Financing the Entrepreneurial Venture*

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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) highlights the importance of ex-ante and ex-post efficiency in contracting; b) determines optimality along two dimensions: the “convexity” of output as a function of incentives, and the size of the initial capital requirement; c) generates empirical predictions about the effects of the type of venture, intangible/tangible asset ratio, initial capital investment, and investor required rate of return, on optimal contracting.

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

JEL Codes: M13, G32.

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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” (U.S. Small Business Administration, 2003)\(^2\). 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\(^3\) 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.

Entrepreneurial ventures have distinctive characteristics related to project financing. 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 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. Since effort levels are not contractable either, the contract signed at the beginning of the game simply specifies the allocation of property rights and control rights over the venture. Control rights, which take the form of 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. “Entrepreneur-control,” for example, allocates all control rights and ownership rights to the entrepreneur; in that case the entrepreneur has all bargaining power and can extract

\(^1\)The Office of Advocacy of the SBA defines a small business as an independent business having fewer than 500 employees.

\(^2\)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 Myers (2002) for an excellent review of this literature.
all rent in negotiation. She\textsuperscript{4} 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 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. In that scenario, both the investor and the entrepreneur participate in management, but anticipating they will have to share the surplus, they have low incentives and exert low efforts.

This simple framework generates several results:

1. Only four types of contract, conditional on the three control right allocations described above, are potentially optimal for the entrepreneur to offer to the investor\textsuperscript{5}. Debt with liquidation assigns control rights to the entrepreneur (entrepreneur-control), that revert to the investor (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

\textsuperscript{4}Throughout the paper we refer to entrepreneurs as female, and to investors as male.

\textsuperscript{5}The entrepreneur initially has all the bargaining power in negotiation: she makes a take-it-or-leave-it offer to the investor.
preferred-type” contracts and “convertible preferred-type” contracts.

2. We show explicitly how both ex-ante efficiency and ex-post efficiency contribute to the determination of the optimal security. Ex-ante inefficiency arises when fewer projects are financed relative to the first-best. Ex-post inefficiency occurs when, conditional on being financed, the contract does not yield the highest possible overall payoff. A contract may be ex-ante optimal, in that it can be used to finance the largest number of ventures, including the ones with the highest initial capital requirements. But at the same time this contract may be ex-post inefficient, in that it returns a low overall payoff. This contract is thus optimal for ventures with high capital requirements, but for smaller investments, another, more ex-post efficient contract will be chosen by the entrepreneur.

3. The optimal contractual form is mainly determined by two factors: the agents’ marginal efficiencies at low incentives relative to their marginal efficiencies at high incentives, or “convexity” of output with respect to incentives, and the size of the initial capital requirement. Relative marginal efficiency affects both ex-post and ex-ante relative efficiency of different contracts, while initial capital requirements size affects the importance of ex-ante relative to ex-post efficiency in the determination of the overall optimal structure. We find that when capital requirements are low and ex-post efficiency matters most, as the agents’ low incentives marginal efficiency increases relative to high incentives marginal efficiency, the optimal contract changes from debt with liquidation to debt with reorganization, to equity-like financing. When capital requirements are high and ex-ante efficiency becomes important, a relative increase in low incentives marginal efficiency leads to changes in contractual optimality, from debt with liquidation to preferred-types contracts (both convertible and straight). We obtain a convenient two-dimensional representation where the parameter space can be partitioned into regions in which different contracts are optimal.

6Gertner, Scharfstein and Stein (1994) highlight both types of (in)efficiency. However they focus on ex-ante efficiency and thus ignore these possibilities.

7We sometimes (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.
4. We provide possible explanations for 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. We also conjecture that size of capital requirements as well as investor required rate of return, should play an important role in optimal contracting. Finally, we discuss convertible preferred contracts in particular, their current prevalence in the U.S., as well as temporal and geographic differences.

This paper contributes to two areas of the literature. The theoretical literature on the financing of new ventures\(^8\) has focused mainly on venture capital (VC) financing\(^9\), and has offered many insights into the use of convertible preferred equity and its ubiquity in VC deals in the U.S.\(^10\) 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 other countries such as Canada, Germany, Finland, Taiwan, and Australia\(^11\), evidence points to the use of a variety of securities. In this paper we develop a model where first, the entrepreneur/investor relationship can be applied to entrepreneurial ventures in general rather than specifically to VC financed ventures, and where second, several types of contracts commonly used in new venture financing (Cumming, 2002a), such as straight debt, common equity, and preferred equity, emerge as potentially optimal.


\(^9\)Three 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.


Much of the work in the security design literature analyzes firms which share some of the characteristics described in the second paragraph. As noted in Fluck (1998), this literature suffers from the drawback that it cannot simultaneously assume characteristics i) and ii) 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, we argue 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, but indirectly through the control rights associated with it, and the bargaining power that they confer in negotiation. Like Fluck (1998), 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 papers are somewhat closer to ours, in that they take incentives into account. Dybvig and Wang (2002) in particular compare debt and equity and argue that whereas debt generates higher (efficient) effort exertion, it also gives 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 is closer to that of Bolton and Scharfstein (1990, 1996) and Hart and Moore (1998), but is probably most closely related to Gertner, Scharfstein and Stein (1994). The

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13We refer the reader to the second paragraph.

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

15Henceforth GSS.

16We draw our model of debt from them, and both our models have agency issues with investors and managers exerting effort in the second period.
two papers, however, have very different focuses: GSS’ 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 results of the paper with examples, and concludes.

2 The Basic Model

2.1 Technology

Consider an entrepreneur who has a two-period, positive NPV project in mind. At the end of the first period, 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 date 2 the project yields a positive expected payoff $V^{17}$. The venture requires an outlay $k$ at date 0 to purchase some physical assets and the entrepreneur, who is wealth-constrained, must turn to an investor to finance the venture. Hence, at date 0, the entrepreneur offers a financing contract to the investor. We implicitly assume that the entrepreneur has all bargaining power at date 0. There are many more financiers wishing to invest than there are good entrepreneurs (good projects to be funded). The case where the investor has some initial bargaining power is discussed in section 5.

At the beginning of the second period, both the entrepreneur and the investor take two sequential decisions. First, each agent decides whether to quit or stay involved with the venture. If one quits, one receives nothing at the end of the second period. If the agent stays involved, she must take the second decision: both the entrepreneur and the investor make a non-verifiable (and thus non-contractible) investment, $e$ and $f$ respectively, to create value $V(e, f)$ for the venture.

**Assumption 1:** $V(e, f) = e + f$.

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17 We denote first period variables with lower case letters, and second period variables with capital letters.
We make this separability assumption for simplicity. Similar results hold when technology is not additively separable.

The entrepreneur invests in her area of expertise, e.g. technology, and exerts either high effort $e_h$ at cost $c^e(e_h) = c_h^e$, or low effort $e_l$ at cost $c^e(e_l) = c_l^e$. Similarly the investor chooses between high effort $f_h$ at cost $c^f(f_h) = c_h^f$, and low effort $f_l$ at cost $c^f(f_l) = c_l^f$. Investment by the financier mainly takes the form of managerial help to the entrepreneur (general managerial guidance, marketing, access to “incubator” services, etc.).

**Assumption 2**: $c_h^e = c_h^f = c_h$ and $c_l^e = c_l^f = c_l$; but $e_h > f_h$ and $e_l > f_l$.

Assumption 2 distinguishes the entrepreneur from the investor. While the entrepreneur devotes all his time to the project and has no other activities, the investor typically is involved in several ventures at the same time. Thus he has a higher opportunity cost of investing in one particular project. Or equivalently, for an equal cost, the investor exerts less effort than the entrepreneur. This is the idea captured here.

### 2.2 Incomplete Contracts

The payoff at the end of the second period, $V$, represents corporate resources. Although observable to entrepreneurs and investors, $V$ is not verifiable by a court, and thus cannot be contracted upon. Bolton and Scharfstein (1996, p.5) explain that “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.”

Since payoff $V$ cannot be contracted upon, the only contractual “tool” available in the second period is the allocation of control rights. There are three possible allocations of control rights: joint

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18 We could obtain similar, though less convenient results by setting the effort levels equal ($e_h = f_h$ and $e_l = f_l$) and by assuming that the investor has higher cost ($c_h^e > c_h^f$ and $c_l^e > c_l^f$).
control, entrepreneur-control, and investor-control\textsuperscript{19}. We describe each one below.

The payoff at the end of the first period, $x$, is also observable but not contractible.

**Assumption 3:** Entrepreneur-control\textsuperscript{20} is the only allocation of control rights available in the first period.

One justification for this assumption would be to argue that $x$ represents personal skill that accrue to the entrepreneur only and the value of which cannot be interfered with. In that case, the entrepreneur can always have access to $x$ in the good state of the world, all control rights allocations yield the same as entrepreneur-control and can thus be ignored. The purpose of this simplifying assumption is to focus our attention on a limited number of interesting contracts. The results of the paper could be extended to take care of other control allocations in period 1, albeit without much benefit.

### 2.3 Joint Control

Joint control occurs when the investor controls enough board rights, voting rights, inspection/monitoring rights, etc., such that used in combination, these rights provide her with bargaining power. Even though perk consumption by the entrepreneurs is not verifiable in court, the aforementioned 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, as the two parties must trade over the surplus from no interference. Acting opportunistically, the investor may be able to use her control rights to extract a part of that surplus.

In this model we make the extreme 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 trade breaks down, however, and he can get nothing either. Thus, having an outside payoff of zero, both parties bargain over the payoff at the end of each period. Assuming Nash bargaining, the two parties split the surplus from trade and the investor extracts a fraction\textsuperscript{21} $\gamma = \frac{1}{2}$

\textsuperscript{19}We use the same terminology as Aghion and Bolton (1992).
\textsuperscript{20}A precise definition follows below.
\textsuperscript{21}The general results of this paper are independent of the value of $\gamma$, as long as $0 < \gamma < 1$. Throughout the paper we
of the second period payoff $V$.

The second period incentive compatibility (IC) constraint and the individual rationality (IR) constraint for the entrepreneur can be described as follows, respectively:

$$e^* (U^e) \in \arg \max U^e (e, f) - c^e (e),$$

$$U^e (e^* (U^e), f) - c^e (e^* (U^e)) \geq 0,$$

where $U^e (e, f)$ is the entrepreneur’s expected payoff at the end of the second period. With joint control, $U^e (e, f) = \frac{1}{2} V (e, f)$. Similarly, the second period IC and IR constraints for the investor can be written respectively in the following way:

$$f^* (U^f) \in \arg \max U^f (e, f) - c^f (f),$$

$$U^f (e, f^* (U^f)) - c^f (f^* (U^f)) \geq 0,$$

where $U^f (e, f)$ is the investor’s expected payoff at the end of the second period. With joint control, $U^f (e, f) = \frac{1}{2} V (e, f)$.

### 2.4 Entrepreneur-Control

In this event, the entrepreneur has complete control over the venture, and all bargaining power in negotiation: she can decide on all actions to be taken regarding the venture. She is thus able to extract all rents in negotiation; the investor cannot behave opportunistically and gets nothing.

The entrepreneurial equilibrium effort $e^* (V)$ is the $e^* (U^e)$ that satisfies conditions (1) and (2),

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assume Nash bargaining for simplicity; this yields $\gamma = \frac{1}{2}$. 
with \( U^e (e, f) = V (e, f) \).

The investor on the other hand expects to get nothing at the end of the second period. Regardless of the level of effort \( f^* (0) \) he would choose, his IR constraint \(-c^f (f^* (0)) \geq 0\), which can be obtained simply by substituting \( U^f (e, f) = 0 \) into (4), can never hold. Consequently, with entrepreneur-control the investor does not participate in the second period.

### 2.5 Investor-Control

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.

The investor’s equilibrium effort \( f^* (V) \) is the \( f^* (U^f) \) that satisfies conditions (3) and (4), with \( U^f (e, f) = V (e, f) \).

The entrepreneur’s IR constraint \(-c^e (e^* (0)) \geq 0\), obtained by substituting \( U^e (e, f) = 0 \) into (2), can never hold, and hence she does not participate in the second period.

### 2.6 Strictly Dominating Strategies

We focus on values of \( f_l, f_h, e_l, e_h, c^f_l = c^e_l = c_l \), and \( c^f_h = c^e_h = c_h \), such that there exists a strictly dominating strategy for each player. These strategies are such that for both the entrepreneur and the investor, the higher the expected fraction of the surplus, the higher the equilibrium level of effort.

More formally:

**Assumption 4:**

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 investment is the optimal choice for both agents: \( e^* \left( \frac{V}{2} \right) = e_l \) and \( f^* \left( \frac{V}{2} \right) = f_l \) (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 ex-ante investment: \( e^*(V) = e_h \), and \( f^*(V) = f_h \). Note that 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.

In sum, from conditions 1)-6) we deduce a strictly dominating strategy for each agent, which we describe in table 1:

<table>
<thead>
<tr>
<th></th>
<th>Entrepreneur-control</th>
<th>Joint control</th>
<th>Investor-control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrepreneur</td>
<td>High effort</td>
<td>Low effort</td>
<td>No participation</td>
</tr>
<tr>
<td>Investor</td>
<td>No participation</td>
<td>Low effort</td>
<td>High effort</td>
</tr>
<tr>
<td>Total Output</td>
<td>( px + V_Y - c_h )</td>
<td>( px + V_Q - 2c_l )</td>
<td>( px + V_L - c_h )</td>
</tr>
</tbody>
</table>

where \( V_Y = V \left( e^*(V), 0 \right) = V \left( e_h, 0 \right), V_Q = V \left( e^* \left( \frac{V}{2} \right), f^* \left( \frac{V}{2} \right) \right) = V \left( e_l, f_l \right), \) and \( V_L = V \left( 0, f^*(V) \right) = V \left( 0, f_h \right) \). The last row shows the expected total net output which results from each control right allocation. Note that by assumptions 1 and 2, we must have \( V_Y - c_h > V_L - c_h \), and thus total output is always higher with entrepreneur-control than with investor-control.

It can easily be shown that 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 assumption 3 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 \( e_l^{\text{min}}, e_l^{\text{max}}, f_l^{\text{min}}, \) and \( f_l^{\text{max}} \) such that conditions 1)-6) hold for all \( e_l \in (e_l^{\text{min}}, e_l^{\text{max}}) \) and \( f_l \in (f_l^{\text{min}}, f_l^{\text{max}}) \).

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, and he has incentives to exert high effort, while the investor does not participate. Conversely with investor-control, the investor has incentives to exert high effort but the entrepreneur does not participate.

**First-Best Outcome**

Let us describe the first-best (FB) scenario as benchmark. In the FB outcome, which represents the social optimum, both the entrepreneur and the investor exert effort to maximize the social surplus:

\[
\max_{e,f} px + V(e, f) - c^e(e) - c^f(f).
\]  

(5)

Conditions 5) and 6) in assumption 3 imply that that the first-best levels of effort for the entrepreneur and the investor, respectively, are \( e^* (V) = e_h \), and \( f^* (V) = f_h \).

The resulting equilibrium social surplus can be expressed as:

\[
R_{FB} = px + V_{FB} - 2c_h,
\]

(6)

where \( V_{FB} = V(e^* (V), f^* (V)) = V(e_h, f_h) \).

**3 Contractual Choices for the Entrepreneur**

At date 0, the entrepreneur can combine the possible allocations of control rights into a contract to be offered to the investor. There are two broad categories of contracts available to the entrepreneur: contingent contracts, and simple “non-contingent” contracts.

Contingent contracts in our model are “debt-like” contracts in which one allocation of control rights is contingent on a prespecified debt repayment\(^{22}\) \( d \) at date 1, with default inducing another, different allocation of control rights. Bolton and Scharfstein (1990) have shown that when investor-control and entrepreneur-control are the only two feasible control right allocations, the optimal contract is one

\(^{22}\)The repayment \( d \) is assumed to be verifiable.
which assigns entrepreneur-control if a debt repayment \( d \) is paid out to the investor at date 1; and assigns investor-control in the event of default.

Here however, another possible control allocation exists, joint control; and thus two other feasible contingent contracts arise. One is debt with entrepreneur-control if \( d \) is paid out, joint control otherwise. The other is joint control if \( d \) is paid out, investor-control otherwise. In addition, three different contingent contracts are theoretically possible\(^{23}\), but we show in the appendix that these are never optimal.

There are also three types of “non-contingent” contracts, which simply correspond to the three available allocations of control rights: entrepreneur-control, investor-control, and joint control. We show in the appendix that unconditionally assigning entrepreneur-control or investor-control is never optimal\(^{24}\). Thus the only non-contingent contract left is joint control, which we call “equity-like” financing. We look at joint control before discussing contingent contracts in greater detail.

### 3.1 “Equity-Like” Financing

Probably the simplest contractual form is the one in which the entrepreneur chooses joint control unconditionally for the second period. In that case both the investor and the entrepreneur have some bargaining power in negotiation and split the surplus equally at the end of period 2. 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 “steal” them), joint control (with or without 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.

Focusing on the control rights associated with equity (joint control) rather than the cash flow rights,
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 interesting. In an interesting study of venture capitalists however, 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. 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.

The date 0 return on investment for the financier is:

\[ R_{f}^{E} = \frac{1}{2} V_{Q} - c_{l} - k - t \geq 0, \]  

(7)

where \( t \geq 0 \) is a date 0 transfer from the investor to the entrepreneur.

The optimal equity-like contract has the following characteristics:

1) If \( k \) is too large for (7) to hold, even with \( t = 0 \), the contract is not feasible and the venture is not undertaken.

2) If \( k \) is small enough for (7) to hold, the entrepreneur, who has all bargaining power ex-ante, chooses a value of \( t \) such that \( R_{E}^{f} = 0 \), and extracts all ex-ante surplus. Her return from a date 0 perspective is :

\[ R_{E}^{e} = px + V_{Q} - 2c_{l} - k. \]  

(8)

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.
3.2 Debt with Liquidation

As shown in Hart and Moore (1998), and Bolton and Scharfstein (1990, 1996), when only investor-control and entrepreneur-control are feasible allocations of control rights, the optimal contract is a debt contract with the following features: 1) At date 0, the investor invests $k$ into the new venture. 2) At date 1, the entrepreneur makes a debt repayment $d$ to the investor, and keeps complete control over the project in period 2. As discussed above, the investor then leaves the venture, the entrepreneur exerts effort $e^*(V) = e_h$, and he receives an expected second period payoff of $V_Y$. We call this the “continuation” scenario. 3) In the “liquidation” scenario, which occurs if the entrepreneur fails to make the repayment $d$ at date 1, total control of the project is transferred to the investor, who then proceeds to either manage the venture himself in period 2, or to sell (liquidate) it to another identical investor/entrepreneur. Both alternatives then yield an expected payoff $V_L$. We call this “debt with liquidation” financing (DL).

There are two possibilities at date 1. If the project does not generate any cash, the entrepreneur must default on payment $d$, the investor liquidates the assets and gets $V_L$. If at date 1 the project generates payoff $x$ (which occurs with probability $p$), the entrepreneur pays $d$ to the investor, keeps $x - d$ for himself, and gets an expected payoff of $V_Y$ at the end of period 2.

For a given value of $d$, the return on investment $R_{DL}$ for the financier is:

$$ R_{DL}^f = pd + (1 - p) (V_L - c_h) - k. \tag{9} $$

If possible, at date 0 the entrepreneur set $d$ such that $R_{DL}^f = 0$. However she is constrained: $d$ must be low enough to be renegotiation-proof. In the good state of the world for example, when the first period payoff is $x$, the entrepreneur may be tempted to default on the debt repayment. In that event, liquidation is inefficient since $V_Y - c_h > V_L - c_h$. Thus, renegotiation between investor and entrepreneur occurs. In the event of renegotiation, the payment $s_{DL}$ from the entrepreneur to the
the Nash bargaining solution, is:

\[ s_{DL} = \arg \max \left( (V_Y - c_h) - z \right) \left( z - (V_L - c_h) \right) \]  
(10)

which yields \( s_{DL} = \frac{1}{2} (V_L - c_h) + \frac{1}{2} (V_Y - c_h) \).

The debt repayment \( d \) must be lower than \( s_{DL} \), otherwise it is in the interest of the entrepreneur to default, renegotiate, and pay out \( s_{DL} \): the contract would not be renegotiation-proof. Hence, for the debt payment to be incentive compatible, we must have:

\[ d \leq \frac{1}{2} (V_L - c_h) + \frac{1}{2} (V_Y - c_h). \]  
(11)

The maximum return the investor can receive is:

\[ R_{DL}^{f} = p \left( \frac{1}{2} (V_L - c_h) + \frac{1}{2} (V_Y - c_h) \right) + (1 - p) (V_L - c_h) - k \geq 0. \]  
(12)

The optimal debt with liquidation contract can be described as follows:

1) If \( k \) is too high for (12) to hold, this contract is not feasible and the venture is not undertaken.

2a) If \( k \) is low enough for (12) to hold, \( d > 0 \) is chosen such that \( R_{DL}^{f} = 0 \), and the entrepreneur extracts all rents from a date 0 perspective:

\[ R_{DL}^{e} = p \left[ x + V_Y - c_h \right] + (1 - p) (V_L - c_h) - k. \]  
(13)

2b) In the special case when \( k \) is so low that \((1 - p) (V_L - c_h) \geq k\), the entrepreneur set \( d = \varepsilon \), with \( \varepsilon \rightarrow 0 \), and requests a transfer \( t \) from the investor at date 0 such that \((1 - p) (V_L - c_h) - k - t = 0\).
3.3 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).

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 \(s_{DR} = \frac{1}{2} (V_Y - c_h)\), and the maximum return the investor can receive is:

\[
R^f_{DR} = p \left( \frac{1}{2} (V_Y - c_h) \right) + (1 - p) \left( \frac{1}{2} V_Q - c_l \right) - k \geq 0. \tag{14}
\]

Similar to debt with liquidation, the optimal debt with reorganization contract is as follows:

1) If \(k\) is too high for (14) to hold, this contract is not feasible and the venture is not undertaken.

2a) If \(k\) is low enough for (14) to hold, \(d > 0\) is chosen such that \(R^f_{DR} = 0\), and the entrepreneur extracts all rents from a date 0 perspective:

\[
R^e_{DR} = p [x + V_Y - c_h] + (1 - p) (V_Q - 2c_l) - k. \tag{15}
\]

2b) In the special case when \(k\) is so low that \((1 - p) \left( \frac{1}{2} V_Q - c_l \right) \geq k\), the entrepreneur set \(d = \varepsilon\), with \(\varepsilon \to 0\), and requests a transfer \(t\) from the investor at date 0 such that \((1 - p) \left( \frac{1}{2} V_Q - c_l \right) - k - t = 0\).

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

\[\text{Using the Nash bargaining solution, we have: } s_{DR} = \arg \max \left( (V_Y - c_h) - z - \left( \frac{1}{2} V_Q - c_l \right) \right) \left( z - \left( \frac{1}{2} V_Q - c_l \right) \right), \text{ which yields } s_{DR} = \frac{1}{2} (V_Y - c_h).\]
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 choose to present the two contracts separately for clarity purposes.

### 3.4 “Preferred-Type” Contracts: “Redeemables” and “Convertibles”

A third category of debt contracts assigns joint control conditionally on a prespecified debt payment \( d \) at date 1; and investor-control in the event of default. These are “preferred-type” contracts (P).

By now it should be clear how to determine the optimal contract within that category. First, we must determine the incentive compatible debt repayment \( d \). If the entrepreneur voluntarily defaults in the good state of the world, renegotiation occurs, and in equilibrium she transfers an amount\(^{27}\)

\[
s_P = \frac{1}{2} (V_L - c_h)
\]

to the investor. This is thus the maximum she is willing to forfeit at date 1, consequently the most the investor can receive:

\[
R^f_P = p \left( \frac{1}{2} V_Q - c_l + \frac{1}{2} (V_L - c_h) \right) + (1 - p) (V_L - c_h) - k \geq 0.
\]

The optimal “preferred-type” contract can be described as follows:

1) If \( k \) is too high for (16) to hold, this contract is not feasible and the venture is not undertaken.

2a) If \( k \) is low enough for (16) to hold, \( d > 0 \) is chosen such that \( R^f_{DP} = 0 \). The entrepreneur extracts all future rents at date 0:

\[
R^f_P = p [V_x + V_Q - 2c_l] + (1 - p) (V_L - c_h) - k.
\]

\(^{27}\)With Nash bargaining, we have: \( s_P = \arg \max \left[ \left( \frac{1}{2} V_Q - c_l \right) - z \right] \left[ \left( \frac{1}{2} V_Q - c_l \right) + z - (V_L - c_h) \right] \), which yields \( s_P = \frac{1}{2} (V_L - c_h) \).
2b) In the special case when \( k \) is smaller than \( p \left( \frac{1}{2} V_Q - c_l \right) + (1 - p) (V_L - c_h) \), the entrepreneur set \( d = \varepsilon \), with \( \varepsilon \rightarrow 0 \), and requests a transfer \( t \) from the investor at date 0 such that \( p \left( \frac{1}{2} V_Q - c_l \right) + (1 - p) (V_L - c_h) - k - t = 0 \).

Note the resemblance between this contract and the preferred equity financings observed in practice. There are two main categories of preferred stock: “redeemable” (or “straight”) preferred, and “convertible” preferred.

**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. Obviously, in the bad state of the world the investor would not convert, thus forcing liquidation and making use of the liquidation preference attached to his security to extract as much out of the liquidation value as possible. In contrast in the good state of the world it makes sense for him to convert, as long as 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 should now be clearer: 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 $d > 0$.

We show in the appendix that these 4 types of contract, namely equity-like, debt with liquidation, debt with reorganization, and preferred-type contracts, are the only ones which can potentially be optimal. In this section we have determined the optimal contract within each type. We now determine which type is optimal.

4 Optimal Contracting

Ex-Ante and Ex-Post Efficiency\(^{28}\)

In this paper we distinguish between *ex-ante* and *ex-post* (in)efficiency\(^ {29}\). We define ex-post inefficiency as the difference between the first-best return and the entrepreneur’s return, \( XP = R_{FB} - R_e \). The entrepreneur’s return \( R_e \) measures the total expected surplus from project, and relative ex-post efficiency, *conditionally on the investor agreeing to finance the project* (i.e. ignoring the investor’s return).

Even conditionally on the project being financed, inefficiency arises ex-post due to agency costs. To understand, recall that with any contract, *the entrepreneur can extract all future rents from a date 0 point of view*, with a date 0 transfer payment \( t \) and/or date 1 repayment \( d \). Thus the revenue to the entrepreneur at the end of the game is one of the three outputs described in the last row of table 1, depending on the control allocation and the state of the world. Note that these outputs are all lower than the FB revenue. This is Grossman and Hart’s (1986) well known result: with incomplete contracting, bargaining at the end of period 2 and the sharing of the surplus leads to inefficient levels of investments at the beginning of that period. For a given level of effort, the marginal return to the agent (entrepreneur or investor) is now weakly lower than the marginal product of effort in the FB. In other words, because the entrepreneur and the investor can never reap 100% of the surplus at the same

\(^{28}\)I greatly benefitted from a discussion with Ralph Winter on this subject.
\(^{29}\)The same distinction was made in Gertner, Scharfstein and Stein (1994).
time, they never both exert the first-best level of effort in period 2, and value created is suboptimal.

In order to be financed, a project must generate a non-negative return \( R_f \) to the investor. Some projects require such a low initial capital outlay \( k \) that all contracts yield a non-negative return to the investor. With these projects the entrepreneur offers the contract that gives her the highest return: the ex-post optimal contract. In contrast, other projects require much larger initial investments, so large in fact that not all contracts allocate sufficient rents for the investor to make a non-negative return. In these cases the entrepreneur offers the contract which maximizes her expected payoff, *among the contracts she knows the investor will accept*. She may not be able to offer the ex-post optimal contract, unless it yields \( R_f \geq 0 \). She must take ex-ante efficiency into account.

We define ex-ante inefficiency as the difference between the first-best return and the investor’s return, \( X_A = R_{FB} - R_f \). Ex-ante inefficiency measures the fact that not as many projects are to be financed, relative to first-best. In the first-best, a project is undertaken as long as the initial outlay \( k \) is low enough for \( R_{FB} \) to be positive. In contrast, in the second best \( k \) must be low enough for the investor’s return to be positive. Since the investor’s return is lower than the FB return, the threshold level of \( k \) above which a project cannot be financed is lower, and in equilibrium fewer projects are undertaken. Thus, the higher \( R_f \) for a given outlay \( k \), the more ex-ante efficient the associated contract: the higher the number of projects that could potentially be financed by such a contract.

A useful way to think this is as follows: whereas ex-post efficiency measures the size of the pie to be created, ex-ante efficiency measures the size of the slice of that pie that the entrepreneur can commit to give to the investor. When that slice is higher than the initial outlay \( k \), the project is financed. Of course, the two measures are not independent: a bigger pie makes bigger slices in absolute terms, even keeping the relative slice size constant.

The distinction between ex-ante and ex-post inefficiency is crucial: a contract may be ex-post efficient because it gives a high return to the entrepreneur, but at the same time ex-ante inefficient: unlikely to be financed because it attributes so little to the investor. We analyze ex-post and ex-ante
efficiency in turn.

4.1 Ex-Post Efficiency

Let us assume for now that the initial investment required \( k \) is so small that all of the contracts described above are feasible: each contract \( Z, Z = E, DL, DR, P \), yields a positive return \( R_Z^e \) for the investor. Since in that case the entrepreneur knows that the investor will participate, she simply chooses the contract which maximizes her return \( R_e \): the ex-post optimal contract.

Which contracts yields the highest return for the entrepreneur evidently depends on the relative values of \( V_Y, V_Q, \) and \( V_L \). For simplicity we treat \( V_Y \) and \( V_L \) as fixed, and we analyze optimal contracting for varying levels of \( V_Q \). We divide the set of values for \( V_Q (V_Q \in (e_l^{\min} + f_l^{\min}, e_l^{\max} + f_l^{\max})) \) into three regions, and analyze optimal contracting in each one in turn.

**Region 1:** \( V_Q \in (e_l^{\min} + f_l^{\min}, V_L - c_h + 2c_l) \).

It should be immediately clear - upon comparing the return to the entrepreneur associated with the different contracts, (8), (13), (15), and (17) - that the ex-post optimal contract in this region is debt with liquidation: \( R_{DL}^e > R_{Z}^e \), with \( Z = E, DR, P \).

The intuition is simple: when the payoff associated with joint control, \( V_Q \) is low, contracts which include joint control in some (or all) contingencies, tend to perform poorly. \( DL \) yields the highest return to the entrepreneur because it never assigns the poorly performing joint control. In contrast, it gives full control to the entrepreneur in the good state, and full control to the investor in the bad state, both of which yield a higher payoff than \( V_Q \).

**Region 2:** \( V_Q \in [V_L - c_h^f + 2c_l, V_Y - c_h^k + 2c_l) \).

In region 2, the net expected payoff with joint control is higher than with investor-control, but lower than with entrepreneur-control. Again we compare the returns to the entrepreneur for the different contracts, and find that \( R_{DR}^e > R_{Z}^e \), with \( Z = E, DL, P \): debt with reorganization is ex-post optimal.

Debt with reorganization dominates debt with liquidation. Both assign entrepreneur control in
the good state, but in the event of default DR assigns joint control, which yields a higher payoff than investor control assigned with the DL contract. Similarly, the equity-like contract yields the same as DR in the bad state, but not as much in the good state, since joint control (with E) generates less than entrepreneur-control (with DR). Finally, the DR contract also dominates the preferred-type contract: in the good state entrepreneur-control dominates joint-control, and in the bad state joint control dominates investor-control.

**Region 3:** \( V_Q \in [V_Y - c_h + 2c_l, e_l^{\text{max}} + f_l^{\text{max}}] \).

In this region, joint control generates the highest possible output, even more than entrepreneur-control. Obviously the highest total surplus, and hence the highest return to the entrepreneur, is obtained by the contract which assigns joint control in as many contingencies as possible. The equity-like contract, which assigns joint control in all contingencies, does just that.

We summarize these results in the following table:

<table>
<thead>
<tr>
<th>Region Name</th>
<th>Region Description</th>
<th>Optimal Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region 1</td>
<td>( V_Q \in (V_Q_{\text{min}}, f_1 (V_L)) )</td>
<td>Debt with Liquidation</td>
</tr>
<tr>
<td>Region 2</td>
<td>( V_Q \in [f_1 (V_L), f_2 (V_Y)] )</td>
<td>Debt with Reorganization</td>
</tr>
<tr>
<td>Region 3</td>
<td>( V_Q \in [f_2 (V_Y), V_Q_{\text{max}}) )</td>
<td>Equity-like Financing</td>
</tr>
</tbody>
</table>

We define \( V_Q_{\text{min}} = e_l^{\text{min}} + f_l^{\text{min}}, f_1 (V_L) = V_L - c_h + 2c_l, f_2 (V_Y) = V_Y - c_h + 2c_l, \) and \( V_Q_{\text{max}} = e_l^{\text{max}} + f_l^{\text{max}} \). We make these abbreviations, as well as \( f_3 (2V_L) = 2V_L - 2c_h + 2c_l \), to simplify the reader’s analysis of figures 1-5 below.

**Interpretation:**

In this model we treat \( V_Y, V_L, c_l, \) and \( c_h \) as fixed, and we analyze optimal contracting for varying levels of \( V_Q \). More specifically we take the high effort levels as given and study optimal contracts for values of \( e_l \in (e_l^{\text{min}}, e_l^{\text{max}}) \), and \( f_l \in (f_l^{\text{min}}, f_l^{\text{max}}) \). Here is why.

A change in \( e_l \) can be interpreted as a change in “high-incentive” marginal efficiency relative to “low-incentive” marginal efficiency. Marginal efficiency refers to the increase in effort/output which
results from an increase in incentives. There are two marginal efficiencies for an agent, say the entrepreneur, in this model. 

i) When control rights switch from investor-control to joint control, date 2 bargaining power is transferred from the investor to entrepreneur, from no bargaining power at all (with investor-control) to some bargaining power (joint control). Consequently the entrepreneur’s incentives increase and his effort/output, net of effort cost, rises from 0 (no participation) to \( e_l - c_l \); marginal efficiency in that case is \( (e_l - c_l) - 0 = e_l - c_l \). 

ii) 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 her marginal efficiency is 

\[
(e_h - c_h) - (e_l - c_l).
\]

Thus, for a given \( e_h, c_h, \) and \( c_l \), a low \( e_l \) implies a low “low-incentive” marginal efficiency and a high “high-incentive” marginal efficiency. Conversely, a high \( e_l \) implies a high “low-incentive” marginal efficiency relative to a low “high-incentive” marginal efficiency.

Similarly for the investor, the “low incentive” level of marginal efficiency, which results from a switch from entrepreneur-control to joint control, is \( (f_l - c_l) - 0 = f_l - c_l \), while the “high incentive” level of marginal efficiency, which occurs with a switch from joint-control to investor-control, is 

\[
(f_h - c_h) - (f_l - c_l).
\]

For both the entrepreneur and the investor, the tradeoff between the two marginal efficiencies measures the importance of high effort relative to mere participation in the venture. A high (low) “high incentive” marginal efficiency relative to “low incentive” marginal efficiency, means that the agent’s high effort has a large (low) impact on performance relative to mere participation.

We measure this relative marginal efficiency for each agent with the values of \( e_l \) and \( f_l \), and consequently with \( V_Q = e_l + f_l \). The lower \( V_Q \), the more important the entrepreneur’s and the investor’s skills and efforts, relative to mere participation in the venture. In other words, the lower \( V_Q \) the more “convex” the output as a function of incentives.

\[\text{Keeping } V_Y = e_h \text{ and } V_L = f_h \text{ as well as } c_h, c_h, \text{ and } c_l, \text{ fixed, the lower } V_Q = e_l + f_l \text{, the higher } (e_h - c_h) - (e_l - c_l) \text{ relative to } (e_l - c_l), \text{ and the higher } (f_h - c_h) - (f_l - c_l) \text{ relative to } (f_l - c_l).\]
In light of this, the results of table 1 can be interpreted as follows:

**In region 1**, high incentive marginal efficiency is large relative to low incentive marginal efficiency, i.e. high effort matters much more than mere participation. Consequently the ex-post optimal contract, debt with liquidation, is one which gives high incentives to the entrepreneur (in the good state) as well as to the investor (in the bad state).

**In region 2**, participation by both agents matters more than inducing high effort by the investor, but less than the entrepreneur’s high effort and skill. Unsurprisingly, the optimal contract, debt with reorganization, gives full incentives to the entrepreneur in the good state, but induces participation by both agents in the bad state.

**Finally, when participation by both agents matters a lot relative to expertise and high effort, as in region 3**, the optimal contract (equity-like financing) generates this collaboration in both states of the world.

**Comparing with Grossman-Hart-Moore**: In order to find the optimal ex-post contract, we implicitly compare the marginal efficiency of the entrepreneur with that of the investor in each contingency. In region 1 for example, the optimal contract assigns investor-control in the bad state of the world, because the (high incentive) marginal efficiency of the investor, \((f_h - c_h) - (f_l - c_l)\), is higher than the (low incentive) marginal efficiency of the entrepreneur \((e_l - c_l)\). This is a well known result from Grossman-Hart-Moore: more control should be given to the agent with higher marginal efficiency.

When comparing ownership structures, in the context of the theory of the firm, the Grossman-Hart-Moore result is simple and intuitive: allocate property rights over the asset to the most efficient agent. It is more difficult, however, to compare financial contracts on the basis of relative marginal efficiency, because as in our model, financial contracts can be state contingent in equilibrium, and

---


\(^{32}\)Very simply, \(V_L - c_h > V_Q - 2c_l\) if and only if \((f_h - c_h) - (f_l - c_l) > (e_l - c_l)\).

\(^{33}\)See also Aghion and Tirole (1994), and de Bettignies (2002) for examples in the context of vertical integration.
different relative marginal efficiencies may be associated with different contingencies. Consider region 1 again. The high incentive marginal efficiency of the investor is higher than the low incentive marginal efficiency of the entrepreneur (that is why investor-control dominates joint control in the bad state). At the same time the low incentive marginal efficiency of the investor is lower than the high incentive marginal efficiency of the entrepreneur (entrepreneur-control dominates joint control in the good state). We must thus use another basis of comparison. Rather than using relative marginal efficiency across agents, we compare marginal efficiencies for the same agent, at different levels of incentive: for both the entrepreneur and the investor we care about “high incentive” marginal efficiency versus “low incentive” marginal efficiency. In other words, in this model it is the “convexity” of output with respect to incentives for both agents which matters.

### 4.2 Ex-Ante Efficiency

Probably the clearest way to visualize ex-post versus ex-ante optimality is graphically. Figure 1 (at the back of the paper) will thus be at the center of our analysis.

Figure 1 represents the returns to the investor for each of the contracts under study, in a \((k, V_Q)\) space. Each line is associated with a contract, and represents an “iso-return” line for the investor, drawn at \(R^I = 0\): 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 figure 1: 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. We use figure 1 to help us explain the intuition behind ex-post and ex-ante optimality; but all the results of this section are proven algebraically in the appendix.

**Region 1**

We already know the debt with liquidation is the ex-post optimal contract in this region. Looking
at figure 1, we also notice that the iso-return line for that contract is the furthest to the right. It is
the contract which make a project most likely to be financed. Debt with liquidation is ex-ante as well
as ex-post optimal in region 1: it is the optimal contract for all points in that region.

There are two main reasons why \( DL \) is ex-ante optimal. The first reason is particular to region 1:
\( V_Q \) is very low: mere participation in the venture, and consequently joint control, do not yield much
of a benefit. All contracts, aside from \( DL \), assign joint control in at least some contingency. This
makes for low overall surplus, and translates into low return to the investor. Using the pie analogy
mentioned earlier, contracts that assign joint control generate a small pie, which in turn tends to yield
a small pie slice for the investor. We call this the pie effect.

The second reason is that with \( DL \) the entrepreneur can commit to forfeit a larger share of the
surplus. In other words, \( DL \) distributes a larger pie slice (as a fraction of the total pie) to the investor.
We call this the slice effect.

Let us illustrate these two points by comparing returns to the investor with \( DL \) and \( DR \) contracts.
In the bad state, both the pie and the slice effect are at work. \( DR \) yields a smaller total pie \( (V_Q - 2c_l < V_L - c_h) \)
and the investor gets a smaller slice: he gets only half of the surplus, whereas with \( DL \) the
investor gets all of it.

In the good state of the world both contracts yield the same total surplus/pie \( (V_Y - c_h) \) but the
investor gets a larger slice with \( DL \). 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.

**Region 2**

In region 2, mere participation (i.e. low effort) by the agents yields a payoff \( V_Q \) that is still too
low relative to that generated by high entrepreneurial effort: \( V_Y - c_h > V_Q - 2c_l \). For that reason, the contracts that do generate high entrepreneurial effort (in the good state of the world), return a higher payoff than the ones that do not. Indeed debt with liquidation dominates the preferred stock contract because it returns a higher payoff to both the entrepreneur and the investor\(^{34}\) \((R^e_{DL} > R^e_{DP}, R^f_{DL} > R^f_{DP})\); and debt with reorganization dominates the equity-like contract for the same reason \((R^e_{DR} > R^e_E, R^f_{DR} > R^f_E)\).

We must hence compare the debt with liquidation and debt with reorganization contracts. As mentioned in our description of region 1 just above, \( DL \) has a “slice effect” advantage over \( DR \): it gives the investor a larger slice of the surplus/pie. In contrast to region 1, however, 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 tends to dominate in this region, making the \( DL \) contract ex-ante optimal\(^{35}\). In region 2, debt with reorganization is the optimal contract when \( k \) is low (ex-post optimality), and debt with liquidation is optimal when \( k \) is high (ex-ante optimality).

**Region 3**

In region 3 participation by both agents is so important that joint control, where both agents participate and exert low effort, yields the highest payoff: \( V_Q - 2c_l > V_Y - c_h \).

In that region contracts that assign joint control tend to yield higher payoffs for the investor and the entrepreneur, than contracts that do not. Indeed it is easy to verify that equity-like and preferred-type contracts tend to dominate the debt with reorganization and debt with liquidation contracts, respectively, both from ex-post and ex-ante point of view: \( R^e_E > R^e_{DR} \) and \( R^e_P > R^e_{DL} ; R^f_E > R^f_{DR} \).

\(^{34}\)When comparing these contracts there is no slice effect. They both allocate the same share of total surplus to the investor (all of \( V_L - c_h \) in the bad state and \( \frac{(V_Y - c_h)+X}{2} \), with \( X = (V_Y - c_h), (V_Q - 2c_l)) \). The difference in contract comes through a pie effect, with \( (V_Y - c_h) > (V_Q - 2c_l) \).

\(^{35}\)In the special case where \( 2(V_L - c_h) \leq V_Y - c_h \) and \( p \) is low enough, the pie effect may dominate, making \( DR \) the ex-ante optimal contract for a subset of region 2. See appendix for details.
and $R^f_P > R^f_{DL}$.

The comparison between equity-like financing and the preferred-type contract in this region is very similar to the comparison between debt with liquidation and debt with reorganization in region 2: the pie effect and the slice effect work in opposite direction. The pie effect favors equity-like financing: it is ex-post superior and yields the highest possible payoff, $V_Q - 2c_l$, in both states of the world. On the other hand, the preferred-type contract gives more bargaining power, and a larger slice of the pie, to the investor. As in region 2, the slice effect dominates the the pie effect, making the $P$ contract ex-ante optimal. Overall, equity-like financing dominates for low values of $k$, while the preferred-type contract is optimal for high $k$.

Note that in figure 1 we make the distinction between convertible preferred and straight preferred contracts. The convertible preferred contract is more ex-post efficient but less ex-ante efficient than straight preferred. Indeed it gives more to the entrepreneur and less to the investor: it corresponds to contracts where the initial outlay is small enough for the equilibrium date 1 payment $d$ to be set to 0.

**Remark:** 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. The reader is encouraged to look at examples where $p \to 0$ and $p \to 1$, which are presented in figures 2 and 3.

Note also that figure 1 exhibits a relatively high value of investor-control payoff, compared to that of the entrepreneur-control payoff: $2\left(V_L - c^f_h\right) > V_Y - c^e_h$. This is the most interesting case because the convertible preferred contract can be optimal under this condition. Examples of the case where $2\left(V_L - c^f_h\right) \leq V_Y - c^e_h$ are presented in figures 4 and 5.

### 5 Concluding Remarks

This paper has evaluated alternative contractual arrangements for financing entrepreneurial ventures and identifies four that, depending on project characteristics, will arise in equilibrium—debt with liquidation ($DL$), debt with reorganization ($DR$), equity-like financing ($E$), and preferred type contracts
(P) (including straight preferred and convertible preferred contracts). We find that as the agents’ low incentives marginal efficiency increases relative to high incentives marginal efficiency, the optimal contractual form changes from debt-related contracts (DL and DR) to equity-related contracts (E and P).

These results may explain why “lifestyle ventures”\(^{36}\) (e.g., doughnut shops; local, unbranded video stores; wineries; or cafes) use debt-type contracts whereas knowledge-based ventures (“classic startups” with high intangible/tangible asset ratios) use equity-related contracts.

Consider a lifestyle venture with low intangible/tangible assets ratio, and with potential for learning-by-doing for the entrepreneur, such as a doughnut store, for example. The investor, a commercial banker, could sell the tangible assets of the venture quite easily in the event of liquidation, to someone who, with high incentives, would manage it well. On the other hand the investor could not bring much to the management of the venture in the event of joint control; he has neither the skills nor the time. His marginal efficiency at low incentives level is likely to be low relative to his high incentives marginal efficiency.

The entrepreneur does not know much about doughnut store management. Learning economies play an important role in the success of such a venture. Exerting high effort enables the entrepreneur to quickly travel down the learning curve: establishing an efficient business format, writing a how-to manual to facilitate replication in other outlets, gaining expertise in the local markets, and getting to know the customers. In contrast, with low effort she does not benefit from this learning. When learning economies are important, the entrepreneur’s high effort yields a large benefit relative to that associated with low effort.

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:

\(^{36}\)A lifestyle venture is often defined as a venture where independence, rather than financial reward, is the chief objective. In this paper we define it more crudely in opposition to the classic startup. Whereas in the classic startup the focus is on growth and the investor has an important role to play, in the lifestyle venture the investor’s input is less important and the entrepreneur simply “learns the ropes” of business over time.
it gives full control to the entrepreneur in the good state, and full control to the investor in the bad state\textsuperscript{37}.

At the other end of the spectrum, consider the classic startup case: a knowledge-based venture with high potential and high intangible/tangible asset ratios. The entrepreneur has designed a very promising new technology that she wants to market, but has no managerial skills and cannot take care of the business side of the venture on her own. She seeks financing from a venture capitalist\textsuperscript{38} who has vast experience and expertise in this industry, and can provide managerial help as well as initial capital. The VC’s input may be so important that the benefit from his participation more than offsets the associated reduction in the entrepreneur’s incentives: joint control yields a higher total surplus than entrepreneur-control. Thus, when the VC’s input is crucial, equity-like financing offers the best return to the entrepreneur.

The size of initial investment plays an important role in the determination of the optimal contract. Namely, debt with liquidation and preferred-type contracts give more to investors and thus will be used to finance investments requiring high capital outlays. Capital requirements differences may explain the prevalence (in private equity finance) of common stock financing in Canada documented by Cumming (2002a), and the difference between Canada and the U.S. where convertible contracts are the norm. Lower initial capital investments in Canada vis-à-vis moderate capital requirements in the U.S. may explain both facts. This conjecture seems to agree with the data: Macintosh (1997) found that on average “investments made by U.S. VCs were somewhat larger than those made by Canadian VCs (p.298).”

Contracts that give more to the investor (\textit{DL} and \textit{P}) may also be used to attract investors who,

\textsuperscript{37}For an example where \textit{DR} might be optimal, fast forward ten years down the road. By then the entrepreneur is an expert in the business. Her knowledge is very valuable. In the event of default at date 1, the investor obtains full control and then can either manage the venture with full incentives, or sell to someone who will manage it with full incentives (\textit{DL}). Or he can convert debt into equity and manage the venture jointly with the entrepreneur, both exerting low effort (\textit{DR}). When the entrepreneur’s 10-year experience is very valuable, it may be worth it to keep her on board, even at the cost of lowering the investor’s control, incentives, and effort. In these cases, debt with reorganization is optimal.

\textsuperscript{38}Our model does not provide a very good explanation for the fact that Angel financing tends to involve equity related contracts, even though they tend not to contribute much to the venture (a fact documented by Wong (2001)). See Chemmanur and Chen (2003) for a model that deals more explicitly with angel financing.
because of good outside opportunities, demand a high rate of return\textsuperscript{39}. Differences in the investor’s required return on investment may explain the change in contracts used in private equity financing between the 1970’s and 1980’s, from straight preferred to convertible preferred. To quote Hardymon and Lerner (1999):

“Anecdotally, private equity deals in the 1970’s tended to be of redeemable preferred structure reflecting the paucity of capital available and the need to get is back as soon as possible to do more deals. As venture capital became more institutionalized during the 1980’s, the market became more competitive and convertible securities became the standard security.”

Finally, the model predicts that convertible contracts are associated with high input levels from the investor\textsuperscript{40}. Optimality requires first that the investor’s participation be more valuable than the entrepreneur’s high effort. This is also a necessary condition for the optimality of equity-like financing as well as of straight preferred financing. But the convertible contract is the only contract to also require the investor’s high effort contribution (investor-control) to be high enough relative the entrepreneur’s high effort contribution\textsuperscript{41}. This implication is consistent with the observation that in the US, where venture capitalists play a crucial role in the development of the ventures their finance, convertible securities are widely used.

\textsuperscript{39}To see this, recall first that throughout the paper we assumed that the investor makes a zero return in the best alternative. Now, what if he could make a positive return $r$ in the next best alternative investment? The higher $r$ the more likely he is to reject to entrepreneur’s offer, and conversely the higher the return he must receive to accept the contract. Our initial investment variable $k$ could be used as a measure of the investor’s outside investment opportunity. Indeed, 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 $k$, the higher $r$, and the higher the investor’s required rate of return.

\textsuperscript{40}Our model also predicts that within private equity finance, “moderate” capital requirements and/or “moderate” required return by investors, favor convertible preferred contracts.

\textsuperscript{41}When this is true, as in figure 1, we observe a region where the convertible contract is optimal. In contrast when, as in figures 4 and 5, the investor’s contribution is not important enough, convertible preferred financing is not optimal.
A Appendix

A.1 Strictly Dominating Strategies for the Entrepreneur and the Investor

Here we show that for 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 \( e_l \in (e_l^{\min}, e_l^{\max}) \) and \( f_l \in (f_l^{\min}, f_l^{\max}). \)

By assumption 1 of additive separability, 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: \( e_l^{\min} = e_h - 2(c_h - c_l), \) and \( e_l^{\max} = e_h - (c_h - c_l). \) Then there exists a \( e_l \in (e_l^{\min}, e_l^{\max}) \) such that conditions 1) and 5) hold. Moreover condition 3) holds for \( e_l^{\min} \) and must thus hold for all \( e_l \in (e_l^{\min}, e_l^{\max}). \) The same reasoning can be applied to conditions 2), 4), and 6). Consider \( f_l^{\min} = f_h - 2(c_h - c_l), \) and \( f_l^{\max} = f_h - (c_h - c_l). \) For any given \( f_h, c_l, c_h, \) conditions 2), 4), and 6) hold as long as \( f_l \in (f_l^{\min}, f_l^{\max}). \)

A.2 Other Contracts

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. Entrepreneur-control

Unconditionally allocating control to the entrepreneur is not feasible. The investor, anticipating he will get no reward for his investment \( k, \) would refuse to participate in the first place.

2. Investor-control

The entrepreneur could unconditionally allocate control to the investor in the second period, thus generating an expected second period payoff of \( R_{sub2}^f = V_L - c_h - k \) for the investor. The entrepreneur could extract all rents \( ex-ante \) by requesting a transfer \( t_{sub2} \) at date 0 such that \( V_L - c_h - k - t_{sub2} = 0. \) In that case the return to the entrepreneur would be \( R_{sub2}^e = px + V_L - c_h - k. \)
Let us compare these returns with the returns to the entrepreneur and to the investor in debt with liquidation. Recalling that $V_Y - c_h > V_L - c_h$, it is straightforward to show that both the entrepreneur and the investor are better off in the case of debt with liquidation ($R_{DL}^e > R_{sub2}^e$, and $R_{DL}^f > R_{sub2}^f$). Thus investor-control is suboptimal.

3. Investor-control conditionally on debt payment $d$, entrepreneur-control otherwise

Recall that: $V_Y - c_h \geq V_L - c_h$. 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.

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: $V_Y - c_h \geq V_Q - 2c_l$. 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) $V_Q - 2c_l > V_Y - c_h$. In that case the payment $d_{sub4}$ would be negative (it is straightforward to show that Nash bargaining in renegotiation would yield the solution $s_{sub4} = -\frac{1}{2} (V_Y - c_h)$). 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: $V_Q - 2c_l \geq V_L - c_h$, 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 $V_L - c_h > V_Q - 2c_l$, 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 Ex-Ante Optimal Contracts

Region 1: $V_Q \in (c_i^{\text{min}} + f_i^{\text{min}}, V_L - c_h + 2c_l)$

$R^f_{DL} - R^f_{DR} > 0$ if and only if (henceforth iff) $p \left( \frac{1}{2} (V_L - c_h) + (1 - p) (V_L - c_h - (\frac{1}{2} V_Q - c_l)) \right) > 0$.

This is always the case in region 1.

$R^f_{DL} - R^f_E > 0$ iff $p \left( \frac{1}{2} (V_L - c_h) + \frac{1}{2} (V_Y - c_h) - (\frac{1}{2} V_Q - c_l) \right) + (1 - p) (V_L - c_h - (\frac{1}{2} V_Q - c_l)) > 0$. Always holds in region 1.

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

Thus $R^f_{DL}$ yields the highest return for the investor. It is the ex-ante optimal contract in this region.

Region 2: $V_Q \in [V_L - c_h + 2c_l, V_Y - c_h + 2c_l)$

We already know that $R^e_{DL} > R^e_{DP}$ and $R^e_{DR} > R^e_E$. Moreover, it is easy to show that $R^f_{DL} > R^f_P$ and $R^f_{DR} > R^f_E$:

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

$R^f_{DR} > R^f_E$ iff $p \left( \frac{1}{2} (V_Y - c_h) - (\frac{1}{2} V_Q - c_l) \right) > 0$ which also holds in region 2.

Hence we need only compare the debt with liquidation and debt with reorganization contracts.

We know that $R^e_{DR} > R^e_{DL}$: debt with reorganization is ex-post optimal.
However the $DR$ contract is ex-ante optimal if $R_{DR}^f - R_{DL}^f > 0$ iff:

$$V_Q > \frac{p}{1-p} (V_L - c_h) + 2 [(V_L - c_h) + c_l], \quad (18)$$

which does not necessarily hold. It depends on the value of $p$, $V_L$, and $V_Y$.

In figure 1, where $2 (V_L - c_h) > (V_Y - c_h)$, condition (18) never holds: regardless of $p$, $V_Q$ can never be high enough within region 2 to have $V_Q - 2c_l > 2 (V_L - c_h)$. Thus in our standard case (figures 1, 2 and 3), debt with liquidation is ex-ante optimal in region 2.

In the special case where $2 (V_L - c_h) \leq (V_Y - c_h)$, represented in figures 4 and 5, condition (18) may hold, if the probability of success $p$ is low enough. In figure 4, $p = \frac{1}{2}$ is still too high for condition (18) to hold, and $DL$ remains ex-ante optimal for all points in region 2. In contrast in figure 5 where $p \to 0$ there is a sub-region where $V_Q$ is high enough for (18) to hold, and where $DR$ is ex-ante as well as ex-post optimal.

**Region 3**

In region 3, equity-like and preferred stock contracts tend to dominate the debt with reorganization and debt with liquidation contracts, respectively, both from ex-post and ex-ante point of view. We know already that $R^e_E > R^e_{DR}$ and $R^e_P > R^e_{DL}$.

Both $R^f_E > R^f_{DR}$ and $R^f_P > R^f_{DL}$ iff $p \left( (\frac{1}{2}V_Q - c_l) - \frac{1}{2} (V_Y - c_h) \right) > 0$, which is always true in region 3.

Let us compare equity-like financing with the preferred stock contract. We already know that equity-like financing dominates ex-post. From an ex-ante point of view, the straight preferred stock contract dominates if and only if it yields a higher return to the investor, i.e. if and only if $R^f_P > R^f_E$, with $d = \frac{1}{2} (V_L - c_h)$. This is true if and only if $V_Q - 2c_l < 2 (V_L - c_h) + \frac{p}{1-p} (V_L - c_h)$. In figure 1 the values of $V_Y$, $V_L$, and $p$ are such that this condition always hold in region 3, and so the preferred-type contract tends to be ex-ante optimal: the slice effect dominates the pie effect.
However, as can be seen in figure 2, this condition may not hold when $p$ is sufficiently low. 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 $R_P^f > R_E^f$ and where $R_P^f \geq 0$ even with $d = 0$. This is the region where the convertible preferred contract is optimal. It is ex-ante superior to equity-like financing because it gives more to the investor. It is also ex-post superior but ex-ante inferior to straight preferred because it gives more to the entrepreneur but less to the investor. As shown in figure 1 there is a region where $k$ 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 $R_P^f > R_E^f$ with $d = 0$. Simplifying we find that this is true iff $V_Q - 2c_l > 2(V_L - c_h)$.

But for this to be true in region 3, we must have $2(V_L - c_h) \geq (V_Y - c_h)$: 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. In figures 4 and 5 however, this condition does not hold, and unsurprisingly the convertible contract is never optimal.

References


Figure 1. Optimal contracts when:
1. Probability of success is $p=\frac{1}{2}$.
2. The payoff associated with investor-control is relatively high compared to that of investor-control.
Figure 2. Optimal contracts when:
1. Probability of success is $p$ tends to 1.
2. The payoff associated with investor-control is relatively high compared to that of investor-control.

Figure 3. Optimal contracts when:
1. Probability of success is $p$ tends to 0.
2. The payoff associated with investor-control is relatively high compared to that of investor-control.
Figure 4. Optimal contracts when:
1. Probability of success is $p = \frac{1}{2}$.
2. The payoff associated with investor-control is relatively low compared to that of investor-control.

Figure 5. Optimal contracts when:
1. Probability of success is $p$ tends to 0.
2. The payoff associated with investor-control is relatively low compared to that of investor-control.