Start-up Financing: From Banks to Venture Capital

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September 14, 2003

Abstract

I develop a model in which entrepreneurs and investors can hold-up each other once the venture is under way: investors can deny further funding, and entrepreneurs can withdraw from the venture. The entrepreneurs' exit option determines which party needs protection. If the exit option is good, venture capital financing protects the investor through control rights, technological monitoring, and staged financing. As the exit option increases, control, monitoring and staging become tighter. If the exit option is bad, bank debt protects the entrepreneur as it involves little technological monitoring, limited control rights, and committed finance. The exit option depends on the legal environment and on the stigma of failure, endogenized in a career concern model. When entrepreneurs can choose project risk, multiple equilibria arise with different financial institutions. Venture capital prevails in the high-risk equilibrium and bank debt in the low-risk equilibrium. The paper investigates why the forms of start-up financing differ across sectors, regions and countries. It offers an explanation for why venture capital has been more prevalent in the US than in Europe.

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I thank Daron Acemoglu, Olivier Blanchard, Denis Gromb and Sendhil Mullainathan. For their useful comments, I am grateful to Manuel Amador, Jessica Cohen, Matthias Dewatripont, Andrew Hertzberg, Bengt Holmstrom, Hans K. Hvide, Simon Johnson, David Scharfstein, Antoinette Schoar, Jean Tirole, Masako Ueda. All remaining errors are mine.

1 Introduction

The financing of start-ups takes widely different forms across sectors and regions. On one end of the spectrum, standard bank debt involves accounting monitoring but little technological monitoring and, outside default, the control right of the investor is limited to assets used as collateral. On the other end of the spectrum, "hands-on" venture capital differs from standard bank finance in three major dimensions.[1] First, venture capitalists use their high level of expertise to perform technological monitoring and to actively manage the companies they finance. Second, the capital infusions in the firms financed by venture capital are staged in several rounds. Third, venture capitalists usually have extensive control rights (e.g., board rights, voting rights).

In the US, venture capital has emerged a common form of financing for high-technology start-ups. But, even in the US, start-ups in more traditional or mature sectors are financed mostly with bank debt. Venture capital is frequently referred to as an important factor in the technological leadership of the US economy and many developed countries have tried to emulate this style of investment. Despite important political effort, the venture capital industry in Europe has remained much smaller than in the US[2] and focusses primarily on financing buyouts rather than on early and expansion-stage financing. Moreover, European venture capitalists are less "hands-on" (they rarely play an active role in the management of the companies they finance), have less control rights and replace the entrepreneurs less often than their American counterparts[3]. Such differences in financing also exist within the US. Saxenian (1994) provides evidence that venture capitalists in Massachusetts are less involved in management and behave more like bankers than in Silicon Valley.

This paper investigates the source of these variations in financing forms, accross sectors and across regions. I formalize the idea that these variations are related to

[1] An extensive description of venture capital contracts can be found in Kaplan and Stromberg (2001)

[2] See for example European Commission (2000).

[3] See for example Schwienbacher (2003), Lerner and Schoar (2003).

differences in the exit option of entrepreneurs, which affect their bargaining power.

Entrepreneurs and investors can hold up each other once the venture is under way: investors can deny further funding, and entrepreneurs can withdraw from the venture. The optimal form of financing balances the terms of bargaining. The entrepreneur's exit option determines which party needs protection.

If the exit option is bad, the entrepreneur needs to be protected from ex-post appropriation of rents by the investor. This goal is achieved by standard bank debt, as it involves little technological monitoring, limited control rights, and committed finance. Infusing a large amount of cash at the beginning solves two problems. First, the entrepreneur behaves efficiently, maximizing the value of the project, and second, the probability that refinancing is needed is small, relaxing the hold-up problem.

If the exit option is good, the investor needs to be protected. Venture capital financing meets this goal through technological monitoring, control rights, and staged financing. The investor acquires technological expertise, allowing him to perform technological monitoring, which increases the liquidation value of the firm if the entrepreneur withdraws. The optimal initial infusion of cash in this context is smaller, reflecting the trade-off between incentives and the ex-post hold-up. The entrepreneur cannot commit to high repayments, given his high bargaining power ex-post. The level of repayments can be decreased by lowering the first cash-infusion. The cost of this form of financing are twofold. First the lower initial infusion decreases the incentives of the entrepreneur to minimize implementation costs. The second cost is the one of the investor's technological expertise. Both costs lower the ex ante value of a given project. The model shows that the higher the outside option of the entrepreneur, the more hands-on the venture-capitalist is (meaning higher control-rights, technological monitoring and tighter staging of cash infusions).

Variations in the outside option of entrepreneurs have two sources. First, they are related to the legal environment. We show how changes in bankruptcy rules affect financial institutions and contracts. Second, and perhaps more interestingly, the outside option depends on the stigma associated with failure in entrepreneurial ventures. This "stigma of failure" is endogenized by formalizing the relationship between a project's risk and the inference about an entrepreneur's ability. Depending on his success or failure, the entrepreneur faces different oportunities on the labor market. The success of a given project depends on luck and ability. The more frequent it is for a "good" entrepreneur to fail, the lower the stigma of failure is, and therefore the stronger the bargaining position of the entrepreneur. On the contrary, if "failing" is a signal of low ability, the stigma beared by a failed entrepreneur in the labor market is high.

When entrepreneurs can choose between risky high growth projects and safer low-growth projects, two types of equilibria are possible and can coexist under certain conditions. The riskiness of the strategies of other entrepreneurs determines in equilibrium the extent of the stigma of failure and, therefore, affects the trade-off between growth and risk that a given entrepreneur faces. This interaction can lead to multiple equilibria and explain cross-country (e.g. Europe vs. US) or cross-regional differences (e.g. Route 128 vs. Silicon valley) that have been so far described as the result of exogenous differences in corporate culture.

In the *low risk equilibrium*, entrepreneurs choose safe strategies. If their ability is high, they are relatively unlikely to fail. Therefore, the pool of failed entrepreneurs is of relatively low quality, making the stigma of failure high. This reduces the need for expertise on the investor's side because the fear of being forced to default on the debt payment enforces the entrepreneur's discipline. As a consequence, the optimal form of financing looks more like bank debt. In turn, the high stigma of failure makes safe strategies ex ante the most attractive choice.

On the contrary, in the *high-risk equilibrium*, entrepreneurs choose aggressive growth strategies. This means that even entrepreneurs with high ability are likely to fail. Therefore, the pool of failed entrepreneurs is of high quality, leading to a low stigma of failure. This tilts the hold-up problem in a direction favorable to the entrepreneur. Therefore the optimal form of financing looks like venture capital, with high investor expertise and investment staging. The inefficiencies that arise due to the hold-up problem increase the cost of capital. In turn, due to the low stigma of failure, the risky strategy is the most attractive.

Which equilibrium is the most efficient depends on the trade-off between growth and hold-up inefficiencies: if the value of high-risk projects is large enough, it offsets the costs generated by the technological monitoring, and therefore, the high-risk equilibrium is the most efficient one.

This paper is related to two strands of literature. The first is the career concern literature initiated by Holmstrom (1982, 1999) where managers are concerned by how their reputation will be affected their actions. For instance, Hirshleifer and Thakor (1992) show how project-choice is affected by the career concerns of a manager and how financial securities should be designed to address this problem. Second, this paper is related to the large literature on the principal-agent problem in financial contracting. Grossman and Hart (1986) and Hart and Moore (1990) build a theory of incomplete contracting under renegotiation and study how the nature of the hold-up problem affects contracting. Aghion and Bolton (1992) show how the dissociation between control rights and cash-flow rights can decrease inefficiencies due to the *ex post* misalignment of objectives of entrepreneurs and investors. Rajan (1992) considers the trade-off between informed and non-informed finance in a set-up where inefficiencies arise due to the threat of termination of informed creditors. Specifically related to our topic, Gompers (1995) shows empirically that venture capitalists concentrate investment in early-stage and high technology companies where informational asymmetries are highest, and that financing rounds become more frequent when the intangibility of assets is higher. Several papers model the relationship between a venture capitalist and an investor, such as Berglof (1994) or Repullo and Suarez (2000). Hellmann (1998) has a model where control rights protect the investor from hold-up from the entrepreneur. These models do not link investment staging with hold-up and the misalignment between the two parties is due to private benefits (as opposed to endogenous career concerns in our model). Cassamatta (2003) and Inderst and Mueller (2003) study optimal contracting between an entrepreneur and an investor in the case where the moral-hazard problem is double-sided. The latest paper endogenizes the outside options of entrepreneurs and investors in a search model of capital markets. Exit options matter for ex-ante bargaining, whereas they matter in my model for ex-post bargaining and the staging of investment. Gromb and Scharfstein (2001) have a model of entrepreneurship where managerial incentives are determined by the career prospects in the event of a project's failure which in turn depends on the type of organization where the project failed (intrapreneurial vs. entrepreneurial). Managers who fail an internal venture can be redeployed by their firms into other jobs which has costs in terms of incentives whereas failed entrepreneurs must seek employment at other firms. Incentive problems depend the organizational choice of firms and, like in my model, on the equilibrium of the labor market. While their focus is on whether projects are done inside or outside large firms, my model focusses on financing institutions and project choice for start-ups. Ueda (2002) offers a model of entrepreneurial finance where venture-capitalists and banks are two modes of financing characterized by different contracting inefficiencies: venture-capitalists are well informed about the entrepreneur's project but can possibly appropriate the entrepreneur's idea. By contrast, banks cannot, but they contract under assymetric information. Depending on the nature of the project and the strengh of property rights, one or the other mode will be optimal. If property rights are perfectly enforced, venture-capital is always the optimal form of financing.

My paper has two main contributions. First, it relates both investment staging and control-rights to the outside option of the entrepreneur, the cost of investors' technological expertise and the characteristics of the project. Second, it offers a capital market equilibrium perspective to the problem of the conflict between creditors and entrepreneurs: The hold-up and moral-hazard problems to which an entrepreneur is subject depend both on financial institutions and on the choices of other entrepreneurs that prevail in equilibrium.

The paper proceeds as follows. Section 2 describes the benchmark model and solves for the optimal contract. Section 3 endogenizes the stigma of failure. Section 4 discusses the cross-sectorial implications of the model. Section 5 studies the conditions for multiple equilibria to arise and discusses their relative efficiency. Section 6 presents two case studies comparing the level and nature of venture-capital finance in Europe vs. the US and Silicon Valley vs. Route 128 respectively. Section 7 concludes. All mathematical proofs are in the appendix.

2 A Model of Start-up Financing

In this section I present a simple model of start-up finance. The model endogenizes the staging of investment as the solution to an optimal contracting problem. I characterize investors by their level of knowledge of the project. Knowledge increases the bargaining position of the investor and depends on control rights (access to information) and technological expertise (ability to process information). Standard bank finance corresponds to a non-expert investor and a unique infusion of funds. Venture capital corresponds to an investor who has a technological knowledge of the project. Venture-capitalists are not uniform: the intensity of their technological knowledge of the entrepreneur's project is a continuum. More hands-on VCs have higher control-rights and technological expertise.

2.1 Model

The model has four periods, $t = 0, 1, 2, 3$. All agents are risk-neutral. There is no discounting.

At $t = 0$, there is a continuum of mass one of wealthless entrepreneurs, each with a project generating a cash-flow V at $t = 3$. Each entrepreneur matches with a competitive investor with whom he enters a contract.

At $t = 1$, the entrepreneur and the investor observe whether the entrepreneur is competent to undertake the project. If he is not (this happens with probability p), the project is liquidated, at a value normalized to zero. No cash has been burnt at this stage, so any initial injection can be fully recovered. If he is competent, the entrepreneur chooses privately a level of effort e, at private cost $e^2/2$.

At $t = 2$, the cost C of the project is revealed. C is observable to both the investor and the entrepreneur, but not contractible. We assume that C is a random variable, distributed uniformly on $[0, 2C(e)]$, where $C(e)$ is a decreasing, convex function of effort e. Higher effort decreases the expected cos of the project. We also assume that $-1/C(e)$ is convex and that continuation is efficient for all levels of e. The investment C has to be irreversibly spent at this time for the project's execution (if $I_0 < C$, an additional injection $I_1 = C - I_0$ is needed so that the payoff V is produced).

At $t = 3$, the entrepreneur's career goes on in a competitive labor market. He receives a wage equal to his expected productivity. The expectations of the labor market on the entrepreneur's productivity only depend on whether he was successful or not on his first venture. The entrepreneur's wage is w_f if he failed and w_s if he succeeded, with $w_s > w_f$. (The next section endogenizes w_f and w_s). We call $\Delta = w_s - w_f$, the stigma of failure.

2.2 Contractual variables

The contract, which is signed at $t = 0$, specifies a cash injection at $t = 0$, I_0, a final repayment D to the investor at time 3, and the level of technological knowledge of the investor, $H > 0$. Technological knowledge H has a unit cost γ. If the entrepreneur fails to repay D, the investor gets ownership. The value that the investor can extract from the project without the entrepreneur depends on his technological knowledge H. A higher H increases the firm value to the investor if the entrepreneur leaves, $V(H)$. Precisely, H is the technological knowledge that the investor has about the project: it represents both the ability of the investor to process technological information relevant for pursuing the project (technological expertise) and the possibility to have access to this information (control rights/information rights). $V(H)$ is increasing concave, with $V'(0) = +\infty$ and $\lim_{H\to\infty} V(H) < V$.

2.3 First-Best

The first-best levels of effort e and technological knowledge H are determined by the maximization of the surplus:

$$\max_{e,H}(1-p)[V - C(e) - e^2/2] - \gamma H$$

Therefore, the first-best levels are:

$$\begin{cases} H^\star &= 0 \\ e^\star &= -C'(e^\star) \end{cases}$$

The optimal level of knowledge is zero, reflecting the fact that H is costly and does not increase the surplus in the absence of market inefficiencies. The wages w_s and w_f have no impact on the first-best values of effort and expertise. This won't be the case any more in the presence of contracting inefficiencies[4].

2.4 Hold-up

We now depart from the first-best world by introducing two contractual frictions. First, we assume that the entrepreneur cannot raise funds from a new investor at time 2, so that any additional funding has to come from the initial investor. Second, we assume that each party can hold-up the other at $t = 2$. The investor can initiate renegotiation when additional funding is needed at $t = 2$, and the entrepreneur can always initiate renegotiation by threatening to quit the project. We assume symmetric Nash-bargaining.

If the investor does not inject the cash required for the project at $t = 2$, the project stops and the entrepreneur gets w_f, namely the wage of a failed entrepreneur[5]. The value functions, E and I, resulting –when renegotiation occurs– from the bargaining of the entrepreneur and the investor, are:

$$\begin{cases} E &= w_f + \frac{1}{2}(V + w_s - V(H) - w_f) \\ I &= V(H) + \frac{1}{2}(V + w_s - V(H) - w_f) \end{cases}$$

The surplus from continuation is $E + I = V + w_s$ and the terms of bargaining do not depend on how much cash has to be reinjected. In what follows, we call $\Delta = w_s - w_f$, the "stigma of failure". We can rewrite the outcome of the bargaining as follows:

$$\begin{cases} E &= w_s + \frac{1}{2}(V - V(H) - \Delta) \\ I &= V(H) + \frac{1}{2}(V - V(H) + \Delta) \end{cases}$$

This shows that, ceteris paribus, an increase of the stigma of failure (Δ), improves the bargaining position of the investor. When Δ is large, the main problem tends to

[4] We could assume that H also affects the surplus (V), therefore providing another motive for investor's expertise. We want to isolate the impact of H on the hold-up problem.

[5] To be precise, we assume that the market only observes if the project has been successfully completed or not, i.e. if V has been produced. The market has no information on the reasons why V "did not happen".

be the investor's ability to appropriate rents ex post if he has the power to do so. Conversely, for a small Δ, the main problem tends to be the entrepreneur's threat to leave the firm. The role of technological knowledge H is to increase the investor's bargaining position.

There is an asymmetry between these two commitment problems. The threat of rent appropriation by the investor can be remedied by injecting more funds initially (or equivalently offering a deeper line of credit), which reduces the states of the world where the entrepreneur has to ask for further funding. Absent default, the investor does not have control and can not threat the entrepreneur. Such a solution, however, does not exist for the entrepreneur's commitment problem.

Apart from that, we assume that the contractual environment is frictionless. In particular, we assume a perfect "accounting monitoring technology": at $t = 1$, the entrepreneur cannot use cash injected by the investor for other means than the implementation of the project. This implies that when the entrepreneur is incompetent, the investor gets all his investment I_0 back because the entrepreneur does not have any bargaining power[6]: he cannot steal money, cannot burn money, since he doesn't know how to implement the project, and if he leaves, the investor gets everything back.

2.5 The Optimal Contract

We look for the optimal contract. We derive it informally to show the intuitions and leave formal proofs for the appendix.

Each time an additional injection of cash is needed at $t = 2$, i.e. $I_0 < C$, the sharing of the payoff is determined by the Nash-bargaining solution. The reason is that for any other sharing rule agreed on ex ante, one of the two parties would find it attractive to renegotiate ex post. It follows that the only case where the sharing rule can be different from the bargaining solution is the case where the first injection

[6] We could alternatively assume that the entrepreneur can threaten to burn the cash inside the firm and can therefore extract $\Delta/2$. This would however lead to a mechanical relation between the risk of the project and inefficiency. Our goal is to isolate the role of the stigma of failure Δ in the hold-up problem described above.

of cash can cover the costs ($I_0 > C$) and the entrepreneur prefers to repay his debt rather than renegotiate. Since the excess amount of cash coming from the first cash injection is $I_0 - C$, the condition for this case to hold is: $w_s + V + I_0 - C - D > E$. Under this condition, the investor (and not the entrepreneur) would like to renegotiate (as the terms of bargaining are in his favor) but cannot force renegotiation, since the survival of the firm does not rely on him injecting more cash.

We first show that when Δ is high enough, it is possible to implement the first-best with a simple debt contract. Assume the investor does not invest in expertise, ($H = 0$), and that an injection of $I_0 = 2C(e^\star)$ is made at the beginning. As long as the repayment level $D^\star$ required for the investor to break even is such that

$$w_s + V - D^\star > E, \tag{1}$$

the entrepreneur prefers to repay his debt for any value of $C < 2C(e^\star)$: Renegotiation only occurs when the entrepreneur needs further funding. But this will never happen, as when equation 1 holds, the fear of renegotiation plays the role of a discipline device which induces the first-best level of effort. To see why we need to look at the maximization program of the entrepreneur which is:

$$\max_e \int_0^{2C(e)} \max(V + I_0 - D + w_s - C, E)\frac{dC}{2C(e)} - e^2/2.$$

Rearranging and dropping the constant terms, we can rewrite it as:

$$\max_e \underbrace{-C(e) - \frac{e^2}{2}}_{\text{First-Best objective}} + \int_{2C(e^\star)}^{2C(e)} \underbrace{(E - V + I_0 - D + w_s - C)}_{<0}\frac{dC}{2C(e)} - e^2/2.$$

It follows that this objective function is maximized for $e = e^\star$, as the first-best objective.

Therefore, we know that for $D^\star = 2C(e^\star)$, the entrepreneur always repay his debt as long as equation 1 holds. It follows that in this case the break-even condition writes simply: $D^\star = 2C(e^\star)$. In turn, equation 1 rewrites :

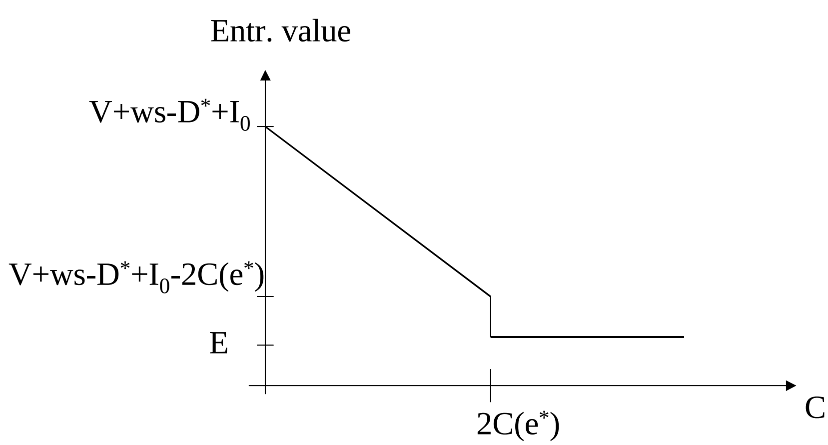
$$w_s - w_f > 4C(e^\star) - V \tag{2}$$

Note that for any $\epsilon \geq 0$, all contracts of the form $I_0 = C(e^\star) + \epsilon$, $D = D^\star + \epsilon$ have the same properties. In term of payoffs and of incentives, only the difference $I_0 - D$ matters. In what follows, when several contracts are optimal, we pick the one that minimizes I_0, a convention that makes comparisons possible[7].

In brief, we have shown informally that when the stigma of failure is high enough, the first-best is implemented. The investor does not invest in technological expertise and the fear of failure is sufficient for the entrepreneur to commit to repay his debt and perform optimal effort. This type of lending has the essential characteristics of bank finance.

Proposition 1 *There exists a threshold value, $\Delta^\star = 4C(e^\star) - V$ such that for $w_s - w_f > \Delta^\star$:*

- *Investor does not have technological knowledge: $H = 0$.*
- *The optimal contract consists of an initial injection of cash $I_0 = 2C(e^\star)$.*
- *Renegotiation never occurs.*
- *First best effort, $e^\star$, is implemented.*
- *There is no need for a second-stage injection of cash.*



Distribution of entrepreneur's payoffs for $I_0 = 2C(e^\star)$.

[7] Such a contract would be the optimal contract for an arbitrary small opportunity cost of injecting money at $t = 0$ rather than $t = 2$.

Consider now what happens when the stigma of failure becomes small, i.e. $w_s - w_f$ just below $\Delta^\star$. Implementing the first-best becomes impossible because the condition that the entrepreneur does not find it attractive to renegotiate for $C < 2C(e^\star)$ is now incompatible with the break-even condition. There are two tools that can be used ex ante to solve the commitment problem of the entrepreneur. First, the investor can decrease I_0, which has only a second-order impact on the surplus (through a first-order decrease in effort) but relaxes the break-even constraint to the first-order. The other tool that the contract can rely on is the investor's technological knowledge, H. Increasing H rebalances the terms of bargaining in favor of the investor. Since $V'(0) = +\infty$, both tools are used at the optimum contract. We let the formal proof for the appendix and go further with an intuitive derivation of the optimal contract. Decreasing I_0 decreases incentives to perform effort and leads to a level of effort $e < e^\star$, since the excess cash that the entrepreneur can hope to keep is smaller. This positive relationship between effort and I_0 (which constitutes the incentive compatibility constraint) is given by the first-order condition:[8]

$$I_0 = 2\sqrt{-\frac{C(e)^2}{C'(e)}e}.$$

Therefore, a larger I_0 also means a larger average cost, $C(e) > C(e^\star)$. Since $I_0 < 2C(e^\star)$, this implies that with a positive probability $(1 - I_0/2C(e))$, the entrepreneur does not have sufficient cash from the first injection to pursue the project and has to negotiate for a second cash-injection. When this occurs, the sharing rule is determined by the terms of bargaining. Now, when the realization of C is smaller than I_0, as I show in appendix, at the optimal contract, the entrepreneur repays his debt[9].

Proposition 2 *For $w_s - w_f < \Delta^\star$, optimal contracting results in:*

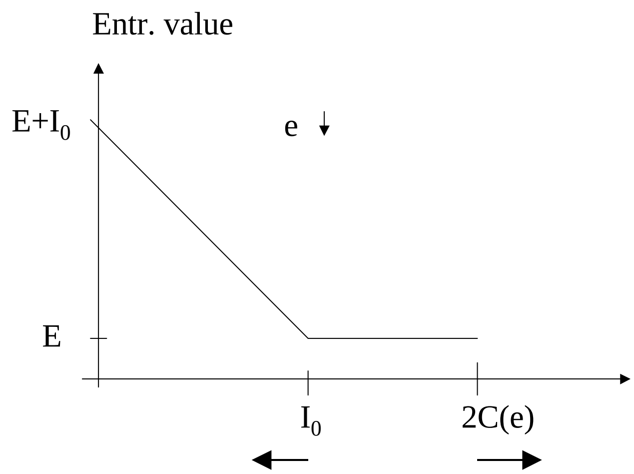
- *A positive level of technological expertise H,*
- *A first injection $I_0 < C(e^\star)$. Effort is second-best, $e^{\star\star} < e^\star$.*

[8] Note that $e^\star$ is solution of this equation for $I_0 = 2C(e^\star)$.

[9] The repayment D is equal to the final payoff I that the entrepreneur whould get in case of renegotiation.

- *There is a positive probability that a second injection I_1 occurs.*

- *The cost of capital for a given project is higher than when $w_s - w_f < \Delta^\star$, reflecting undereffort and the cost of expertise.*



Effect ceteris paribus of a decrease in I_0 on the entrepreneur's payoffs.

Comparative Statics

As the stigma of failure, $w_s - w_f$, decreases, effort decreases and the investor's knowledge H increases. The probability that a second cash injection is needed is now $1 - \frac{I_0}{C(e^{\star\star})}$ which increases. The level of the first cash injection decreases and the average level of the second one, $\frac{C(e^{\star\star})-I_0}{2}$ increases. The total expected level of cash needed to finance the venture, $\gamma H + C(e^{\star\star})$, increases, due to the inefficient underprovision of effort. The loss in efficiency due to the hold-up friction is $L = \gamma H + (1-p)(C(e^{\star\star}) - C(e^\star))$.

Proposition 3 *In the second-best region ($\Delta < \Delta^\star$), as the stigma of failure $\Delta = w_s - w_f$ decreases:*

- *The level of technological expertise of investor increases.*

- *Effort decreases : The lower the stigma of failure, the more stringent the incentive constraint is.*

- *The probability that a second-stage investment occurs increases as the level of effort decreases. This probability is:* $1 - (-e^{\star\star}/C'(e^{\star\star}))^{1/2}$.

- *The initial cash injection decreases, the average second cash-injection increases, the total amount of cash needed increases.*

- *The loss in efficiency with regard to the first best is decreasing with* Δ *and increasing with the cost of technological expertise* H.

To summarize, this benchmark start-up finance model captures the following:

As long as the stigma of failure $(w_s - w_f)$ is "high enough" simple debt contracts are the optimal mode of financing. The investor does not need to acquire technological knowledge: the fear to be forced to raise new funding operates as a discipline device and forces entrepreneurs to choose the first-best effort[10]. In turn, the investor has no power to exercise a threat on the entrepreneur as long as he repays his debt. This kind of financing has the characteristics of bank debt.

Conversely, when the stigma of failure is low, the entrepreneur cannot commit (ex ante) not to trigger renegotiation (ex post). This leads to a loss in efficiency that is partly solved by having the investor acquire technological knowledge and staging the investment. The investor's knowledge, by alleviating the hold-up threat of the entrepreneur, rebalances the terms of bargaining. In our model, the "value-added" of the venture-capitalist's knowledge lies in this rebalancing in the terms of bargaining represents as a style of financing in our model. It however has costs, simply those of high-skilled technological expertise. The model shows that an endogenous staging of capital injection in two rounds occurs. The lower the stigma of failure is, the more frequent a second round is and the higher the level of investor's technological expertise

[10] In our model, the value enhancement of investor's expertise lies exclusively in the resolution of a hold-up problem. As a consequence, whenever bank debt is possible, it is also first-best efficient. This feature is not essential to the model. For example, when the technological knowledge of the investor adds value to the project (e.g., if the payoff is an increasing function of H, $V(H)$) it might be first-best to have a positive level of H and a large stigma of failure would lead to a level of technological monitoring lower than H. In this case, the relationship between efficiency and stigma might be non-monotonic. Venture capitalists are known to add value to the ventures they finance, e.g. by helping to hire appropriate managements, or using their network to help the entrepreneur obtaining contracts.

is.

The model has the following out-of-sample testable prediction:

Proposition 4 *Ceteris paribus, the higher the stigma of failure, the higher the ratio of second-stage infusion over first-stage infusion.*

3 The Stigma of Failure

The framework we have developed allows us to clarify the link between the stigma of failure and the nature of financial and contractual institutions. The determinants of the stigma can be both exogenous (institutions) or endogenous (informational).

3.1 Exogenous Stigma: Bankruptcy cost

We first consider the case where bankruptcy rules or liquidation rules are the determinants of the stigma. All entrepreneurs get the same wage w on the labor-market at $t = 3$, but "failed entrepreneurs" incur a loss Δ. Therefore, $w_s = w$, and $w_f = w - \Delta$. We assume that Δ is a pure waste cost (one can think about Δ as the time it takes for the entrepreneur to be discharged and able to go on with his career). We can use our model to describe how Δ affects financial contracts and what level of Δ is efficient. There is a trade-off between the disciplining effect of Δ and its pure-waste cost. A higher Δ alleviates the commitment problem of the entrepreneur but diminishes the expected surplus ex ante by $p\Delta$.

As $H(\Delta)$ and $e^{\star\star}(\Delta)$ are decreasing in Δ, the contractual gains from a positive Δ are increasing in Δ for $\Delta < \Delta^{\star}$. The marginal contractual gains from a higher bankruptcy cost write:

$$\frac{\partial L}{\partial \Delta} = \gamma \frac{\partial H}{\partial \Delta} + (1-p)C'(e^{\star\star})\frac{\partial e^{\star\star}}{\partial \Delta}$$

The marginal social loss associated to the bankruptcy cost Δ is p.

Proposition 5

- *There exists a threshold $p^\star < 1$ such that for $p < p^\star$, the optimal bankruptcy cost Δ is positive and decreases with the sector's risk, p.*

- *In equilibrium, the investor's expertise and the probability of second-stage financing decrease weakly with the cost of bakruptcy, Δ (strictly decrease for $p < p^\star$).*

The first point shows that bankruptcy rules are an effective way to give bargaining-power to the investor, which helps solving contractual imperfections. However, the riskier the sector, the more costly it is to have such an institution, since the (pure-waste) costs of bankruptcy occur when projects fail.

The second point is a corollary of the comparative statics results of the previous section. It shows that an economy with softer bankruptcy rules asks for an investor with higher technological monitoring.

3.2 Endogenous Stigma

Bankruptcy rules are a potentially important source of variation of the stigma of failure across countries. But they are not the only source.

We now extend our model so as to endogenize the stigma of failure, $w_s - w_f$ in a simple career-concern set-up[11] where the labor-market makes inferences about the ability of an entrepreneur based on his past sucess or failure.

Assume that there are two types of entrepreneurs: Good types (G) –in proportion θ– and bad types (B). Initially, the types are unknown to everyone, including the entrepreneurs. The type of an entrepreneur matters for two distinct reasons: it affects the probability of being competent on the entrepreneurial project and the entrepreneur's productivity on the labor-market. High (low) types have a probability p_G ($p_B = 1$) to be incompetent to finish their project and therefore, the ex ante probability for an entrepreneur to fail on a project is $p = \theta p_G + (1 - \theta)$. The wage w at time $t = 3$ reflects the market's inference conditional on the history of the

[11] This formalization is related to Landier (2001).

entrepreneur (failed or not). Bad types have a productivity normalized to zero on the labor market, while high types have productivity y.

Inference on productivity:

Since there is a proportion θ of good types in the population, the probability that a "failed" entrepreneur is of high type is:

$$\pi_f = \frac{\theta p_G}{\theta p_G + (1-\theta)}.$$

Since bad entrepreneurs never succeed, the probability that a "successful" entrepreneur is of the good type is one: $\pi_s = 1$.

The labor market is competitive and therefore, the wage is equal to the expected productivity of the entrepreneur conditional on the available information. The wage is therefore $w_s = \pi_s y$ if the entrepreneur has been replaced and $w_f = (1-\pi_f)y$ if he has successfully completed his project.

It follows that:

Proposition 6 *The "stigma of failure" is :*

$$w_s - w_f = \frac{1-\theta}{\theta p_G + (1-\theta)} y = \frac{1-\theta}{p} y.$$

We use this career concern model two study two questions. First we want to study how sectorial characteristics impact financial contracts and institutions in equilibrium. Second, we show how complementarities between the strategies chosen by entrepreneurs might lead to multiple equilibria and therefore to differences in financing styles in a given sector across similar economies.

4 Start-up Finance and Sector Characteristics

There is a continuum of sectors characterized by different risk levels. Entrepreneurs (good or bad) are randomly affected across sectors (θ is constant across sectors). When p_G goes through $[0,1]$, the ex ante risk of failure $p = \theta p_G + (1-\theta)$ goes through $[1-\theta, 1]$. p can be seen as an index of sectors, a higher p meaning a riskier sector.

The payoff in case of success in sector p is $V(p)$ and the cost function is $C(p,e)$. In sector p, bad entrepreneurs always fail and good entrepreneurs fail with probability $p_G(p) = 1 - \frac{1-p}{\theta}$, which is increasing with sector-risk p.

Because the stigma of failure, $\Delta(p) = (\frac{1-\theta}{p})y$, is decreasing in p, failing in a low-risk sector is a more negative signal about productivity than failing in a high-risk sector: to fail in a low-risk sector, "you really have to be bad".

Lemma 1

- *A failed entrepreneur is more likely to be of high type in a riskier sector.*
- *The stigma of failure,* $\Delta(p) = w_s^p - w_f^p = (\frac{1-\theta}{p})y$, *decreases with the index* p.

We now compare the equilibrium financial contracts in these sectors. To do so, we need a normalization assumption. Specifically, we assume payoffs to be homogeneous in $(1-p)$, to impose that expected returns are non-decreasing with risk.

Assumption 1 $(1-p)C(p,e)$, $(1-p)V(p)$, *and* $(1-p)V_p(H)$ *are independent on* p *and the private cost for project* p *is* $\frac{e^2}{2(1-p)}$.

Under these assumptions, the level of first-best effort does not depend on p. As a consequence, assuming that sectors are financed with the optimal institution , the following is true when we move towards more risky sectors (higher p) :

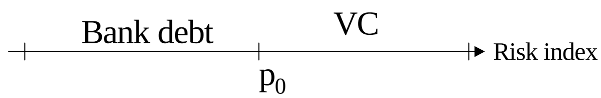
Proposition 7 *When* p *increases:*

- *The level of technological expertise* $H_p^\star$ *is higher and the level of effort diminishes (weakly).*
- *The cost of capital increases, due to the higher level of expertise required from the investor.*
- *The level of the first cash injection decreases and the probability of a second cash injection to occur increases. The expected level of this second cash injection increases as well, while the first cash injection decreases.*

Moreover, if we assume that the less risky sector ($p = 1 - \theta$) can be financed by "bank debt" (i.e. with $H = 0$) while the most risky is in the second-best region, where renegotiation occurs with positive probability, we have:

Proposition 8 *There exists a cut-off sector p_0 such that:*

- *If $p < p_0$, sector p is financed by an investor without expertise ($H_p^{\star} = 0$) and a simple debt contract. In other words, traditional bank lending prevail in these sectors.*
- *If $p > p_0$, sector p is financed by an investor with expertise $H_p^{\star} > 0$, increasing in p. This type of financing has the characteristics of venture capital (e.g. staging in two rounds).*



We see in this picture how the negative relationship between risk and the stigma of failure has implications for what type of financial institutions will be optimal in a given sector: in more risky sectors, where failing is not a very bad signal about productivity, more staging and investor's technological expertise are needed, in other words, as risk increases, the optimal investors look more and more like "hands-on" venture-capitalists.

5 Growth Strategies and Multiple Equilibria.

So far our model explains why different types of institutions and financial contracts might emerge to finance entrepreneurship in different sectors. We now examine a dual question: In a given sector, what might drive differences across in financing across regions and countries? Why might venture-capital fail to become a common form of start-up funding in certain economies. The question is of interest as many countries are trying to emulate the US venture-capital system. A first answer to these questions might be the differences in bankruptcy laws or differences in the cost of technological expertise γ. An alternative and perhaps more interesting answer might be based on multiple equilibria.

Assume that entrepreneurs within a given sector can choose different development strategies. They can choose aggressive business plans leading to "big hits" but likely to fail or they can choose more secure growth strategies, leading to smaller but more certain payoffs. Two equilibria can exist.

- In a "high-risk" equilibrium, entrepreneurs choose "high-risk" strategies for their project (meaning the probability for the entrepreneur to be incompetent is high). Therefore the stigma of failure is low which ensures that low-risk strategies do not look attractive.
- Conversely, in a "low-risk" equilibrium, the fact that all entrepreneurs choose low-risk strategies makes the stigma of failure high. Therefore, "high-risk" strategies are unattractive.

We now formalize this idea. The set-up is as in section one, except for the fact that the entrepreneur now chooses irreversibly at time zero among two possible strategies (or business plans) for the project: a risky one (p_2, V_2) and a low-risk one (p_1, V_1). This choice is observable by the investor but cannot be credibly signaled to the labor market once the entrepreneur has failed.

There are two potential pure strategy equilibria in our model: one where entrepreneurs all choose the low-risk strategy and one where they all choose the high-risk strategy. Since $p_2 > p_1$, the stigma of failure is higher in the low-risk equilibrium. We show in appendix that these two equilibria can coexist for a same set of parameters. The financial institutions that emerge in those two equilibria differ in their nature. Compared to the low-risk equilibrium, the high-risk equilibrium is characterized by investors with more technological expertise and more staging of investment. The probability that the founder entrepreneur "fails" is higher in the high-risk equilibrium.

Both types of equilibria might be the most efficient one, but when the returns of the risky strategy are high, the high-risk equilibrium is the efficient one. This is likely to be the case in high-tech sectors where the returns are particularily skewed. The picture that emerges from the description of these two equilibria matches some differences in Europe vs. the US and Massachussets vs. Silicon Valley.

5.1 New Ventures: Europe vs. the US.

Venture Capital has played a prominent role in the technological leadership of the US[12]. More than 70% of firms in the personal computer industries have been venture-capital backed. Giant companies such as Cisco, Cray, Genentech, Lotus, Apple and Microsoft got started with venture capital.

5.1.1 Levels

In 1999, the US venture capital industry raises more than three times more capital than the rest of the world taken together. Even though venture capital funding has been developping recently in Europe, it is still lagging far behind the US. As stated in a report of the European Commission (European Commission (2000)), "The EU risk capital market remains small and fragmented in comparison to that of the United States. Although there is no evidence of a generalised market failure, early stage and technology investment remains particularly low". Direct comparisons in levels are difficult since many funds that are categorized as "venture-capital" in Europe are in fact doing mostly later stage financing (e.g. LBOs) rather than start-up financing. This means that relying on aggregate venture-capital data will largely overestimate the funds that go into the financing of start-ups[13]. European Commission (2000) estimates levels of early stage venture capital investment as a percentage of GDP that are about four to five times higher in the US than in the EU.

[12] Venture capital rivals in-house R&D as a major source of funding for innovation: as reported by M.Mandel, based on a report of the NVCA, “in the first quarter of 2000, Venture Capital equaled one-third of all money spent on R&D compared to 3% in the 80s”.

[13] According to European Commission (2000), About 13% of "VC financing" went to seed and start-up in Europe against more than 30% in the US in 1999. Restricting oneself to the high tech industry makes this opposition even more striking: 26% in Europe against 80% in the US.

5.1.2 Contracts

Characteristics of venture-capital contracts in the US include staging of investment and a high level of control rights (c.f. Hellmann (1998) and Kaplan and Stromberg (2001)). The replacement of the founder of the company by a manager who is more able to accomplish the project occurs with high probability. Moreover, venture capitalists spend a large amount of time learning about the technological aspects of the project of the firm both pre and post first-state financing. In our model, this intensity of technological monitoring –requiring a high level of expertise on the investor's side– and the staging of cash infusions are endogenous features of venture-capital as a lending technology.

It is frequently reported that European venture capitalists are traditionally less "hands on" and less strategically involved than their American counterparts. In the context of our model, this means that they perform less technological monitoring. Sapienza, Manigart and Vermeir (1996) provide empirical evidence that French venture capitalists spend much less effort than their American counterparts in monitoring the firms they finance. They describe French venture capitalists as closer to bank managers than value-added investors.

Schwienbacher (2003) shows on the basis of a comparative survey that the replacement of the founder by a venture-capitalist is much less frequent in Europe than in the US.

5.1.3 The Stigma of Failure: Empirical Evidence

One might try to quantify the "stigma of failure", based on labor-market data. Two studies based on US data, Evans and Leighton (1989) and Hamilton (2000), establish that American entrepreneurs returning to employment earn slightly higher wages than other workers with similar characteristics. By contrast, Landier (2001) find that French entrepreneurs returning to paid employment earn significantly lower wages than other workers. This wage discount reflects the fact that leaving self-employment is a bad signal to the labor-market.

In summary, the picture that emerges from these empirical results confirms that the French and US labor markets react differently to the termination of entrepreneurial activity. In contrast with the US labor market, the French labor market penalizes heavily those who quit self-employment for employment.

These elements of evidence are broadly coherent with our description of the high-risk and the low-risk equilibria:

- In Europe, young firms tend to have strategies that are not very aggressive. This leads to few "firings" of entrepreneurs and a high-stigma of failure (you have to be a bad manager to fail a conservative strategy), which in turn makes aggressive strategies too risky to be attractive. Financing does not require financial expertise of the investor: the stigma of failure plays the role of a discipline device, making simple debt contracts possible.
- On the contrary, in the US entrepreneurs choose risky, more aggressive strategies, that make them more likely to be unsuccessful. For this reason, the stigma of failure is low (having failed does not reveal much about your ability). This in turn creates a hold-up problem, leading to:
  - Acquisition of expertise from the investor to rebalance the terms of bargaining.
  - Tighter staging of the investment.
  - A higher cost of project's financing, reflecting the cost of investor's skills and the moral hazard problem (undereffort).

A quotation of Eric Benhamou, a french entrepreneur who emigrated to Silicon Valley and became the CEO of 3Com summarizes this link between strategy choice and the stigma of failure:

> *"As a student at Stanford, I realized how naive I had been to believe I could start a business in France.[...]in France, you keep all your life the stigma of a failure. Here [in Silicon Valley] it is the mark of your entrepreneurial*

spirit. In France, it is common practice to give up on growth in order to limit risk. Here, when you start a venture, your goal is to become number one of your sector".

5.2 Route 128 vs. Silicon Valley

Saxenian (1994) describes how Silicon Valley and Route 128 –two regions that had similar innovative advantages in the early 1980's– evolved differently. Route 128 lost its competitive edge, generating three times less jobs in the high tech industry between 1975 and 1990 than Silicon Valley. Saxenian shows how this divergence is related to different social norms concerning job mobility and failure. While Route 128 has a conservative culture, valuing safer projects and careers, Silicon Valley has created an environment that encourages risk and accepts failure. "There is little embarrassment or shame associated with business failure. In fact, the list of individuals who failed, even repeatedly, only to succeed later was well-known in the region." The different performance of the two regions is reflected in the levels of venture capital investment. For example, in 1981, 38% of the US venture capital went to California, but only 12% to Massachusetts based companies. Interestingly, the nature of venture-capital itself has been different in the two regions. Saxenian gives the following quote from a top executive of DEC who became a consultant in Silicon Valley: "There is no real venture capital in Massachussets. The venture capital community is a bunch of very conservative bankers. They are radically different from the venture capitalists in Silicon Valley." This picture matches also the multiple equilibria characteristic of the model.

6 Conclusion

This paper presents a model of entrepreneurial finance, where the outside option of entrepreneurs in case of failure determines the staging of investment in different rounds and the choice of a monitoring technology. I show how, in turn, the outside option depends on the industry parameters, on the legal environment and on the coordination of agents. I describe how these different styles of financing relate to bank debt vs. venture capital. If agents can choose between aggressive or safe growth strategies, I show that two equilibria can arise with different efficiency consequences. In a low-risk equilibrium, entrepreneurs choose safe projects, failure is highly stigmatized and, therefore, the optimal style of financing is bank debt. In a high-risk equilibrium, entrepreneurs choose riskier projects. In this equilibrium, failure is not stigmatized and the optimal form of financing requires intense technological monitoring and investment staging, features which are characteristic of venture capital. The theory explains why similar economies might be in different entrepreneurial regimes, characterized by different growth strategies and different financial institutions.

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7 Appendix

Proof of proposition. 1 and proposition 2:

Take H as given, effort e is chosen by the entrepreneur such as to maximize :

$$\max_e \int_0^{2C(e)} \max(V + I_0 - D + w_s - C, E)\frac{dC}{2C(e)} - e^2/2.$$

Remark that only $I_0 - D$ is relevant for incentives. When several contracts are optimal, we select the one that minimizes I_0. This contract would be dominant for an arbitrarily small opportunity cost of injecting money at the beginning.

Let $C^\star$ be such that $V + I_0 - D + w_s - C^\star = E$.

- First assume that the optimization problem leads to a level of effort $e^{\star\star}$ such that $C^\star > C(e^{\star\star})$. That means that the entrepreneur will never find it attractive to trigger renegotiation, and therefore, his maximization problem rewrites:

$$\max_e (V + I_0 - D + w_s) - C(e) - e^2/2$$

which is the first-best program. Therefore, $e^{\star\star} = e^\star$. The contract that minimizes the level of D is an initial injection $I_0 = 2C(e^\star)$ and a level of debt $D^\star$ determined by the break-even condition of the investor:

$$(1-p)D^\star = 2(1-p)C(e^\star) + \gamma H$$

It follows that, as long as $D^\star = 2C(e^\star) + \frac{\gamma H}{1-p}$ verifies :

$$V - D^\star + w_s > E = w_f + \frac{1}{2}(V + w_s - V(H) - w_f).$$

i.e.

$$(w_s - w_f) > 4C(e^\star) + 2\frac{\gamma H}{1-p} - (V + V(H)) = \Delta^\star,$$

then an initial injection $I_0 = 2C(e^\star)$ leads to the implementation of the first best effort $e^\star$.

Note that in this region, higher bargaining power of the investor does not lead to inefficient outcomes, since as long as he repays his debt, the investor cannot hod-up the entrepreneur. In this region, the optimal level of H is zero, which is also the first-best level. Therefore, the threshold is:

$$\Delta^\star = 4C(e^\star) - V.$$

- Now, consider $(w_s - w_f)$ below $\Delta^\star$. The level of effort $e^{\star\star}$ is now such that $C^\star < C(e^{\star\star})$, so that the optimization problem rewrites:

$$\max_e \left(\frac{C^\star}{2C(e)}\right)(E + C^\star) + \left(1 - \frac{C^\star}{2C(e)}\right)E - e^2/2$$

$$\max_e \left(\frac{C^{\star 2}}{C(e)}\right) - e^2 = U(e)$$

U is concave and $U\prime(e) = -\left(\frac{C^\star}{C(e)}\right)^2 C'(e) - 2e$

The first order condition writes:

$$f(e^{\star\star}) = -2\frac{C(e^{\star\star})^2}{C'(e^{\star\star})}e^{\star\star} = C^{\star 2}$$

The function f increases with $e^{\star\star}$ (from the assumption that $1/C(e)$ is concave). Therefore, $e^{\star\star}$ decreases with $C^\star$.

Remark that for $C^\star = C(e^\star)$, the solution is $e^{\star\star} = e^\star$ since $e^\star = -C'(e^\star)$. Since we look for the contract that minimizes I_0, at the margin, the entrepreneur is just able to cover his costs, namely $I_0 = C^\star$.

The second-best choice of effort and technological expertise is determined by the maximization of the ex-ante surplus,

$$\max_{e,H} -C(e) - e^2/2 - \gamma H/(1-p)$$

under the following constraints:

1. Threshold condition 1:

$$V - D + w_s = E.$$

2. Threshold condition 2:

$$I_0 = C^\star$$

3. Break-even condition:

$$\frac{C^\star}{2C(e)}(D-I)+I \geq C^\star + (1-\frac{C^\star}{2C(e)})(\frac{2C(e)-C^\star}{2}) + \frac{\gamma H}{1-p}.$$

Remark that $D - I = 0$[14], so this rewrites:

$$V + w_s - E \geq C^\star + (1-\frac{C^\star}{2C(e)})(\frac{2C(e)-C^\star}{2}) + \frac{\gamma H}{1-p}.$$

i.e.,

$$C^\star + (1-\frac{C^\star}{2C(e)})(\frac{2C(e)-C^\star}{2}) + \frac{\gamma H}{1-p} \leq \frac{\Delta + V + V(H)}{2}.$$

i.e.,

$$C^\star + (1-\frac{C^\star}{C(e)})(\frac{C(e)-C^\star}{2}) + \frac{\gamma H}{1-p} + 2C(e^\star) \leq \frac{\Delta - \Delta^\star + V(H)}{2}.$$

4. Incentive constraint:

$$-2\frac{C(e)^2}{C'(e)}e = C^{\star 2}$$

Since by assumption, even for $e = 0$, continuation is efficient, and since $[\frac{\partial}{\partial e}(e^2/2)](e = 0) = 0$, there is an interior solution. It is solution of the following reduced-form problem:

$$\max_{e,H} -C(e) - e^2/2 - \gamma H/(1-p)$$

such that:

$$\begin{cases} C^\star + (1-\frac{C^\star}{C(e)})(\frac{C(e)-C^\star}{2}) + \frac{\gamma H}{1-p} + 2C(e^\star) \leq \frac{\Delta-\Delta^\star+V(H)}{2}. \\ -2\frac{C(e)^2}{C'(e)}e = C^{\star 2} \end{cases} \tag{3}$$

Proof of proposition 3:

[14] This is another way to write threshold contition one.

The maximization problem can be rewritten to have the form:

$$\max_{e,H} v(e) - H$$

such that:

$$f(e) + g(H) < \Delta. \tag{4}$$

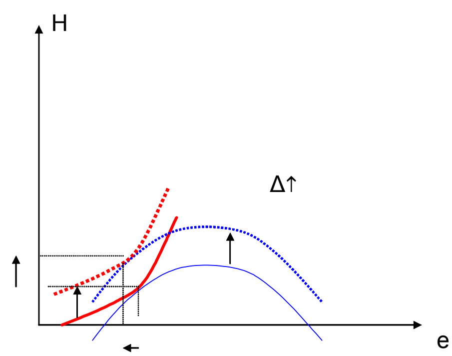
where v is concave and $g(H) = -V(H)/2 + \gamma H/(1-p)$ is convex.

We want to show that when Δ increases, $e^{\star\star}$ decreases and $H^{\star\star}$ increases.

For a given e, the isocurves of the objective function all have the same slope ($v'(e)$). What we need to establish is therefore that for a given e, the slope of the constraint ($f(e) + g(H) = \Delta$) increases for a given e. This slope is:

$$\frac{dH}{de} = -\frac{f'(e)}{g'(g^{-1}(\Delta - f(e)))}$$

g is decreasing in the zone where the interior solution lies, and $(-g')$ is decreasing (g is convex). It follows that the slope of the constraint at a given e increases as Δ increases.



When Δ increases, $e^{\star\star}$ decreases and $H^{\star\star}$ increases.

Proof of proposition 7:

The critical threshold below which "standard debt" is not optimal in sector p, $\Delta^\star(p) = \frac{\Delta^\star(0)}{1-p}$, increases with p.

Therefore, $(1-p)(\Delta(p)-\Delta^{\star}(p))$ decreases with p, implying that the incentive constraint becomes more stringent.

$$\left\{ \begin{array}{c} (1-p)\left[C^\star + (1-\frac{C^\star}{C(e)})(\frac{C(e)-C^\star}{2})\right] + \gamma H \leq \frac{(1-p)(V+\Delta)+(1-p)V(H)}{2} \\ -2\frac{C(e)^2}{(1-p)C'(e)}e = C^{\star 2} \end{array} \right. \qquad (6)$$

Therefore, the solutions are functions of $\Delta + V$, independent of p by homogeneity.

We note: $L(\Delta+V) = (1-p_i)(C_i(e_i(\Delta+V)) - C_i(e_i^\star) + (e_i(\Delta+V)^2 - e_i^{\star 2})/2) + \gamma H_i(\Delta+V)$ the efficiency loss as a function of $\Delta + V$. L is a decreasing function of $\Delta + V$.

The condition for project i to be preferred to project j in equilibrium (i) is that:

$$-p_i\Delta_i + (B_i - L(\Delta_i + V_i)) > -p_j\Delta_i + (B_j - L(\Delta_i + V_i))$$

Proposition 9

- *The low-risk equilibrium exists if*

$$\Delta_1 > \frac{B_2 - B_1}{p_2 - p_1}.$$

- *The high-risk equilibrium ("high-risk") exists if*

$$\Delta_2 < \frac{B_2 - B_1}{p_2 - p_1}.$$

- *Therefore, the condition for the two equilibria to coexist is that:*

$$\frac{1-\theta}{p_2} < \frac{(1-p_2)V_2 - (1-p_1)V_1}{p_2 - p_1} < \frac{1-\theta}{p_1}$$

The high-risk equilibrium is characterized by a higher level of technological expertise if $(1-p_1)(V_1 + \frac{1-\theta}{p_1}) > (1-p_2)(V_2 + \frac{1-\theta}{p_2})$, which holds if V_1 and V_2 are sufficiently close or if p_1 is small enough, which makes the stigma in the low-risk equilibrium sufficiently high. The reason behind the inequality is that two competing effects are at work: on the one hand, the stigma is lower in the low-risk equilibrium which leads to more "hands-on VC" contracts (high H, small e). On the other hand if the value of a risky project, $(1-p_2)V_2$ is really higher than the one of a safe project, the break-even constraint is relaxed, which relaxes the need for monitoring devices.

To perform welfare analysis, since the investor makes zero profit, we have to compare the ex ante value of a project in each equilibrium, i.e.

$$W_i = B_i - L_i(\Delta_i)$$

Using this criterion, we can discuss the relative efficiency of the equilibria:

Proposition 10 *The high-risk equilibrium is the most efficient if the difference in the value of the projects exceeds the higher costs of financing, i.e.,*

$$(1 - p_2)V_2 - (1 - p_1)V_1 > L_2(\Delta_2) - L_1(\Delta_1),$$

To summarize, we compare the two regimes of entrepreneurship in the case where the difference in stigmas in the two equilibria is large enough such that $\Delta_1 < \Delta_1^\star$ and $\Delta_2 > \Delta_2^\star$ (a condition under which the coexistence result still holds). An increase in V_2 increases the efficiency of the high-risk equilibrium.

An increase in the cost of technological expertise reduces the efficiency of the high-risk equilibrium.