Convertible Securities and Optimal Exit Decisions in Venture Capital Finance

by

Andreas Bascha[a] and Uwe Walz[b]

a University of Tübingen

b University of Tübingen, and CEPR, London*

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Abstract

We develop a theoretical framework which enables us to analyze the interaction between exit decisions and contract design in venture capital finance. One of the main characteristics of venture capital funds is that they are closed-end. This requires that the relationship between the venture capitalist and the entrepreneur has to end some point in time. However, in many cases the venture capitalist and the entrepreneur have diverging interests with respect to different exit solutions (e.g. initial public offerings or trade sales). In order to avoid serious efficiency losses, it is crucial to adopt an instrument which solves this problem in an ex-ante agreed contract. We show that with convertible securities, an ex-ante agreed optimal exit policy can be implemented. We therefore provide a theoretical explanation for the wide-spread use of convertible securities in venture capital finance.

*Address of authors: Andreas Bascha, Department of Economics, University of Tübingen, D-72074 Tübingen, Germany, e-mail: andreas.bascha@uni-tuebingen.de; Uwe Walz, Department of Economics, University of Tübingen, 72074 Tübingen, Germany, e-mail: uwe.walz@uni-tuebingen.de

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1 Introduction

Entrepreneurs with innovative ideas of potentially high economic value, very often find it difficult to meet their financing needs through traditional channels, such as personal savings and bank loans. These difficulties are due to four critical factors: uncertainty, asymmetric information, the nature of firm assets, and the conditions in the relevant financial and product markets. Nonetheless, private equity investors have tried to develop adequate responses to these challenges, namely in the institutional form of specialized financial intermediaries such as venture capital organizations (VC) (see e.g. Sahlman (1990)).

Venture capitalists differs from other intermediaries in some important ways. For example they play a more active governance role by employing an array of instruments like capital staging (see Gompers (1995)), direct monitoring (see Lerner (1995)), explicit control covenants (see Gompers (1997) and Cornelius (1997)) such as founder replacement (see Chan (1983), Hellmann (1998)), only to mention a few. Another main characteristic of venture capital finance is that most venture capital funds are closed-end. This is often interpreted as an instrument by which the limited partners of the venture capital fund aim to control the manager of the venture capital organisation, in order to assure the distribution of their investment returns. Implicitly, the investors also preserve the right not to invest in any later fund managed by the same VC. Insofar, reputation concerns provide another argument for a limited investment period.

Given the limitation of its investment period, the VC wants to or has to terminate the financial relationship with the firm after a more or less given period of time. This together with the non-existence of verifiable information about firm value at the moment when the VC wants to divest, leads to major control problems and thus possible inefficiencies for example about the timing - the so called *grandstanding* phenomenon (see Gompers (1996)) or the exit channel if there is more than one possible way for the VC to divest his share.

There are a number of different ways to terminate the financial relationship. Besides liquidation, share repurchase by the founder (buy-back), and selling shares to institutional investors (secondary purchase), the empirically most common ones are trade sales (TS), i.e. selling the firm as a whole to a large outside firm and an initial public offering (IPO). Through the IPO, the firm is sold to a disperse spectrum of shareholders, none of them having a majority stake in the firm. These two exit modes accounted on average over the last decade for approximately two-thirds of the overall exitvolume in the EU (see BVK (1998)).

Motivated by this empirical observation we focus in this paper on the problem how to select efficiently between an IPO or a TS and the consequence for the design of the financial contract between the founder (in the following we call him the owner manager (OM)) and the VC. We discuss potential ways of resolving problems associated with the exit decision by using a well specified contract design. We argue that the interests of the OM and VC diverge not only about the distribution of the monetary surplus, but even more importantly with respect to the choice of the exit mode because of the non-monetary benefits associated with the different exit modes. In addition, the problem of observation and verification of major variables such as the value of the firm makes it impossible to contract directly upon the choice of the exit mode. We show that it is possible to avoid efficiency losses, stemming from unresolved conflict of interests, with the help of one of the major empirically observed instruments of corporate control in venture capital finance, namely convertible securities (see SAHLMAN (1990)). Convertibles can be used to assure an efficient exit choice.

In order to show this we develop a simple model which describes the relationship between the OM and the VC over a certain period of time. Typically, the VC engages in extensive evaluation before investing in the project and since the VC is in most cases also involved in managerial issues and decisions (hands-on), his information gap with respect to the expected and realized firm value is most likely to be small or does not exist at all. Moreover, due to the fact that it is the idea of the OM which creates the investment opportunity, the OM is assumed to work on a best effort basis. Therefore we abstract from adverse selection and moral hazard problems except for the exit decision.

The completely externally financed investment project yields a strictly positive stochastic return in the following period, which represents the discounted cash flow value of the firm. Firm value is observable by both parties but not verifiable in court. As usual the pay-off claims can only be conditioned on the monetary surplus that is generated, when the firm is sold via one of the two exit channels. We assume further that for a given firm value a TS has a superior liquidation value because on the one hand underpricing effects lower the IPO proceeds and on the other hand the firm can capture a premium in a TS because of synergy gains realized by the buyer (see BYGRAVE and TIMMONS (1992)).

The OM is assumed to receive non-monetary benefits if he has control over the firm both during and after the implementation of the project. This preference for control of the OM is an often used hypothesis in the small business literature and results among other things from the desire of the firm founder to complete "his" project. [1] In the case of a TS the OM is no longer truly independent, whereas in most cases control remains with the OM in the case of an IPO. Therefore the OM has, both regardless of the exact realization of the firm value and the structure of the payoff rights, always a strict preference either for an IPO or a TS.

For the VC, an IPO is associated with a reputation effect, which is driven by returns. This together with a superior liquidation value in case of a TS, implies that with a badly performing firm, the VC prefers a TS to an IPO. Hence there is ex-ante always a possible conflict of interest between OM and VC with regard to the exit mode. In order to see what a contractually efficient solution looks like, we divide the analysis in two parts.

First, we identify the set of efficient contracts, i.e. the set of efficient allocations of control rights and division of surplus. This includes the description of the ex-ante efficient solution, the characterization of all admissible contracts and the derivation of the necessary conditions for efficient contracts, in order to pin down the boundaries of the set of efficient contracts.

Second, we show that it is possible to implement the ex-ante efficient solution with the help of incentive compatible financing contracts in the form of convertible preferred stock (CPS). By concentrating the search for an efficient contract on the empirically most relevant financing instruments one can see why simple contracts using debt and equity or a combination of both fail to achieve efficiency. Additionally in the context of CPS we are able to present an argument for both the separation and the combination of control from/with pay-off rights. Thereby, our paper rationalizes a recent empirical observation by Trester (1998) where it is shown that the mean percentage of deals where the ability to convert preference shares into ordinary shares results in a transfer of control is only 28%.

Previous rationalizations of convertible securities in the context of venture capital can be categorized into two set of papers. One part of the theoretical literature views convertibles as an instrument of incentive compatible financing as it emphasizes the role of entrepreneurial incentives along the life of the project. These papers study how the choice of financing instru-

[1] See e.g. Cressy (1995), Hutchinson (1995), Vivarelli (1991), Stanworth, Stanworth, Granger and Blyth (1989)

ments can ameliorate the incentive distortions originated by the reliance on external funding. Gompers (1993) argues that convertible debt induces exactly the right incentives for the entrepreneur to invest in projects with different risks and helps to separate out entrepreneurs with low ability. Cornelli and Oved (1997) show that convertible debt reduces the incentive of the entrepreneur to invest in (inefficient) short-term signal manipulation ("window dressing") when capital contributions are staged. Hansen (1991), Trester (1993), Neher (1994) and Bergemann and Hege (1998) model a stopping game between an entrepreneur and a VC under moral hazard. They derive the optimal sharing contract which explains the use of convertible securities. By incorporating an advisory role of the VC Repullo and Suarez (1998) extends the analysis of the interactions between staging and moral hazard to the case in which the incentive problem is double-sided.

But the use of convertible securities can also be of economic value if the VC is making a specific major decision over which he has control rather than making a managerial contribution alongside with the OM. This is shown by the second set of papers that views convertibles as a mean to allocate control rights efficiently. Potential inefficiencies are stemming from conflicts of interest between entrepreneurs, and VCs. They are due to information problems, and non-transferable private benefits of control affecting critical decisions in the life of the project. This is the case of the liquidation decision in Marx (1998), or the sale of the firm to another company in Berglöf (1994). But rather than concentrating on the most efficient way to terminate the economic life of the firm, we focus on the efficient allocation of future control over a young and possibly further expanding firm.

Most closely related to our approach is Black and Gilson (1998) who stress the importance of the opportunity to enter into an implicit contract over control, which gives a successful entrepreneur the option to reacquire control from the VC by using an initial public offering as the means by which the VC exits from a portfolio investment. They argue that this implicit contract will be self-enforcing as long as a reputable investment banker will underwrite a firm commitment offering. But as Michaely and Womack (1999) show, recommendations by underwriter analysts are significantly biased, suggesting a potential conflict of interest inherent in the different functions that investment bankers perform. We therefore believe that the supposed superiority of the implicit contract over an explicit contract specifying at least some (contingent) shifts of control is not as clear cut as claimed.

As the above mentioned papers, our paper also aims to extend the basic idea of AGHION and BOLTON (1992) to venture capital finance by stressing the importance of the (possibly contingent) allocation of control rights over these decisions to the VC. But rather than conditioning control rights on the realization of a verifiable state of the world, we ask to what extent it is necessary and possible to separate control rights from the allocation of pay-off rights so that the contracting parties behave in an ex-ante efficient manner. Thereby we are able to replicate both proposed features of convertible securities in one framework.

The paper is organized as follows. In section 2 we outline the main assumptions of the model as well as the timing of the game. In section 3 we look at the first-best solution to the exit problem and characterize the set of efficient contracts. In section 4 we ask if it is possible to implement the first-best solution with a the use of standard financing instruments. Thereby we analyze the characteristics of convertible securities that lead to an efficient outcome and show their superiority over other financing instruments. Section 5 concludes.

2 Basic Model

We look at a simple one-stage investment project.[2] In order to realize a promising idea an entrepreneur has to invest a particular amount. This investment (I) results after the implementation stage in a present value of future cash flows w (the gross firm value), which is stochastic and continuously distributed with density $f(w)$ on the interval $[\,\underline{w}\,,\,\overline{w}\,]$, whereby $\underline{w}$ and $\overline{w}$ represent the minimum and the maximum firm value respectively. The corresponding cumulative distribution function $F(w)$ is assumed to be completely independent of the effort and type of the involved entrepreneur. That is, we entirely abstract from incentive problems as well as from issues of adverse selection and focus on our main theme: how to organize separation of control and ownership between the entrepreneur and the external investor. Since the entrepreneur lacks any resources of his own, he has to rely completely on external funds.[3] A potential source of external funds is the venture capital industry which is organized

[2] It is usually the case that venture capitalists invest in multiple stages in order to mitigate various agency problems during project implementation (see GOMPERS (1995)). Since there are already several theoretical papers that examine stage financing, we abstract from problems of this kind and concentrate on agency problems stemming from non-monetary benefits of control both during and after project implementation.

competitively. Venture capitalists are, however, committed to restricting their investment in young firms to only on a limited time period because they refinance their investments with closed-end investment funds. Additionally to this legal constraint, venture capital funds have strong incentives to exit from their investments, when feasible, well before the end of the partnership (see BLACK and GILSON (1998), S. 256). Besides the aim to free capital for other investments (see LIN and SMITH (1998)), a fund's performance record is the principal tool to attract investors in future funds of the VC (see GOMPERS and LERNER (1999b)).[4]

At the end of the first period, the VC and the OM can observe the realization of the discounted value of the stochastic project return, subsequently denoted by w^r. As in ADMATI and PFLEIDERER (1994) the firm value can, however, not be verified by outsiders. This reflects the idea that the VC is very familiar with the profitability of the firm because of the typical engagement of the VC in management issues. Due to the special features of the investment project which involves investment in non-tangible assets to a large degree, this information can, however, not be passed on to courts in a credible manner.

There are two potential exit channels.[5] On the one hand there exists the possibility to sell the firm to an outside firm or conglomerate, a trade sale (TS). This outside firm takes over all assets of the firm as well as the control over the firm. Even if the previous OM holds a managerial function in the outside firm, he does not hold control over "his" firm to the same extent as before the TS. On the other hand the VC and the entrepreneur have the chance to sell the firm to disperse shareholders via an initial public offering (IPO). In this case the OM generally stays after the IPO as central executive officer on the board of the firm. The corresponding liquidation values are observable and verifiable.

We assume that in both cases the observed firm value must not be distorted unsystem-

[3]Since there are neither adverse selection nor moral hazard problems our results would remain completely unchanged if the entrepreneur would possess initial wealth which he can or is required to invest in the project. In this case, I can be regarded as the additional investment the entrepreneur needs from the venture capitalist.

[4]In contrast to the positive effects of the closed-end feature there is also evidence for some inefficiencies created by this requirement. For example by rushing firms too early in IPOs (see GOMPERS (1996)) or negative share price reactions as a result of venture capital distributions (see GOMPERS and LERNER (1998)).

[5]For matters of simplicity we limit our analysis to the two exit modes which are empirically the most important ones. Though by taking a larger number of exit channels into account our basic line of argument would not change, this would complicate the analysis considerably.

atically for different w^r's. For simplicity we say that buyers pay the true price for the firm. In effect the VC signals the true value of the firm credibly to capital markets because he has reputation capital at stake (see e.g. GOMPERS (1996)). In the case of an IPO, market participants notice that overstating the firm's value implies an underperformance of the respective share in the future, leading to pronounced reputation losses for the VC. Understating the firm's value is not in the interest of the VC either because he then receives a lower payoff without gaining anything. Contrary to that in a TS the buyer is familiar with the business and is able to acquire the necessary information in sales negotiations.

Whereas the gross value of the firm alone, w, is independent of the chosen exit channels, this is not true with respect to the aggregate monetary payoff for the VC and the entrepreneur. If the firm is sold in the capital market (IPO), emission costs (E) are incurred. Either in the form of bonding and certification costs caused by the use of an underwriter (see BOOTH and SMITH (1986)), or because of the costs associated with the building of a loss capacity in order to stabilize the offer price ex-post (see CHOWDHRY and NANDA (1996)). Additionally in the case of a first registration the company has to incur expenses because of liquidity and publicity regulations in the stock exchange market (see BARTLETT (1988), p. 170). In contrast, in the case of a TS the outside conglomerate experiences synergy effects between the newly acquired firm and its established business (see BYGRAVE and TIMMONS (1992)). It suffices to assume that there are at least two potential buyers bidding for the firm so that the firm extracts the highest potential premium (P) the conglomerate is willing to pay after subtracting potential auditing costs which must not be too high.

Hence we could define a general value-at-exit function $v(w^r, P, E \mid IPO, TS)$ by mapping the gross value of the firm (w^r) and potential exit costs (E) or premiums (P) into such a value function. For our analysis it suffices to assume that this value-at-exit function is continuous, monotone and has in the respective arguments the partial derivatives $\partial v/\partial w^r > 0$, $\partial v/\partial P > 0$, $\partial v/\partial E < 0$. In order to facilitate the analysis and allow for explicit solution we use the specific case that the respective arguments enter linear and additive into this value-at-exit function. Hence, the value-at-exit function can be expressed by $w^r - E$ for an IPO and by $w^r + P$ for a TS, with $P, E > 0$ and constant $\forall\ w^r$. We can now turn to the description of the preferences of the entrepreneur and the VC.

2.1 Entrepreneur

For the sake of simplicity both agents are assumed to be risk-neutral. Their preferences are additively separable and linear in income. The main feature of the entrepreneur's preferences is that he realizes non-monetary benefits if he has the control of the management of the firm. This assumption, which is very well founded in the empirical small business literature (see e.g. WESTHEAD and WRIGHT (1998), VIVARELLI (1991) and STANWORTH, STANWORTH, GRANGER and BLYTH (1989)), simply reflects the notion that one of the main reasons for the entrepreneur to set up a business is his desire for independence. Then, according to legal standards, the OM realizes control benefits during the project if he holds for example a majority of voting shares. We refer to these control benefits during the implementation period of the project as $CB_I > 0$. With regard to the allocation of control after the exit of the VC we argue that in most cases the independence of the OM is assured in the case of an IPO, where the firm remains an independent unity. With a TS, in contrast, the entrepreneur is likely to loose control as the firm is sold as a whole. Even if the founder continues to run the firm as a division manager of the larger firm he is not solely in control of all decisions concerning "his" firm. Hence, we normalize the OM's utility benefits of control in the case of a TS to zero and assume them to be strictly positive in the case of an IPO.

These control benefits after exit ($CB_e > 0$) are, for the rest of the paper, assumed to be smaller than the sum of the premium paid by the outside conglomerate (P) in the case of a TS and the emissions costs (E) which have to be incurred with an IPO:[6]

$$CB_e < P + E \tag{1}$$

In order to illustrate the preference structure of the OM with regard to the exit channel, let us denote the entrepreneur's share in net proceeds of sales by his equity holdings (α).[7] This allows us to write his utility function at the point of time when the exit decision has to be made as: [8]

$$U^{OM}_{equity} = \begin{cases} U^{OM}_{IPO,\alpha} = \alpha(w^r - E) + CB_e \\ U^{OM}_{TS,\alpha} = \alpha(w^r + P) \end{cases} \tag{2}$$

[6] It turns out that this assumption is necessary for our problem. Without this assumption an IPO would always be optimal for $w^r > 0$. In this case, the basic economic problem stressed in our paper vanishes.

[7] Exit preferences depend on the payoff structure. As we will show later with debt financing, the OM always prefers a TS to an IPO as long as condition (1) holds.

[8] Note that at this time control benefits during the implementation stage have already been realized.

Hence, we find the following exit preferences for the entrepreneur:

$$IPO \succeq (\prec) TS \quad \text{for} \quad CB_e \geq (<) \alpha(P+E) \tag{3}$$

The OM prefers the exit solution which meets his expectations regarding monetary payoff and control benefits for the most part.

2.2 Venture Capitalist

The VC does not only engage in one project but plays the game repeatedly. In the course of this repeated engagement in project finance the VC accumulates a "reputation capital stock" (see BLACK and GILSON (1998), S. 254). The notion that the increase in reputation resulting from a single project depends on the exit mode and the realized value of the firm is supported by several practitioner accounts and empirical studies (see BERLIN (1998), GOMPERS and LERNER (1997b). The VC selects the projects and engages typically in management assistance of the consulting type. As GOMPERS and LERNER (1999a)) have shown there is evidence for the assumption that the VC, as other outsiders, learns of his own ability only as he gets to observe firm value. Hence, the larger the realized firm value, the better the signal for the quality of the VC, and the higher the reputation gain as the revised estimate of the VC's quality. Since the true value of the firm is easier to observe for the interested public in the case of an IPO, we assume that the reputation gain is more pronounced with an IPO than with a TS. [9] As with the other arguments of the value at exit function, we choose to model the reputation gain linearly in the realized value of the firm. The marginal reputation gain is larger with an IPO than with a TS. In order to save notation we normalize, without loss of generality, the reputation gain with a trade sale to zero and denote the differential reputation gain with an IPO (relative to a TS) by $R_{IPO} = r_{IPO} w^r$. Hence, we can write the utility function of the VC as:

$$U^{VC}_{equity} = \begin{cases} U^{VC}_{IPO,\alpha} = (1-\alpha)(w^r - E) + r_{IPO} w^r \\ U^{VC}_{TS,\alpha} = (1-\alpha)(w^r + P) \end{cases} \tag{4}$$

[9] There are with no doubt several prominent examples of firms for which an acquisition at a high price cerated a tremendous reputation. But it seems quite obvious that in these cases the reputation gain associated with an IPO would not have been less, but even larger. For the empirical discussion about the "value added" by venture capital firms see also (SAPIENZA, MANIGART and VERMELT (1996)).

The level of utility as a function of the realized firm value is depicted in figure 1.

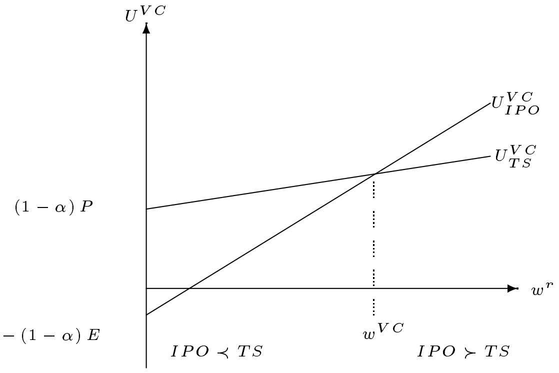

Figure 1: Utility of the VC for a TS (IPO) with an equity contract.

For $\quad U^{VC}_{IPO,\alpha}(w^{VC}) = U^{VC}_{TS,\alpha}(w^{VC}) \quad$ we find: $\quad w^{VC} = \dfrac{(1-\alpha)(P+E)}{r_{IPO}}$

For small realized firm values, $w^r < w^{VC}$, the VC prefers the TS to the IPO whereas the opposite is true for large realized firm values, $w^r > w^{VC} \Leftrightarrow IPO \succ TS$. This just reflects the fact that with larger firm values the differences in reputation effects become more pronounced. For $w^r > w^{VC}$ this gain in reputation overcompensates the lower net revenues arising with an IPO (from the VC's perspective: $(1-\alpha)(P+E)$).

Comparing the interests of the VC with those of the entrepreneur with respect to the exit modes it becomes obvious now that a potential ex-post (i.e. when it comes to deciding on the exit channels) conflict of interests exists. As can be seen form figure 2 for small α's and for large realized values of the firm both parties prefer an IPO. But for relatively low realized firm values, the VC would choose a TS, whereas the entrepreneur is still in favour of an IPO. The underlying reason for this conflict of interest between the OM and the VC are the non-monetary benefits accruing asymmetrically to them. Without these benefits both parties would always prefer a TS.

That is, we have ex-ante two non-coinciding areas of conflicting interests: i) the distribution of the resulting net surplus and ii) the choice of the exit mode. Whereas the first conflict is always prevalent, independent of the realization of w, the second conflict does not necessarily arise for all w. The fact that there are two potential conflicts of interest between the OM and the VC will require a separation of the sharing rule for the surplus resulting from the investment and the rule governing the distribution of control and decision rights with respect to the exit mode.

Against this background we outline the timing of the game between the VC and the OM in the next subsection before we turn to potential ways to resolve these conflicts in a Pareto efficient manner.

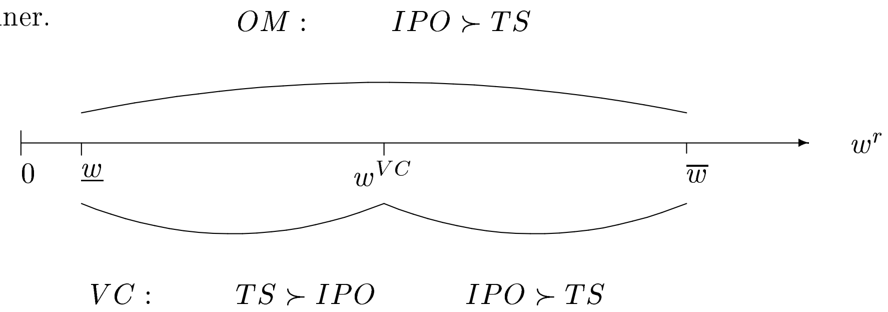

Figure 2: Possible ex-post conflict of interests with equity contract and $\alpha \leq \frac{CB_e}{P+E}$.

2.3 Timing of the Game

We model the idea that a novice founder (the future OM) approaches the competitively organized venture capital industry for financial resources. We look at the interaction between a single VC and the entrepreneur. Competition between at least two equally reputable VC's pushes the VC down to his reservation utility, U_r^{VC}, consisting of the cost of capital plus eventually a fee for his management assistance. Technically speaking this implies that the participation constraint of the VC binds with equality. Given this, the entire surplus accrues to the entrepreneur, who chooses the VC that helps him to maximize his expected utility.[10]

There are three stages of the game. In the first stage the entrepreneur offers a contract to the VC which specifies the VC's payoff structure as well as the decision rights to choose the exit channel. In the second stage the VC accepts or rejects the offer. Then parties invest in the project and nature decides upon the realized value of the firm. The VC and the OM observe w^r and decide in the third stage on the mode of exit given the rule over decision rights specified ex-ante. This includes eventually the execution of a conversion option so that decision rights switch from one party to the other. The described time structure can be seen in figure 3.

[10] This notion does not necessarily imply that the OM opts always for a VC with a low reputation, i.e. a high marginal reputation gain as this has a positive effect on the VC's utility. Though we do not model them explicitly, at least two countervailing effects have to be mentioned. On the one hand more reputable VC's provide better management services and therefore increase the expected project payoff and on the other hand they have lower refinancing costs and therefore a lower reservation utility.

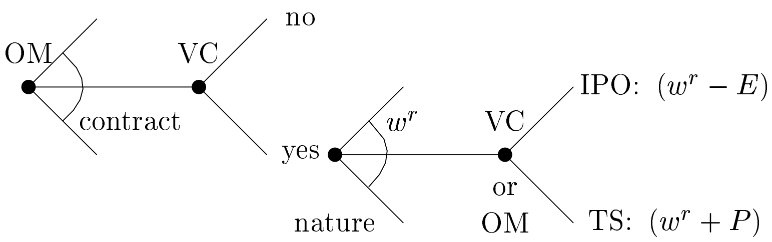

Figure 3: Time structure.

3 Optimal Exit Decisions and Financing Instruments

Now we turn to possible solutions of our main problem: the potential conflict of interests with respect to the mode of exit and the possession of control rights . This is simply due to the fact that the other conflict, namely the division of the respective share of the realized firm, is only a distributional one which has, in contrast to the control rights and exit mode problem, no efficiency effect.

In order to analyze the control rights and exit problem in more detail and to discuss potential solutions, we first deduce the first-best solution as a reference case. Then, we derive the conditions for the efficient contract. Against this background, we analyze the standard financing arrangements. We show that standard debt <u>or</u> equity contracts are no suitable solutions to our problem and therefore turn to financing instruments containing elements of debt <u>and</u> equity.

3.1 First-Best Solution

The first-best solution characterizes the point of reference with perfect information, In this case it is feasible to write state-contingent contracts which define the mode of exit depending on the value of the firm. One major element of the first-best contract is the necessity of making exit decisions in an efficient manner. Hence, the correct choice of exit mode for different w^r's, is the solution to the following problem:

$$\text{Maximize} \quad U^{VC} + U^{OM} \quad \text{through the choice of the exit mode.}$$

The sum of utility U^s for the two exit channels can be written as:

$$\text{Exit via IPO} \qquad U^s_{IPO} := U^{VC}_{IPO} + U^{OM}_{IPO} = w^r - E + CB_e + r_{IPO} w^r \tag{5}$$

$$\text{Exit via TS} \qquad U^s_{TS} := U^{VC}_{TS} + U^{OM}_{TS} = w^r + P \tag{6}$$

Comparing these two utility functions reveals that for low firm values, a TS is preferable to an IPO and with large firm values the reverse is true. This simply reflects the fact that with low firm values the premium paid in the case of a TS (P) overcompensates the positive net aspects of an IPO. With large firm values the positive aspects of an IPO (control benefits minus emission costs and higher reputation effects) loom larger than those of the TS.

By using Eqs. (5) and (6) we find for the critical firm value ($U^s_{IPO}(w^*) = U^s_{TS}(w^*)$):

$$w^* = \frac{P + E - CB_e}{r_{IPO}} \tag{7}$$

The other main element of the first-best contract is the necessity of giving the OM control during the implementation in order to maximize the overall utility benefits from the project. We can summarize this findings in

Proposition 1 *The exit rule is ex-ante Pareto optimal if it leads to an IPO for $w^r \geq w^*$ and to a TS for $w^r < w^*$. Overall efficiency requires the allocation of control during the project to the OM.*

3.2 Characterization of the Efficient Contract

The crucial question which we will deal with in the rest of the paper is whether it is possible to replicate this first-best solution if the value of the firm is not verifiable in the third stage of the game. An obvious way out, namely the possibility of state verification by one of the two agents is not feasible since this entails verification costs leading to an outcome which is worse than the one described above. Another solution would be renegotiation. As Aghion, Dewatripont and Rey (1994) have shown, renegotiations will always lead to efficient outcomes if the contractual status quo is properly chosen and all bargaining power is given to one of the parties when renegotiating. But we argue that as state verification, renegotiation is also costly and thereby distorts the first-best solution.

The set of feasible contracts is quite large. We just require that contracts leads to a unequivocal distribution of control rights and to a clear-cut distribution of pay-offs among the two parties. The set of Pareto efficient contracts, however, is potentially much smaller and can be characterized by two conditions. The first condition relates to an efficient choice of exit modes by the controlling party.

Condition 1 *For an efficient exit mode, control rights should be allocated so that*

i) for $w < w^*$, there should be no control rights with the OM (VC) if $U_{TS}^{OM} < U_{IPO}^{OM}$ ($U_{TS}^{VC} < U_{IPO}^{VC}$),

ii) for $w \geq w^*$, there should be no control rights with the OM (VC) if $U_{TS}^{OM} > U_{IPO}^{OM}$ ($U_{TS}^{VC} > U_{IPO}^{VC}$).

There always exists a distribution of control rights contingent on w which fulfils this condition. By the definition of Pareto efficiency, it can never happen that both parties prefer the inefficient exit mode. For instance, for any $w < w^*$ it cannot be true that the OM and the VC prefer the IPO to the TS because in this case an IPO would be Pareto preferred to a TS, thereby contradicting Proposition 1. At least one party is always willing to exercise the efficient exit mode. At the same time, however, the above condition does not necessarily give us a unique distribution of control rights because it is perfectly feasible that both parties are willing to choose the efficient exit channel for some range of w. In this case one can grant either of the two parties the control rights on the basis of the efficient contract.

The second condition serves to assure overall efficiency:

Condition 2 *During the implementation stage, the control rights have to be with the OM.*

Otherwise the OM's control benefits CB_I are simply foregone. Hence we can state

Proposition 2 *Conditions 1 and 2 are necessary and sufficient for contracts in the efficient set.*

With the two conditions characterizing the efficient contract it becomes most obvious that only the distribution of control rights is an allocative problem but not the division of the surplus of the project.

4 Financing Instruments and the Efficient Contract

Using the characteristics of the efficient contract we now ask whether and how it is possible to translate them into a financing arrangement resulting in a market equilibrium. As we assume competition between VCs, an efficient contract in equilibrium is characterized by

Condition 3 *In market equilibrium the participation constraint of the VC always has to be met with equality.*

Hence, an efficient contract in equilibrium has to fulfil conditions 1-3.

4.1 Standard debt and equity contracts

Let us start with a conventional **debt contract**. The main feature of a standard debt contract is the state-contingent shift of control. The contract leaves efficiently control during the project (condition 2) and thus also the choice of the exit mode to the OM as long as he can repay the ex-ante agreed debt value D. If he fails to repay, control shifts to the VC. But in this case the exit has already taken place and there is nothing left to decide upon for the VC. So it remains to show that with a debt contract the OM will not act in an ex-ante Pareto efficient way. If we assume that the OM is able to repay the contracted debt, his utility function is:

$$U_{debt}^{OM} = \begin{cases} U_{IPO,D}^{OM} = w^r - E + CB_e - D \\ U_{TS,D}^{OM} = w^r + P - D \end{cases} \tag{8}$$

Comparing the utility levels for the two exit modes, it becomes apparent that the OM will always opt for the TS (note that $P + E > CB_e$). Hence, the debt contract does not meet one of the characteristics of the efficient contract: it does not lead to a switch in exit modes.

The same is true for conventional **equity finance**: it does not achieve Pareto efficiency. With conventional equity finance, the VC receives an ex-ante agreed share $(1 - \alpha_e)$ of the realized firm value as he holds the equivalent percentage of all common stocks of the firm. Depending on the value of α_e, the VC or the OM has the majority and thus the decision rights over the exit. Therefore independently of the realized firm value it is either the VC or the OM who is in control, both during the project and when the exit decision is made.

From our discussion in the preceding section (see Eq. (3)) we know that, if according to condition 2 the OM is in control he at least weakly prefers the IPO, if $CB_e \geq \alpha_e(P + E)$.

Otherwise he strictly prefers a TS. Hence, if the OM has the right to choose the exit channel, this will never lead to a switch in the exit mode according to the first-best solution.

Even if we abstract for a moment from condition 2 and assume unconditional control of the VC ($1 - \alpha > 0,5$), the VC prefers the IPO (TS) if $w^r \geq (<) w^{VC}$. We see that the VC always chooses the first-best exit mode if and only if $w^* = w^{VC}$. Comparing these two values we find, as one would expect, that this is valid only if $\alpha_e = CB_e/(P+E)$. But since the share of the OM results from the VC's participation constraint (see the appendix for details)

$$\hat{\alpha}_e = 1 + \frac{\int_{w^*}^{\overline{w}} r_{IPO} w f(w) dw - U_r^{VC}}{\int_{\underline{w}}^{\overline{w}} w f(w) dw + \int_{\underline{w}}^{w^*} P f(w) dw - \int_{w^*}^{\overline{w}} E f(w) dw} \tag{9}$$

and given that w is continuously distributed we see that $\alpha_e = CB_e/(P+E) > 0,5$ is sheer coincidence. Therefore also, with pure equity the first-best exit choice is not feasible.

The underlying reason why standard debt and equity contracts fail to achieve efficiency is that we aim at the same time at three objectives (i.e. conditions to fulfil): i) to achieve an efficient choice of exit mode; ii) to meet the participation constraint of the VC with equality, and iii) to give the OM control during the implementation period. Neither standard debt nor equity contract are flexible enough to met all three requirements simultaneously. For example they can not be designed such that the individual interest of one party with respect to the switch point (in the exit mode) coincides with the Pareto efficient switch point while at the same time fulfilling the VC's participation constraint with equality.

Hence, in the search of a solution to this problem one has look for financing instruments with a greater flexibility with regard to the determination of the VC's expected monetary payoff. A natural candidate for this is the combination of debt and equity.

4.2 Debt-Equity Mix

With a combination of debt and equity (common stock) control is held by the party owning more than 50% of ordinary shares. So we have to find a combination of $\alpha > 0.5$ (condition 2) and D so that the participation constraint for the VC holds (condition 3). But even if this is possible one can easily verify that the first-best exit mode will not be implemented. In order to see this one can follow the same line of argument as in the pure equity case.

The OM's utility function is in the case of a debt-equity mix is:

$$U^{OM}_{debt/equity} = \begin{cases} U^{OM}_{IPO,D/e} = \alpha_{D/e}(w^r - E - D) + CB_e \\ U^{OM}_{TS,D/e} = \alpha_{D/e}(w^r + P - D) \end{cases} \tag{10}$$

If we compare these two utility levels, we get the same condition as in (3) which states, that the OM has a strict preference for one exit channel depending on the level of his equity share. Hence, if the OM is in control the first-best exit choice will not be undertaken.

The only way to satisfy condition 1 if we use a debt-equity mix, is to give the VC unconditional control and to set $\alpha_{D/e} = CB_e/(P+E)$ so that $w^{VC} = w^*$. This gives the VC the first-best incentives because his utility function is:

$$U^{VC}_{debt/equity} = \begin{cases} U^{VC}_{IPO,D/e} = D + (1-\alpha_{D/e})(w^r - E - D) + r_{IPO}w^r \\ U^{VC}_{TS,D/e} = D + (1-\alpha_{D/e})(w^r + P - D) \end{cases} \tag{11}$$

But, as already mentioned above, condition 2 is violated in this case.

Taking the findings of subsections 4.1 and 4.2 together, we can state

Proposition 3 *i) It is not feasible to implement the first-best solution by using conventional debt or equity financing. ii) With an appropriate debt-equity mix it is feasible to induce ex-post an efficient exit choice. This instrument lacks, however, overall efficiency because it gives control during the implementation period to the VC, thereby violating our condition 2 in Proposition 2.*

At this point of our analysis it becomes obvious that our assumption $CB_I > 0$, leading to condition 2, is crucial for our problem. Namely, if the OM would not value control during the project the feasibility of an efficient debt-equity contract depends only on two conditions. First with $\alpha_{D/e} = \alpha^+ = CB_e/(P+E)$ and $D = 0$ the expected utility of the VC must not be larger than U^{VC}_r. Second and more importantly α^+ has to be lower than 50% if the VC holds ordinary shares. But since α^+ is determined by the parameter values of CB_e, P and E it is also possible, that $\alpha^+ > 0,5$. In this case the OM should hold non-voting shares. Hence we see that even with a combination of debt and equity financing and a deviation from the one share one vote rule (e.g. preference shares) one may achieve efficiency if $CB_I = 0$.

Allowing for $CB_I > 0$ has two crucial implications and advantages. On the one hand this corresponds well with the above mentioned studies favouring non-monetary control benefits.

On the other hand, it allows us to provide a rational for the observation by TRESTER (1998) that deals in which preferred equity was used the mean percentage of the use of convertible preferred was 88.8%. We show in the following that by maintaining condition 2 we are able to explain the predominant use of convertible securities because contracts on the basis of convertible securities can be designed such that all our three conditions for an efficient equilibrium contract can be met.

4.3 Convertible Securities

Two of the most common instruments in venture capital finance are convertible debt and convertible preferred equity (see GOMPERS and LERNER (1997a), SAHLMAN (1990) TYEBJEE and BRUNO (1984). The main difference between the two instruments concerns the rights in the case of a default. Whereas the preference shareholders do not have any particular rights in this case, debt holders can force the firm into liquidation, or in our context, they are able to take over the exit decision. Since the agency problem associated with the two exit channels, liquidation and trade sale, is already treated by BERGLÖF (1994), we exclude as above the case in which the OM cannot repay his debt (we assume that $\underline{w} - E > D$).

Convertible debt and convertible preferred equity are very similar with respect to the resulting payoff structure. With convertible debt as well as with convertible preferred equity the VC has a fixed claim (the debt component or accumulated dividends) on the monetary pay-off and a call option on a proportional share according to his equity holdings. As can be seen in figure 4, with convertible preferred shares the VC receives the entire firm value (represented by the 45° line) as long as his pay-off claim is not fully satisfied.

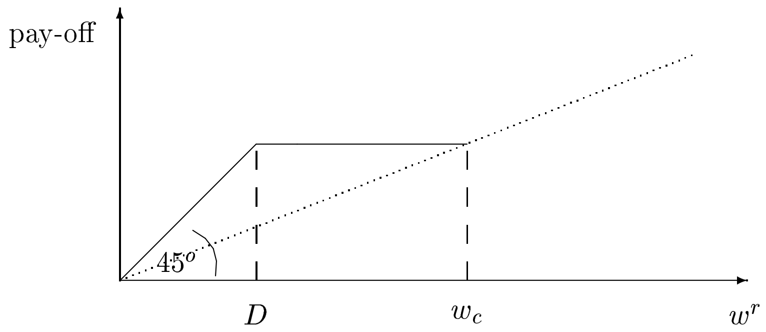

Figure 4: VC's payoff with convertible preferred equity.

After that he gets a fixed amount of accumulated dividend payments (the flat line), until he decides to convert the preferred shares into ordinary shares which is usually achieved by the so called conversion rate. The slope of the dotted line represents the pay-off share of the VC after conversion. The VC's conversion point is denoted by w_c and depends on the relation between the a-priori contracted share in the firm's value and the debt claim.

The reason why we will find convertible securities useful, lies in the analogy between the actual control allocation before and after the conversion of preference shares and the required control allocation during and at the exit decision. Before conversion and hence during implementation the OM has unconditioned control as the VC holds either a debt claim or non-voting preference shares. After conversion and hence at the point of time when the exit decision is made it is either the VC or the OM who is holding control, depending on the allocation of voting rights. Therefore with the use of convertible securities it is already assured that condition 2 will always be satisfied. It remains to be shown, that we can also assure an efficient choice between exit modes in an market equilibrium.

4.3.1 Convertible Securities and the Efficient Choice between Exit Modes

The basic problem facing us here is that there is no variable which is verifiable and on which conversion can be made contingent.[11] Hence, an efficient set-up requires that conversion must be incentive compatible, i.e. it has to be in the interest of the VC to convert his debt into equity so that the first-best exit solution actually takes place. It turns out that such an incentive compatible contract is possible with convertible preferred shares.

We distinguish between conversion with and without a switch in control, henceforth referred to as the non-voting and the voting case. Thereby, we emphasize the fact that a shift in control is not always necessary to achieve the first-best solution. Instead, what is much more needed is a switch in the payoff structure of the agent deciding on the exit mode (obviously, this can also involve a switch in control). In a recent study by Trester (1998) it is shown that the mean percentage of deals where the ability to convert in voting shares results

[11] While one can often observe automatic conversion provisions from preference to ordinary shares for the realization of an IPO, this is in our model no possibility to implement the first-best exit rule. Instead we believe that such a conversion provision is mainly due to legal registration requirements in case of an IPO and to a less extent an instrument to influence incentives.

in a transfer of control is only 28%. We want to rationalize this fact within our framework by arguing first that it is feasible to achieve the first-best solution with conversion to non-voting equity in some cases (i.e. without a switch in control). Second we show that in other situations, a switch to voting equity is required to implement an efficient solution.

With convertible preferred shares, the VC's utility function consists of two parts:

First, if conversion has not taken place yet (nc), we get:

$$U_{nc}^{VC} = \begin{cases} U_{IPO,D}^{VC} = D + r_{IPO} w^r \\ U_{TS,D}^{VC} = D \end{cases} \tag{12}$$

Second, after conversion (c), we find:

$$U_c^{VC} = \begin{cases} U_{IPO,\alpha_c}^{VC} = (1-\alpha_c)(w^r - E) + r_{IPO} w^r \\ U_{TS,\alpha_c}^{VC} = (1-\alpha_c)(w^r + P) \end{cases} \tag{13}$$

Whereby α_c is the ex-ante agreed share of the OM of the net firm value in the case of conversion. This is usually achieved via the agreed conversion rate. The utility function of the OM is expressed by (8) and (2).

In the **non-voting case**, control remains with the OM. Hence either $\alpha_c > 0,5$ or the VC converts his debt holdings into non-voting shares. To achieve the first-best solution, it is necessary that the OM changes his mind at w^* and chooses an IPO (TS) for $w^r \geq (<) w^*$. This can be achieved if the VC converts at w^* so that the payoff structure of the OM changes.

Our discussion about the behaviour of the OM therefore implies that the first requirement is met if after conversion to non-voting equity (see (3))

$$\alpha_c \leq \frac{CB_e}{P+E} \tag{14}$$

holds.

The VC will convert at w^* (anticipating the OM's behaviour), if the debt level and the VC's share of firm value after conversion are arranged in the way that the VC is just indifferent at w^* between the debt arrangement (leading to a TS) and the equity arrangement (leading to an IPO). More formally:

$$U_{TS,D}^{VC}(w^*) = U_{IPO,\alpha_c}^{VC}(w^*) \tag{15}$$

Note that it is optimal for the VC to convert at w^* since for $w^r < (>) w^*$ $U_{TS,D}^{VC} > (<) U_{IPO,\alpha_c}^{VC}$.

The contract we look at is, however, only an equilibrium if in addition to the conditions expressed in (14) and (15) the participation constraint holds with equality.

We can express the participation constraint in the case just discussed as

$$U_r^{VC} = \int_{\underline{w}}^{w^*} (D)\, f(w)dw + \int_{w^*}^{\overline{w}} [(1-\alpha_c)(w-E) + r_{IPO}w]\, f(w)dw \tag{16}$$

whereby the first (second) term on the RHS represents the payoff if a TS (IPO) is realized before (after) conversion. We see that for a rather low reservation utility of the VC, either the VC's share $(1-\alpha_c)$ or his debt component has to be reduced. But from condition (14) we know that there is a lower bound to which the VC's share can decrease, i.e. $(1-\alpha_c^+)$ whereby $\alpha_c^+ = CB_e/P+E$.

Using α_c^+ and (15) we can compute a floor of the debt level which must be exceeded in order to simultaneously achieve an efficient conversion and exit decision. We can rewrite (15) to:

$$D + r_{TS}w^* - R = (1-\alpha_c^+)(w^*-E) + r_{IPO}w^* \tag{17}$$

Plugging α_c^+ as well as w^* into (17) yields the lower bound of feasible debt level in the non-voting case:

$$\begin{aligned} \bar{D} &= (1-\alpha_c^+)(w^*-E) + r_{IPO}w^* \\ &= \left(\frac{P+E-CB_e}{P+E}\right)\left(\frac{P+E-CB_e}{r_{IPO}} + P\right) \end{aligned} \tag{18}$$

Hence with conversion to non-voting equity, the agreed debt level has to exceed $\bar{D}$. However, if U_r^{VC} is quite low a potential problem arises. Given that α_c^+ is rather low, see (14), so that the VC's minimal share is already quite high, the debt level has to be reduced drastically in order to satisfy the participation constraint. This in turn is only possible to a certain extent since the debt level cannot be lower than $\bar{D}$. If, however, the combination of $(1-\alpha_c^+)$ and $\bar{D}$ leads to a payoff for the VC which exceeds his reservation utility, a contract with conversion to non-voting equity does not represent an equilibrium, because - as we will show in the following - there exists another contract with conversion to voting equity which pulls the expected utility of the VC down to his reservation utility.

In the **voting case** the switch in the chosen exit mode comes about through a switch in control (and therefore of the deciding party). After conversion the VC decides on the exit mode, hence either $\alpha_c < 0,5$ or the VC converts into voting shares so that he holds the majority of voting rights. In order to achieve the first-best solution with convertible preferred shares when conversion to voting equity takes place, it needs to be ensured that for $w^r < w^*$ a TS is chosen and for $w^r \geq w^*$ an IPO is selected. Our previous discussion revealed that the OM always prefers the TS to the IPO with a debt contract. Hence, the contract has to be set-up so that the VC has an incentive to convert for $w^r \leq w^*$. A second condition is that the VC chooses the optimal exit mode (if he is in charge), or to be more precise, that the VC chooses the IPO (TS) for $w^r \geq (<) w^*$. Both conditions must be fulfilled simultaneously. We can express these conditions formally as:

$$U^{VC}_{TS,D}(w^*) \quad \leq \quad U^{VC}_{TS,\alpha_c}(w^*) \tag{19}$$

$$w^* = w^{VC} \qquad \text{or} \qquad \alpha_c = \alpha_c^+ = \frac{CB_e}{P+E} \tag{20}$$

In addition, the participation constraint of the VC (16), has to hold in equilibrium. Figure 5 illustrates the basic idea behind the optimal contract with convertible preferred equity for the voting equity case.

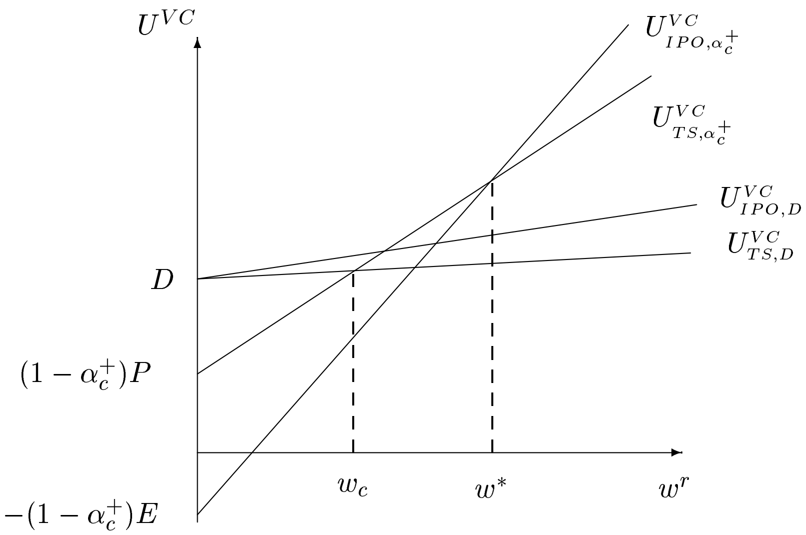

Figure 5: VC's utility in the voting case

In bad states of nature, i.e. low w^r, the VC prefers to hold his debt claim and the OM chooses a TS. For $w^r \geq w_c$ the VC converts his preferred stocks in voting common stocks because in the case of a TS his utility with an equity stake exceeds his utility with a debt claim. By converting into voting equity he takes over control and realizes a TS. For $w^r \geq w^*$ the preference of the VC switches from a TS to an IPO and henceforth the Pareto optimal exit policy is pursued for all possible realizations of w.

Combining (19) with (20) enables us to derive an upper bound for the feasible debt level in the present case. Expressing (19) as:

$$D + r_{TS} w^* \leq (1 - \alpha_c^+)(w^* + P) \tag{21}$$

and inserting α_c^+ as well as w^* gives us:

$$D \leq \bar{D} = \left(\frac{P + E - CB_e}{P + E}\right)\left(\frac{P + E - CB_e}{r_{IPO}} + P\right) \tag{22}$$

That is, the upper bound in the voting case is just equal to the debt-level-floor of the non-voting case. This implies that in any situation one of the two instruments leads to an optimal solution. If the participation constraint of the VC is violated in the case of non-voting equity it is always feasible to convert to voting equity and to achieve the first-best outcome. Comparing (18) with (22) reveals that the range in which the two instruments are used efficiently does not overlap. Figure 6 illustrates our findings.

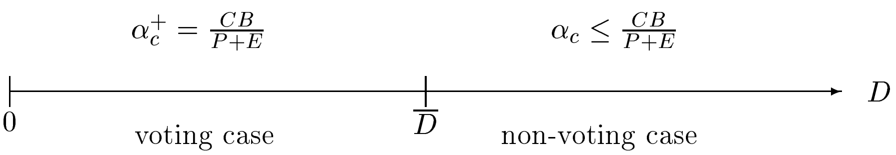

Figure 6: Conversion into voting vs. conversion into non-voting equity.

We can summarize our findings in

Proposition 4 *It is always feasible to achieve the first-best solution by using convertible preferred equity. Depending on the parameter constellations the participation constraint of the VC requires conversion to non-voting or to voting shares.*

Taking proposition 4 and the fact that convertible securities leave the control during project implementation with the OM shows us the superiority of convertible securities to the discussed financing instruments. So despite the fact that there are two alternative financing instruments allowing for an efficient exit solution and market equilibrium, convertible securities are always preferred to a debt-equity mix, since with the former the OM has control over the firm until the VC converts.

Though we find our results convincing, there are at least two qualifications to be made. First, without a calibration of our model, which is beyond the scope of this paper, we can not definitely claim that our results are in line with the stylized facts mentioned above. Second, while we have restricted our search for efficient contracts on the empirically most relevant financing instruments, namely all those containing elements of debt and equity, there might exist optimal contracts that are nonlinear and thus not in the class considered. Nevertheless, we think that one of the main reasons why we do not observe nonlinear contracts is that standardized financing instruments like debt and equity help to economize on transaction costs and are, as has been shown, flexible enough to achieve efficiency.

4.3.2 The Choice between Voting and Non-Voting Equity

We now want to be more explicit on the factors influencing the form of the participation constraint and therefore deciding whether conversion to voting or non-voting equity turns out to be optimal. In order to do this, we look at the strictly binding participation constraint for the border case at $D = \bar{D}$ and $\alpha = \alpha_c^+$. Note that $\bar{D} = (1-\alpha_c^+)(w^* + P)$, then (16) gets:

$$(1-\alpha_c^+)(w^*+P)F(w^*) + \int_{w^*}^{\overline{w}} \left[(1-\alpha_c^+)(w-E)\right] f(w)dw = U_r^{VC} - \int_{w^*}^{\overline{w}} \left[r_{IPO} w\right] f(w)dw \quad (23)$$

The monetary payoff for the VC consists of his expected share in the maximum value of a TS plus his share in the expected revenue of an IPO. This is equal to the VC's reservation utility which is reduced by the expected non-monetary payoffs due to the reputation effects.

Now it is clear, if U_r^{VC} decreases by a small amount and α is already at its upper bound α_c^+, D has to be reduced under $\bar{D}$ and we are in the voting case.

If we integrate and rearrange (23) by using the values of w^* and α_c^+, whereby $\Theta(w)$ denotes the integral of $F(w)$ (see the appendix for details), we get:

$$PC: \qquad (1-\alpha_c^+ + r_{IPO})(\overline{w} - \Theta(\overline{w})) - (1-\alpha_c^+)E - U_r^{VC} + (1-\alpha_c^+ + r_{IPO})\Theta(w^*) = 0 \quad (24)$$

Now we are able to analyze the influence of at least some of the other factors on the PC.

First, the values of $\overline{w}$ and $\underline{w}$ are insignificant with respect to the VC's payoff since $\partial PC/\partial\overline{w} = \partial PC/\partial\underline{w} = 0$.

Second, each value of r_{IPO}, P, E and CB_e has a contrary effect on the PC whose net effects are a priori not clear. This is because all these factors affect the value of w^* and hence the integration limits of all monetary and non-monetary payoff components.

Third, a greater probability of a TS makes the PC less strict as we can see from: $\partial PC/\partial F(w^*) = -(1 - \alpha_c^+ + r_{IPO})F(w^*) < 0$. The intuition of this result is that the positive direct effect on the expected share in the maximum value of a TS overcompensates the possibly negative effect on the sum of the share in the expected revenue of an IPO and the expected reputation gain and thus increases the VC's overall expected payoff. Therefore, we would expect that projects with a high probability of low and medium returns are more likely to be financed with a conversion option into voting equity.

5 Conclusion

In this paper we have provided an explanation for the wide-spread use of convertible securities in venture capital finance. One of the main characteristics of venture capital funds is that they invest in particular projects only for a limited time period. Therefore exit becomes crucial for the venture capitalists. It has been shown that parameter values and realizations of firm value exist such that there is a conflict of interests ex-post with respect to the exit mode. If this problem can not be solved by using ex-ante contractual provisions, the agreement between the owner manager and the venture capitalist may be suboptimal as renegotiation is likely to be costly and an implicit contract over control can be difficult to enforce.

One result of our analysis is that conventional debt and/or equity instruments are not flexible enough to achieve overall efficiency. However, with the use of convertible securities, especially convertible preferred shares it is possible to leave the OM with control during the project so that convertibles prove to be superior to a debt-equity mix from this point of view. This corresponds very well to the empirical fact that preference shares are almost always complemented with a conversion option in venture capital finance. In addition it has been shown that convertible preferred shares provide for the switch in payoff structures which is in some cases already sufficient for achieving an efficient solution with respect to the exit mode. In other words in situations with conversion to non-voting equity the use of a conversion option does not lead to a shift in control to the VC, which is very well in line with empirical observations. The conversion into voting equity and hence a control shift seems to be most likely for venture capital funds with low reservation utilities on the one hand and projects with a high probability for a TS on the other hand.

Our simple analysis abstracts from a number of important features with respect to the OM-VC relation, most notably incentive problems on the side of the OM and adverse selection problems. Our analysis has shown that even in the absence of these issues, the use of convertible preferred shares makes sense because they are able to provide for an efficient separation of ownership and control between the OM and the VC with respect to the exit decision, making a contract between the two more beneficial and more likely.

Appendix

Derivation of Equation (9)

Suppose that the VC switches from a TS to an IPO at w^*. Then the VC receives his share $(1-\alpha_e)$ for $w < w^*$ from the TS and for $w \geq w^*$ from the IPO. This expected utility must just be equal to the reservation utility. Hence, we get:

$$\begin{aligned} U_r^{VC} = \quad & (1-\hat{\alpha}_e) \quad \int_{\underline{w}}^{\overline{w}} wf(w)dw + \int_{\underline{w}}^{w^*} Pf(w)dw - \int_{w^*}^{\overline{w}} Ef(w)dw \\ + \quad & \int_{w^*}^{\overline{w}} r_{IPO} wf(w)dw \end{aligned}$$

After some rearrangements this equation gives us (9).

Derivation of Equation (24)

If we integrate (by parts) equation (23) we get:

$$\begin{gathered} (1-\alpha^+)(w^*+P)F(w^*) - (1-\alpha^+)EF(\bar{w}) + (1-\alpha^+)EF(w^*) \\ +(1-\alpha^+)F(\bar{w})\bar{w} - (1-\alpha^+)F(w^*)w^* - (1-\alpha^+)\Theta(\bar{w}) + (1-\alpha^+)\Theta(w^*) \\ = \\ U_r^{VC} - r_{IPO}F(\bar{w})\bar{w} + r_{IPO}F(w^*)w^* + r_{IPO}\Theta(\bar{w}) - r_{IPO}\Theta(w^*) \end{gathered}$$

By noting that $F(\bar{w}) = 1$ and $F(\underline{w}) = 0$ as well as by inserting α^+ and w^* gives us after some rearrangements equation (24).

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