Financing the Entrepreneurial Venture*

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This Draft: November 1, 2005

Abstract

This paper is about financial contracting choices for the entrepreneur. In an incomplete contracts model, the entrepreneur can design contracts contingent on three possible control right allocations: entrepreneur-control, investor-control, and joint control, with each allocation inducing different effort levels by both the entrepreneur and the investor. Four types of contract emerge as potentially optimal: debt with liquidation, debt with reorganization, equity-like financing, and preferred-type (convertible and straight) financing. The model: a) determines optimality along two dimensions: the "convexity" of output as a function of incentives, and the investor's opportunity cost of capital; b) highlights the importance of ex-ante and ex-post efficiency in contracting; c) generates empirical predictions about the determinants of financial contracts.

Keywords: Entrepreneurial finance, incomplete contracts, debt versus equity.

JEL Codes: M13, G32.

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*I thank Martin Boyer, Jim Brander, Gilles Chemla, Matt Clements, Doug Cumming, Murray Frank, Keith Head, Bob Helsley, Thomas Hellmann, Gordon Phillips, John Ries, Tom Ross, and Ralph Winter, for helpful comments. Able research assistance was provided by Chris Bidner. All errors are mine.

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1 Introduction

Entrepreneurial ventures play a crucial role in the economy: in the U.S. small firms[1] "represent more than 99.7 percent of all employers, [...] employ more than half of all private sector employees, [...and] create more than 50 percent of the nonfarm private gross domestic product."[2] The vast majority of the 550,100 new businesses in the U.S. in 2002 required a capital investment to get started. How did the founders finance these initial requirements? The theory of financial structure of the firm has been one of the central themes of corporate finance since Modigliani and Miller's (1958) irrelevance result. This paper addresses this theme in the context of small business: it analyses optimal contracting for the entrepreneur.

The internet boom of the late 1990s spurred much research on the financing of new ventures.[3] That literature has focused mainly on venture capital (VC) financing,[4] and has offered many insights into the use of convertible preferred equity and its ubiquity in VC deals in the U.S.[5] However venture capitalists finance only a small fraction of entrepreneurial ventures: Davis (2003) reports that venture capitalists finance less than 10 percent of startups in Canada, and that in 2000 Canadian venture capital represented 4 percent of the dollar investment in small firms. Moreover, the prevalence of convertible preferred equity in VC deals appears to be particular to the U.S. In Europe in general,

[1]The Office of Advocacy of the U.S. Small Business Administration (SBA) defines a small business as an independent business having fewer than 500 employees.

[2]See SBA (2003). These statistics can be obtained from the frequently asked questions on "how important are small businesses to the U.S. economy?" at www.sba.gov.

[3]See, for example, Bascha and Walz (2001), Berglöf (1994), Bergmann and Hege (1998), Casamatta (2003), Cornelli and Yosha (1997), Gompers (1997), Gompers and Lerner (1999), Hellmann (2000), Kaplan and Strömberg (2003), Marx (1998), Repullo and Suarez (1998), Schmidt (2002), Trester (1998), Yerramilli (2004).

[4]Four exceptions come to mind which do not focus on convertible preferred contracts. Garmaise (2001) show that when investors are better informed than entrepreneurs, the entrepreneur tends to prefer junior equity to debt. Landier (2002) develops a model where the choice between bank debt and venture capital financing depends on the entrepreneur's exit option: a good (bad) exit option tends to favor venture capital financing (bank debt). Ueda (2002) argues that the tradeoff between bank and venture capital finance is that although banks are better at project evaluation, they are more likely to expropriate the entrepreneur. Finally, Winton and Yerramilli (2004) show that both uncertainty in continuation strategy choices, and skewness of cash flow distributions (low probability of success, high returns when successful), tend to favor the use of convertible debt instead of pure debt.

[5]Evidence of the prevalence of convertible preferred equity in VC financing in the U.S. can be found in Bergmann and Hege (1998), Gompers (1995, 1997), Gompers and Lerner (1999), Kaplan and Strömberg (2003), Lerner (1994), and Sahlman (1990).

as well as in specific countries such as Canada, Germany, Finland, Taiwan, and Australia,[6] evidence points to the use of a variety of securities. The main contribution of this paper is to offer a unifying theory of the entrepreneur/investor relationship, which can be applied to entrepreneurial ventures in general rather than specifically to VC financed ventures, and where the different types of contracts commonly used in new venture financing, such as straight debt, common equity, and preferred equity, emerge as potentially optimal.

Entrepreneurial ventures have distinctive characteristics. i) They are subject to far less restrictive disclosure laws relative to large, publicly held corporations, and their income and accounts are not easily verifiable by a court of law. ii) Both the entrepreneur and the investor may play an active role in the management of the venture, but these investments in effort are difficult to contract upon. The non-verifiability of profits implies non-contractability: parties do not want to make contracts contingent on profits or cash flows as they would have no recourse in court in the event of disagreement. The contract signed at the beginning of the game thus only specifies the allocation of control rights over the venture. As argued in Grossman and Hart (1986) and Hart and Moore (1990) (GHM), control rights - board rights, voting rights, veto rights, liquidation rights, etc. - play an important role because they confer bargaining power in the negotiation over the profits generated. This in turn provides anticipating agents with incentives to invest in effort. In our model, for example, *"Entrepreneur-control"* allocates all control rights and ownership rights to the entrepreneur; in that case the entrepreneur has all bargaining power and can extract all rent in negotiation. She[7] thus has high incentives to exert effort. The investor on the other hand anticipates he will get nothing and does not participate in the management of the venture. Conversely, *"investor-control"* gives all control to the investor: he exerts high effort while the entrepreneur does not participate. Finally, *"joint-control"* allocates enough control rights to the investor to provide him with some bargaining power, and consequently with the

[6] See Cumming (2002), and the references cited therein.
[7] Throughout the paper we refer to entrepreneurs as female, and to investors as male.

ability to extract some rents. The investor may for example have enough control to influence the entrepreneur's use of first-class airline tickets or her access to the company car. As long as the investor can interfere with the entrepreneur's ability to enjoy the surplus, he can extract a fraction of that surplus by threatening interference. With joint control, both the investor and the entrepreneur participate in management, but anticipating that they will have to share the surplus, they have low incentives and exert low efforts. We show that when the entrepreneur is wealth constrained,[8] this simple framework generates several results:

1. Only four types of contract are potentially optimal for the entrepreneur to offer to the investor.[9] *Debt with liquidation* assigns all control rights to the entrepreneur, which revert to investor-control in case of default on the debt repayment. *Debt with reorganization* is similar to the first contract except that default leads to joint control. The entrepreneur may also offer a simple joint control contract to the investor. This alternative, despite non-contractibility of profits, yields an expected cash flow to the investor which looks much like that of equity: the investor has enough control to interfere with the entrepreneur's ability to enjoy the rents, and can thus extract a fraction of the surplus. Therefore we call this *"equity-like" financing.* Finally, the entrepreneur may offer a contract which assigns joint control conditionally on debt repayment, with default resulting in investor-control. This contract looks very much like the preferred equity contracts observed in practice. For this reason we call it the *"preferred-type"* contract. In the paper we distinguish between two sub-categories: *"straight preferred-type"* contracts and *"convertible preferred-type"* contracts.

2. The optimal contractual form is mainly determined by two factors: a) agents' "motivational" marginal efficiency relative to "participatory" marginal efficiency, or "convexity" of output with respect to incentives;[10] and b) the investor's opportunity cost of capital. We find that for ventures in which

[8] If the entrepreneur were not wealth constrained, then, as shown in GHM, the optimal allocation of control rights would be the one which maximizes total surplus. See our discussion in section 5.

[9] The entrepreneur initially has all the bargaining power in negotiation: she makes a take-it-or-leave-it offer to the investor.

[10] The three control rights allocations yield three types of incentives for the agents: a) no incentives (zero expected payoff): in that case they don't participate; b) low incentives: enough to participate, but low effort exerted; c) high incentives: participation and high effort exerted. We define participatory marginal efficiency as the increase in output

motivation - rather than participation - matters,[11] debt with liquidation is optimal. In contrast, when participation - rather than motivation - matters, equity-like financing dominates when cost of capital is low, while the preferred-type contract is optimal when it is high.

3. We use the results of the model to address interesting issues in entrepreneurial finance: the prevalent use of debt contracts to finance "lifestyle venture," and of equity contracts (common equity, straight and convertible preferred equity) in classic startup ventures; investors' outside options, investor "sophistication," and temporal/geographical differences in VC contracts.

Much of the work in the security design[12] literature analyzes firms which share some of the characteristics described in the third paragraph of this introduction. As noted in Fluck (1998), this literature suffers from the drawback that it cannot simultaneously assume characteristics i) and ii)[13] and incorporate outside equity financing. Fluck solves this problem by arguing that equity-holders who have the right to dismiss the manager, and have an unlimited time horizon, can discipline the manager into paying out dividends with a credible threat of dismissal. In contrast, our contribution to that literature is the following. We get around Fluck's critique by arguing that *in entrepreneurial ventures* the crucial components of equity contracts are control rights, such as board rights, voting rights, veto rights, etc. which are typically associated with it. These control rights give ex-post bargaining power to the investor, who is thus able to extract some rents. We incorporate equity not directly through its claim on cash flows[14], but indirectly through the control rights associated with it, and the bargaining power that they confer in negotiation. Like Fluck, Myers (2000) and Dybvig and Wang (2002) also use the threat of dismissal to introduce equity in a model with non-verifiable cash flows. These two

resulting from a switch from a) to b); and motivational marginal efficiency as the increase in output resulting from a switch from b) to c). Lower participatory marginal efficiency relative to motivational marginal efficiency implies a more "convex" output as a function of incentives.

[11] In other words, ventures in which agents' "motivational" marginal efficiency is high relative to their "participatory" marginal efficiency: output is highly convex with respect to incentives.

[12] See for example Aghion and Bolton (1992), Bolton and Scharfstein (1990, 1996), Chang (1992), DeMarzo and Fishman (2000), Dewatripont and Tirole (1994), Diamond (1984), Gale and Hellwig (1985), Hart and Moore (1998), Fluck (1998), Povel and Raith, (2003), Townsend (1979), Williams (1989).

[13] We refer the reader to the third paragraph.

[14] This claim is irrelevant when cash flows are not verifiable.

papers are somewhat closer to ours, in that they take incentives into account. Dybvig and Wang in particular compare debt and equity and argue that whereas debt generates higher (efficient) effort exertion, it also give the manager incentives to default. Our paper however differs not only in context - our focus is on entrepreneurial ventures where the investor, as well as the entrepreneur, exert effort - but also in modeling structure, contracts, and results. Dybvig and Wang's tradeoff described above, for example, does not necessarily hold in our model, where total investment in effort may be higher in with equity than with debt.

Our modeling structure builds on the work of Bolton and Scharfstein (1990, 1996) and Hart and Moore (1998) (BSHM), as well as Aghion and Bolton (1992). We show that results can be quite different if we introduce a key variable that is absent in their models: effort. Gertner et al. (1994) also introduce effort in a financing model. The two models remain quite dissimilar,[15] however, and the papers address two very different questions: their focus is on the tradeoff between internal and external financing choices for the firm, whereas ours is on optimal security design for the entrepreneur.

The paper is structured as follows: section 2 presents the basic model. Section 3 describes the contractual choices for the investor, and section 4 analyzes optimal contracts. Section 5 discusses the main empirical predictions of the model, and concludes.

2 Model

2.1 Basic Setup

Consider a wealth constrained entrepreneur who has a two-period, positive net present value project in mind, which requires an initial investment k. The timing of the game is as follows. **At date 0**, the entrepreneur makes a take-it-or-leave-it contractual offer to an investor[16]. The investor's next-

[15] For example, whereas they focus on two control allocations (investor control and entrepreneur control), we allow for a third feasible allocation, joint control, which enriches considerably the set of contractual possibilities.

[16] We implicitly assume that there are many more financiers wishing to invest than there are good entrepreneurs (good projects to be funded).

best opportunity yields an expected net return r over two periods. We call r the investor's (dollar) opportunity cost of capital. If the investor accepts the entrepreneur's offer, then **at date 1**, the project produces a payoff x with probability p, and zero payoff with probability $1-p$. Both x and p are exogenous.

At the beginning of the second period, the entrepreneur decides whether to 1) quit the venture, 2) stay involved and exert low effort e_l at cost $c(e_l) = c_l$, or 3) stay involved and exert high effort e_h at cost $c(e_h) = c_h$, with $c_h > c_l$. Similarly, at the same time the investor decides whether to quit the venture, stay involved and exert low effort f_l at cost c_l, or stay involved and exert high effort f_h at cost c_h. While the entrepreneur's effort is managerial and technology improving in nature, effort by the investor mainly takes the form of managerial help to the entrepreneur (general managerial guidance, marketing, access to "incubator" services, etc.).

Both e and f are assumed to be non-verifiable - and thus non-contractible - investments embodied in physical (rather than in human) capital.[17] Moreover, $e_h > f_h$ and $e_l > f_l$. This assumption distinguishes the entrepreneur from the investor. While the entrepreneur devotes all her time to the project and has no other activities, the investor typically is involved in several ventures at the same time and thus has a higher opportunity cost of effort. Equivalently, for an equal personal cost, he exerts less effort than the entrepreneur.

At date 2, the project yields a positive payoff $v(e, f) = e + f$, which depends on the investments made at the beginning of the second period. We make this separability assumption for simplicity. Similar results hold when technology is not additively separable.

[17] Investments in human capital increase the size of the end-of-period payoff only if the agent remains involved in the venture. If the agent leaves the venture, he/she takes his/her human capital with her. In contrast, investments embodied in physical capital increase the size of the end-of-period payoff whether or not the agent remains involved with the venture. The reason for our focus on physical capital investments should become clear below.

2.2 Incomplete Contracts and Nash Bargaining

We assume that payoffs x and v are not verifiable by a court (though they are observable to entrepreneurs and investors), and thus cannot be contracted upon. To quote Bolton and Scharfstein (1996, p.5), "this assumption is meant to capture the idea that managers have some ability to divert corporate resources to themselves at the expense of outside investors," and that "such perk consumption and investment may be difficult to distinguish from appropriate business decisions and thus impossible to control through contracts."

Because of non-contractability, at the end of each period the entrepreneur and the investor bargain over realized payoffs. Let $z(e,f)$ be the total payoff realized if negotiations succeed (i.e. x or $v(e,f)$). Let $z^e(e,f)$ and $z^f(e,f)$ denote the payoffs to the entrepreneur and investor, respectively, should bargaining negotiations break down, i.e. their outside option.[18] In equilibrium the negotiations always "succeed" and the entrepreneur keeps total payoff $z(e,f)$, minus an equilibrium transfer t^* (the Nash bargaining solution), defined as: $t^* \in \arg\max \left[z(e,f) - t - z^e(e,f)\right]\left[t - z^f(e,f)\right]$, or $t^* = \frac{1}{2}\left(z(e,f) - z^e(e,f) + z^f(e,f)\right)$.

Bargaining in period 1

Two striking features characterize the entrepreneur in the early stages of a new venture. First, the entrepreneur is indeed indispensable to the success of the venture. If this were not the case, many entrepreneurs would simply sell their ideas to investors, and move on to another project. Second, the entrepreneur's indispensability typically comes from her human capital, e.g. her idea, and until specific investments are made, her idea tends to be highly "portable". For that reason investors try to include "golden handcuffs" covenants in financing contracts. These covenant however cannot perfectly "immobilize" the entrepreneur, who could, in many cases, take her human capital elsewhere.

To reflect these features of early stage ventures in a stark way, we assume that in period 1, a) the entrepreneur is absolutely indispendable to the venture, in the sense that the investor cannot generate

[18] In the first period there are no investments e and f, so $z(e,f) = z = x$, $z^e(e,f) = z^e$ and $z^f(e,f) = z^f$.

any rents on his own, i.e. $z^f = 0$; and b) the potential payoff x is based entirely on the entrepreneur's human capital, and could be replicated elsewhere at no extra cost, i.e. $z^e = x$. These assumption have the advantage of making first period bargaining very simple, as they imply $t^* = 0$: the entrepreneur always extracts the entire payoff x at date 1.[19]

Investments and Bargaining in Period 2

The indispensability and portability of the entrepreneur's human capital become much less important in the medium run, as two changes gradually occur. First, as time goes by the entrepreneur's human capital becomes more and more specific to the venture, and hence less and less portable. Second, the success of the venture, as well as the ability to extract rents from it, starts to depend relatively more on physical assets and access to them. In period 2 in our model, this access is determined by the allocation of control rights, which can be of three types.

Joint Control. With this allocation of control rights, the investor controls enough board rights, voting rights, inspection/monitoring rights, etc., such that used in combination, these rights provide him with some bargaining power. Despite the fact that perk consumption by the entrepreneurs is not verifiable in court, these control rights may enable the investor to interfere with it. Even the ability to interfere only slightly with the entrepreneur's perks gives the investor bargaining power, and enables him to extract a part of the surplus. For clarity purposes, we make the strong assumption that joint control gives the investor enough control rights for maximum interference: the investor can block completely the entrepreneur's access to perks. If he does that, however, trade breaks down, and he can get nothing either. More formally, $z^e(e, f) = z^f(e, f) = 0$. Under Nash bargaining, this leads to the two parties splitting the payoff in equilibrium: the entrepreneur and the investor each obtain $\frac{1}{2}v(e, f)$ at date 2.

[19] If instead of assuming that $z^e = x$, we assumed that the entrepreneur could not exactly replicate x, and that her outside option were $0 < z^e < x$, all results of the model would still hold, despite the fact that date 1 bargaining would lead to x being split between the two parties. If we assume that the entrepreneur is not indispensable in the first period, the model predicts what we would expect to see in practice: the entrepreneur would sell the venture to the investor (perhaps with equity vesting in the second period).

Entrepreneur-Control gives the entrepreneur complete authority over the venture, and the investor cannot interfere with her access to rents. If negotiations break down, the entrepreneur continues to enjoy all rents ($z^e(e,f) = V(e,f)$), while the investor gets nothing ($z^f(e,f) = 0$). This leads to a bargaining equilibrium in which the entrepreneur gets all of the rents and the investor gets nothing at date 2. **Investor-Control** is the flip-side of entrepreneur-control: the financier has 100% of the control rights over the venture and full bargaining power in negotiation: $z^f(e,f) = z(e,f)$ and $z^e(e,f) = 0$ imply that the investor gets all of the rents, and that the entrepreneur gets nothing at date 2.

Strictly Dominating Strategies. For simplicity, we focus on values of f_l, f_h, e_l, e_h, c_l, and c_h, such that there exists a strictly dominating strategy for each player. Clearly the entrepreneur will exit the venture under investor control: she anticipates no reward at date 2, and even low participation effort is costly. Similarly, the investor will exit under entrepreneur control. It is natural to expect that for both the entrepreneur and the investor, the higher the expected fraction of the surplus, the higher the equilibrium level of effort. This implies:

	Entrepreneur-control	Joint control	Investor-control
Entrepreneur	High effort	Low effort	No participation
Investor	No participation	Low effort	High effort
Date 2 Exp. Output	$V_Y = v(e_h, 0) - c_h$	$V_Q = v(e_l, f_l) - 2c_l$	$V_L = v(0, f_h) - c_h$

Thus, with joint control the entrepreneur and the investor must share the surplus, and even though they both participate, their individual incentives are low and they exert low effort. With entrepreneur-control, all ex-post bargaining power is transferred to the entrepreneur: he has high incentives and exerts high effort, while the investor does not participate. Conversely with investor-control, the investor has high incentives and exerts high effort, but the entrepreneur does not participate.

More formally we focus on values of f_l, f_h, e_l, e_h, c_l, and c_h, such that:

1) $\frac{1}{2}v(e_l, f) - c_l > \frac{1}{2}v(e_h, f) - c_h$,

2) $\frac{1}{2}v(e, f_l) - c_l > \frac{1}{2}v(e, f_h) - c_h$,

3) $\frac{1}{2}v(e_l, f) - c_l \geq 0$,

4) $\frac{1}{2}v(e, f_l) - c_l \geq 0$,

5) $v(e_h, f) - c_h > v(e_l, f) - c_l$,

6) $v(e, f_h) - c_h > v(e, f_l) - c_l$.

Conditions 1-4 refer to joint control. They imply first that low effort is the optimal choice both agents (cond. 1,2); and second they imply that both agents choose to participate in the venture (cond. 3,4) in the second period. Conditions 5 and 6 refer to entrepreneur-control and investor-control, respectively. They imply that whenever an agent has full control over the venture, he/she has an incentive to make the large investment. Conditions 3 and 4 also imply that participation of the entrepreneur with entrepreneur-control, and of the investor with investor-control, are optimal in equilibrium.

There exists a (large) set of values for parameters f_l, f_h, e_l, e_h, c_l, and c_h, such that conditions 1)-6) in hold. We show in the appendix that for given values of f_l, f_h, c_l, and c_h, with $f_h > 2c_h$, there exist variables $e_l^{\min}$, $e_l^{\max}$, $f_l^{\min}$, and $f_l^{\max}$ such that conditions 1)-6) hold for all $e_l \in \left(e_l^{\min}, e_l^{\max}\right)$ and $f_l \in \left(f_l^{\min}, f_l^{\max}\right)$. We define $V_{Q\min} = v\left(e_l^{\min}, f_l^{\min}\right) - 2c_l$, and $V_{Q\max} = v(e_l^{\max}, f_l^{\max}) - 2c_l$. Then, $V_Q \in (V_{Q\min}, V_{Q\max})$

Note that due to entrepreneurial superiority, we must have $V_Y > V_L$, and thus total output is always higher with entrepreneur-control than with investor-control. Note also that here joint control may well generate the largest total output, provided $V_Q \geq V_Y$. This is unlike the GHM standard framework in which joint control is never an efficient control allocation. Our result comes from our assumption that e and f represent investments embodied in physical capital.[20] If instead we assumed investments in human capital, as in GHM, then entrepreneur control would always dominate joint

[20] This point was made previously by Hart (1995, p. 68). Recently, other authors have described situations in which joint effort provision may be optimal. See for example Casamatta (2003), De Meza and Lockwood (1998), Halonen (2002), Rajan and Zingales (1998), Yerramilli (2004).

control.[21]

3 Contractual Choices for the Entrepreneur

Let us describe the first-best (FB) scenario as benchmark.

First-Best Outcome. In the FB, both the entrepreneur and the investor exert effort to maximize the social surplus: $\underset{e,f}{Max}\ px + v\left(e,f\right) - c^{e}\left(e\right) - c^{f}\left(f\right).$

Conditions 5) and 6) in assumption 3 imply that that the first-best levels of effort for the entrepreneur and the investor, respectively, are $e^{*}\left(v\right) = e_{h}$, and $f^{*}\left(v\right) = f_{h}$.

The resulting equilibrium social surplus can be expressed as: $R_{FB} = px + V_{FB}$, where $V_{FB} = v(e_{h}, f_{h}) - 2c_{h}$.

3.1 Debt with Liquidation

BSHM have shown that when investor-control and entrepreneur-control are the only two feasible control right allocations, the optimal contract assigns entrepreneur-control if a debt repayment d is paid out to the investor at date 1; and investor-control in the event of default.[22] This debt contract - which we denote **"debt with liquidation" (DL)** because in the event of liquidation the investor obtains full control and either manages the venture himself or liquidates it - is still potentially optimal in our framework.

The expected return for the entrepreneur, from a date 0 perspective, follows directly from the form of the contract and from the above analysis: $R_{DL}^{e} = p\left(x - d + V_{Y}\right)$. If the projects was successful in period 1 and generated payoff x (which occurs with probability p), the entrepreneur pays d to the investor, keeps $x - d$ for herself, and expected net payoff V_{Y} at date 2. I. If the project was not successful in the first period and no cash was generated, the entrepreneur must defaults and gets nothing. The expected return for the investor is $R_{DL}^{f} = pd + \left(1-p\right)V_{L} - k$. In the "good" state

[21] This is easily shown by replacing $z^{f}\left(e,f\right)$ by $z^{f}\left(f\right)$, and $z^{e}\left(e,f\right)$ by $z^{e}\left(e\right)$ in the Nash bargaining solution.

[22] The repayment d is assumed to be verifiable.

he receives d from the entrepreneur, and in the "bad" state he obtains control of the assets, with an expected payoff V_L at date 2.

To fully characterize DL, we must determine a) the equilibrium value of d, and b) when this contract is feasible. Since by assumption the entrepreneur makes a take-it-or-leave-it offer to the investor at date 0, whenever possible she will set d such that $R^f_{DL} = r$, i.e. such that the investor is indifferent between investing or not. However d must be low enough to be incentive compatible. Indeed the entrepreneur may be tempted to strategically default in the good state, anticipating that since liquidation is inefficient ($V_Y > V_L$), renegotiation would take place. Under Nash bargaining, the renegotiation outcome would be a payment $s_{DL} = \frac{1}{2}V_L + \frac{1}{2}V_Y$ from the entrepreneur to the investor.[23] For the debt payment to be incentive compatible, we must thus have $d \leq s_{DL}$;[24] in other words, s_{DL} is the maximum debt repayment that the entrepreneur can commit to make. It then follows that the maximum return that the investor can expect to receive is $R^f_{DL}(\max) = p\left(\frac{1}{2}V_L + \frac{1}{2}V_Y\right) + (1-p)(V_I - f_I) - k$.

Thus, as long as the investor's opportunity cost r of investing in the venture is small enough for $R^f_{DL}(\max) \geq r$ to hold, there exists an equilibrium debt repayment $d \leq s_{DL}$ such that $R^f_{DL} = r$, and the entrepreneur extracts all rents from a date 0 perspective: $R^e_{DL} = p(x + V_Y) + (1-p)V_L - k - r$.[25] If r is so large that $R^f_{DL}(\max) < r$, then DL is not feasible.

Note that this contract is only feasible if and only if (henceforth iff) $\frac{1}{2}v(e_l, f_l) - c_l \leq v(0, f_h) - c_h$, i.e. iff $V_Q \leq 2V_L$; otherwise, renegotiation would always occur in the bad state: the investor would always propose to switch from investor-control to joint control, and the entrepreneur naturally would accept. To avoid this possibility and keep the model as simple as possible, we assume that $2V_L \geq V_{Q\max}$. The consequences of relaxing this assumption are discussed in the appendix.

In contrast to BSHM, in this paper entrepreneur-control and investor-control are not the only two

[23] Using the Nash bargaining solution, $s_{DL} = \arg\max (V_Y - z)(z - V_L)$.

[24] Otherwise it is in the interest of the entrepreneur to default, renegotiate, and pay out s_{DL}.

[25] In the special case when k and r are so low that $(1-p)V_L \geq k + r$, the entrepreneur set $d = \varepsilon$, with $\varepsilon \to 0$, and requests a transfer t_0 from the investor at date 0 such that $(1-p)V_L - k - t_0 = r$.

possible allocations of control rights. Indeed, joint control is also available here, and as a result three other types of contract are potentially optimal for the entrepreneur.[26] We analyze each one in turn.

3.2 Debt with Reorganization

Another possible debt contract is to have entrepreneur-control if the entrepreneur makes the debt repayment d at date 1, and joint control if she defaults. In that case the debt contract is in some sense converted into equity in bankruptcy, and reorganization occurs, with both agent sharing control. We call this **"debt with reorganization" (DR)**.[27]

This contract is very similar to the debt with liquidation contract, the main difference being the allocation of control rights in bankruptcy. This difference in control rights affects the entrepreneur's bargaining power in renegotiation, and hence the maximum payment she can commit to repay at date 1. Here the entrepreneur can commit to pay at most[28] $s_{DR} = \frac{1}{2}V_Y$, and the maximum return the investor can receive is: $R^f_{DR}(\max) = p\left(\frac{1}{2}V_Y\right) + (1-p)\left(\frac{1}{2}V_Q\right) - k$.

If r is such that $R^f_{DR}(\max) \geq r$, there exists an equilibrium $d \leq s_{DR}$ such that $R^f_{DR} = r$, and the entrepreneur extracts all rents from a date 0 perspective: $R^e_{DR} = p\,(x + V_Y) + (1-p)\,V_Q - k - r$.[29] If r is so large that $R^f_{DR}(\max) < r$, then DR is not feasible.

[26] In addition to these three contracts, several other types of contracts may be feasible. As shown in the appendix, however, these other contracts are all suboptimal: they are always dominated by one of the contracts presented in the text.

[27] The distinction we make between debt with liquidation and debt with reorganization is not as clear in the real world. Indeed most contracts tend to look like the DL contract in that in the event of default the investor takes control over the assets. Only after taking control the investor decides whether to a) manage the venture himself or liquidate it, or b) reorganize, keep the entrepreneur on board, and manage the venture jointly. We could thus have set up the problem with one type of debt contract, which in the bad state sometimes leads to liquidation, other times to reorganization. From a date 0 perspective, the two ways to present are identical: the date 1 payment d always reflects the agents expectation about whether liquidation or reorganization will occur. We present the two contracts separately for clarity purposes.

[28] With Nash bargaining, we have: $s_{DR} = \arg\max\left((V_E - e_E) - z - \left(\frac{1}{2}V_J - e_J\right)\right)\left(z - \left(\frac{1}{2}V_J - f_J\right)\right)$, which yields $s_{DR} = \frac{1}{2}\left[(V_E - e_E) + (e_J - f_J)\right]$.

[29] In the special case when k and r are so low that $(1-p)\,\frac{1}{2}V_Q - k \geq r$, the entrepreneur set $d = \varepsilon$, with $\varepsilon \to 0$, and requests a transfer t_0 from the investor at date 0 such that $(1-p)\,\frac{1}{2}V_Q - k - t_0 = r$.

3.3 "Preferred-Type" Contracts: "Redeemables" and "Convertibles"

"Preferred-type" (P) contracts assign joint control conditionally on a prespecified debt payment d at date 1; and investor-control in the event of default. If the entrepreneur strategically defaults in the good state of the world, renegotiation occurs, and in equilibrium she transfers an amount[30] $s_P = \frac{1}{2}V_L$ to the investor. This is thus the maximum debt payment d she is willing to forfeit at date 1, and consequently the most the investor can receive is: $R_P^f(\max) = p\left(\frac{1}{2}V_Q + \frac{1}{2}V_L\right) + (1-p)V_L - k$.

If r is such that $R_P^f(\max) \geq r$, there exists an equilibrium $d \leq s_P$ such that $R_P^f = r$; and the entrepreneur extracts all rents and expects $R_P^e = p\left[x + V_Q\right] + (1-p)(V_L) - k - r$.[31] In the special case when $p\left(\frac{1}{2}V_Q\right) + (1-p)V_L - k > r$, the entrepreneur sets $d = \varepsilon$, with $\varepsilon \to 0$, and requests a transfer t_0 from the investor at date 0 such that $p\left(\frac{1}{2}V_Q\right) + (1-p)V_L - k - t_0 = r$. Finally, if r is so large that $R_P^f(\max) < r$, then P is not feasible.

Note that, as in the case of DL, and for the same reasons, the P contract is feasible iff $V_Q \leq 2V_L$. This is always the case when, as assumed, $2V_L \geq V_{Q\max}$.

There is a clear resemblance between this contract and the two main categories of preferred equity financings observed in practice: *Redeemable ("straight") preferred contracts (SP)* typically specify the redemption value of the investment (say d), the redemption date (say date 1), and the amount of common stock to be issued in combination with the preferred stock. This common stock gives the investor some rights over the future cash flows, *in addition* to the pre-specified redemption value; this is the so-called "double-dipping." If the company cannot make the redemption payment, the assets are liquidated, with the proceeds accruing to the investor first ("liquidation preference").

Convertible preferred contracts (CP) give the investor the choice between redeeming his stock at the pre-specified redemption value d, and converting it into common stock. In the bad state, the investor does not convert, thus forcing liquidation and making use of the liquidation preference attached to his

[30] With Nash bargaining, we have: $s_P = \arg\max\left[\frac{1}{2}V_Q - z\right]\left[\frac{1}{2}V_Q + z - V_L\right]$, which yields $s_P = \frac{1}{2}V_L$.

[31] In the special case when k and r are smaller than $p\left(\frac{1}{2}V_Q\right) + (1-p)V_L$, the entrepreneur set $d = \varepsilon$, with $\varepsilon \to 0$, and requests a transfer t_0 from the investor at date 0 such that $p\left(\frac{1}{2}V_Q\right) + (1-p)V_L - k - t_0 = r$.

security to extract as much out of the liquidation value as possible. In contrast, in the good state he converts, provided that the claim on a fraction (say $\frac{1}{2}$) of the proceeds he can get with the common stock after conversion is higher than the redemption value.

The reason why we call this contract the "preferred-type" contract is this: for small investments, when k is so low that in equilibrium d tends to zero, our contract mimicks the payoff of convertible preferred stock. In contrast, when k is larger and the equilibrium date 1 payment d is strictly positive, our contract mimicks the payoff of redeemable preferred stock: double-dipping occurs as the payment d is followed by joint-control and a sharing of the surplus. Thus we call this preferred-type contract convertible preferred when equilibrium d tends to zero, and redeemable (or straight) preferred when $d > 0$.

3.4 "Equity-Like" Financing

This contract assigns joint control unconditionally for the second period. Even though in our model an equity contract per se would not yield any payoff to the investor (since by assumption cash flows are not verifiable, the entrepreneur would "divert" them), joint control (with equity) generates a stream of payoffs to the investor which is similar to the one typically obtained in a standard equity contract. For that reason we call this **"equity-like" financing (E)**. Focusing on the control rights associated with equity (joint control) rather than the cash flow rights,[32] we are able to introduce an equity-like contract in the model and to compare with other contracts, all the while keeping our assumptions of non-verifiability of cash flows and performance, necessary for debt to be emerge as potentially optimal.

Contract E is very simple: as long as the investor's opportunity cost of investing, r, is small

[32] In an interesting study of venture capitalists, Kaplan and Strömberg (2003) found evidence that the control rights allocated to venture capitalists through covenants are independent of the financial contracts offered. One may thus argue that this implies that control rights cannot be used as a good "instrument" for equity since the two are assigned independently. However Kaplan and Strömberg only look at entrepreneurial ventures financed with venture capital, and thus where private equity is used. They do not look at entrepreneurial ventures in general, including the ones financed with debt by commercial banks. We argue that even if control rights are separately allocated *within* the class of VC equity financings observed by Kaplan and Strömberg, on average the VC has much less control than would a creditor in a debt contract following default, and much more control than the creditor in a debt contract where the contracted debt repayment has been made. These are the important differences in our model.

enough for $R_Q^f(\max) = \frac{1}{2}V_Q - k \geq r$ to hold, the entrepreneur can give joint control to the investor in exchange for (k and) a date 0 transfer t_0 such that the investor's expected return exactly equals r, i.e. such that $R_Q^f = \frac{1}{2}V_Q - k - t_0 = r$. The entrepreneur extracts all ex ante surplus and expects $R_Q^e = px + V_Q - k - r$. If r is such that $\frac{1}{2}V_Q - k < r$, then contract E is not feasible.

We show in the appendix that these 4 types of contract, namely ***debt with liquidation, debt with reorganization, preferred-type contracts****, and* ***equity-like financing*** *are the only ones which can potentially be optimal.*

In this section we have determined the optimal contractual form within each type. We now determine which type is optimal.

4 Optimal Contracting

Determinants of the Optimal Contract

Convexity of Output as a Function of Incentives: Motivation Versus Participation. Let us treat e_h, f_h, and c_h as constant. A change in e_l can be interpreted as a change in "participatory" marginal efficiency relative to "motivational" marginal efficiency for the entrepreneur. When control rights switch from investor control to joint control, bargaining power is transferred from the investor to entrepreneur, from no bargaining power at all (investor control) to some bargaining power (joint control). Consequently the entrepreneur's incentives increase enough for her to participate, but not enough to be highly motivated, and her effort/output, net of effort cost, rises from 0 (no participation) to $e_l - c_l$ (participation with low effort). The entrepreneur's *participatory marginal efficiency* in that case is $(e_l - c_l) - 0 = e_l - c_l$. When the allocation of rights switches from joint control to entrepreneur control, more bargaining power is transferred from the investor to the entrepreneur. The entrepreneur's incentives increase even more and she becomes highly motivated: her *motivational marginal efficiency* is $(e_h - c_h) - (e_l - c_l)$.

Thus, for a given e_h, c_h, and c_l a low (high) e_l implies a low (high) participatory marginal efficiency relative to a high (low) motivational marginal efficiency for the entrepreneur. Similarly for the investor, for a given f_h, c_h and c_l, a low (high) f_l implies a low (high) participatory marginal efficiency, $(f_l - c_l)$, relative to high (low) motivational marginal efficiency, $(f_h - c_h) - (f_l - c_l)$. We measure this relative marginal efficiency for each agent with the values of e_l and f_l, and consequently with $V_Q = e_l + f_l - 2c_l$.[33]

We divide the set of values for $V_Q \in (V_{Q\min}, V_{Q\max})$ into three regions, represented on the vertical axis in figures 1 and 2.

Region 1: $V_Q \in [V_{Q\min}, V_L)$**.** When V_Q is small, the entrepreneur and the investor do not create much value by merely participating in the venture with low incentives. Much more value can be added (comparatively), by motivating them with high incentives. Thus, when V_Q is small, output as a function of incentives is "highly convex,"[34] and we say that *motivation*, rather than participation, is the primary driver of success in the venture. Firms in region 1 are "motivation" ventures.

Region 3: $V_Q \in [V_Y, V_{Q\max})$**.** At the other end of the spectrum, when V_Q is large, the entrepreneur and the investor create a lot of value even with low incentives, simply by participating in the venture. Motivating them with high incentives yields little more value added. In that case output is a "highly concave" function of incentives, and we say that *participation*, rather than motivation, is what really drives success in the venture. Firms in region 3 are "participation" ventures.

Region 2: $V_Q \in [V_L, V_Y)$**.** Finally, in between regions 1 and 3 is, the "intermediate" region where output is neither "highly convex" nor "highly concave."

Opportunity cost of capital, and ex-ante versus ex-post (in)efficiency. We compare contract A's ($A = DL$, DR, E, P) total expected payoff - net of cost of effort and initial capital requirement - to a pie. Note that: a) since the entrepreneur always extracts all expected payoffs from

[33] Keeping $V_Y = e_h - c_h$, $V_L = f_h - c_h$, and c_l, fixed, the lower V_Q, the higher $(e_h - c_h) - (e_l - c_l)$ relative to $(e_l - c_l)$, and the higher $(f_h - c_h) - (f_l - c_l)$ relative to $(f_l - c_l)$.

[34] We (perhaps crudely) use convexity to refer to relative marginal efficiencies, even though the output function is only defined in three points. We could convexify the function by linking the three points. In that case, moving the middle point up (down) corresponds to making the convexified function less (more) convex.

a date 0 point of view, the entrepreneur's expected return R_A^e is an appropriate measure of the pie associated with contract A. b) Contract A yields a pie R_A^e that is smaller than the FB pie, R_{FB}. Conditionally on being financed, the contract does not yield the highest possible overall payoff; and this so-called *ex-post inefficiency* is denoted $XP_A = R_{FB} - R_A^e$. The contract yielding the largest pie is ex-post optimal.

The part of the total pie that the investor receives, R_A^f, must be superior to his opportunity cost of capital r for him to finance the venture. However, $R_A^f(\max) < R_{FB}$, and hence some projects which should be financed because $R_{FB} > r$, are not undertaken because $R_A^f(\max) < r$. Fewer projects are financed relative to the first-best, and this *ex-ante inefficiency* associated with contract A is denoted $XA_A = R_{FB} - R_A^f(\max)$. Two factors affect our measure of ex-ante efficiency, $R_A^f(\max) = R_A^e - \left(R_A^e - R_A^f(\max)\right)$. i) The *pie effect,* or ex-post efficiency effect, R_A^e, simply means that ceteris paribus, the larger the pie, the larger the part of it that the entrepreneur can give to the investor. ii) The *slice effect,* $\left(R_A^e - R_A^f(\max)\right)$, represents the smallest slice of the pie that the entrepreneur can commit to keep to herself in renegotiation. The smaller that slice, the larger the part of the pie that the investor can expect to get, and and the more likely that he will agree to finance the project.

The opportunity cost of capital r plays an important role in determining the importance of ex-post versus ex-ante efficiency. When the investor's opportunity cost of capital is low, $R_A^f(\max)$ is likely to be superior to r for many different types of contracts, and ex-post efficiency matters most: the entrepreneur chooses amongst the many feasible contracts the one which yields the largest pie. In contrast, when the opportunity cost of capital is high, only very ex-ante efficient contracts are feasible, and must be chosen even if they are ex-post inefficient. In other words, the pie and slice effects may work in opposite directions: the optimal contract may yield a small pie, but may allow the entrepreneur to commit to keep only a very small slice, leaving enough to the investor for the project to be financed.

Graphical Representation of Optimal Contracts. To understand how the optimal contract depends on convexity of output and the opportunity cost of capital, we analyze how r affects optimal contracting in each region in turn. Figure 1 (at the back of the paper) illustrates our results by depicting optimal contracts in a (r, V_Q) space.[35] Each line represented on the figure represents an "iso-return" line for the investor, drawn at $R_A^f(\max) = 0$: it is the locus of points for which that contract yields a zero return to the investor. All points to the left of that line yield a positive return to the investor, and all points to the right of the line yield a negative return. It is easy to understand which contract is optimal from figures 1 and 2: at each point on the figure, the optimal contract maximizes the entrepreneur's return among all contracts whose iso-return line for the investor is to the right of that point. (All the results of this section are also proven algebraically in the appendix.)

Region 1: $V_Q \in (V_{Q\min}, V_L)$ - "Motivation" Ventures

In motivation ventures, joint control yields a comparatively small output. Mere participation in the venture with low incentive is relatively unproductive; but much value can be added by motivating the agents with high incentives. As a consequence, contracts which provide low incentives (by assigning joint control), such as E, DR, and P, tend to yield a small pie. In contrast, DL never assigns joint control: with high incentives, it motivates the entrepreneur in the good state and the investor in the bad state, respectively. For that reason, DL yields the largest pie and is ex-post optimal: it is the entrepreneur's preferred choice as long as $R_{DL}^f(\max) \geq r$.

Figure 1 shows that DL is also ex-ante optimal: its iso-return line is the furthest to the right in region 1. As a result, there are no projects that could not be financed with DL, but that could be financed with another contract. DL makes the project most likely to be financed as well as yielding the largest pie: hence it must be optimal contract for all points in region 1. DL's ex-ante optimality can be explained in terms of pie and slice effects. We illustrate this by comparing maximum returns

[35] Note that figure 1 is drawn for a probability of date 1 success $p = \frac{1}{2}$. We do this for simplicity but the results of the paper hold for all $0 < p < 1$, unless stated otherwise. Note also that figure 1 exhibits a relatively high value of investor-control payoff, compared to that of the entrepreneur-control payoff: $2V_L > V_Y$. This is the most interesting case because the convertible preferred contract can be optimal under this condition.

to the investor for DL and DR. The difference $R^f_{DL}(\max) - R^f_{DR}(\max)$, can be expressed as:

$$[(1-p)(V_L - V_Q)] - \left[(1-p)\left(-\frac{1}{2}V_Q\right) + p\left(-\frac{1}{2}V_L\right)\right] > 0. \tag{1}$$

The first square-bracketed factor represents the difference in pie effects, which here favors DL. In the bad state DR yields a smaller total pie than DL: $V_Q - 2c_l < V_L - c_h$. In the good state the two contracts yields the same expected total output, and the difference between the two cancels out.

The second square-bracketed factor represents the difference in slice effects, which also favors DL. In the bad state, with DL the entrepreneur can commit not to interfere in period 2 by relinquishing all controls to the investor in case of default: the investor gets all of V_L and there is no slice effect. In contrast, with DR the entrepreneur cannot commit not to extract a slice $\frac{1}{2}V_Q$ of the total pie, at the detriment of the investor. In the good state, with DL the entrepreneur can commit to keep a smaller slice in renegotiation, thus leaving more to the investor. The net slice effect is $\frac{1}{2}V_L$ in favor of DL. This is related to Nash bargaining. DL puts the entrepreneur into a worse bargaining position in renegotiation by worsening her situation if no agreement is reached (investor control yields a lower expected payoff to the entrepreneur than does joint control). Because of that inferior bargaining position, the entrepreneur has less incentive to default and is less likely to renegotiate on the debt payment d: the maximum renegotiation-proof payment the entrepreneur can commit to repay at date 1 through Nash bargaining is higher by an amount $\frac{1}{2}V_L$. In region 1 the pie and the slice effects both favor DL, thus explaining why this contract is ex-ante optimal. The main result in region 1 is the following:

For ventures in which motivation - rather than participation - matters, debt with liquidation is ex-ante as well as ex-post optimal. It is the optimal contract regardless of the investor's opportunity cost of capital.

Region 2: $V_Q \in [V_L, V_Y)$ **- "Intermediate Region"**

In intermediate ventures, mere participation with low incentives yields a payoff V_Q that is still too low relative to that generated by high entrepreneurial incentives: $V_Q < V_Y$. Due mainly to this pie effect,[36] contracts that provide high incentives to entrepreneurs (through entrepreneur control) tend to dominate contracts that do not. Indeed we show in the appendix that DR and DL dominate E and P, respectively, in terms of both ex-ante and ex-post efficiency. As a consequence, in region 2 only DR and DL are potentially optimal.

Low opportunity cost of capital. The pie effect is also the reason why DR is ex-post superior to DL. In the good state of the world, both contracts yield the same expected payoff associated with entrepreneur control. In the bad state however, DR leads to reorganization (joint control), which in region 2 is superior to the liquidation associated with DL. Thus, debt with reorganization is the entrepreneur's preferred choice when $R^f_{DR}(\max) \geq r$.

High opportunity cost of capital. Looking at figure 1, we see that DL is ex-ante superior to DR. Let us go back to condition (1). The sign of the second square-bracketed term does not change in region 2: just as in region 1, DL has a "slice effect" advantage over DR; it gives the investor a larger slice of the surplus/pie. In contrast, the sign of the first square-bracketed term does change in region 2: it becomes negative. Our ex-post analysis shows that here debt with reorganization yields a higher overall surplus: it generates the largest pie. In other words, in region 2 the pie effect and the slice effect work in opposite directions: they favor different contracts. We show in the appendix that the slice effect dominates in this region,[37] making DL ex-ante superior. It must be, therefore, that when r is too high for DR to be feasible, DL becomes the optimal contract. In sum:

For "intermediate" ventures, the debt with reorganization contract is ex-post optimal; it dominates when the investor's opportunity cost of capital is low. Debt with liquidation is generally ex-ante optimal, and dominates when the investor's opportunity cost of capital is high.

[36] The slice effect also plays a limited role in these results. See appendix for details.
[37] This holds under the assumption that $2V_L \geq V_{Q\,\max}$.

Region 3: $V_Q \in [V_Y, V_{Q\,\max})$ **- "Participation" Ventures**

In region 3, participation is what is crucial to the success of the venture, and in contrast motivation provides little value added. Indeed, joint control generates the highest possible output, even more than entrepreneur-control: $V_Q > V_Y$. Due mainly to this pie effect,[38] contracts that rely on participation (through joint control) tend to dominate contracts that do focus on providing high incentives to one agent or the other. We show in the appendix that E and P dominate DR and DL, respectively, in terms of both ex-ante and ex-post efficiency. As a consequence, in region 3 only E and P are potentially optimal.

Low opportunity cost of capital. The pie effect is also the reason why E is ex-post superior to P. In the good state of the world, both contracts yield the same expected payoff associated with joint control. In the bad state however, E assigns joint control, which is superior to the liquidation associated with P. Thus, the equity-like contract is the entrepreneur's preferred choice when the investor's cost of capital is sufficiently low: $R_E^f(\max) \geq r$.

High opportunity cost of capital. Looking at figure 1, we see that P is ex-ante superior to E. It turns out that the ex-ante comparison between E and P in this region is the same as the comparison between DL and DR: $R_P^f(\max) - R_E^f(\max) = R_{DL}^f(\max) - R_{DR}^f(\max)$. Let us therefore go back to condition (1). The difference in pie effects - represented by the first square-bracketed factor - favors E over P. In the bad state E yields the highest possible expected payoff, V_Q, while with P the venture is liquidated, generating V_L. In contrast, the difference in slice effects - represented by the second square-bracketed factor - favors P over E. The reasons are the same as with DL and DR. In the bad state, there is no slice effect with P, whereas with E the entrepreneur cannot commit not to extract a slice $\frac{1}{2}V_Q$ of the total pie, at the detriment of the investor. In the good state, relative to E, P puts the entrepreneur into a worse Nash bargaining position in renegotiation by worsening her situation if no agreement is reached. And this allows her to commit to keep a smaller slice in renegotiation, thus

[38] See appendix for details.

leaving more to the investor. The net slice effect is $\frac{1}{2}V_L$ in favor of P. Thus, as in region 2 the slice and pie effects favor different contracts. The former effect tends[39] to dominate the latter, making the P contract ex-ante optimal. In sum:

For ventures in which participation - rather than motivation - matters, equity-like financing is ex-post optimal; it dominates when the investor's cost of capital is relatively low. Preferred-type contracts (straight and convertible) are ex-ante optimal; they dominate when cost of capital is high.

Note that in figure 1 we make the distinction between convertible preferred and straight preferred contracts. Within region 3, there is a sub-region where $R_P^f(\max) > R_E^f(\max)$ and where $R_P^f \geq 0$ even with $d = 0$. This is where the *convertible preferred contract* is optimal: r is too large for the E contract to be feasible, but low enough for CP to be optimal. As r increases, it becomes necessary to promise a positive date 1 payment d to the investor to convince him to invest (in addition to the share of date 2 surplus he was already getting with the convertible preferred contract): straight preferred becomes the optimal contract.

5 Discussion and Concluding Remarks

Two important characteristics of entrepreneurial ventures are contractual incompleteness, and effort exerted by entrepreneurs and by investors. When we take these characteristics into account in a modelling framework, contracts commonly used in practice, such as debt, equity, and preferred-type contracts (including straight preferred and convertible preferred) emerge as potentially optimal for an entrepreneur seeking financing. The optimal contractual choice for a particular venture depends on: 1) the tradeoff between *motivation and participation.* 2) The investor's *opportunity cost of capital* and the tradeoff between ex-post and ex-ante (in)efficiency.

Neither one of these tradeoffs is new. The first tradeoff can be traced back to GHM, who high-

[39]Under our assumption that $2V_L \geq V_{Q\max}$.

lighted its importance when contracts are incomplete. GHM focus on the theory of the firm, however, and say nothing about wealth constraints[40] and financial contracting. The second tradeoff was highlighted by Aghion and Bolton (1992) and Hart (1995), among others, as they extended the GHM incomplete contracting paradigm to corporate finance, by introducing a wealth constraint. Their results are quite different from ours,[41] for one reason mainly: they ignore effort[42] and are thus silent on the motivation/participation tradeoff. To our knowledge, ours is the first paper to bring these tradeoffs together *simultaneously* in a financial contracting framework. The result is a rich model of entrepreneurial finance which can be used to explain a variety of stylized facts about new venture contracting:

"Classic Startups" Versus "Lifestyle Ventures": Lifestyle ventures (e.g., doughnut shops; unbranded video or wine stores; cafés) and classic startups tend to use debt-type contracts and equity-related contracts, respectively. Two points can be made to distinguish one type of venture from the other. First, a lifestyle venture is often defined as a venture in which independence and control are the entrepreneur's chief objectives. Second, In contrast, in the classic startup the goals are value creation and growth, and the entrepreneur recognizes the importance of the investor's role in achieving those goals.

Let us compare a lifestyle venture and the classic startup which yield similar payoffs with investor control and entrepreneur control. Then the first point implies that the negative impact on entrepreneurial effort and, in turn, on output, of switching from entrepreneur control to joint control, is larger for an entrepreneur in a lifestyle venture than for an entrepreneur in a classic startup, because the former is more affected by losing independence and control. In other words, the output function is likely to be more convex in incentives for the lifestyle venture entrepreneur than for the classic startup

[40] If we were to relax our assumption of entrepreneurial wealth constraint, our results would coincide with GHM and the optimal contract would be entrepreneur control in regions 1 and 2, and joint control in region 3.

[41] Aghion and Bolton (1992) for example find that as financial slack decreases, the optimal contract should switch from entrepreneur control, to contingent control (similar to our DL and DR contracts), and in turn to investor control.

[42] Another important difference is that in their model monetary payoffs are contractible.

entrepreneur. The second point implies that the positive impact on output, due to increased investor effort, of switching from entrepreneur control to joint control, is smaller for the investor in a lifestyle venture than for an entrepreneur in a classic startup, because investor participation is less important in the former case than in the latter one, where the investor (typically a venture capitalist) plays a crucial role. Thus, the output function is likely to be more convex in incentives for the lifestyle venture investor than for the classic startup investor.

In the lifestyle venture, where output is convex in both the entrepreneur's and the investor's incentives, the optimal contract should thus induce maximum control, incentives and effort to the entrepreneur and the investor, when they are to play a management role. Debt with liquidation does just that: it gives full control to the entrepreneur in the good state, and full control to the investor in the bad state. At the other end of the spectrum, in the classic startup output is not as convex in incentives, and participation by both the investor and the entrepreneur is more important than high incentives: they do not need high incentives to be efficient. In these situations, equity-related contracts are optimal.

Investors' Outside Options, Temporal and Geographical Differences, and Investor Sophistication: Variable k in our model may also be interpreted as a measure of the investor's outside opportunities.[43] Contracts that give more to the investor (DL and P) could be used to attract investors who, because of good outside opportunities, demand a high rate of return. The increase in competition among VC investors between the 1970's and 1980's may have lead to a fall in required returns. This could explain the change in contracts that occurred during that time, from "investor friendly"straight preferred, to convertible preferred contracts - which are more favorable to the entrepreneur (Hardymon and Lerner, 1999).

[43] Recall our assumption that the investor makes a zero return in the next best alternative. Assume instead that he could make a positive return r in the next best investment. Let us define $k = k_0 + r$, where k_0 is the constant initial investment outlay, and r is the return the investor expects to make if he invests in another venture. The financier still invests only if his expected revenue is larger than k. The higher r, the higher k, and the higher the return the investor must expect to receive for him to agree to finance the venture.

Investors' required returns may also explain geographical difference in the types of VC contracts used. As mentioned in the introduction, recent research has shown that while preferred-type contracts are ubiquitous in the U.S., a variety of contracts, but most frequently common equity, has been used in other countries. One could use our model and argue that perhaps VC investors in the U.S. have more opportunities to choose from - more entrepreneurs for a given number of investors. They thus have better outside options and must be given "generous" preferred-type contracts, whereas elsewhere investors have lesser outside opportunities and common equity is sufficient to induce them to invest.

Finally, Kaplan, Martel, and Strömberg 's (2004) recently found that experienced, sophisticated venture capitalists tend to invest in (convertible) preferred contracts, while "novices" invest in common stock. Our model can explain this if one believes that more experienced venture capitalists have better outside options and can require a higher return, thus forcing entrepreneurs to offer them more attractive contracts such as convertible preferreds.

A Appendix

A.1 Strictly Dominating Strategies for Entrepreneur and Investor

We show that for values of e_h, f_h, c_l, and c_h, with $f_h > 2c_h$, there exist variables $e_l^{\min}$, $e_l^{\max}$, $f_l^{\min}$, and $f_l^{\max}$ such that conditions 1)-6) hold for all $e_l \in \left(e_l^{\min}, e_l^{\max}\right)$ and $f_l \in \left(f_l^{\min}, f_l^{\max}\right)$:

By assumption 1, we can remove f from conditions 1), 3), and 5), and we can remove e from conditions 2), 4), and 6), by replacing V by its functional form. Let us take any given c_l, $c_h > 0$, with $c_l < c_h$. Let us also make the sufficient (though not necessary) assumption that $f_h > 2c_h$: output is sufficiently high relative to its cost. Consider the following two variables: $e_l^{\min} = e_h - 2\left(c_h - c_l\right)$, and $e_l^{\max} = e_h - \left(c_h - c_l\right)$. Then there exists a $e_l \in \left(e_l^{\min}, e_l^{\max}\right)$ such that conditions 1) and 5) hold. Moreover condition 3) holds for $e_l^{\min}$ and must thus hold for all $e_l \in \left(e_l^{\min}, e_l^{\max}\right)$.

We apply the same reasoning to conditions 2), 4), and 6). Consider $f_l^{\min} = f_h - 2\left(c_h - c_l\right)$, and

$f_l^{\max} = f_h - (c_h - c_l)$. For any f_h, c_l, c_h, conditions 2), 4), and 6) hold as long as $f_l \in \left(f_l^{\min}, f_l^{\max}\right)$. $\square$

A.2 Other (Suboptimal) Contracts

Aside from the four types of contract analyzed in the text, five other contracts are theoretically possible, but we show that they are either non-implementable, or weakly dominated by at least one of the contracts already described:

1. Unconditional Entrepreneur-control. This is not feasible. The investor anticipates he will get no reward for his investment k, and refuses to participate in the first place. $\square$

2. Unconditional Investor-control. This generates expected second period payoff $R^f_{sub2} = V_L - k$ for the investor. The entrepreneur could extract all rents ex-ante by requesting a transfer t_{sub2} at date 0 such that $V_L - k - t_{sub2} = 0$. In that case the return to the entrepreneur would be $R^e_{sub2} = px + V_L - k$.

Let us compare these returns with the returns to the entrepreneur and to the investor in debt with liquidation. Recalling that $V_Y > V_L$, it is straightforward to show that $R^e_{DL} > R^e_{sub2}$, and $R^f_{DL} > R^f_{sub2}$. Thus investor-control is suboptimal. $\square$

3. Investor-control conditionally on debt payment d, entrepreneur-control otherwise. Recall that: $V_Y \geq V_L$. In that case there is no feasible payment d_{sub3}, positive or negative, that the entrepreneur would accept: she is always better off with entrepreneur control. $\square$

4. Joint control conditionally on debt payment d, entrepreneur-control otherwise. There are two possibilities.

a) The (second period) expected payoff under entrepreneur-control is higher than that under joint control, net of effort costs: $V_Y \geq V_Q$. In that case there is no feasible payment d_{sub4}, positive or negative, that the entrepreneur would accept: she is always better off with entrepreneur control.

b) $V_Q > V_Y$. In that case the payment d_{sub4} would be negative (it is straightforward to show that Nash bargaining in renegotiation would yield the solution $s_{sub4} = -\frac{1}{2}V_Y$). The investor pays to obtain joint control, rather than entrepreneur control which would yield him nothing. But since the investor is not wealth constrained, he can make the equilibrium incentive compatible payment d_{sub4} in all states of the world, and joint control in period two always occurs. Moreover the entrepreneur can request a transfer t_{sub4} at date 0 to make sure she extracts all ex-ante rents. Whether she receives payment at date 1 through d_{sub4}, at date 0 through t_{sub4}, or with a combination of d_{sub4} and t_{sub3}, is the same to the entrepreneur. Therefore, in this case b), joint control occurs systematically, and the entrepreneur extracts all rents: this is the same equilibrium as with equity like financing.

This contract is either infeasible, as in a), or identical to equity like financing, as in b). We can thus ignore it. □

5. Investor-control conditionally on debt payment d, joint control otherwise. This is similar to the contract just described:

a) If the (second period) expected payoff under joint control is higher than that under investor-control, net of effort costs: $V_Q \geq V_L$, there is no feasible payment d_{sub5}, positive or negative, that the entrepreneur would accept: she is always better off with joint control.

b) If $V_L > V_Q$, then the entrepreneur can choose a d_{sub5} and request a transfer t_{sub5} at date 0 such that investor-control always occurs in period 2 and such that she can extract all ex-ante rents. This yields the same payoff as unconditional investor control (contract 2 described in this appendix), which is shown to be suboptimal. □

A.3 Optimal Contracts

Region 1: $V_Q \in (V_{Q\min}, V_L)$.

Proof that DL is ex-post optimal

1) $R^e_{DL} - R^e_{DR} > 0$ if and only if (henceforth iff) $(1-p)(V_L - V_Q) > 0$, which always holds when

$V_Q - 2c_l < V_L - c_h$ (region 1).

2) $R^e_{DL} - R^e_E > 0$ iff $p\,(V_Y - V_Q) + (1-p)\,(V_L - V_Q) > 0$, which always holds when $V_Q < V_L$.

3) $R^e_{DL} - R^e_P > 0$ iff $p\,(V_Y - V_Q) > 0$, which always holds when $V_Q < V_L$, since $V_Y > V_L$.

Thus $R^e_{DL} > R^e_A$ for $A = DR$, E, P, and DL is ex-post optimal in region 1. □

Proof that DL is ex-ante optimal

a) $R^f_{DL}(\max) - R^f_{DR}(\max) > 0$ if and only if (henceforth iff):

$$p\left(\frac{1}{2}V_L\right) + (1-p)\left(V_L - \frac{1}{2}V_Q\right) > 0, \tag{2}$$

which always holds in region 1.

b) $R^f_{DL}(\max) - R^f_E(\max) > 0$ iff $p\left(\frac{1}{2}V_L + \frac{1}{2}V_Y - \frac{1}{2}V_Q\right) + (1-p)\left(V_L - \frac{1}{2}V_Q\right) > 0$, which always holds in region 1.

c) $R^f_{DL}(\max) - R^f_P(\max) > 0$ iff $p\left(\frac{1}{2}V_Y - \frac{1}{2}V_Q\right) > 0$, which always holds in region 1.

Thus $R^f_{DL}(\max) > R^f_A$ (max)for $A = DR$, E, P, and DL is ex-ante optimal in region 1. □

Region 2: $V_Q \in [V_L, V_Y)$.

Proof that DR dominates E in terms of both ex-ante and ex-post efficiency

1) $R^e_{DR} - R^e_E > 0$ iff $p\,(V_Y - V_Q) > 0$, which always holds when $V_Q < V_Y$ (region 2). This implies that DR is ex-post superior to E.

2) $R^f_{DR}(\max) > R^f_E(\max)$ iff $p\left(\frac{1}{2}V_Y - \frac{1}{2}V_Q\right) > 0$. We can rearrange this condition as follows: $[p\,(V_Y - V_Q)] - \left[p\left(\frac{1}{2}V_Y - \frac{1}{2}V_Q\right)\right] > 0$. The first square-bracketed factor is the pie effect difference, and the second square-bracketed factor is the slice effect difference. The first factor is twice the second factor and always dominates it. Moreover, in region 2, $V_Q < V_Y$, and hence the pie effect is in favor of DR. Therefore DR is ex-ante superior to E. □

Proof that DL dominates P in terms of both ex-ante and ex-post efficiency

a) $R^e_{DL} - R^e_P > 0$ iff $p\,(V_Y - V_Q) > 0$, which always holds in region 2. This implies that DL is ex-post superior to P.

b) $R^f_{DL}(\max) - R^f_P(\max) > 0$ iff $p\left(\frac{1}{2}V_Y - \frac{1}{2}V_Q\right) > 0$. We can rearrange this condition as follows: $[p\,(V_Y - V_Q)] - \left[p\left(\frac{1}{2}V_Y - \frac{1}{2}V_Q\right)\right] > 0$. The first square-bracketed factor is the pie effect difference, and the second square-bracketed factor is the slice effect difference. The first factor is twice the second factor and always dominates it. Moreover, in region 2, $V_Q < V_Y$, and hence the pie effect is in favor of DL. Therefore DL is ex-ante superior to P. □

Proof that DR is ex-post superior to DL, and conditions for DL to ex-ante dominate DR

i) $R^e_{DR} - R^e_{DL} > 0$ iff $(1-p)\,(V_Q - V_L) > 0$, which always holds in region 2. This implies that DR is ex-post superior to DL.

ii) Rearranging (2), it is easy to show that $R^f_{DL}(\max) - R^f_{DR}(\max) > 0$ iff $[(1-p)\,(V_L - V_Q)] - \left[(1-p)\left(-\frac{1}{2}V_Q\right) + p\left(-\frac{1}{2}V_L\right)\right] > 0$.

As discussed in the main text, the first square-bracketed term represents the difference in pie effects, while the second squre-braketed term represents the difference in slice effects. Rearranging, we obtain:

$$V_Q < \frac{p}{1-p}V_L + 2V_L, \tag{3}$$

which does not necessarily hold. It depends on the value of p, V_L, and V_Y. In figure 1, where $2V_L > V_Y$, condition (3) always holds: regardless of p, V_Q can never be high enough within region 2 to have $V_Q > 2V_L$ Thus in our standard case (figure 1), the slice effect dominates the pie effect and debt with liquidation is ex-ante optimal in region 2. □

Region 3: $V_Q \in [V_Y, V_{Q\,\max})$.

Proof that E dominates DR in terms of both ex-ante and ex-post efficiency

1) $R^e_E - R^e_{DR} > 0$ iff $p\,(V_Q - V_Y) > 0$, which always holds in region 3. This implies that E is ex-post superior to DR.

2) $R^f_E(\max) > R^f_{DR}(\max)$ iff $p\left(\frac{1}{2}V_Q - \frac{1}{2}V_Y\right) > 0$. We can rearrange this condition as follows: $[p\,(V_Q - V_Y)] - \left[p\left(\frac{1}{2}V_Q - \frac{1}{2}V_Y\right)\right] > 0$. The first square-bracketed factor (pie effect) dominates the second square-bracketed factor (slice effect). Moreover, in region 3 where $V_Q > V_Y$, the pie effect is in favor of E; and therefore E is ex-ante superior to DR. $\square$

Proof that P dominates DL in terms of both ex-ante and ex-post efficiency

a) $R^e_P - R^e_{DL} > 0$ iff $p\,(V_Q - V_Y) > 0$, which always holds when $V_Q > V_Y$. This implies that P is ex-post superior to DL.

b) $R^f_P(\max) - R^f_{DL}(\max) > 0$ iff $p\left(\left(\frac{1}{2}V_Q\right) - \frac{1}{2}V_Y\right) > 0$. We can rearrange this condition as follows: $[p\,(V_Q - V_Y)] - \left[p\left(\frac{1}{2}V_Q - \frac{1}{2}V_Y\right)\right] > 0$. The first square-bracketed factor (pie effect) dominates the second square-bracketed factor (slice effect). Moreover, in region 3 where $V_Q > V_Y$, the pie effect is in favor of P; and therefore P is ex-ante superior to DL. $\square$

Proof that E is ex-post superior to P, and that P is ex-ante superior to E

i) $R^e_E - R^e_P > 0$ iff $(1-p)\,(V_Q - V_L) > 0$, which always holds when $V_Q > V_Y$. This implies that E is ex-post superior to P.

ii) It can easily be shown that the condition for $R^f_P(\max) > R^f_E(\max)$, with $d = \frac{1}{2}V_L$, can be expressed as in (2). This in turn can be rearranged as in (3). In figure 1 the values of V_Y, V_L, and p are such that condition (3) always holds in region 3, and so the preferred-type contract tends to be ex-ante optimal (the slice effect dominates the pie effect).

When p is sufficiently low and the payoff associated with investor control is relatively high compared to that of entrepreneur control - as illustrated in figure 2 - condition (3) may not hold. In the bad state of the world, the pie effect dominates the slice effect: the total surplus with equity-like financing (joint control) is so much higher than that associated with the preferred-type contract (investor-control), that even a slice equal to half of the former pie is larger than all of the latter one. When p is very low, the likelihood of the bad state occurring is high enough to make the equity-like contract ex-ante optimal.

In figure 1 there is a region where $R_P^f(\max) > R_E^f(\max)$ and where $R_P^f \geq 0$ even with $d = 0$. This is the region where the convertible preferred contract is optimal: k is too large for the E contract to be used, but low enough for CP to be optimal. Note that for the convertible contract to be ex-ante superior to equity-like financing, we must have $R_P^f(\max) > R_E^f$ with $d = 0$. Simplifying we find that this is true iff $V_Q < 2V_L$. But for this to be true in region 3, we must have $2V_L \geq V_Y$: the investor's high effort output must be sufficiently high relative to the entrepreneur's high effort output. As noted above this holds in figure 1. $\square$

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Figure 1

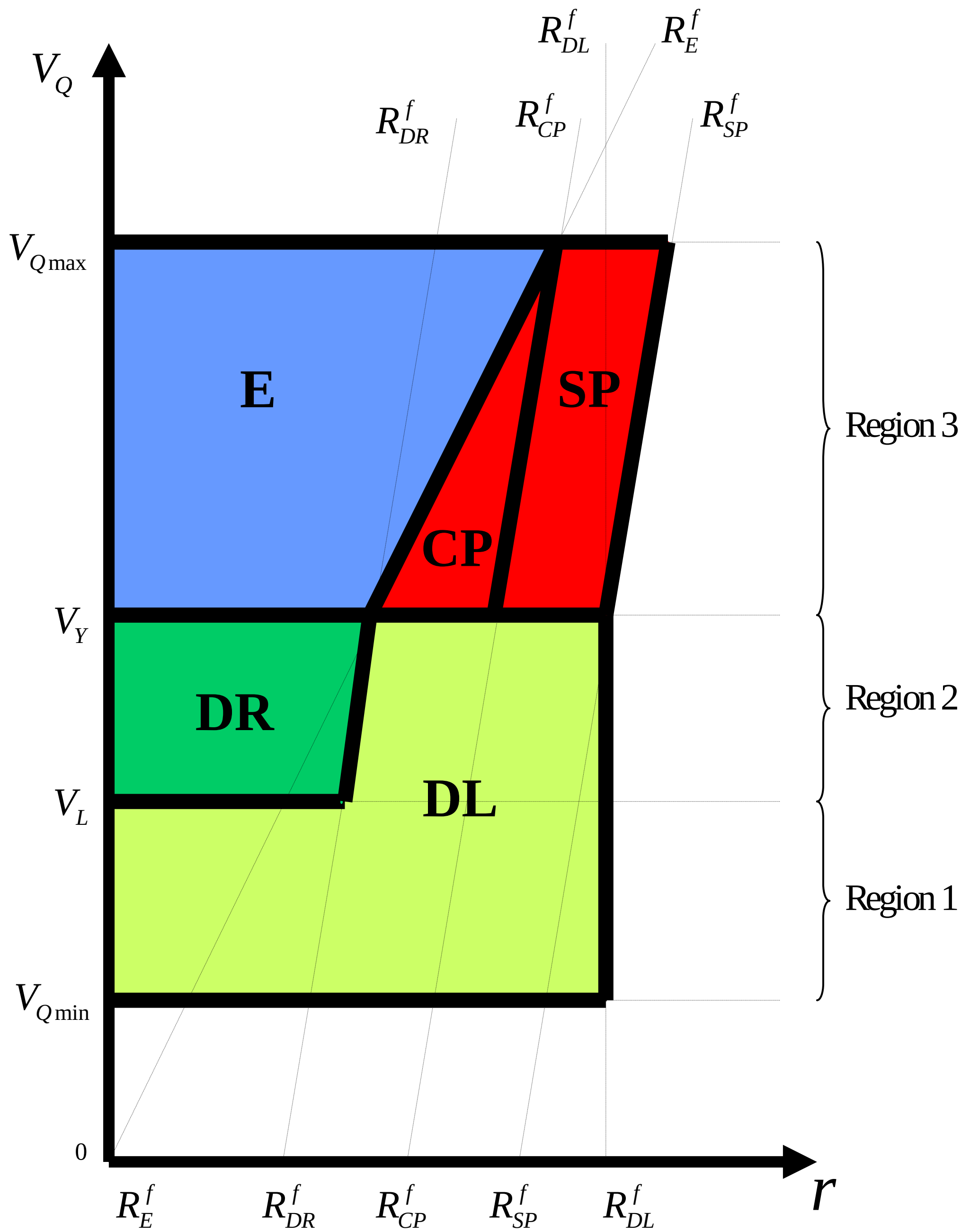

Figure 1 depicts the optimal contract in a (r, VQ) space. In region 1, debt with liquidation is optimal (DL). In region 2, debt with reorganization (DR) is optimal when the investor's cost of capital (r) is low, and DL is optimal when r is high. In region 3, equity (E) is optimal when r is low. As r increases, convertibles preferred (CP), and then straight preferred (SP) contracts become optimal.