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Participating Convertible Preferred Stock in Venture Capital Exits

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Abstract

This paper provides an explanation for the use of Participating Convertible Preferred (PCP) securities in venture capital contracting. We argue that venture capitalists (VCs) use PCP to signal the quality of their venture. VCs signal by exercising the option of converting their PCP stake into common equity, when they exit from the venture. Based on the model we derive empirical implications for the two major forms of exit observed in venture capital i.e. IPOs and Trade Sale.

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1 Introduction

It is a well known fact that convertibles are the most commonly used securities in venture capital contracting especially in the US. The security of choice in most venture financed deals is convertible preferred stock. Kaplan and Strömberg (2003) in their empirical analysis of venture contracts find that nearly 80% of all venture financing use convertible preferred stock. Further, they also find that in nearly 50% of the cases the convertible preferred was participating. "Participating" preferred means securities which participate in excess earnings with the common shareholder over and above their preferred dividend. One of the most important features of these securities is that they allocate different cash flow rights depending on whether exit occurs through a Trade Sale (TS) or an Initial Public Offering (IPO). We give below simple examples which illustrate this feature.

Assume that a venture capitalists' (VC) investment entitles him to $5 million in a given venture in the form of a Convertible Preferred (CP), which is convertible into 50 percent of the common equity. Further assume that the company is finally liquidated for $12 million. The VC then has two choices he can either convert his stake to common equity and be entitled to 50% of the proceeds i.e. $6 million or he need not convert and can be paid his preferred proceeds i.e. $5 million.

Participating Convertible Preferred (PCP) is similar to convertible preferred stock, with participation rights. Participating rights allow the holder to participate in excess earnings with the common shareholders in case of liquidation. Thus for simplicity in the above example assume that the PCP holder is entitled to participation rights of 50 percent. Again referring to

the above example if the VC has invested \$5 million and has a PCP stake then on conversion to common equity he gets \$6 million (i.e. 50% of \$12 million), but if he chooses not to convert he gets \$5 million back plus shares in 50 percent of the remaining \$7 million (i.e. \$12 million minus \$5 million). Accordingly the PCP holder can get \$8.5 million (if he does not convert) and the common shareholders get the remaining \$3.5 million. Thus it is obvious from both examples that the cash flow rights to the holder of the PCP varies depending on whether he converts his stake or not.

Most venture capital agreements provide for mergers or trade sale as a liquidation event, in which case the venture capitalist is entitled to participation/preferred rights. In contrast, most agreements provide for automatic conversion of the convertible stake into common equity in case of an IPO. There is therefore a clear dichotomy in the treatment of "participation/preferred rights" of the VC based on the type of exit viz. IPOs and Trade Sales/Mergers. In giving up the participation and preferred rights during an IPO the VC in many cases is giving up a substantial portion of his cash flow rights. The question we address in this paper is why is the VC prepared to give up his rights in case of IPO and why not in case of a TS?

We begin by looking at the existing explanations for the use and conversion of PCPs. Practitioners as epitomised by Bartlett (1995) say that automatic conversion on the eve of an IPO is necessary to clean up the balance sheet and cancel various special rights peculiar to separate classes of stock. Further, automatic conversion is necessary because in many cases it is difficult to cajole holders (especially former disgruntled employees) into converting and who can hold-up the exit process. This explanation however

is not convincing because presumably VCs will face similar problems in case of a TS too. It is not clear why the buyer in a TS is prepared to accept the hassle of dealing with former employees and other associated problems.

A major reason for use of PCPs is of course the protection it affords VCs from unscrupulous entrepreneurs. This has been eloquently described 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 this was unfair because the investors "double-dipped," meaning that they got back their original investment and then shared in the remaining equity pool. The VCs in the case-study countered that the clause was important to create a disincentive for the entrepreneurs to sell the company early in life at a low price. This is a valid reason for the issue of these securities but it still does not answer the question posed above i.e. why are they treated differently in different exit situations?

Kaplan and Strömberg (2003) also document that the automatic conversion provision kicks off, only if the company completes an IPO at a price which is on a median around 3.0 times greater than the stock price of the latest financing round. This ratio is significantly higher if the price of the first VC rounds is considered. It is therefore quite clear that the VC is not prepared to give up control as well as participation/preferred rights unless he is assured of a high exit value. This leads to our argument for the use of PCPs.

We believe that PCPs are used by VCs to signal the quality of a firm. Signalling is particularly important in case of an IPO since the shares are

sold to investors who are relatively uninformed about the true value of the company. In contrast, in case of a TS bidding firms have the opportunity to conduct due diligence before finalizing the deal and are thus relatively well informed about the value of the company. We will argue that the VCs convert their stake into common equity and accept a lower stake in case of exits through IPOs to signal the quality of the venture to investors but do not do so in case of TS since the buyers are relatively well informed about the value of the firm. Thus the relative costs (as compared to TS) of exiting through an IPO creates the possibility of a signalling equilibrium in which good firms choose that route. Such an "ex-post" equilibrium can also provide ex-ante incentives to the entrepreneur, since after an IPO the VC exits and the entrepreneur remains in control of the venture. In contrast, in a TS the entrepreneur loses control of her venture. Thus exit through an IPO, provided it happens only when firm value is high has the desirable property of rewarding the good entrepreneur with control.

The role of VCs in certifying IPOs has been well documented. Megginson and Weiss (1991) provide support for the certification role of venture capitalists in bringing new issues to market. They show that the presence of venture capitalists in the offering firm certifies the quality of the issue through their investment in financial and reputational capital. The paper provides empirical support for their hypothesis 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. They find that the costs of going public for VC backed IPOs is significantly lower than those for non-VC backed IPOs. They however contend that the mere pres-

ence of the VC is enough to certify the venture, we take this a step further and argue that VCs use the conversion of their stake to signal the quality of the venture.

Black and Gilson(1997) do not present a formal model but make the point about rewarding the good entrepreneur with control. They argue that in a stock market based system like the US (unlike a bank based system like Germany) there is an implicit contract between the VC and the entrepreneur in which the VC agrees to give control back to the entrepeneur, if the venture does well, by exiting through an IPO. In case of a TS control of the venture is transferred to the acquirer whereas in IPOs control remains with the entrepreneur. The authors argue that the opportunity to acquire control is a powerful incentive for the entrepreneur much beyond the purely financial gain arising out of an appreciation of her stake. Our model while formalising the above argument additionally points to the signalling role of PCPs in the VCs' exit decisions.

The only other paper that deals with the use of convertible preferred stock in venture capital exits is by Hellmann (2004). In his paper Hellmann using a double moral hazard model shows that pure equity is the optimal security for this problem. Convertible preferred equity preserves balanced incentives if the venture remains independent (i.e. an IPO), but allow the VC to extract additional rents if it gets acquired (i.e. a Trade Sale). The model therefore contends that these securities are useful in providing incentives to entrepreneurs *after the exit event*. It is an empirical fact that VC and entrepreneurs have lock-in periods (usually 6 months) attached to their stakes and usually cannot exit in an IPO. The exit event normally signals that the

VC cannot add any further value and IPO signals that the VC is confident of the entrepreneurs ability to manage. Also unlike the pre-IPO stage, post-IPO the VC is no longer involved in the running of the venture. He is simply interested in giving up his stake from the venture as soon as possible. It is therefore not clear why optimal incentives for post IPO effort to the entrepreneur should be an issue to the VC.

The current paper also contributes to the literature on exits in venture capital. Berglöff (1994) and Bascha and Walz (2001) model the trade-offs between IPOs and trade sales. In both these papers and also in the above paper by Hellmann (2004) there are conflicts between the entrepreneur and VC on most appropriate method of exit from a venture. Convertible securities can help in the selection of the optimal exit strategy by allocating control rights suitably. In our model we abstract from this conflict and instead focus on how convertibles help in resolving information asymmetry and provide ex-ante incentives to the entrepreneur.

This paper is also related to the work of Faure-Grimaud and Gromb(2004) and Aghion, Bolton and Tirole(2001) who examine how liquidity shocks affect a venture capitalists desire to exit an investment. Finally, Gilson and Schizer (2002) provide a tax explanation for the use of convertible preferred stock. They argue that the use of these kind of securities triggers a tax subsidy for the intensely incentivised management compensation structures that are central to venture capital contracting.

The structure of the paper is as follows. *Section 2* describes the set-up of the model, *Section 3* sets out the first-best incentives of the entrepreneur and the choices facing the VC, *Section 4* looks at the various signalling

equilibria possible, *Section 5* describes incentives in the context of signalling, comparative statics and their empirical implications. *Section 6* concludes. Most of the proofs are provided in the appendix.

2 The Model

Consider a young technology firm that has a novel idea, but lacks financial means and, hence, must rely on a venture capitalist to implement the project. To set-up the project, the technology firm, referred to as the *entrepreneur (she)* or the *venture capitalist (he)* must commit some resources, whose opportunity cost we denote by K. Our entrepreneur is wealth constrained and hence the entire resources for the project comes from the venture capitalist. We further assume that there is more than one VC interested in the project so that the investing VC cannot appropriate any rents.

Contracts: The VC gets a proportion f of the cash flows of the venture in return for his investment. For the moment we think of the security held by the VC as some kind of convertible preferred equity and take it as given to isolate its properties. Since the security is convertible, the VC can convert his stake into common equity which will entitle him to some proportion q ($\neq f$) of the cash flows. The entrepreneur is entitled to the remaining cash flows and holds a common equity stake.

Project: After the investments are made at $t = 1$ either the venture is a good firm having a value of V^H with probability p or with the complementary probability $(1-p)$ the venture is mediocre and is valued at V^L (where $V^H > V^L$). The probability p will depend on the effort of the entrepreneur, which

is described below.

After the initial investment K is made by the VC at sometime in the future, after the value realization, an investment of I needs to be made to take the venture forward. This investment is a positive NPV project and gives a constant rate of return of x. Thus the overall value of the firm after investment is either $V^H(1+x)$ or $V^L(1+x)$ as the case may be. We assume that unless this investment I is made, the value generated by the venture cannot be realised and distributed to the entrepreneur and the VC. Both the good and mediocre projects are positive NPV i.e. $V^L(1+x) \geq K+I$, it is therefore worthwhile to invest. However, both the entrepreneur and the VC cannot provide the required investment for the reasons described below:

- The entrepreneur because she is wealth constrained.

- The VC because he wants to exit the investment. The justification for this is the fact that VCs generally tend to invest in firms through a limited partnership. These limited partnerships have a finite life of 10-12 years after which they are dissolved. VCs thus tend to invest in the first 5-6 years of the partnership after which they stop investing. They then try and exit their investments so that the partnership can be dissolved. We wish to capture the exit motive of the VCs by this assumption. The VC is at the stage where he has finished investing and is now interested in exiting the venture[1].

[1]Another interesting research question is to investigate why VCs partnerships have limited life (See Sahlman (1990)). We ignore this question as we take this feature as given, but explore in our setting the implications of this feature for the form of exit.

We can also think of K and I as start-up and late-stage investments respectively. The start-up investment can in fact be a series of smaller amounts $k_1, k_2....., k_n$ provided in stages on achievement of certain miletsones by the VC as is usually the case in practice in VC investing and the investment I is late stage investment. It is well known that investors providing start-up financing are distinct from those investing at later stages. The description in the preceding paragraphs aims to capture this fact for our model.

Exits: The only methods of raising the investment is either through a Trade Sale (TS) or an Initial Public Offering (IPO). We focus only on IPOs and Trade Sales since these are the most common forms of exit observed in the VC industry. For the puposes of this paper the exit options are modeled only in terms of how well informed the buying parties are. TS and IPO are thought to be the two extreme cases of this spectrum. Investors in a TS are assumed to be the most informed and those in an IPO the least informed. To simplify the analysis we make the following assumptions:

- **Trade Sale (TS):** Trade Sales investors in our model are perfectly informed, in other words investors would know the value of the venture with probability 1.

- **Initial Public Offerings (IPO):** In case of IPOs, however, the true value of the venture is known only with a probability $r < 1$. Thus $(1 - r)$ is the normalised maximum *informational advantage* of a TS buyer.

Looking at IPOs and TS from an informational point of view it is well know that shares in an IPO are normally sold to buyers through an Invest-

ment Bank. The investors in an IPO do not have access to the books of the company and usually have to rely on the recommendations of the Investment Bank. On the other hand trade buyers (in an acquisition) who make an offer are given access to the company's books and can conduct due diligence to find out the true state of the firm and are thus normally better informed than the IPO investors in line with our assumptions.

Preferences: Both the VC and the entrepreneur are risk neutral in income. Both may however get *private benefits* from the project.

Firstly, since it was the entrepreneur who thought about the project and took the initiative of setting it up she would like the freedom to develop and manage it in her own way. She therefore derives a private benefit, if she is in control of the project. This usually happens in case of an IPO, where the entrepreneur is left in control after the VC exits. We therefore assume that the private benefit that the entrepreneur gets after an IPO, B, is greater than that after a TS, b. We further distinguish between the private benefits for the good and medicore firms by using the subscripts G and M. Thus $B_G(B_M)$ and $b_G(b_M)$ are the private benefits if the venture is good(mediocre) and exit is through an IPO and TS respectively.

The entrepreneur also provides effort which affects the probability of success of the venture. If she exerts effort the probability of the venture being good is p and 0 otherwise. The effort provided is unobservable and costly. We assume these costs to be e. As the effort is costly there may be a moral hazard problem that has to be addressed. This is not because the entrepreneur is insufficiently motivated and may shirk for e.g. with regard to the technical aspects of the venture. Typically the entrepreneur is a researcher who

is interested in the pursuit of her scientific idea. But contrary to that, VCs believe that entrepreneurs are too often preoccupied with these problems and hence neglect the financial and business development aspects of their ventures. Hence, we assume that there are costs to the entrepreneur, if she has to spend some effort on the business administration aspects that are crucial for the success probability of the venture.

We similarly assume that the VC gets a private benefit if the firm is good and the exit is through an IPO. We like to think of this private benefit as a reputation effect. Amit et al. (1998) show that VCs might try to acquire reputation for presenting only high quality ventures in IPOs. Besides it is well known empirically that IPOs are the holy grail of VC exits. Most VCs want to try and exit through an IPO to prove themselves (see Gompers (1996)). It therefore reasonable to assume that IPOs are associated with a greater reputation effect for VCs than TS. Thus for simplicity we assume that the VC gets a private benefit, only if he exits through an IPO and not a TS. Additionally even when exiting through an IPO the reputation gain is definitely likely to be higher if the VC brings a good firm like Amazon.com to the market as compared to an unknown firm. We therefore assume that the VC gets a private benefit Z if the venture is good and the method of exit is an IPO and 0 in all other cases.

Information: The value realisation of the venture can be observed only by the insiders i.e. the entrepreneur and the venture capitalist. The outside investors (both trade buyers and IPO investors) cannot observe the value at the time of the investment I. Also as described above the investors after investing know the value of the venture with probability r (or 1) in case of

an IPO (or TS).

A further implication of this assumption is that in case of a TS the investors once having invested I observe the true value of the firm and pay a fair price for the remaining stake of the VC whereas investors in an IPO pay the fair price only with probability r.

Control: Finally in our model we assume that the VC is in control and makes all exit decisions. The question of control allocation has received a lot of attention in the literature. We wish to abstract from that question in this model and have simply made the empirically most relevant assumption.

Timeline: The timeline of our model is summarised below:

1. $\mathbf{t = 0}$: Entrepreneur has an idea and approaches the VC. VC provides investment of K in return for a convertible stake f. Entrepreneur provides effort.

2. $\mathbf{t = 1}$: Value of the venture is realised and observed by the VC and the entrepreneur.

3. $\mathbf{t = 1.5}$: VC can decide whether or not to convert his stake into common equity.

4. $\mathbf{t = 1.75}$: I raised by selling stake either through a TS or an IPO.

5. $\mathbf{t = 2}$: Investor observes value of firm with probability r (if IPO) or 1 (if TS).

6. $\mathbf{t = 3}$: VC exits by selling his remaining stake

Typically VCs exit from a venture in two stages. A small fraction of their holdings is sold during the IPO and the bulk of their holdings are sold

sometime after the IPO. VC's typically retain a large fraction of their equity holdings subsequent to an IPO. Megginson and Weiss(1991) report that on average, venture capitalists own 36.6% of the firm prior to the IPO and 26.3% immediately thereafter. The timeline presented above seeks to capture this fact.

3 First Best

3.1 Entrepreneur's Incentives

Assume initially that the entrepreneur cares only about private benefits. For reasons already described above we focus only on IPOs and TS as methods of exit. Thus the entrepreneur's incentives to create a venture is given by

$$p\left[\mu B_G + (1-\mu)b_G\right] + (1-p)\left[\gamma B_M + (1-\gamma)b_M\right] \geq e + \left[\gamma B_M + (1-\gamma)b_M\right] \quad (1)$$

where

p is the probability that the venture is good if the Entrepreneur exerts effort, 0 otherwise.

μ is the probability of an IPO given that the venture is good.

γ is the probability of an IPO given that the venture is mediocre.

B_G is the private benefit the entrepreneur gets if the venture is good and exit is through an IPO.

b_G is the private benefit the entrepreneur gets if the venture is good and exit is though a Trade Sale.

Similarly, B_M and b_M are the private benefits if the venture is mediocre and exit is through an IPO and TS respectively.

Finally, e is the disutility of effort incurred by the entrepreneur.

After an exit through a TS the entrepreneur is not in control of the venture. Control of the venture passes to the acquiring company, the entrepreneur therefore does not get any private benefits i.e. $b_G = b_M = 0$. Thus the entrepreneur's incentive compatibility simplifies to

$$p\left[\mu B_G - \gamma B_M\right] \geq e \tag{2}$$

Assume for simplicity that $B_G = B_M = B$. The equation then simplifies further to

$$pB\left[\mu - \gamma\right] \geq e \tag{3}$$

From the above it is clear that the entrepreneur's incentives to exert effort goes up with μ, the probability of an IPO when the firm value is high and is maximum when $\mu = 1$. Further her incentives go down with γ, the probability of an IPO when the firm value is low. This is interesting because like the argument in Black and Gilson(1997) the entrepreneur can be suitably rewarded for her efforts, if the VC can commit to exit through an IPO whenever value of the firm is high. To reiterate, entrepreneur's incentives to exert effort and thus to start a venture in the first place increases with μ, and is maximum when $\mu = 1$.

3.2 VCs' Choices

The VC on the other hand is concerned with both cash flows and private benefits. He faces a dilemma in choosing the appropriate method of exit. IPOs maximise the incentives of the entrepreneur, however informationally they are at a disadvantage compared to a TS. Also given the informational asymmetries between the insiders and the investors, the VC of the good venture might not even get a fair price for the initial investment I, as discussed below.

If there were no information asymmetries between the VC and the investors, the venture will have to offer the following stakes in return for the investment I.

If the venture was good with a value V^H then the investor would demand a share S_H which is as follows.

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

On the other hand if the venture was mediocre with a value of V^L then the investor will be given a stake of S_L in the venture defined as follows.

$$S_L = \frac{I}{V^L(1+x)} \tag{5}$$

Assuming instead that outside investors hold some prior beliefs α that the quality of the venture is good and absent any other signal they would use the prior probabilities of the state of the firm to price their investment i.e.

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

Consider now the situation from the point of view of a VC who holds a stake of f, that may be converted prior to raising new capital into q. Suppose that the venture is successful with value, V^H, and the VC knows that, he then faces the following trade-off:

- Sell his stake as it is to investors with most optimistic beliefs i.e. highest α. Given that we are considering the strategic choice faced by a VC who knows V^H this amounts to choosing the form of exit involving the best informed buyers; which is the TS;

- or the VC can consider the possibility to use of an exit mode to signal additional information to the market.

Given our previous discussion on entrepreneur's incentives it would be most efficient if the VC chose IPO as the method of exit as it will efficiently reward the entrepreneur, but our realistic assumption is that other things being equal investors in an IPO are relatively less informed than a TS.

The problem is that because of the informational disadvantage of the IPO, the good venture does not always get a fair value for the venture. Therefore the VCs of the good firms need to take some action to signal their type to the investors. By doing so they can exit through an IPO which preserves the entrepreneur's incentives and also get a full price for their stake. In what follows we argue that VCs' can signal the firm's type by converting their preferred convertible stake into common equity in case of an IPO. The signal is costly since the VC has to give up his preferred rights. In what follows we look at the various possibilities of signalling.

4 Conversion as a Signal

In this section we argue that one of the ways in which the VC can ensure a fair value for his stake as well as preserve incentives for the entrepreneur is to signal to the market by converting his PCP stake. To be effective in conveying additional information to the market the signalling action should have the following features. First to be effective, a signal has to be costly. Second, it has to be more costly for the bad type than for the good type. As discussed earlier PCPs have the feature whereby on conversion the stake q that the VC gets is lower than his original stake f. Conversion thus clearly satisfies the first feature. We now look at the conditions under which the second feature can be satisfied.

4.1 Conversion without exit choice

We begin by looking at whether a signalling equilibrium exists if there is only one method of exit available. To give an example, unlike the US in many countries in continental Europe TS is the only possible method of exit available to VCs' mainly stock markets are not very active and well developed. Assume as described above VCs' cannot choose the method of exit but they can convert their PCP stake for signalling to the market. Further assume that once having invested investors can find the true value of the venture with some probability r_B that can take values in the interval $[r, 1]$. We use r_B here to distinguish from r, the probability that an investor in the IPO finds the true value of the venture. Again to distinguish the exit type from IPOs we assume that the probability of investors finding the true value

is $\geq r$.

The VC of the venture can try and signal his type by converting his preferred stake f to common equity q. We look for a separating equilibrium in which the VC of good firm converts whereas the VC of the mediocre does not. The analysis of the equilibrium is constructive. A set of investor beliefs is specified, and a program that assures that firms behave accordingly is constructed. We begin by assuming that investors believe that the VC of the good firm converts his stake to common equity to signal his type. Therefore if the investors observe conversion they think that the venture is good and mediocre otherwise. Based on their beliefs they accordingly demand a suitable stake in return for their investment. Since there is only one method of exit there is no impact on the reputation of the VCs' and therefore no VC derives any private benefits.

For such an equilibrium to exist the following incentive compatibility conditions must be satisfied.

$$q(1-S_H)V^H(1+x) \geq f(1-S_L)(1+x)\left[r_B V^H + (1-r_B)V^L\right] \qquad (7)$$

$$f(1-S_L)V^L(1+x) \geq q(1-S_H)(1+x)\left[r_B V^L + (1-r_B)V^H\right] \qquad (8)$$

If the venture is good the investors accept a stake S_H (4) in return for their investment. The first condition (7) simply states that the VC's payout from the good venture after conversion of his stake into common equity is greater than not converting and being unsure of the price that will be offered by the investors. Investors offer the correct price with a probability of r_B.

Similarly, the condition (8) states that it is not worthwhile for the VC of the mediocre firm to mimic a good firm. By converting his stake to mimick the good, the mediocre firm is offered the price of the good firm for the investment I. However, once having bought a stake in the venture the investor knows the true value of the firm with probability r_B. The above conditions lead to the following proposition:

Proposition 1 *There does not exist a separating equilibrium in which the good VC can signal the firms' type by converting his convertible preferred stake into common equity, if both types have only one available exit strategy.*

Proof. See the appendix. ■

It is thus not possible for a VC who has no control over the exit decision but who can only convert his holdings to signal to the market. The reason being that even though the good VC is prepared to convert to signal his type, it is easy for the mediocre VC to mimick the good. In mimicking the good VC the mediocre VC gives up $f - q$ stake in the venture but in return gets the higher price S_H (instead of S_L) for the initial investment I and also with probability $(1 - r_B)$ he is likely to be mistaken for the good VC. Therefore ex-ante it is difficult to satisfy the mediocre VC's IC given by (8).

If there exists no separating equilibrium the VC of the good firm will not convert, since conversion results in a lower stake. The above result clearly depends upon the fact that there is only one available exit strategy and the fact the investors after their invetment know the true value of the firm with probability r_B.

Finally, notice that if there is only method it is impossible to satisfy the entrepreneur's IC. The entrepreneur's IC (3) can be satisfied (when $B_G =$

$B_M = B$) provided there is a difference in the probabilities of exit through an IPO, in particular when $\mu > \gamma$. In the above situation there is only one method of exit and thus there is no way of satisfying her IC, and motivating her to exert effort.

4.2 Exit choice without conversion

Consider now the opposite case where VCs hold a share f, of common equity without any conversion rights. However, they can exit through either an IPO or TS. Now they can use the method of exit to try and signal their type to the market.

We now look at whether a separating equilibria is possible in which the good exits through an IPO and the mediocre through a TS. Again the analysis of the equilibrium is constructive. Investors beliefs are that firms exiting through an IPO are good and those that exit through a TS are mediocre. The incentive compatibility conditions for such an equilibrium are:

$$f(1 - S_H)V^H(1 + x) + Z \geq f(1 - S_L)V^H(1 + x) \tag{9}$$

$$f(1 - S_L)V^L(1 + x) \geq f(1 - S_H)(1 + x)[rV^L + (1 - r)V^H] \tag{10}$$

The first condition (9) is the IC for the good VC which simply states that the overall payoff to the good VC when he exits through an IPO is greater than exiting through a TS. When the good VC exits through an IPO additionally he also gets the private benefit Z or reputation effect described above. Please note that the good VC does not get the private benefit Z, if he exits through a TS.

Similarly, the second condition is the IC for the mediocre VC. It states that it is worthwhile for the mediocre VC to exit through a TS rather than an IPO. Anyone exiting through a TS is believed to be medicore and investors pay a price S_L for the initial stake. Subsequently, TS invetsors know the true value of the venture (with probability 1) and pay the actual price for the remaining stake of the VC. In contrast, in case of an IPO investors pay the actual price of the venture for the VCs' remaining stake, only with a probability $r < 1$.

The good VC's IC (9) will always be satisfied but the mediocre VCs' IC (10) will never be satisfied. Since $V^H > V^L$, for all values of $r < 1$, $[rV^L + (1-r)V^H]$ will be greater than V^L and by definition $(1 - S_H)$ is greater than $(1 - S_L)$. The right hand side of (10) will always be greater than the left hand side and mediocre's IC can never be satisfied. Therefore a separating equilibrium in which VCs' hold common equity stakes and the good exits through an IPO and the mediocre using a TS does not exist. Similarly, it can be shown that a separating equilibrium with VCs' holding common equity and the good exiting through a TS and the mediocre by an IPO does not exist. The above leads us to the following proposition.

Proposition 2 *There does not exist a separating equilibrium in which VCs can signal their firms' type by choosing an exit strategy (either IPO or TS), if VCs hold common equity.*

Proof. Refer to discussion above. ■

The above result obtains because the mediocre VCs' incentive compt-ability condition cannot be satisfied. Unlike the case with conversion but

no exit choice, in which conversion imposes a cost, here the mediocre VC is always better off mimicking the good since there is no cost. As a result a separating equilibrium cannot exist without conversion and consequently in such a situation both the good and mediocre VC will pool and choose the same exit strategy. Again if both the good and mediocre VCs choosing the same method of exit is not good for the entrepreneur's incentives and her IC (3) cannot be satisfied.

4.3 Exit choice with conversion

In this section we look at the presence of a separating equilibrium when both trade sale and IPO are available to the VCs as exit strategies and the VCs hold a PCP stake, which they can convert. We look for a separating equilibrium in which the good converts and exits through an IPO whereas the mediocre does not convert and exits through a TS. Thus investors beliefs are that the venture is good, if they observe that the VC has converted his stake and is exiting through an IPO, and mediocre otherwise. In case of an exit through an IPO, the investors do not know the true value of the firm even after investment. They observe the true value only with probability r.

Our approach is again constructive. The incentive compatibility conditions for such an equilibrium given the investors beliefs are as follows:

$$\left[q(1-S_H)V^H(1+x)\right] + Z \geq f(1-S_L)V^H(1+x) \tag{11}$$

$$f(1-S_L)V^L(1+x) \geq q(1-S_H)\left[rV^L + (1-r)V^H\right](1+x) \tag{12}$$

For a separating equilibrium to exist the investors believe that the VC converting his stake is good and accept a stake S_H from that venture. The first condition (11) simply states that the good VC is better off converting (and accepting a stake q) and paying a price S_H for the investment rather than not converting (and retaining the stake f) being mistaken for a mediocre one and exiting through a TS. As described in the setup above the VC gets a private benefit of Z in case of successful IPO for a good firm. It should be clear from the condition that for the conversion signal to be credible $q < f$.

The second condition (12) similarly states that it is not worthwhile for the mediocre to mimic the good and exit through an IPO. The mediocre is better off not converting and exiting through a TS. However, even when he converts, the mediocre firm is not assured of a high valuation for the remaining stake. Investors (in an IPO) realise the true value of the venture with probability r and only with the complementary probability $(1-r)$ the firm is mistaken for the good. The conditions yields the following proposition

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

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

2) $Z \geq Z_{\min} = \frac{q}{V^L}[V^H(1+x) - I](1-r)\Delta V.$

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

Proof. See Appendix ■

We define the range in which a fully separating equilibrium exists as $f \in \left(\underline{f_{FS}}, \overline{f_{FS}}\right)$. The lower bound of the range i.e.$\underline{f_{FS}}$, defines the threshold

below which the mediocre VC no longer finds it worthwhile to exit through a TS. Similarly, above the higher bound $\overline{f_{FS}}$ the good VC's payoff from the TS is greater than that of the IPO. Thus a fully separating equilibria in which the good converts and exits through an IPO whereas the mediocre does not convert and exits though a TS exists only if f lies in this range.

The other necessary condition for a separating equilibria to exist is that the private benefits Z should be at least equal to $Z_{\min}$ defined above where ΔV is equal to $\left(V^H - V^L\right)$. Both conditions above are necessary for a fully separating equilibria to exist.

Given a value of q a separating equilibrium exists only for the stated values of f and Z. A separating equlibrium cannot exist for values of $f > \overline{f_{FS}}$ since in such cases the payoff to the good VC from a TS is much higher than an IPO, so he will prefer exiting through a TS. On the other hand whenever $f < \underline{f_{FS}}$, the mediocre VCs' payoff from exiting through an IPO is higher than a TS, so he will prefer exiting through an IPO rather than a TS. Also, the good VC converts to a lower stake and exits though an IPO because of the reputation (private benefit Z) he gains from bringing a good firm to the market. This is crucial because given our assumption of TS being informationally more efficient than an IPO the firm does not gain in terms of firm valuation in an IPO vis-a-vis a TS.

Exiting through an IPO is good for the entrepreneur's incentives. Empirical evidence also suggests that exiting through an IPO is the holy grail of VC investing. It is well documented that returns from an IPO to VCs are much higher than any other form of exit. It is also a requirement of most venture agreements that convertible stakes are automatically converted into

common equity in case of IPOs when certain conditions are satisfied.

4.4 Other equilibria

4.4.1 Semi-separating equilibria

We also look at the range of f in which there is a possibility of a semi-separating equilibria. In this section we therefore look at the possibility that the VC of the good firm does an IPO with probability μ and a TS otherwise. We investigate whether it is possible to have an equilibrium under such circumstances. For the good VC to be willing to randomize between separating by converting and exiting through an IPO and pooling by not converting and exiting through a TS, the payoff must make the VC indifferent between the two. Again for the signal to be credible $q < f$. The condition for the existence of such a hybrid or semi-separating equilibrium is thus:

$$[q(1 - S_H)V^H(1 + x)] + Z \geq f(1 - \widehat{S})V^H(1 + x) \tag{13}$$

$$f(1 - \widehat{S})V^L(1 + x) \geq q(1 - S_H)\left[rV^L + (1 - r)V^H\right](1 + x) \tag{14}$$

This condition is similar to those of the fully separating equilibria, the only difference being that in case of a TS the investors can no longer conclude that the venture is mediocre. The investors know that a firm doing an IPO is good, whereas a firm raising investment through a TS might be good or mediocre. The investors update their prior probabilities of good and mediocre i.e. α and $(1 - \alpha)$ with the additional information about the probability of the good performing an IPO i.e. μ. Using Bayesian updating the investors

arrive at the new share for companies performing TS i.e. $\widehat{S}$. This share $\widehat{S}$ is given by the following relationship:

$$\widehat{S}\left[\frac{(1-\mu)\alpha}{(1-\mu)\alpha+(1-\alpha)}V^H(1+x)+\frac{(1-\alpha)}{(1-\mu)\alpha+(1-\alpha)}V^L(1+x)\right]=I \tag{15}$$

Proposition 4 *There exists semi separating equilibria in which the good VC randomises between converting his PCP stake (and exiting through an IPO) and not converting (and exiting through a Trade Sale) provided*

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

2)$Z \geq Z_{\min} = \frac{q}{V^L}[V^H(1+x)-I](1-r)\Delta V$

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

Proof. See Appendix ■

Again similar to the condition on f for a fully separating equilibria, the range of f which supports the semi-separating equilibria is defined as $f \in (\overline{f_{SS}}, \underline{f_{SS}})$. Note that the value of $Z_{\min}$ which supports the separating equilibria is the same for both the fully separating and the semi-separating equilibria. $Z_{\min}$ is the minimum reputation gain required for the good VC to exit through an IPO. The fully separating equilibrium and the semi-seperating equilibria differ only in terms of the probability of exiting through an IPO in the high state. The payoffs to a VC if exit is through an IPO is the same for both fully separating and semi-separating equilibria. Therefore the value of $Z_{\min}$ is the same for both equilibria.

The payoff to the good VC when he does not exit through an IPO in a semi-separating equilibria is higher than in a fully separating equilibrium. This is reflected in the lower bound of f in a semi-separating equilibria f_{SS},being lower than that of the fully separating equilibrium viz. $\underline{f_{FS}}$.

Comparing the range of f for a fully separating and semi-separating equilibria it can be shown that $\overline{f_{FS}} > \overline{f_{SS}} > \underline{f_{FS}} > \underline{f_{SS}}$ where the $f \in (\overline{f_{SS}}, \underline{f_{SS}})$ is the range of values where a semi-separating equilibria exists and similarly $f \in (\overline{f_{FS}}, \underline{f_{FS}})$ is the range in which a fully separating equilibrium exists.

It is clear from the above discussion that higher values of f in the range support a fully separating equilibria, medium values support both both fully separating and semi-separating equilibria and low values support only a semi-separating equilibria.

Higher values of f increase the payoffs when the good VC does not convert. However the upper bound of f in case of the fully separating equilibria is higher than that of semi-separating equilibria. This is because in case of the fully separating equilibria if the good does not convert and exits through a TS he is mistaken for the mediocre and gets only the price offered to the mediocre for the initial investment. This is lower than the price the VC is offered in a semi-separating equilibria, since in a semi-separating equilibria the good and mediocre might pool in case of a TS and the price offered reflects that.

Finally, the lower range supports only a semi-separating equilibria because the the lower bound is that value of f below which the mediocre VC is not prepared to exit through a TS. The VC gets a higher price in a semi-separating equilibria, because of pooling, than in a fully separating equilibria.

Hence the lower bound of f in a fully-separating equilibria is greater than that of the semi-separating equilibria.

It is clear from the above discussion that certain values of the parameters support both a semi-separating as well as fully separating equilibria. However, the probability of exiting through an IPO given V^H, is lower in the case of semi-separating equilibria as compared to the fully separating equilibrium. Thus from a point of view of incentivising the entrepreneur, it is optimal for VCs to commit to exit through an IPO all other things being equal. A VC will prefer to randomise between an IPO and TS ex-ante when V^H is realised only if his stake in the venture f is low and lies in the range $[\underline{f_{FS}}, \underline{f_{SS}}]$.

4.4.2 Pooling equilibria

There is always the possibility of a pooling equilibria for all parameter values. In a pooling equilibria both the good and the mediocre venture exit using the same method. The entrepreneur therefore does not have an incentive to exert effort and work for a good outcome.

4.5 Out of equilibrium beliefs

In the above section we constructed separating equilibria in which the VC of the good firm converted his stake and exits through an IPO whereas the VC of the mediocre firm does not convert and exits through a TS. In this section we look at whether these actions by the good and mediocre VCs dominate the other possible actions open to them. We will look at the good and the mediocre VC separately.

4.5.1 Good VC

We have looked at the parameter values which ensure that the payoff to the good VC of conversion and exit by IPO is greater than not converting and exit through a TS. The other actions of the good VC that need to be evaluated are:-

1. *Conversion and TS*

   The good VC's IC condition in case of a separating equilibrium is given by condition (11). This condition ensures that the payoff to a good VC when he converts and exits through an IPO is greater than not converting and exiting through a TS. This means that if condition (11) is satisfied then the VC would not prefer converting and exiting through a TS, since by conversion he gets a lower payoff as compared to not converting

2. *No conversion and IPO*

   Second, we evaluate the case if the good VC does not convert and tries to exit through an IPO. Assume that following this out of equilibrium deviation, investors believe that the firm is mediocre. The payoff that the good VC gets will therefore be

   $$f(1 - S_L)(1 + x)[rV^H + (1 - r)V^L] \tag{16}$$

   The investors pay the medicore firm's price for the initial investment and since exit is through an IPO investors pay V^H only with probability r. The payoff to the good VC (16) is lower in value than the payoff from not converting and exiting through a TS. We have already shown

in Section 4.3 that the good VC prefers conversion and IPO to not converting and TS. He will therefore not prefer this deviation since it yields a lower payoff. Thus the good VC's equilibrium choice of converting and exit through an IPO dominates all other options.

4.5.2 Mediocre VC

We similarly need to look at the out-of-equilibrium choices of the mediocre VC and compare the payoffs with the equilibrium choice. The mediocre VC's equilibrium choice is not to convert and exit through a TS. We have already derived parameter values which ensures that choice. The other actions we need to evaluate are:-

1. *Conversion and TS*

   From condition (12) it is quite clear that the VC would definitely not prefer conversion and exit through a TS, since on conversion he gets a lower payoff.

2. *No Conversion and IPO*

   If the mediocre VC decides not to convert and exits through an IPO, then given our assumption above investors will assume that he is exiting from a mediocre firm. This is because the VC of the good venture converts and then exits through an IPO. Since investors assume he is mediocre they will offer a valuation of $V^L(1+x)$ for his stake. His payoff is thus $f(1 - S_L)V^L(1 + x)$ which is exactly equal to his equilibrium payoff from the TS. Thus there is no reason for the VC to prefer one

over the other. We therefore assume that in such a circumstance the VC will not convert and exit through a TS.

Based on the above we can thus conclude that both in the case of the good and the mediocre VCs their equilibrium choices will dominate all other options available and the actions described in the separating equilibrium will dominate all others.

5 Exit, signalling and incentives

It is clear from the discussion above that there exists a separating equilibrium in which the good converts and exits through an IPO whereas the mediocre does not convert and exits through a TS. Given that the Entrepreneur's private benefits are maximised in an IPO, exit through an IPO by the good venture can be used to reward her efforts, since the success of the venture depends on her efforts. In contrast, if the venture is mediocre the VC exits through a TS and the entrepreneur does not get any private benefits.

Suppose now that the private benefit Z that the VC gets on exiting a good venture through an IPO is stochastic with a probability distribution $f(Z)$ and cumulative probability distribution $F(Z)$. One of the reasons for assuming Z to be stochastic is the fickleness of the IPO market. It is well known that IPO markets tend to operate in cycles with periods of intense activity followed by quiet periods. In a quiet period even with a good venture, it might not be always possible for the VC to exit through an IPO.

Given the above scenario we look at the probability of an IPO if the venture is successful. If no PCPs (or convertible securities) are in place then

the VC has no means to signal the quality of the venture to the investors. In such a case no separation between the good and mediocre ventures is possible and only a pooling equilibrium exists. In a pooling equilibrium the probability μ of an IPO when the venture is good is equal to γ the probability of an IPO when the venture is mediocre. As already pointed out earlier such an equilibrium is not good for the entrepreneur's incentives. The entrepreneur is motivated to exert effort and increase the probability p of the venture being good so that exit is through an IPO and the entrepreneur is in control of the venture. However the probability of an exit through an IPO being the same for both good and mediocre ventures in a pooling equilibrium the entrepreneur is better off not exerting effort.

However, if PCPs are in place then there exists the possibility of conversion by the VC to signal the quality of the venture. In particular, we have shown that there exists a separating equilibrium in which the good converts and exits through an IPO whereas the mediocre VC does not convert and exits through a TS. One of the necessary conditions for the existence of such an equilibrium is $Z \geq Z_{\min}$. If this condition is satisifed then a separating equilibrium is possible in which $\mu = 1$and $\gamma = 0$ i.e. the good exits through an IPO and the mediocre via a TS. This equilibrium is good for entrepreneur incentives since it rewards the good entrepreneur with control of the venture.

If we select this equilibrium then the probability $\mu^*$of an IPO when the venture is good is given by $\mu^* = (1 - F(Z_{\min}))$ and $\gamma^* = 0$. The VC's payoff which needs to be maximised subject to the entrepreneur's IC is thus given by the following programme:-

Max

$$p\left[\int_{Z_{\min}}^{\overline{Z}}\left[Z+q(1-S_H)V^H(1+x)\right]dF(Z)+\int_0^{Z_{\min}}f(1-S_A)V^H(1+x)dF(Z)\right]+$$
$$(1-p)\left[\int_{Z_{\min}}^{\overline{Z}}\left[f(1-S_L)V^L(1+x)\right]dF(Z)+\int_0^{Z_{\min}}f(1-S_A)V^L(1+x)dF(Z)\right] \tag{17}$$

s.t.

$$p\left[\int_{Z_{\min}}^{\overline{Z}}\left[Z+q(1-S_H)V^H(1+x)\right]dF(Z)+\int_0^{Z_{\min}}f(1-S_A)V^H(1+x)dF(Z)\right]+$$
$$(1-p)\left[\int_{Z_{\min}}^{\overline{Z}}\left[f(1-S_L)V^L(1+x)\right]dF(Z)+\int_0^{Z_{\min}}f(1-S_A)V^L(1+x)dF(Z)\right]\geq K \tag{18}$$

$$(1-F(Z_{\min}))B\geq e/p \tag{19}$$

where $\overline{Z}$ is some arbitrary maximum value of Z. All other variables are same as defined in the earlier sections.

Equation (17) is the payoff function of the VC. If the entrepreneur exerts effort then the venture is good with probability p and mediocre otherwise. If the venture is good and $Z \geq Z_{\min}$ then the VC exits through an IPO, if not he pools with the mediocre and exits through a TS. The participation constraint of the equation is given by (18) and simply states that the payoff to the VC should be greater than his initial investment K. The entrepreneur's IC is given by (19) and is based on our assumption that she cares only for the private benefits of control. She gets private benefits B only if the venture is good and exit is through an IPO. Note that this condition is same as (3) where $\mu = (1 - F(Z_{\min}))$ and $\gamma = 0$.

The solution to the above programme will help us in pinning down the value of q which maximise's the VCs' payoff. The good VC converts his PCP

stake (and thus gets a share q) and exits through an IPO if $Z \geq Z_{\min}$. In all other cases the VC does not convert his stake and exits through a TS. In case conversion and exit through an IPO we have calculated the parameter values in Proposition 3 which ensures that the good VC's payoff exceeds that of not converting and exiting through a TS. The value of q resulting from the above programme ensures that the entrepreneur's IC is satisfied thus also providing incentives to her to exert effort. Thus as can be seen from above use of PCPs helps the VC in signalling the venture's quality to uninformed investors in an IPO and the use of IPO incentivise the entrepreneur to exert effort in the first place.

5.1 Comparative statics

We have in the previous sections looked at the values of f and Z required for the existence of the separating equilibria . In this section we look at how f and Z are affected by changes in different parameter values.

Lemma 5 *The minimum private benefit $Z_{\min}$ required to sustain a separating equilibrium (i) increases with $(1-r)$, the difference in values of the good and mediocre firms ΔV, with the value of the good firm V^H and with the VC's stake after conversion q (ii) decreases with value of the mediocre firm V^L and the amount of investment raised I.*

Proof. Obvious from the value of $Z_{\min} = \frac{q}{V^L}[V^H(1+x) - I](1-r)\Delta V$ ■

Both $(1-r)$ and ΔV can be thought of as measures of information asymmetry which the outside investors face. An increase in the information asymmetry implies that the good VC requires a higher private benefit Z to con-

vince him to exit through an IPO. An increase in information asymmetry increases the probability that the mediocre VC gets if he exits through an IPO by mimicking the good VC. A higher Z in such circumstances ensures that the good VC gets a higher payoff on exit through an IPO. Similarly, a higher Z is required to enable the good VC to separate in case of a higher q, since again a higher q increases the incentives of the mediocre to mimic. In this context it is important to note that the private benefit Z enjoyed by the VC of the good venture in case of a successful exit through an IPO, is not available to the VC of the mediocre venture even when he exits through an IPO. It is for this reason that Z plays such a crucial role in our analysis in sustaining a separating equilibria.

An increase in the value of the good firm V^H increases the incentives of the VC of the good firm to exit through a TS hence an increase in Z is required to preserve incentives for exiting through an IPO.

An increase in V^L with all other things remaining constant reduces the information asymmetry thus requiring a lower Z to sustain the separating equilibrium

Finally, an increase in the amount of investment I required increases the stakes S_H and S_L that both the good and mediocre have to give up. However, it affects the mediocre more than the good venture reducing the incentives of the mediocre to mimic and thus a lower Z.

Lemma 6 *In a fully separating equilibrium the range of f supporting the equilibria (i) increases as r increases; (ii) increases as Z increases; (iii) decreases as V^H increases ;and (v) decreases as V^L increases (vi) increases as q increases.*

Proof. See Appendix ■

An increase in r means that the probability that investors know the true value of firm is very high. Increase in r slackens the incentive compatibility condition for the mediocre VC and in the limit when $r = 1$the investors know the true value of the mediocre firm. In such a circumstance a lower value of f is sufficient to satisfy the mediocre VC's IC. On the other hand r does not affect the good VC's IC which means that the upper bound of f is not affected. Overall this increases the range of f in which a separating equilibrium is supported.

An increase in Z increases the payoff which a good VC gets on exiting through an IPO. Thus a higher value of f is required for the VC to prefer a TS over an IPO which increases the higher bound of f supporting the equilibria. This results in an increase in the range of f supporting the the equilibria. An increase in Z makes it attractive for the good VC to exit through an IPO and therefore supports a higher range of f .

An increase in the value of the good firm V^H increases the lower bound $\underline{f_{FS}}$ and decreases the upper bound $\overline{f_{FS}}$ which supports the equilibria thus reducing the range of the fully separating equilibria. An increase in the value of the good firm affects the incentive compatibility conditions for both the good and mediocre VCs. It increases the payoff to the good if he does not convert and exits through a TS. This implies that a lower value of f is now sufficient for a TS to be attractive to the VC. Thus the upper bound supporting the equilibria is now lower. Similarly, increase in V^H increases the payoff to the mediocre if he mimic's the good. Thus a higher value of f is required to prevent him from doing so. This increases the lower bound of

f. Overall the range supporting the equilibria reduces with V^H.

The effect of an increase is V^L is to decrease both the lower bound and upper bound of f supporting the equilibrium. Higher V^L increases the payoff the VC of a mediocre venture gets if he exits through a TS. Thus a lower value of f is sufficient to satisfy his IC. An increase in V^L increases the payoff of a good VC if he does not convert and exits through a TS. Thus again a lower value of f is enough to fulfil his IC with equality. This reduces the upper bound and has the effect of reducing the overall range supporting the equilibria.

Finally the effect of an increase in q, the VC's stake after conversion, is to increase the both the lower and upper bounds of the range supporting the equilibria.

5.2 Empirical implications

The first implication concerns the probability of revelation of the firm r in case of an IPO. As discussed above as r increases the range of f supporting a separating equilibria. It can be reasonably assumed that r is high for informationally efficient markets like the US and UK as compared to others. In these markets there are a lot of analysts following stocks and the probability of getting the value of a stock right after an IPO is therefore relatively high implying a high r. We are thus likely to observe more exits through an IPO in such markets since the range of f supporting a separating equilibrium is much higher. Whereas in markets where r is low the range of f supporting an equilibrium is lower. This will deter a lot of VCs who might thus not find it worthwhile to exit through an IPO. This is the reason why we observe

more exits through an IPO in the US than in any other market. Also for very low values of r (i.e. $r \to 0$) a separating equilibrium cannot be sustained at all. Thus the use of Convertible securities is itself redundant. This is again borne out by empirical and anecdotal evidence. We hardly observe the use of such securities outside the US.

The second implication concerns the private benefits of control Z for the good VC. These can be interpreted as reputation effects which help VCs establish themselves among their investors. The range that supports a separating equilibria is higher if the distribution of Z is higher in the sense of first order stochastic domination. In the dominant distribution it is more likely that $Z \geq Z_{\min}$, which makes it easier to give incentives to the entrepreneur through more IPOs. In the real world, Z is likely to be higher for younger VCs who need to establish their reputations as compared to older more established VCs. This means that the model predicts that we will observe more exits through IPOs by younger VCs as compared to older VCs. This has been empirically confirmed by Gompers (1996) who observes grandstanding by younger VCs. Gompers finds that younger VCs are more likely to exit through a venture using an IPO as compared to older more established VCs.

The value of Z itself increases with an increase in the information asymmetry $(1 - r)$. Again it can be argued that the information asymmetry is higher for European markets as compared to the US. This means that the private benefit Z required for the VC to do an IPO in Europe is higher than the US. This is another reason why we observe more venture capital exits in the US through IPOs in contrast to other markets.

During periods of high activity in the VC market like the recent dot-com

bubble we would expect valuations of all companies to be high. This means that both V^H and V^L will be high. Higher valuations for companies as discussed above leads to an decrease in the upper bound of f supporting the equilibria. The reason for this being that increase in valuations of firms increases the payoff that a firm gets by not converting and exiting through a TS. Therefore even at lower levels of f VCs prefer to exit through a TS rather than an IPO. The lower bound of f increases with an increase in V^H and decreases with V^L, causing the range of f to decrease in both cases. Counterintuitively, our model predicts that increases in valuation of both the good and mediocre companies leads to lower exits through IPOs. This is so because from the good VC's point of view even at lower levels of f his payoff from exiting through a TS is higher than in an IPO.

6 Conclusion

This paper presents a signalling model of exits by VCs. We argue that participating convertible preferred securities can be used by VCs to signal the quality of the venture at the time of exit. Exit through an IPO also helps in incentivising entrepreneurs, since they are rewarded with control after the VC exits. On the other hand in a trade sale(TS) the entrepreneur normally loses control of her venture. However, from the VCs point of view IPOs are at an informational disadvantage as compared to a TS. The VCs are therefore reluctant to exit through an IPO.

PCPs can help solve this problem. By converting their PCP stake into common equity VCs signal the quality of their venture. We show based on our

model that there exists a separating equilibrium in which the VC of the good venture converts his stake and exits through an IPO whereas the mediocre venture exits through a TS. This also rewards the entrepreneur with control if the venture is good. We thus provide an explanation for the commonly observed phenomenon in venture capital exits viz. automatic conversion of VC's stake in case of an IPO.

Based on our model we then derive comparative statics and arrive at empirical implications some of which have been confirmed by previous work.

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7 Appendix

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

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

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

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

The above conditions will be satisfied only if

$$\frac{V^L}{[r_B V^L + (1-r_B)V^H]} \geq \frac{\left[r_B V^H + (1-r_B)V^L\right]}{V^H}$$

Simplifying the above leads us to the following condition

$$0 \geq (V^H - V^L)^2$$

which can never be satisfied for any values of V^H and V^L,which means that there exists no separating equilibrium. ■

Proof (Proposition 3). The condition (11) for the good can be simplified and rewritten as

$$f \leq \frac{[q(1-S_H)V^H(1+x)] + Z}{(1-S_L)V^H(1+x)} \tag{20}$$

Similarly (12) can be rewritten as

$$f \geq \frac{q(1-S_H)[rV^L + (1-r)V^H]}{(1-S_L)V^L} \tag{21}$$

Thus a fully separating equilibrium exists if f 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 f lies in the range described by (20) and (21). The above conditions imply that

$$\frac{q(1-S_H)[rV^L + (1-r)V^H]}{(1-S_L)V^L} \leq \frac{[q(1-S_H)V^H(1+x)] + Z}{(1-S_L)V^H(1+x)} \tag{22}$$

Rearranging and simplifying (22) gives us the minimum value of Z, $Z_{\min}$ above which a fully separating equilibria exists. ■

Proof (Proposition 4). We 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

$$f \leq \frac{[q(1-S_H)V^H(1+x)]+Z}{(1-\widehat{S})V^H(1+x)} \tag{23}$$

Similarly (14) can be rewritten as

$$f \geq \frac{q(1-S_H)[rV^L+(1-r)V^H]}{(1-\widehat{S})V^L} \tag{24}$$

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 wederive below the minimum value of $Z, Z_{\min}$ which ensures that f lies in the range described by (23) and (24). The above conditions imply that

$$\frac{q(1-S_H)[rV^L+(1-r)V^H]}{(1-\widehat{S})V^L} \leq \frac{[q(1-S_H)V^H(1+x)]+Z}{(1-\widehat{S})V^H(1+x)} \tag{25}$$

Rearranging and simplifying (25) gives us the minimum value of Z, $Z_{\min}$ above which the semi-separating equilibria exists. ■

Proof (Lemma 6). The comparative statics of the various parameters with respect to the f supporting the fully separating equilibrium is arrived at by differentiating the values of f with the respective parameters.

(i) With respect to r

Differentiating the upper and lower bounds of f with respect to r we have $\frac{\partial \underline{f_{FS}}}{\partial r} = \frac{q(1-S_H)[V^L-V^L]}{(1-S_L)V^L}$ which can be further simplified as $\frac{\partial \underline{f_{FS}}}{\partial r} = \frac{-q(1-S_H)[V^H-V^L]}{(1-S_L)V^L}$. Thus $\frac{\partial \underline{f_{FS}}}{\partial r} < 0$. Also the upper bound $\overline{f_{FS}}$ does not depend on r and hence does not change with r. Thus an increase in r results in the lower bound $\underline{f_{FS}}$ decreasing which causes the entire range to increase.

(ii) With respect to Z

Only the upper bound $\overline{f_{FS}}$ depends on Z. On inspecting the value $\overline{f_{FS}} = \frac{q(1-S_H)V^H(1+x)+Z}{(1-S_L)V^H(1+x)}$ we can immediately see that an increase in Z increases $\overline{f_{FS}}$. The value of $\underline{f_{FS}}$ does not depend on Z and thus is not affected by it. Therefore an increase in Z result 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 we have the following:

$\frac{\partial f_{FS}}{\partial V^H} = \frac{q}{(1-S_L)}\left[\frac{I[rV^L+(1-r)V^H]}{[V^H(1+x)]^2} + (1-S_H)(1-r)\right]$.

which is clearly > 0 if. Thus $\frac{\partial \underline{f_{FS}}}{\partial V^H} > 0$.

Similarly $\frac{\partial \overline{f_{FS}}}{\partial V^H} = \frac{qI-Z}{(1-S_L)[V^H]^2(1+x)}$ which is < 0.

Thus an increase in V^H leads to an increase in $\underline{f_{FS}}$ and a decrease in $\overline{f_{FS}}$ 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 we have the following:

$\frac{\partial f_{FS}}{\partial V^L} = q(1-S_H)\left\{\frac{I}{(1-S_L)^2[V^L(1+x)]^2}[r+(1-r)\frac{V^H}{V^L}] - \frac{(1-r)}{[V^L]^2}\frac{V^H}{(1-S_L)}\right\}$

The above expression is positive if

$\frac{I}{(1-S_L)^2[V^L(1+x)]^2}[r+(1-r)\frac{V^H}{V^L}] \geq \frac{(1-r)}{[V^L]^2}\frac{V^H}{(1-S_L)}$

Simplifying it can be shown that it is not true, thus $\frac{\partial \underline{f_{FS}}}{\partial V^L} < 0$.

Similarly, $\frac{\partial \overline{f_{FS}}}{\partial V^L} = -\frac{q(1-S_H)V^H(1+x)+Z}{V^H(1+x)}\frac{I}{(1-S_L)^2}\frac{1}{[V^L(1+x)]^2}$ which is clearly < 0.

Thus an increase in V^L causes both the lower bound and upper bound to decrease resulting in an decreased range of f supporting the separating equilibria.

(v) With respect to q

Obvious on inspection that both the lower and upper bound supporting the separating equilibria increases with q. ■