)^2}{V^L(1-x)} \right]
$$
which is clearly $> 0$. Thus $\frac{df_{FS}}{dV^H} > 0$. Similarly, $\frac{df_{FS}}{dV^L} = \frac{q}{(1-S_h)} \left[ \frac{I}{(1-S_L)^2\left[V^L(1+x)\right]^2} \left[ r + (1-r) \frac{V^H}{V^L} \right] - \frac{(1-r)\left(V^H\right)^2}{V^L(1-x)} \right]$, which is $< 0$. Thus an increase in $V^H$ leads to an increase in $f_{FS}$ and a decrease in $F_{FS}$ which has the effect of decreasing the range supporting the equilibria.

(iv) With respect to $V^L$
Differentiating the upper and lower bounds of $f$ with respect to $V^L$ I have the following:
$$
\frac{df_{FS}}{dV^L} = q(1-S_h) \left\{ \frac{I}{(1-S_L)^2\left[V^L(1+x)\right]^2} \left[ r + (1-r) \frac{V^H}{V^L} \right] - \frac{(1-r)\left(V^H\right)^2}{V^L(1-x)} \right\},
$$
The above expression is positive if
$$
\frac{I}{(1-S_L)^2\left[V^L(1+x)\right]^2} \left[ r + (1-r) \frac{V^H}{V^L} \right] \geq \frac{(1-r)\left(V^H\right)^2}{V^L(1-x)}.
$$
Simplifying it can be shown that it is not true, thus $\frac{df_{FS}}{dV^L} < 0$. Similarly,
$$
\frac{df_{FS}}{dV^L} = -q(1-S_h)\frac{V^H(1+x)}{V^L(1+x)} + Z \frac{I}{(1-S_L)^2\left[V^L(1+x)\right]^2},
$$
which is clearly $< 0$.
Thus an increase in $V^L$ causes both the lower bound and upper bound to decrease resulting in a decreased range of $f$ supporting the separating equilibrium.

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