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# Product Market Competition and the Financing of New Ventures

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This paper examines the interaction between venture risk, product market competition, and the entrepreneur's choice between bank financing and venture capital (VC) financing. Under bank financing, a debt-type contract emerges as optimal, which allows the entrepreneur to retain full control of the venture and thus yields strong effort incentives, as long as the entrepreneur can service the debt repayment; however, this leads to liquidation in the case of default, making the venture's success quite sensitive to exogenous, even temporary, shocks that may hinder debt repayment. Under VC financing, an equity-type contract emerges as optimal. Although it is not sensitive to exogenous shocks, this contract requires the entrepreneur to share a fraction of the rents with the financier, thus yielding lower effort incentives for the entrepreneur. There exists a threshold level of venture risk such that bank financing is optimal if and only if venture risk is below that threshold. Product market competition increases the value of stronger entrepreneurial incentives and thus increases the maximum level of risk the entrepreneur is willing to take before switching from bank financing to VC financing. This is a robust result that is shown to hold in various models of competition, including the Hotelling, Salop, Dixit–Stiglitz, and Cournot-to-Bertrand switch.

**Keywords:** competition; venture risk; bank financing; venture capital

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## 1. Introduction

Small firms are of critical importance to the economy.<sup>1</sup> In the United States, they represent 99.9% of all firms, employ half of all private sector employees, produce 16 times more patents per employee than large patenting firms (U.S. Small Business Administration 2014), and have a significantly positive impact on urban growth (Glaeser et al. 2015).

The creation and growth of these entrepreneurial ventures often requires external capital, and financial intermediaries such as banks and venture capitalists play a key role in that regard. What factors affect the entrepreneur's choice between the two types of financing? In practice it is sometimes argued that entrepreneurs prefer bank-provided debt financing over venture capital and thus would always choose bank financing as long as it is feasible, that is, as long as the venture has enough assets to collateralize the loan. Under that hypothesis, a key factor in the

entrepreneur's choice would be some ratio of collateral value to investment requirement. This is a plausible, but likely incomplete, hypothesis: it relies on the argument that unsecured debt is very difficult if not impossible to obtain in new ventures, an argument somewhat inconsistent with the fact that 40% of loans taken by small firms are unsecured (Leeth and Scott 1989). In this paper, we suggest that two key factors—venture risk and product market competition—may affect the financing strategy of new ventures (see the discussion of the related empirical evidence in the next section), and we examine the interaction between these two factors and the trade-off between bank financing and venture capital (VC) financing.

We propose a two-period, incomplete contracting model in which a wealth-constrained entrepreneur chooses between bank financing and VC financing, anticipating that a negative shock may or may not occur at date 1. In our simple setup, under bank financing a debt-type contract emerges as optimal. On one hand, conditional on repaying the debt, the entrepreneur retains full control of the venture and, as a result, full access to the venture's realized profit. She

<sup>1</sup> The Office of Advocacy of the U.S. Small Business Administration (SBA) defines a small business as an independent business with fewer than 500 employees.

thus has strong incentives to exert effort and create value.<sup>2</sup> On the other hand, default on the debt leads to liquidation, making the venture's success quite sensitive to exogenous, even temporary, shocks that may hinder debt repayment.

We argue that unlike the bank, which receives none of the realized profit when the entrepreneur controls the firm, the venture capitalist can use expertise, social networks, and financial resources to extract a fraction of ex post profit even when the entrepreneur controls the venture. Accordingly, under VC financing, an equity-type contract emerges as optimal. This contract is not sensitive to exogenous shocks but requires the entrepreneur to share a fraction of the profit with the financier, yielding lower entrepreneurial effort. Thus our first key result emerges: there exists a threshold level of venture risk (probability of a negative shock occurring) such that below that threshold the entrepreneurial incentive advantage of the debt contract more than offsets the disadvantage associated with expected default and liquidation, and bank financing is preferred to VC financing. Above that risk threshold, the elimination of default risk associated with equity-type contracts more than offsets the incentive disadvantage, and VC financing is optimal.

In our model, the entrepreneur's effort increases the probability of gaining a cost advantage over her product market rival. We show that competition, measured by the degree of substitutability between products, increases the value of a cost reduction—the marginal product of entrepreneurial effort. The intuition is simple: in markets with more homogeneous products, consumers become more sensitive to prices, and this increases the demand advantage of the cost-leading entrepreneur charging a lower price than her rival. The value of gaining a cost advantage thus increases with competition, and this disproportionately favors bank financing, where (as discussed) entrepreneurial effort and the resulting likelihood of a cost reduction are greater in equilibrium.

Thus, competition increases the appeal of bank financing relative to VC financing—it raises the maximum level of risk the entrepreneur is willing to take before switching from bank financing to VC financing. This second key result is robust and is shown to hold in various models of competition, including the Hotelling, Salop, Dixit–Stiglitz, logit, and Cournot-to-Bertrand switch. It also is consistent with anecdotal evidence,<sup>3</sup> and with the empirical evidence discussed in the next section.

<sup>2</sup> For clarity purposes, throughout the text we refer to entrepreneurs as female and to financiers as male.

<sup>3</sup> Consider, for example, the opinion of Andras Forgacs, managing director at Richmond Global, a New York VC firm, on looking at investment opportunities in Chengdu, China: "There are some interesting investment opportunities where there is *less competition*

There exists a fairly large theoretical literature on the impact of debt financing on the competitive behavior of rivals in the product market.<sup>4</sup> Brander and Lewis (1986) pioneered this line of research when they examined the impact of debt on competitive behavior in a Cournot duopoly. They argued that debt forces firms to focus their attention on the good states of the world where the marginal return to output is highest, and hence can serve as a commitment to increase output, resulting in a reduction in the rival's own output choice. Showalter (1995) showed that similarly, under price competition, debt could serve as a commitment device to raise one's own prices and those of rivals. In contrast, Bolton and Scharfstein (1990) argued—in an optimal contracting framework—that debt may lead to predatory behavior by deep-pocketed rivals. In turn, Faure-Grimaud (2000) and Povel and Raith (2004) brought together strategic elements of the Cournot approach of Brander and Lewis (1986) and optimal contracting elements of Bolton and Scharfstein (1990).<sup>5</sup>

More recently, a new theoretical literature has emerged that examines the entrepreneur's choice between VC financing and bank financing more specifically. Factors affecting this financing trade-off are shown to include intellectual property protection and the "high-techness" of projects (Ueda 2004), entrepreneur/investor input complementarity (Bettignies 2008), entrepreneurial "stigma of failure" (Landier 2003), and "strategic uncertainty" (Winton and Yerramilli 2008).<sup>6</sup>

Although these two literatures provide valuable insights into the impact of financial structure on competitive behavior and into entrepreneurial financing

[emphasis added] and more patient development of companies and talent" (Knowledge@Wharton 2011).

<sup>4</sup> See, for example, Brander and Lewis (1986), Maksimovic (1988), Poitevin (1989), Bolton and Scharfstein (1990), Glazer (1994), Showalter (1995), Faure-Grimaud (2000), and Povel and Raith (2004). See also Peress (2010), who examines the more general interaction between product market competition and firms' behavior in financial markets.

<sup>5</sup> There also exists a small body of literature on venture capital and start-up financing in a competitive context. In particular, Inderst and Mueller (2004) consider the impact of competition among start-ups on VC investment decisions and financing contracts: competition shifts the bargaining power between the entrepreneur and the VC and thus affects ownership shares of the two parties and valuation of the project. Additionally, Fulghieri and Sevilir (2009) study how market conditions affect the composition of a venture capitalist's portfolio (in particular the trade-off between larger/smaller portfolios and diversified/concentrated portfolios).

<sup>6</sup> Other trade-offs have been examined in the entrepreneurial finance literature, for example, the entrepreneur's choice between venture capital and angel financing (Chemmanur and Chen 2014), or between private and public ownership (Boot et al. 2006). See also Renucci (2014), who examines bargaining with a venture capitalist when bank financing is an option.

trade-offs, neither can address the issue examined here, that is, the interaction among product market competition, venture risk, and the entrepreneur's choice between bank financing and venture capital.<sup>7</sup> Indeed—and this is the key contribution of this paper—we build a simple model of entrepreneurial finance where relatively risky ventures use VC financing while safer ventures use bank financing, and where the positive impact of competition on the appeal of bank financing relative to VC financing emerges as a robust result.<sup>8</sup>

One exception in the prior literature, and one more closely related to this paper, is the recent work of Inderst and Mueller (2009), which offers a compelling analysis of the interaction between product market competition and the entrepreneur's choice between active investors (e.g., venture capitalists) and passive ones (e.g., banks). In their model, active investors may enable ventures to “strategically overinvest” early on, thus forestalling their rivals’ future investment and growth” (p. 276), a strategic advantage for active investors that becomes more valuable as competition intensifies. In our paper, in contrast, the distinction between bank and VC financing does not rest on strategic overinvestment, but rather on differences in entrepreneurial incentives, and it generates a different outcome: here, product market competition leads to less VC financing and more bank financing, not the other way round.

This paper is organized as follows: Section 2 discusses empirical evidence related to VC financing and bank financing, and to the effects of venture risk and product market competition on the trade-off between the two types of financing. Section 3 describes the basic setup, and §4 presents a simple trade-off between bank financing and VC financing. Section 5 examines the impact of product market competition on the financing trade-off. Section 6 discusses empirical implications of the model, and §7 concludes. All proofs are in the appendix. Extensions to the main model are presented in the online supplement to this paper (available on the authors’ websites).

## 2. Empirical Motivation

Although a variety of sources of financing are available to entrepreneurs (Fraser 2005, Industry Canada

2009, Robb and Robinson 2014), two financial intermediaries emerge as particularly relevant. First, banks play a key role for venture creation and growth. Cosh et al. (2009) point out that among the UK firms that sought external financing during 1996–1997, 81% approached banks, far more than any other financial intermediary. Fraser’s (2005) and Robb and Robinson’s (2014) analyses suggest, respectively, that banks were also the most frequent capital provider for UK start-ups in 2004 and for U.S. start-ups over the 2004–2007 period.

Another financial intermediary playing a key role in the creation and development of new firms is the VC fund. Although VC funds are used by a narrower set of entrepreneurs (Fraser 2005, Cosh et al. 2009), they provide much more capital to the ventures that they do back. In the United States, the average amount of funding from VC funds over 2004–2007 was \$1,162,898, whereas the average funding in business bank loans was \$261,358 (Robb and Robinson 2014). Moreover, VC-financed firms helped to create many successful companies, including Apple, Intel, Federal Express, and Microsoft (Sahlman 1990), and VC-backed companies generate 5%–7% of employment in the United States (Puri and Zarutskie 2012).

Thus, both banks and VC funds are essential to the financing of new ventures and indeed are substitute forms of financing in that, as shown by Berger and Schaeck (2011), VC-backed firms are less likely to rely on bank financing. So what factors affect the entrepreneur’s choice between these two types of financing? Two factors in particular may have an impact on the bank/VC trade-off.

### 2.1. Venture Risk

Anecdotal evidence suggests that “riskier” ventures—defined as ventures that have a lower probability of success, but a higher payoff in case of success—are *relatively* more likely to be financed by venture capital, whereas “safer” ventures are more likely to be financed by banks. The vast majority of entrepreneurial ventures are so-called “lifestyle” ventures (e.g., hair salons, auto-repair shops, etc.), which have a relatively low probability of failure but will never yield very high growth or profit,<sup>9</sup> and these ventures are predominantly bank financed (Fraser 2005). On the other hand, lifestyle ventures are never financed by venture capital. VC funds focus instead on high-growth ventures,<sup>10</sup> which are riskier ventures: they

<sup>7</sup> The concept of “strategic uncertainty” used in Winton and Yerramilli (2008) is somewhat related to the concept of venture risk used here. However, the trade-off between bank and VC financing is very different in their model, as are the effects of strategic uncertainty on that trade-off. As well, product market competition is altogether absent from their model.

<sup>8</sup> In a differentiated Cournot extension of their model, Povel and Raith (2004) briefly discuss the impact of product homogeneity on the competitive behavior of firms. However they do not examine the impact of competition on the entrepreneur’s choice between bank and VC financing.

<sup>9</sup> The terms “high-growth” and “lifestyle” ventures are commonly used to divide entrepreneurial ventures into two broad categories. See, for example, Hisrich et al. (2006, pp. 19–20) and Harvard Business School (2006).

<sup>10</sup> To the extent that (the inverse of) the time to bring a product to market is a proxy for growth, this is consistent with Hellmann and Puri’s (2000) finding that VC-backed firms enjoy a significantly lower time to market.



have a relatively high probability of failure but can be extremely profitable when successful. Of course, some high-growth ventures are bank financed, and taken together these facts suggest that riskier high-growth ventures are more likely to be financed by venture capital, and safer lifestyle ventures are more likely to be financed by banks.

Cosh et al. (2009) explicitly examined the hypothesis that riskier ventures are more likely to be financed by VC funds than by banks and found some evidence consistent with it. For example, they found that banks provide male-founded firms with 18% less of their desired capital relative to female-founded firms. Citing Jianakopulos and Bernasek (1998) to underline evidence that women are more risk averse than men, they argue that this is illustrative of a negative connection between bank financing and venture risk. They also find that firms that recently developed a new innovation and hence are—as implicitly argued—riskier are more likely to seek VC financing.

Similarly, Hellmann and Puri (2000) found that innovator firms are significantly more likely to obtain VC financing, and obtain VC financing earlier in the life cycle, than imitator firms. To the extent that innovators are riskier than imitators, and/or that there is more risk earlier in the venture life cycle, this is consistent with a positive relationship between venture risk and VC financing.

## 2.2. Product Market Competition

A vast empirical literature exists that examines the connection between product market competition, on one hand, and decisions, behavior, and performance in organizations on the other. Perhaps the most compelling finding to emerge from this broad line of research is that competition affects organizations in many ways.<sup>11</sup> What about the interaction between competition and financing strategy specifically? Importantly here, Cosh et al. (2009) show that entrepreneurs are more likely to choose bank financing, and less likely to choose VC financing, as the degree of competition, measured by the number and/or size of competitors, increases.

Moreover, as discussed above, both Hellmann and Puri (2000) and Cosh et al. (2009) find evidence of a positive relationship between venture innovativeness and VC financing. Although we highlighted the

strong positive correlation between venture innovativeness and venture risk, it is also important to underline the negative correlation between venture innovativeness and product market competition. In Hellmann and Puri (2000, p. 969), for example, “the innovator variable captures the notion of firms that introduce a new product that is considered not to be a close substitute to any product or service already offered on the market; firms that introduce a new product or service that is considered to perform an order of magnitude better than any substitute products already offered in the market; or firms that are developing new technologies that could lead to products satisfying either of the two criteria above.” Indeed this corresponds quite closely to a description of lack of competition in the product market.<sup>12</sup> To the extent that innovation captures (lack of) competition, the evidence presented in these two papers is consistent with a negative connection between competition and VC financing.

Related to this, we note that patents, which are associated with less substitutable products and confer significant monopoly power to their holders, may arguably capture lack of competition. Kortum and Lerner’s (2000) finding that VC-financed firms have higher quality patents than non-VC-financed firms then also suggests a negative connection between competition and VC financing.

Finally, the evolution of the financing strategy over the product life cycle—namely the relative prevalence of VC financing early in the product life cycle and of bank financing later (Berger and Udell 1998)—could also be the result of a connection between competition and financing choice. Early in the life cycle, when the entrepreneur introduces a new product and creates a new market, competition is low and VC financing is chosen. As the life cycle progresses, however, similar products emerge, competition intensifies, and bank financing eventually becomes the preferred choice.

The above discussion yields two key implications regarding the bank/VC financing trade-off. It suggests first that riskier ventures are more likely to be VC financed than bank financed, and second that a greater degree of product market competition is likely to favor bank financing over VC financing. In what follows we propose a theory of entrepreneurial financing that highlights the interaction among the bank/VC financing trade-off, venture risk, and product market competition.

<sup>11</sup> The evidence suggests a positive impact of competition on innovation (Geroski 1990, Bertschek 1995, Blundell et al. 1999, Bloom et al. 2011, Teshima 2010, Hashmi 2013) and productivity (Caves and Barton 1990, Green and Mayes 1991, Haskel 1991, Nickell 1996, Griffith 2001, Syverson 2004a, b), the power of managerial incentives (Burgess and Metcalf 2000, Cuñat and Guadalupe 2005, Baggs and Bettignies 2007), collective bargaining and wage negotiations (Abowd and Lemieux 1993), mergers and acquisitions (Hoberg and Phillips 2010), and IPO decisions (Chemmanur and He 2011).

<sup>12</sup> The degree of substitutability between products (e.g., Sutton 1992), and the similarity between perceived product performance and/or between firms’ costs (e.g., Bertrand competition with asymmetric costs or performance components), are often used as measures of competition in industrial organization.

### 3. Basic Model

An entrepreneur  $e$  has a novel venture idea that may open a new and untapped market. Entrepreneur  $e$  is wealth constrained with no initial wealth and is soliciting a (small) cash investment  $I$  from a financier  $f$  to start her venture, which is to last for two periods. Both  $e$  and  $f$  are risk neutral, and  $f$ 's cost of capital is normalized to zero.

At the beginning of the game,  $e$  makes a take-it-or-leave-it contractual offer to  $f$ ,<sup>13</sup> specifying a credible way in which  $f$  is to receive a nonnegative expected payoff (net of  $I$ ) from the investment, thus ensuring his participation. Once the initial investment is made, the venture is started, but it requires  $e$ 's active management for its success. The key elements of the model can be described as follows.

*First-Period Profit and Exogenous Shocks.* Under  $e$ 's management, the venture is launched in the first period, offering goods/services at marginal cost  $\bar{c} \in \mathbb{R}^+$  in a new monopolistic market. One of two states of the world emerges. In the good state, which occurs with exogenous probability  $(1 - R_1)$ , with  $R_1 \in [0, 1]$ , the venture generates monopoly profit  $\Pi_1(R_1)$ . In the bad state, which occurs with probability  $R_1$ , however, a negative and temporary<sup>14</sup> shock affects the venture, which generates zero profit in that period as a result. This shock captures an exogenous randomness that is inherent to all ventures, for example, random consumer preferences, or macroeconomic or technological shocks.

The good-state profit  $\Pi_1(R_1)$  is strictly increasing in  $R_1$  such that the expected first-period profit  $(1 - R_1)\Pi_1(R_1) = \bar{\Pi}_1$  is a constant for all  $R_1 \in [0, 1]$ . Conveniently, one can easily verify that the variance of the first-period profit is a strictly increasing function of the shock probability  $R_1$ , and in what follows we refer to  $R_1$  as the “short-term risk” of the venture. Thus, two projects with different shock probabilities yield the same expected short-term profit but face different levels of risk.

*Second-Period Profit and Product Market Competition.* In the second period, a rival  $r$  enters the market, offering related but distinct goods/services at marginal cost  $\bar{c}$ . Thus emerges competition in the product market. Parameter  $\theta \in [\theta_{\min}, \theta_{\max}]$ , with  $\theta_{\max} > \theta_{\min} > 0$ , captures the degree of competition in the industry, which, as discussed in §5, will depend on the way demand/competition is modeled: it may represent the inverse of the transport cost in a Hotelling (1929)

or Salop (1979) model, or the inverse of variance of errors in a logit model, for example.

Benefitting from a first-mover advantage, under  $e$ 's management the venture may—through innovation—lower the marginal cost of production from  $\bar{c}$  to  $\underline{c}$ , where  $\underline{c} < \bar{c}$ , thus gaining a cost advantage over the entrant and generating “high” profit  $\Pi^h(\theta) = \Pi(\underline{c}, \bar{c}, \theta) > 0$ .<sup>15</sup> The successful innovation required for gaining a cost advantage takes place with endogenous probability  $\gamma \in [0, 1]$ . With probability  $1 - \gamma$  the marginal cost remains unchanged at  $\bar{c}$ , and in the second period the venture yields “status quo” or “symmetric” profit  $\Pi^s(\theta) = \Pi(\bar{c}, \bar{c}, \theta) > 0$ . Accordingly, in the second period,  $e$ 's venture generates the expected duopoly profit  $\Pi_2(\gamma, \theta) = \Pi^s(\theta) + \gamma(\Pi^h(\theta) - \Pi^s(\theta))$ , which can be expressed as the sum of the status quo profit  $\Pi^s(\theta)$  and the expected gain from a cost advantage  $\gamma(\Pi^h(\theta) - \Pi^s(\theta))$ .

Note that, similar to the first period, we could have an exogenous negative second-period shock occurring with probability  $R_2$  and leading to zero profit in that period. However, unlike the first-period shock, which will be shown to play a key role in our model, a second-period shock plays little role here, and indeed our results can be shown to hold for all  $R_2 \in [0, 1]$ . Hence, for simplicity, and without loss of generality, we assume  $R_2 = 0$ .

*Entrepreneurial Participation and Effort.* Entrepreneur  $e$  affects the venture in two primary ways. First, as mentioned above, her active management is required for the venture to operate successfully. Absent the entrepreneur in period 1, the venture yields zero profit in that period. Absent the entrepreneur in period 2, the venture is liquidated and yields liquidation value  $L$ , with  $L \in (0, \Pi^s(\theta_{\max}))$ .<sup>16</sup> The entrepreneur's personal opportunity cost of remaining involved in the venture is  $\varepsilon > 0$  with  $\varepsilon \rightarrow 0$ , and she must thus expect a payoff of at least  $\varepsilon$  in period  $i$  to remain involved in the venture in that period.

The second way in which  $e$  can affect the venture is by exerting effort  $a$  at the beginning of the second period, which increases the probability  $\gamma$  of successful innovation and of decreasing the marginal cost from  $\bar{c}$  to  $\underline{c}$ .<sup>17</sup> For simplicity we assume  $\gamma = a$ , and use  $\gamma$

<sup>15</sup> In any profit function  $\Pi(\cdot, \cdot, \theta)$ , price–cost margin function  $P(\cdot, \cdot, \theta)$ , or demand function  $x(\cdot, \cdot, \theta)$ , the first argument refers to the marginal cost of the firm generating the profit under study, and the second argument refers to the rival's marginal cost. Equilibrium prices have been determined as functions of costs and substituted out of these functions.

<sup>16</sup> This condition is sufficient to ensure that liquidation is inefficient: it generates less surplus than keeping the venture as a going concern, regardless of entrepreneurial effort or degree of competition.

<sup>17</sup> We could model entrepreneurial effort in both periods rather than in the second period only. However, as will become clear below (see expression (5)), first-period profits do not affect the trade-off

<sup>13</sup> The entrepreneur has all ex ante bargaining power: there are many more financiers wishing to invest than there are good entrepreneurs (good projects to be funded).

<sup>14</sup> This negative shock is temporary in that it does not affect second-period payoffs. The case of a long-term shock that yields zero profit in the second period as well (or that conveys negative information about second-period profitability prospects) is less interesting (as discussed in Footnote 33).

to capture both entrepreneurial effort and innovation probability. Effort comes at a personal cost  $K(\gamma) = (k/2)\gamma^2$  to the entrepreneur. It is observable but not verifiable in court and thus noncontractible.

*Contractual Incompleteness and Property Rights.* Realized profits at the end of periods 1 and 2 are assumed to be observable by both parties, but not verifiable in court, and thus cannot be contracted upon.<sup>18</sup> To quote Bolton and Scharfstein (1996, p. 5), “this assumption is meant to capture the idea that managers have some ability to divert corporate resources to themselves at the expense of outside investors,” and that “such perk consumption and investment may be difficult to distinguish from appropriate business decisions and thus impossible to control through contracts.” This has two important consequences. First,  $e$  and  $f$  must bargain at the end of each period, over profit  $\Pi_1$ , and  $\Pi^h$  or  $\Pi^s$ , as they arise. Second, the contract designed at date 0 can only specify the (possibly contingent) allocation of property rights over the venture, which can be of two types. Under *entrepreneur control* ( $E$ ),  $e$  has full ownership of the venture and complete control over the assets of the venture. At the other end of the ownership spectrum, under *financier control* ( $F$ ),  $f$  owns the venture and controls the assets.

*Bank vs. Venture Capital.* Entrepreneur  $e$  can seek financing from one of two types of investors: a venture capitalist (or angel investor) or a banker. We posit that banks and venture capitalists share similarities and exhibit differences in the way in which control-right allocations affect bargaining with the entrepreneur. Financier control, for example, is likely to affect financier/entrepreneur bargaining similarly whether the financier is a bank or a venture capitalist. In both cases,  $f$  has complete control over the assets of the venture and can extract 100% of the realized profit through bargaining at the end of a period. This is consistent with Nash bargaining where, in case negotiations break down,  $f$  can simply exclude  $e$  from accessing the venture and continue to enjoy all rents. Entrepreneur  $e$  cannot interfere and gets nothing.

In contrast, we argue that entrepreneur control may lead to different bargaining outcomes under bank financing and VC financing. Under bank financing,

entrepreneur control is the converse of financier control:  $e$  has complete control over the assets of the venture and can extract 100% of realized profit through bargaining at the end of a period. In case negotiations break down during Nash bargaining,  $e$  can simply exclude  $f$  from accessing the venture and continue to enjoy all rents. Financier  $f$  cannot interfere and gets nothing.

Under VC financing, however, this bargaining outcome is unlikely to happen even under entrepreneur control. Indeed, a key characteristic of venture capitalists here is that—given their level of expertise, their social networks, and their financial resources—they may be able to extract second-period rents even when  $e$  owns the venture and controls its assets. In the second period, once the venture capitalist is familiar with the idea and its implementation, he may be in a stronger bargaining position relative to the entrepreneur because—as argued by Ueda (2004) previously—in the case of a bargaining breakdown he may be able to successfully “steal” the entrepreneur’s idea with some probability  $\lambda \in [\lambda_{\min}, 1]$  with  $\lambda_{\min} \in (0, 1)$ . In that case, as is easily shown, the Nash bargaining equilibrium split would lead the entrepreneur and the venture capitalist to obtain shares  $1 - \lambda$  and  $\lambda$  of realized profit, respectively. Indeed, even without any “stealing” by the venture capitalist, as long as he has the ability to interfere with the entrepreneur’s access to second-period rents in the case of a bargaining breakdown,<sup>19</sup> even with a small probability, then he will be able to extract a share of profit in equilibrium.<sup>20</sup>

Accordingly in what follows we assume that entrepreneurial control under bank financing leads the entrepreneur to extract 100% of realized profits in both periods, whereas under VC financing the entrepreneur extracts all realized profits in the first period, but only a fraction  $1 - \lambda$  of these realized

between bank financing and VC financing; hence neither does potential first-period entrepreneurial effort affecting these profits. To avoid unnecessary complications and keep the model as simple as possible, we do not model first-period effort explicitly here.

<sup>18</sup> The assumption of nonverifiable cash flows fits squarely within the recent literature on corporate/entrepreneurial finance, where it is commonly used. See, for example, Hart and Moore (1989, 1994, 1995), Bolton and Scharfstein (1990, 1996), Berglöf (1994), Gertner et al. (1994), Fluck (1998), Myers (2000), Bascha and Walz (2001), Dybvig and Wang (2003), Repullo and Suarez (2004), and Bettignies (2008).

<sup>19</sup> For example, suppose that in the case of a bargaining breakdown, the venture capitalist can use his clout in entrepreneurial circles and his access to related portfolio companies to interfere with the venture’s profits, and that as a result the entrepreneur ends up with only a fraction  $\eta$  of the profits she would have obtained without interference. One can easily show that, in that case, the Nash bargaining split would lead the entrepreneur and the venture capitalist to obtain shares  $1 - \lambda = (1 + \eta)/2$  and  $\lambda = (1 - \eta)/2$ , respectively.

<sup>20</sup> Note an implicit distinction between the venture capitalist and the entrepreneur. On one hand, in the case of VC financing, the venture capitalist can extract rents from the entrepreneur, even under entrepreneur control, by essentially threatening to “steal” her idea or interfere with her business in the case of a bargaining breakdown. In contrast, under bank financing, the entrepreneur cannot extract rents from the banker under financier control. The reason for this is that the entrepreneur, unlike the venture capitalist, does not have the financial resources required to credibly threaten the banker to “steal” the idea (she could not finance a new venture with the “stolen” idea), nor does she have the clout/networks to credibly interfere with the banker’s access to rents.



profits in the second period.<sup>21</sup> As we shall see below, this distinction between bank and VC financing leads to a significant trade-off between these two financing possibilities.

*Timing of the Game.* We summarize the timing of the game as follows:<sup>22</sup>

- At date 0,  $e$  makes a contractual offer to  $f$ , who is either a banker or a venture capitalist. The contract only specifies the (possibly contingent) allocation of property rights over the venture, as well as possible date 0 monetary transfers. The entrepreneur decides whether or not to manage the venture in the first period, at personal cost  $\varepsilon$ , with  $\varepsilon \rightarrow 0$ .
- At date 1, under  $e$ 's management, the venture generates monopoly profit  $\Pi_1$  with probability  $(1 - R_1)$ , and zero profit with probability  $R_1$ . Absent  $e$ , the venture generates zero profit.
- At the beginning of the second period, rival  $r$  enters the market. The entrepreneur decides whether or not to manage the venture in the second period, at personal cost  $\varepsilon$ , with  $\varepsilon \rightarrow 0$ . In the former case, she exerts innovation effort  $\gamma$ , at personal cost  $K(\gamma) = k\gamma^2/2$ .
- At date 2, under  $e$ 's management, the venture generates expected profit  $\Pi_2(\gamma, \theta)$  with probability  $1 - R_2 = 1$ . Absent  $e$ , the venture generates zero profit.

*Regularity Condition.* Throughout the paper we assume that

$$I \leq \lambda_{\min} \Pi^s(\theta_{\max}). \quad (1)$$

This is a sufficient condition to ensure that the project can be financed under VC financing for all  $\lambda \in [\lambda_{\min}, 1]$  and  $\theta \in [\theta_{\min}, \theta_{\max}]$ , and that there exists an  $R_{\max}(\theta) > 0$  such that for all  $\theta \in [\theta_{\min}, \theta_{\max}]$  bank financing is feasible if and only if (henceforth iff)  $R_1 \in [0, R_{\max}(\theta)]$ . Because our primary interest lies with the trade-off between VC financing and bank financing, we henceforth focus on situations where condition (1) holds, and refer to it where relevant.<sup>23</sup> We relax this

<sup>21</sup> We assume that the venture capitalist can extract a fraction  $\lambda$  of realized profits even under entrepreneur control, but only in the second period. This assumption is made to capture the idea, important in our view, that it requires learning about the venture before the venture capitalist can gain real bargaining power over the entrepreneur, and for analytical simplicity. All results of the model continue to hold if we assume the venture capitalist can extract  $\lambda$  in both periods rather than in the second period only.

<sup>22</sup> Our model shares some of the model timing elements, as well as the assumptions of contractual incompleteness and entrepreneurial effort, with Bettignies (2008). Despite these similarities, the two models differ significantly. Bettignies' (2008) focus is on the effects of investor cost of capital and entrepreneur-investor effort complementarity on an entrepreneur's optimal contracting environment. It cannot address issues of venture risk and competition that are central to this paper, nor does it examine specifically the entrepreneur's choice between bank and VC financing.

<sup>23</sup> If parameter  $I$  is such that only one type of financing is feasible, the financing decision problem becomes exceedingly simple and obviously less interesting.

regularity condition in §A.4 in the appendix and show that the main results of the model continue to hold.

*First-Best Benchmark.* We consider the first-best scenario where the entrepreneur is not wealth constrained and can finance the venture herself. Proceeding by backward induction, we find that in the second period, if she actively manages the venture, she exerts effort  $\gamma_{FB}$  to maximize her expected payoff  $\Pi_2(\gamma, \theta) - k\gamma^2/2 = \Pi^s(\theta) + \gamma[\Pi^h(\theta) - \Pi^s(\theta)] - k\gamma^2/2$ , yielding first-best effort  $\gamma_{FB}(\theta) = [\Pi^h(\theta) - \Pi^s(\theta)]/k$ . Her equilibrium expected payoff,  $\Pi_2(\gamma_{FB}(\theta), \theta) - k[\gamma_{FB}(\theta)]^2/2$  is larger than  $\varepsilon + L$ ,<sup>24</sup> and anticipating this she chooses to be actively involved in the venture in the first place. In the first period, her expected payoff  $\bar{\Pi}_1$  is also larger than her cost  $\varepsilon$  of managing the venture, and hence she chooses to be actively involved in the venture in that period. Thus, from a date 0 point of view,  $e$ 's expected payoff, and the first-best total surplus created, can be expressed as

$$U_{FB}(\theta) = \bar{\Pi}_1 + V_{FB}(\theta) - I, \quad \text{with} \\ V_{FB}(\theta) = \Pi_2(\gamma_{FB}(\theta), \theta) - k[\gamma_{FB}(\theta)]^2/2, \quad (2)$$

where  $V_{FB}(\theta)$  captures the venture's (expected) continuation surplus in the second period. Regularity condition (1) ensures that the venture is worth financing in the first-best scenario.<sup>25</sup>

## 4. Optimal Financing Choice

We now turn to bank financing and VC financing and examine how these sources of capital compare to the first-best benchmark and to each other.

### 4.1. Bank Financing

The entrepreneur has two control-rights allocations available to design the optimal contract for the financier/banker: under financier control in period  $i$ ,  $i = 1, 2$ ,  $e$  anticipates that end-of-period bargaining will result in  $f$  extracting all rents, and in her getting nothing. This zero expected payoff is less than her opportunity cost  $\varepsilon$  of actively managing the venture, and accordingly she decides not to remain involved in the venture during that period.

Under entrepreneurial control, in contrast,  $e$  anticipates that end-of-period bargaining will result in

<sup>24</sup> We know from  $e$ 's maximization program that her equilibrium expected payoff in the second period is strictly larger than  $\Pi^s(\theta)$ , which itself is larger than  $\varepsilon + L$ .

<sup>25</sup> To see this, note that  $V_{FB}(\theta) = \Pi_2(\gamma_{FB}(\theta), \theta) - k[\gamma_{FB}(\theta)]^2/2 \geq \Pi^s(\theta)$  for any given  $\theta \in [\theta_{\min}, \theta_{\max}]$ . This is because  $e$  could generate a payoff  $\Pi^s(\theta)$  if she chose effort  $\gamma = 0$ , and must thus do at least as well by choosing equilibrium effort  $\gamma_{FB}(\theta)$ . Moreover, as discussed below in §5, symmetric profit  $\Pi^s(\theta)$  is decreasing in the degree of competition, and hence  $\Pi^s(\theta) \geq \Pi^s(\theta_{\max})$  for all  $\theta \in [\theta_{\min}, \theta_{\max}]$ . From these two points, it follows directly that  $V_{FB}(\theta) \geq \Pi^s(\theta_{\max}) > I$ , which in turn implies  $U_{FB}(\theta) \geq 0$  for all  $\theta \in [\theta_{\min}, \theta_{\max}]$ .



her extracting all rents, as in the first-best scenario described above. Thus, entrepreneurial control in period  $i$ ,  $i = 1, 2$  leads to the first-best outcome in that period. In period 2,  $e$  chooses to be actively involved in the management of the venture, exerts the first-best effort  $\gamma_b(\theta) = [\Pi^h(\theta) - \Pi^s(\theta)]/k = \gamma_{FB}(\theta)$ , and generates equilibrium expected payoff  $\Pi_2(\gamma_b(\theta), \theta) - k[\gamma_b(\theta)]^2/2$ . In period 1,  $e$  also chooses to be actively involved in the management of the venture, generating expected payoff  $\bar{\Pi}_1$  in that period.

Following Hart and Moore (1989) and Bolton and Scharfstein (1990, 1996), we know that in a framework with these two feasible control allocations, the optimal “pure strategy”<sup>26</sup> contract for  $e$  to offer to  $f$  is a simple debt contract, which specifies at date 0 the debt repayment  $D$  to be made at date 1. If  $e$  pays  $D$  to  $f$  at date 1, she retains full control in period 2. On the other hand, if  $e$  does not repay  $D$  at date 1,  $f$  obtains full control over the venture.

If the negative shock does not occur in period 1 and the venture generates profit  $\Pi_1$ ,  $e$  faces two options at date 1. First, she can repay  $D$  and retain control over the venture in period 2. In that case, as mentioned she exerts effort  $\gamma_b(\theta)$ , and generates expected second-period continuation surplus  $V_b(\theta) = \Pi_2(\gamma_b(\theta), \theta) - k[\gamma_b(\theta)]^2/2$ . Alternatively, she can strategically default (see, e.g., Bolton and Scharfstein 1990). Doing so would lead to renegotiation since financier control and the ensuing liquidation yield a lower payoff ( $L$ ) than entrepreneur control, and  $e$ 's payoff in that case would depend on the outcome of renegotiation. Without loss of generality we assume that  $f$  has full bargaining power in renegotiation following a default<sup>27</sup> and requires payment  $D_{\max}(\theta) = V_b(\theta)$  from  $e$  in exchange for letting her retain venture control. Anticipating this,  $e$  makes debt repayment  $D$  at date 1 if  $D \leq V_b(\theta)$  but would default and renegotiate if  $D > V_b(\theta)$ .

In contrast, if the negative shock does occur in period 1,  $e$  gets no cash and must default at date 1. As a result,  $f$  takes control over the assets at that time, and  $e$  quits the venture, and this in turn leads to liquidation payoff  $L$ . (There can be no scope for renegotiation here since  $L > 0$  implies that  $f$  is strictly better off with venture control than without, and  $e$  has no cash with which to renegotiate.)

<sup>26</sup> For expositional simplicity, we focus on “pure strategy” contracts where an allocation of control is assigned with probability 0 or 1 contingent on debt repayment or default. In the online supplement to this paper, we allow for “mixed strategy” debt contracts whereby  $e$  retains control with probability  $\beta_D$  if she repays the debt, and with probability  $\beta_0$  if she does not. The main results of the model continue to hold.

<sup>27</sup> The main results of our model do not depend on the allocation of bargaining power in renegotiation and indeed would continue to hold under alternative bargaining allocations. See discussion in §A.4 in the appendix.

Naturally, at date 0  $f$  foresees that he will get at most  $V_b(\theta)$  in the good state and  $L$  in the bad state. Thus bank financing will be feasible only if  $L \leq (1 - R_1)V_b(\theta) + R_1L$ , or  $R_1 \leq R_{\max}(\theta)$  with  $R_{\max}(\theta) = (V_b(\theta) - L)/(V_b(\theta) - L)$ . Regularity condition (1) ensures that  $R_{\max}(\theta) > 0$  for all  $\theta \in [\theta_{\min}, \theta_{\max}]$ .<sup>28</sup>

Since  $e$  has full bargaining power at date 0, she sets  $D$  so that she extracts all rents from  $f$ , i.e., such that  $(1 - R_1)D + R_1L - I = 0$ , for all  $R_1 \leq R_{\max}(\theta)$ . Accordingly, from a date 0 point of view,  $e$ 's expected payoff from bank financing is the total surplus generated by the venture under that type of financing:

$$U_b(\theta) = \bar{\Pi}_1 + (1 - R_1)V_b(\theta) + R_1L - I, \quad \text{with} \quad (3)$$

$$V_b(\theta) = \Pi_2(\gamma_b(\theta), \theta) - k[\gamma_b(\theta)]^2/2.$$

Thus, absent a negative shock in the first period, bank financing is efficient: it enables  $e$  to retain full control over the venture and generates first-best entrepreneurial effort  $\gamma_b(\theta) = \gamma_{FB}(\theta)$  and in turn first-best continuation surplus  $V_b(\theta) = V_{FB}(\theta)$ . On the other hand, with probability  $R_1$  a negative shock does occur in the first period, and this leads to inefficiency: although this shock is temporary and does not signal anything about the prospects of the venture in the second period, it leads to the inefficient liquidation of a venture which should instead—in a first-best world—continue business as usual in the second period. More formally, the inefficiency associated with bank financing can be expressed as  $U_{FB}(\theta) - U_b(\theta) = R_1[V_b(\theta) - L]$ .<sup>29</sup>

We summarize the foregoing results in the following proposition.

**PROPOSITION 1.** *Conditional on short-term venture success, bank financing generates first-best entrepreneurial effort  $\gamma_b(\theta) = \gamma_{FB}(\theta)$  and continuation surplus  $V_b(\theta) = V_{FB}(\theta)$ . On the other hand, conditional on short-term failure—even when this failure is temporary and uninformative about long-term prospects—bank financing leads to inefficient liquidation of the venture at date 1.*

<sup>28</sup> As demonstrated in Footnote 25,  $V_b(\theta) = V_{FB}(\theta) > \Pi^s(\theta_{\max})$ . Together with our condition that  $L < \Pi^s(\theta_{\max})$ , this implies  $V_b(\theta) > L$ , and together with regularity condition (1) this implies  $V_b(\theta) > I$ . From this it immediately follows that  $R_{\max}(\theta) > 0$  for all  $\theta \in [\theta_{\min}, \theta_{\max}]$ .

<sup>29</sup> Note that these characteristics of bank financing are similar to the classic models of debt mentioned above (Hart and Moore 1989; Bolton and Scharfstein 1990, 1996). Here, however, second-period profits are driven by endogenous efforts, and (as shall become clear in §§4.3 and 5.2) this will play a crucial role in the analysis of the trade-off between bank financing and VC financing, and of the effects of product market competition, neither of which were examined in these prior models.

## 4.2. VC Financing

With VC financing, the entrepreneur again has two control-rights allocations available to design the optimal contract: financier control in period  $i$ ,  $i = 1, 2$ , yields the same outcome as that under bank financing:  $e$  anticipates getting nothing in end-of-period renegotiation and decides not to remain involved in the venture during that period.

Entrepreneurial control, on the other hand, is different with VC financing. In period 2,  $e$  anticipates that end-of-period bargaining will result in her extracting a fraction  $1 - \lambda$  of the rents. If she manages the venture, she exerts effort  $\gamma_{vc}$  to maximize her expected payoff  $(1 - \lambda)\Pi_2(\gamma, \theta) - k\gamma^2/2 = (1 - \lambda)[\Pi^s(\theta) + \gamma[\Pi^h(\theta) - \Pi^s(\theta)]] - k\gamma^2/2$ . She has lower effort incentives than under entrepreneurial control with bank financing, since she anticipates extracting a fraction  $(1 - \lambda)$ , rather than 100%, of the rents and thus exerts a second-best effort:

$$\gamma_{vc}(\theta) = (1 - \lambda) \frac{\Pi^h(\theta) - \Pi^s(\theta)}{k} < \gamma_{FB}(\theta).$$

Her equilibrium expected payoff,

$$(1 - \lambda)\Pi_2(\gamma_{vc}(\theta), \theta) - \frac{k[\gamma_{vc}(\theta)]^2}{2},$$

is larger than  $\varepsilon + (1 - \lambda)L$  (for reasons provided in Footnote 24), and anticipating this she chooses to remain actively involved in the venture in that period. In period 1, again her expected payoff  $\bar{\Pi}_1$  is larger than her cost  $\varepsilon$  of managing the venture, and she remains actively involved.

Entrepreneurial control enables  $e$  to commit to return some rents to the venture capitalist through bargaining at the end of period 2. In this environment, it follows directly that it is optimal for  $e$  to offer the following contract to the venture capitalist: entrepreneurial control in both periods regardless of the state of the world and a payment  $I + T$  from the venture capitalist to the entrepreneur at date 0, with  $T \geq 0$  chosen so as to leave no ex ante rents to the financier (i.e., such that  $\lambda\Pi_2(\gamma_{vc}(\theta), \theta) - I - T = 0$ ). Since  $e$  can use date 0 transfer  $T$  to extract all ex ante rents, her contractual objective is to maximize total surplus. Additionally, since entrepreneurial control leads to more effort—and hence, ceteris paribus, to more profit—than investor control, it is optimal to assign entrepreneurial control regardless of the state of the world.<sup>30</sup>

<sup>30</sup> In the online supplement to this paper, we examine an extension of the main model where the venture capitalist exerts effort as well. In that case the optimal allocation of control rights depends on the efficiency of  $e$  relative to  $f$ . Indeed, if the venture capitalist is sufficiently more efficient than  $e$  in exerting effort, giving control rights to him may, by increasing his incentives, generate more surplus than giving control rights to  $e$ . In that case  $e$  may do just that: she may sell the venture to the venture capitalist.

Note that the maximum gross payoff that  $f$  can expect to get under VC financing is  $\lambda\Pi_2(\gamma_{vc}(\theta), \theta)$ . Hence VC financing is feasible iff  $I \leq \lambda\Pi_2(\gamma_{vc}(\theta), \theta)$ . Regularity condition (1) ensures that VC financing is feasible for all  $\lambda \in [\lambda_{\min}, 1]$  and all  $\theta \in [\theta_{\min}, \theta_{\max}]$ .<sup>31</sup>

From a date 0 point of view,  $e$ 's expected payoff from VC financing is the total surplus generated by the venture under that type of financing:

$$\begin{aligned} U_{vc}(\theta) &= \bar{\Pi}_1 + V_{vc}(\theta) - I, \quad \text{with} \\ V_{vc}(\theta) &= \Pi_2(\gamma_{vc}(\theta), \theta) - k[\gamma_{vc}(\theta)]^2/2, \end{aligned} \quad (4)$$

where  $V_{vc}(\theta)$  captures the venture's continuation surplus in the second period.

As mentioned above, anticipating she will have to share rents with the venture capitalist mutes  $e$ 's incentives, leading to second-best entrepreneurial effort  $\gamma_{vc}(\theta) < \gamma_{FB}(\theta)$  and, in turn, to second-best continuation surplus  $V_{vc}(\theta) < V_{FB}(\theta)$ . On the positive side, however, the venture capitalist's bargaining power and rent extraction ability serve as commitment devices for  $e$  to return some of the rents to  $f$ , which in turn enables  $e$  to finance the venture without resorting to debt and facing the associated liquidation inefficiencies discussed above. More formally, the inefficiency associated with VC financing can be expressed as  $U_{FB}(\theta) - U_{vc}(\theta) = V_{FB}(\theta) - V_{vc}(\theta)$ .

We summarize the foregoing results in the following proposition.

**PROPOSITION 2.** *Under VC financing, short-term venture failure, resulting from a negative first-period shock, has no lasting impact on the venture, which continues to operate in the second period regardless. On the other hand, VC financing generates second-best entrepreneurial effort  $\gamma_{vc}(\theta) < \gamma_{FB}(\theta)$  and continuation surplus  $V_{vc}(\theta) < V_{FB}(\theta)$ .*

Importantly, although in our model an equity contract per se would not yield any payoff to the investor (since by assumption cash flows are not verifiable), under VC financing, even when the entrepreneur retains overall control of the venture, the venture capitalist is still able to extract a stream of payoffs—a fraction  $\lambda$  of profit—that is similar to the one typically obtained in a standard voting equity contract. Indeed the contract offered to the venture capitalist is in effect an “equity-type” contract.

In practice, VC contracts include both control rights and cash flow rights (Kaplan and Strömberg 2003). Cash flow rights do have a role in practice because profits are *verifiable to some extent*. They are not perfectly verifiable, however, in that entrepreneurs have the ability to divert some, if not all, of the cash flows. Indeed, that is an important reason why control rights are also used in VC contracts: they complement cash

<sup>31</sup> This follows directly from the logic used in Footnote 25.

flow rights, controlling opportunistic behavior by the entrepreneur. In this model, we assume that profits are *not verifiable at all*.<sup>32</sup> In doing so, we focus on control rights and on end-of-period bargaining, rather than on the cash flow rights, and this enables us to introduce an equity-like contract in the model (similar to equity contracts observed in practice), all the while keeping our assumption of nonverifiability of cash flows necessary for debt to emerge as optimal under bank financing. The modeling of equity financing under the assumption of non-verifiability of cash flows is neither novel nor specific to this paper. See, for example, Fluck (1998), Myers (2000), and Dybvig and Wang (2003).

#### 4.3. Financing Trade-off

Comparing  $e$ 's expected payoffs, it is easy to see that she chooses bank financing over VC financing iff

$$U_b(\theta) - U_{vc}(\theta) \geq 0, \\ \text{iff } [V_b(\theta) - V_{vc}(\theta)] - R_1[V_b(\theta) - L] \geq 0. \quad (5)$$

Expression (5) yields two key results. First, it illustrates the main trade-off between bank financing and VC financing.

**PROPOSITION 3.** *The entrepreneur's financing trade-off is the following: on the upside, bank financing leads to a larger continuation surplus than VC financing,  $V_b(\theta) > V_{vc}(\theta)$ . On the downside, with probability  $R_1$ , a negative shock occurs that prevents continuation under bank financing but not under VC financing.*

The intuition follows directly from Propositions (1) and (2): conditional on repaying the debt, bank financing enables  $e$  to retain full access to the venture's rents, giving her first-best effort incentives and yielding a surplus larger than what could be obtained under VC financing, where rent sharing mutes entrepreneurial incentives. On the other hand, in the event of a negative short-term shock, lack of cash flow prevents the repayment of bank debt, leading to inefficient liquidation—an inefficiency that does not arise under VC financing.<sup>33</sup>

<sup>32</sup> In the online supplement to this paper, we examine an extension to the main model where venture capitalists can verify cash flows with some probability. We show that the main results of the model continue to hold in that case.

<sup>33</sup> Note that if the negative first-period shock were not temporary and instead led to zero profits in the second period as well as in the first period, the trade-off between bank financing and VC financing would become exceedingly simple and much less interesting. Following a negative shock, the prospects of future profits would disappear and the venture would be liquidated regardless of the financing choice. In that case, bank financing has no inefficient liquidation disadvantage relative to VC financing but retains its incentive advantage and thus unambiguously dominates VC financing.

The second key result emerging from expression (5) is that there exists a threshold level of venture risk  $R_1$ , denoted  $R_1^*(\theta) = [V_b(\theta) - V_{vc}(\theta)]/[V_b(\theta) - L]$ , such that

$$U_b(\theta) - U_{vc}(\theta) \geq 0 \quad \text{iff} \quad R_1 \leq R_1^*(\theta). \quad (6)$$

We state this result in the following proposition.

**PROPOSITION 4.** *There exists a threshold level of venture risk  $R_1^*(\theta) = [V_b(\theta) - V_{vc}(\theta)]/[V_b(\theta) - L]$ , such that the entrepreneur's optimal financing choice is bank financing if  $R_1 \leq R_1^*(\theta)$ , and VC financing otherwise.*

Intuitively, for relatively risky ventures (i.e., ventures with a relatively high probability of failure ( $R_1 > R_1^*(\theta)$ ) but a relatively high profit  $\Pi_1(R_1)$  in case of success), bank financing is not optimal, because the advantage of this type of financing in terms of continuation incentives is more than offset by the risk of liquidation associated with short-term failure. VC financing, which is not subject to this liquidation risk, is preferred in that case. Conversely, for relatively safe ventures (i.e., ventures with a relatively low probability of failure ( $R_1 \leq R_1^*(\theta)$ ) but a relatively low profit  $\Pi_1(R_1)$  in case of success), bank financing makes sense because the downside risk of liquidation is relatively low relative to the upside continuation potential associated with high incentives.

Note that regularity condition (1) ensures that bank financing is always feasible at the venture risk threshold  $R_1^*(\theta)$ . In other words, it ensures that  $R_1^*(\theta) < R_{\max}(\theta)$  for all  $\theta \in [\theta_{\min}, \theta_{\max}]$ .<sup>34</sup>

## 5. Product Market Competition

In his classic work on sunk costs and market structure, Sutton (1992, p. 9) argued that for a given concentration level “such features of the market as the physical nature of the product (homogeneous versus differentiated products) and the climate of competition policy (a strict or acquiescent approach to price coordination by firms)” will affect *toughness of competition in the industry*. Many of the workhorse models of competition used in the industrial organization literature today are consistent with that view: a decrease in the transport cost  $t$  on a Hotelling (1929) line or a

Similarly, if the negative first-period shock were to convey negative information about second-period prospects, this would have no impact under bank financing (where liquidation occurs whether or not this information is present) but would reduce expected payoffs under VC financing. It would therefore tilt the trade-off in favor of bank financing.

<sup>34</sup> Strict bank financing feasibility at  $R_1^*(\theta)$  requires  $I < (1 - R_1^*(\theta))V_b(\theta) + R_1^*(\theta)L$ , which simplifies to  $I < V_{vc}(\theta)$ . (Equivalently, one can verify that  $R_1^*(\theta) < R_{\max}(\theta)$  iff  $I < V_{vc}(\theta)$ .) Using logic similar to that of Footnote 25, one can readily verify that  $V_{vc}(\theta) > \lambda_{\min}\Pi^*(\theta_{\max})$ . Together with condition (1), this implies  $I < V_{vc}(\theta)$  for all  $\theta \in [\theta_{\min}, \theta_{\max}]$ .



Salop (1979) circle, a decrease in the variance of errors in a logit model, or an increase in the constant elasticity of substitution in a Dixit–Stiglitz framework (Dixit and Stiglitz 1977), for example, all capture an increase in the degree of homogeneity across products. In this paper as well we use the degree of homogeneity across products as our main measure of competition  $\theta$ .<sup>35</sup> Rather than focusing on a particular demand specification, however, we highlight commonalities across specifications and show that because of these commonalities, under these various demand frameworks, competition has qualitatively similar effects in our model.

### 5.1. Status Quo Profit and the Value of Cost Advantage

In this section we highlight two characteristic effects of competition that are common to the Hotelling line, Salop circle, Dixit–Stiglitz, logit, and Cournot-to-Bertrand switch demand specifications, namely a reduction in the status quo profit  $\Pi^s(\theta)$  and an increase in the value of a cost advantage  $\Pi^h(\theta) - \Pi^s(\theta)$ . In the next section we use these simple results to explain why competition increases the overall appeal of bank financing relative to VC financing.

**5.1.1. Status Quo Profit.** Generated when the venture has failed to innovate and faces the same marginal cost  $\bar{c}$  as the entrant, status quo profit can be expressed as the product of markup and demand:  $\Pi(\bar{c}, \bar{c}, \theta) = P(\bar{c}, \bar{c}, \theta)x(\bar{c}, \bar{c})$ , where  $P(\bar{c}, \bar{c}, \theta)$  represents the markup and  $x(\bar{c}, \bar{c})$  represents demand. The only effect of competition here is to lower equilibrium prices. Intuitively, as the degree of homogeneity across products increases, consumers become more sensitive to prices, putting downward pressure on prices and in turn on markups:  $dP(\bar{c}, \bar{c}, \theta)/d\theta < 0$ . Since  $e$ 's venture and the entrant have identical costs, equilibrium prices are identical in both firms, and the two rivals share the market equally regardless of the degree of competition:  $x(\bar{c}, \bar{c}) = 1/2$ . Accordingly, the overall impact of competition on the status quo profit is  $d\Pi(\bar{c}, \bar{c}, \theta)/d\theta = (dP(\bar{c}, \bar{c}, \theta)/d\theta)x(\bar{c}, \bar{c}) < 0$ .

**5.1.2. Value of a Cost Advantage.** This is the difference between profit obtained when the venture successfully innovates and gains a cost advantage over the entrant, and the status quo profit:  $\Pi(\underline{c}, \bar{c}, \theta) - \Pi(\bar{c}, \bar{c}, \theta) = P(\underline{c}, \bar{c}, \theta)x(\underline{c}, \bar{c}, \theta) - P(\bar{c}, \bar{c}, \theta)x(\bar{c}, \bar{c})$ . The main effect of competition here works through demand: again, in markets with more homogeneous products, consumers become more sensitive to prices,

and the cost-leading venture (in the event of successful innovation), which charges a lower equilibrium price than the higher-cost entrant, increases its demand advantage over its rival. By increasing demand for the venture when it gains a cost advantage, competition increases the value of gaining such a cost advantage.

As discussed above in the analysis of the status quo profit, competition also puts downward pressure on prices. However, this affects profit whether or not the innovation takes place, and the net effect on the value of innovation is, if not negligible, always dominated by the first-order demand effect just described. Thus, overall competition unambiguously increases the value of a cost advantage:

$$\begin{aligned} & \frac{d[\Pi(\underline{c}, \bar{c}, \theta) - \Pi(\bar{c}, \bar{c}, \theta)]}{d\theta} \\ &= \frac{dx(\underline{c}, \bar{c}, \theta)}{d\theta} P(\underline{c}, \bar{c}, \theta) \\ &+ \left[ \frac{dP(\underline{c}, \bar{c}, \theta)}{d\theta} x(\underline{c}, \bar{c}, \theta) - \frac{dP(\bar{c}, \bar{c}, \theta)}{d\theta} x(\bar{c}, \bar{c}) \right] > 0. \end{aligned}$$

Indeed, we show in the appendix that these effects of competition on the status quo profit and on the value of innovation hold under all of demand specifications listed below.

**LEMMA 1.** *Under demand specifications such as the Hotelling line, Salop circle, Dixit–Stiglitz, logit, and Cournot-to-Bertrand switch, competition unambiguously reduces the status quo profit,  $d\Pi^s(\theta)/d\theta < 0$ , and unambiguously increases the value of a cost advantage,  $d[\Pi^h(\theta) - \Pi^s(\theta)]/d\theta > 0$ .*

### 5.2. Effects of Competition on the Financing Trade-off

Consider a product market where the degree of competition is initially  $\theta_0$  and a venture with risk  $R_1^0 = R_1^*(\theta_0)$ . We know from Propositions 3 and 4 that, at that threshold risk level, the upside of bank financing over VC financing—the gain  $V_b - V_{vc}$  in continuation surplus—is exactly offset by the downside  $R_1^*[V_b - L]$  of bank financing; and accordingly, the entrepreneur is indifferent between the two types of financing. In what follows we show that competition unambiguously increases the appeal of bank financing over VC financing: a marginal entrepreneur initially indifferent between the two types of financing will begin to strictly prefer bank financing as competition intensifies.

Using (3) and (4), we can express the continuation surplus under financing of type  $j$ ,  $j = b, vc$ , as  $V_j(\theta) = \Pi^s(\theta) + \gamma_j(\theta)[\Pi^h(\theta) - \Pi^s(\theta)] - k[\gamma_j(\theta)]^2/2$ .

<sup>35</sup> Another common measure of competition is the number of competitors. We consider this in an extension to the main model in the online supplement to this paper. The main results of the model continue to hold.



Differentiating  $V_b(\theta)$  and  $V_{vc}(\theta)$ , and using the envelope theorem, we obtain

$$\begin{aligned}\frac{dV_b(\theta)}{d\theta} &= \frac{d\Pi^s(\theta)}{d\theta} + \gamma_b(\theta) \frac{d[\Pi^h(\theta) - \Pi^s(\theta)]}{d\theta}, \\ \frac{dV_{vc}(\theta)}{d\theta} &= \frac{d\Pi^s(\theta)}{d\theta} + \gamma_{vc}(\theta) \frac{d[\Pi^h(\theta) - \Pi^s(\theta)]}{d\theta} \\ &\quad + \lambda \frac{d\gamma_{vc}}{d\theta} [\Pi^h(\theta) - \Pi^s(\theta)].\end{aligned}\quad (7)$$

Competition affects continuation surpluses in the two ways described above. It reduces the status quo profit  $\Pi^s(\theta)$ , which has a negative impact on  $V_j(\theta)$ , and it increases the value of a cost advantage  $\Pi^h(\theta) - \Pi^s(\theta)$ , which has a positive, direct impact on  $V_j(\theta)$ . This latter effect also increases entrepreneurial effort  $\gamma_j$ . Which, as shown in §4, is an increasing function of  $\Pi^h(\theta) - \Pi^s(\theta)$ ; under VC financing this effort increase has a positive effect on the continuation surplus (under bank financing, this effect can be shown to be null by the envelope theorem).<sup>36</sup>

**5.2.1. Competition and the Upside of Bank Financing.** Subtracting  $dV_{vc}(\theta)/d\theta$  from  $dV_b(\theta)/d\theta$ , one can readily establish that the upside  $V_b(\theta) - V_{vc}(\theta)$  of bank financing over VC financing is strictly increasing in competition:

$$\begin{aligned}\frac{d[V_b(\theta) - V_{vc}(\theta)]}{d\theta} &= [\gamma_b(\theta) - \gamma_{vc}(\theta)] \frac{d[\Pi^h(\theta) - \Pi^s(\theta)]}{d\theta} \\ &\quad - \frac{d\gamma_{vc}}{d\theta} \lambda [\Pi^h(\theta) - \Pi^s(\theta)] > 0.\end{aligned}\quad (8)$$

The main intuition for this result comes from the first factor in (8): competition increases the value of a cost advantage  $\Pi^h(\theta) - \Pi^s(\theta)$ , and this increase has a larger effect on the continuation surplus under bank financing because it occurs with a higher probability ( $\gamma_b(\theta) > \gamma_{vc}(\theta)$ ). Another way to explain this is to point out that competition increases the marginal product of effort  $\Pi^h(\theta) - \Pi^s(\theta)$ , and that the impact on the continuation surplus is larger under bank financing, where superior entrepreneurial incentives lead to greater equilibrium effort. The second factor, increased entrepreneurial effort under VC financing, works the other way but can readily be shown to be of second-order importance relative to the first factor for all  $\lambda \in [\lambda_{\min}, 1]$ .<sup>37</sup> Indeed the upside of bank

financing over VC financing is strictly increasing in  $\theta$ :  $d[V_b(\theta) - V_{vc}(\theta)]/d\theta > 0$ .

**5.2.2. Competition and the Overall Appeal of Bank Financing Relative to VC Financing.** Let us start by using (7) to express the effects of competition on the downside of bank financing  $R_1^*(\theta_0)[V_b(\theta) - L]$  as follows:

$$\begin{aligned}R_1^*(\theta_0) \frac{dV_b(\theta)}{d\theta} \\ = R_1^*(\theta_0) \left[ \frac{d\Pi^s(\theta)}{d\theta} + \gamma_b(\theta) \frac{d[\Pi^h(\theta) - \Pi^s(\theta)]}{d\theta} \right].\end{aligned}\quad (9)$$

On one hand, the positive effect of competition on the value of a cost advantage  $\Pi^h(\theta) - \Pi^s(\theta)$  has a positive impact on continuation surplus  $V_b(\theta)$  and on the downside of bank financing. Most importantly, however, competition reduces the status quo profit  $\Pi^s(\theta)$ , which has a negative effect on the continuation surplus and the downside of bank financing. As shown in the appendix, under some demand specifications (e.g., Hotelling or Salop duopoly) this latter effect strictly dominates the former for all  $\theta \in [\theta_{\min}, \theta_{\max}]$ , and competition unambiguously reduces the downside of bank financing. At the very least, this negative latter effect significantly weakens the strength of the former effect, ensuring that the overall impact of competition on the downside of bank financing, regardless of its sign, is always strictly dominated by its positive effect on the upside of bank financing. Proposition 5 then follows immediately.

**PROPOSITION 5.** *Competition increases the appeal of bank financing relative to VC financing.*

At a given degree of competition  $\theta_0$ , the marginal entrepreneur managing a venture associated with risk  $R_1^*(\theta_0)$ , who is indifferent between the two types of financing, will begin to strictly prefer bank financing over VC financing if competition intensifies. Equivalently, the threshold risk level  $R_1^*(\theta)$  at which the entrepreneur remains indifferent between the two financing types will increase with competition, as will the domain of risk  $R_1$  over which the entrepreneur chooses bank financing over VC financing.

This result works primarily through the effect of competition on the upside of bank financing, and the intuition for this important result, which comes from two key elements of the model, is worth reiterating here. First, in allowing the entrepreneur to keep full control of the venture in continuation and full access to ex post profit, bank financing yields stronger entrepreneurial incentives and higher effort in continuation than VC financing. Second, under the various demand specifications examined in this paper, competition increases the value of a cost advantage, and the impact of this increase on the continuation surplus is greater under bank financing,

<sup>36</sup> As discussed above, competition increases the value of gaining a cost advantage, and this in turn increases the entrepreneur's incentive to lower cost and her equilibrium effort level. This is similar to the positive "escape competition effect" of competition on incentives highlighted previously by Aghion et al. (2005).

<sup>37</sup> The second factor in (8) can easily be rewritten as

$$\lambda(1 - \lambda) \gamma_b(\theta) \frac{d[\Pi^h(\theta) - \Pi^s(\theta)]}{d\theta},$$

whereas the first factor can be expressed as  $\lambda \gamma_b(\theta) \frac{d[\Pi^h(\theta) - \Pi^s(\theta)]}{d\theta}$ . Clearly the latter is strictly larger than the former for all  $\lambda \in [\lambda_{\min}, 1]$ .

where the probability of gaining such a cost advantage (i.e., entrepreneurial effort) is greater. In that way competition increases the upside of bank financing ( $d[V_b(\theta) - V_{vc}(\theta)]/d\theta > 0$ ) and the overall appeal of bank financing over VC financing.

Note that the conditions of Lemma 1—that competition reduces the status quo profit ( $d\Pi^s(\theta)/d\theta < 0$ ) and increases the value of a cost advantage ( $d[\Pi^h(\theta) - \Pi^s(\theta)]/d\theta > 0$ )—are sufficient to generate Proposition 5.<sup>38</sup> This key result is thus robust to any demand specification satisfying these two conditions.

## 6. Empirical Implications

Our model yields several empirical predictions, which we describe and discuss below.

**PREDICTION 1.** *Absent negative shocks in the short term, bank financing provides stronger entrepreneurial incentives and superior effort and performance. In the case of negative short-term shock, it is VC financing that provides stronger entrepreneurial incentives and superior effort and performance.*

This prediction is a corollary to Propositions 1 and 2 and highlights a simple trade-off between entrepreneurial incentives and inefficient liquidation affecting the choice between bank financing and VC financing. It has three implications. First, it rests on the ideas that stronger incentives lead to superior entrepreneurial effort and that in turn higher entrepreneurial effort increases venture performance. This is indeed consistent with the recent work of Bitler et al. (2005), who use unique data on entrepreneurial effort and wealth in privately held firms to examine the connection between entrepreneurial incentives, effort, and venture performance. They find that entrepreneurial effort, measured by hours worked, responds positively to incentives and that it has a positive impact on venture performance.

The second implication is that bank financing yields stronger entrepreneurial incentives following short-term success. In our opinion this implication makes good sense: conditional on short-term success, under bank financing the entrepreneur can repay her debt and retain 100% of all subsequent profit and hence has “first-best” incentives, certainly stronger incentives than under VC financing where she must inevitably relinquish a significant fraction of profit to the venture capitalist.<sup>39</sup>

<sup>38</sup> Moreover, these conditions are not necessary for our results to hold. We show in an extension to the main model in the online supplement to this paper that Proposition 5 holds even under demand specifications where the conditions of Lemma 1 are not satisfied.

<sup>39</sup> In practice, even if the entrepreneur has not yet repaid the debt entirely, as long as short-term success ensures a small probability of default in the future, she essentially retains first-best incentives.

The third implication is that VC financing generates stronger incentives following short-term failure, because the entrepreneur retains access to at least some fraction of profit, unlike under bank financing where following default the entrepreneur loses control of the venture. It might be surprising at first sight that the venture capitalist does not liquidate or exit the venture following short-term failure, although evidence suggests that venture capitalists are aggressive in that regard (e.g., Kaplan and Strömberg 2003). Our goal here is to capture what we view as a compelling *distinction* between debt contracts and equity-type contracts,<sup>40</sup> namely that even a firm with good long-term prospects is more likely to fail under bank financing, where for instance temporary cash flow shortages might be enough to trigger default and liquidation, than under VC financing, where such inefficient liquidations would not occur.<sup>41</sup> This is consistent with the recent empirical work of Puri and Zarutskie (2012), which suggests that VC-financed ventures are less likely to shut down, and have lower profit when they do shut down, than similar non-VC-backed ventures.

**PREDICTION 2.** *Relatively risky ventures should be financed with venture capital, and relatively safe ventures should be financed by banks.*

This prediction is a corollary to Proposition 4 and can be explained easily: ventures that are more sensitive to exogenous shocks are more likely to have to default on bank debt and face liquidation, even when cash flow problems are temporary. This raises the expected cost of bank financing relative to VC financing, which is immune to such inefficient liquidation. Thus, the model yields a prediction that is consistent with, and an intuitive explanation for, the first key empirical result discussed in §2, namely that riskier ventures are more likely to be VC-financed than bank-financed.

Note that in the main model we have assumed that there are no negative shocks in the second

<sup>40</sup> Recall that in our model short-term failure says nothing about the intrinsic quality of the venture; indeed both the banker and the venture capitalist know that loss of entrepreneurial control in the second period is inefficient. Although VC financing’s equity-type contract avoids the problem, bank financing’s debt contract unavoidably leads to loss of entrepreneurial control and to inefficiency.

<sup>41</sup> One could add a third state of the world at the end of period 1 where the venture would be revealed to be a total failure with no future prospects. In that case liquidation/exit would occur under both bank financing and VC financing. Even in this richer environment, our prediction would still hold: incentives following failure would remain (weakly) superior under bank financing. Thus, we feel that the complications associated with such a change would not be offset by additional insights and choose to focus on a model with only two states.

period:  $R_2 = 0$ . Suppose we now assume that negative shocks  $R_1$  and  $R_2$  can occur in periods 1 and 2, respectively: in period 1 a profit  $\Pi_1$  is generated with probability  $(1 - R_1)$ , and in period 2 the continuation payoff  $V_i$ ,  $i = b, vc$ , is generated with probability  $(1 - R_2)$ . Moreover, suppose that these shocks are negatively correlated: let us assume  $1 - R_2 = R_1$ . Two points are worth making here. First, the trade-off between the two sources of financing (and the effects of competition on that trade-off), remains exactly the same as in the main model: bank financing is preferred over VC financing iff  $[V_b(\theta) - V_{vc}(\theta)] - R_1[V_b(\theta) - L] \geq 0$ . Second, we now have a new interpretation of  $R_1$ , with lower values of  $R_1$  capturing shorter cash flow horizons and larger values of  $R_1$  capturing longer horizons. Prediction 2 can thus be reinterpreted within this context: bank financing works well for shorter cash flow horizons, and VC financing works better for longer horizons.

**PREDICTION 3.** *Product market competition should increase the probability that entrepreneurs choose bank financing over VC financing.*

This prediction is a corollary to Proposition 5. Important to this result is the idea that bank financing yields stronger entrepreneurial incentives than VC financing. Then product market competition, by increasing the value of stronger entrepreneurial incentives, increases the benefit of bank financing relative to VC financing. With this prediction, the model provides an intuitive explanation for the second key empirical result discussed in §2, namely the apparent positive correlation between product market competition and the preponderance of bank financing relative to VC financing.

Note that in our model, lack of competition is closely associated with highly differentiated products and a relatively low value of cost reduction; in contrast, intense competition is defined by highly substitutable products and a relatively high value of cost reduction. Another corollary follows immediately from Proposition 5.

**PREDICTION 4.** *Firms that focus on product innovation (i.e., they develop new, highly differentiated products) may prefer VC financing, and firms that focus on process innovation (i.e., they produce less novel products albeit at a lower cost) may prefer bank financing.*

To the extent that firms tend to rely more on VC financing early in the life cycle of their product and on bank financing later in the life cycle (see, e.g., Berger and Udell 1998), this prediction is consistent with Klepper (1996), who finds that firms devote an increasing share of their R&D to process innovation rather than product innovation over the product life cycle.

A related implication concerns the distinction between radical innovations, which create new products or completely change technologies, and incremental innovations, which are minor modifications of existing products or processes. Radical innovations might give a firm a first-mover advantage or a dominant position with little competition (Lieberman and Montgomery 1988), as opposed to incremental innovations that still compete with other technologies. In a study of the financing and R&D decisions of UK public firms between 1990 and 2002, Casson et al. (2008) find that radical innovation is usually associated with equity financing, whereas incremental innovation is associated with debt financing. This finding is consistent with Atanassov et al. (2007) who examine the interaction between capital structure and patenting activity and find a positive correlation between equity financing and more novel (drastic) patents.<sup>42</sup> Note that this distinction between radical and incremental innovation is also related to Prediction 2, since radical innovation has a higher level of risk than incremental innovation, due to the complexity associated with new product requirements and to the added uncertainty regarding technology, market needs, and the actions of competitors (Song and Montoya-Weiss 1998).

Finally, noting the one-to-one correspondence between bank financing and debt-type contracts on one hand, and VC financing and equity-type contracts on the other, our model suggests that competition could have an impact not only on the choice between bank financing and VC financing in entrepreneurial ventures, but also on the financial structure of more established corporations.

**PREDICTION 5.** *Product market competition should increase the probability that managers choose debt financing over equity financing.*

This prediction is consistent with findings in empirical corporate finance literature. Titman and Wessels (1988), for example, find that debt levels are negatively related to product uniqueness, which is a good measure of the degree of horizontal differentiation, or lack of competition  $\theta$  as used in our model. Using U.S. newspaper industry data, Schargrodsky (2002) finds that oligopolies have higher debt ratios than monopolies. Lord and McIntyre (2003) provide evidence that leverage increases with import competition in the textile and apparel industry. Similarly, Baggs

<sup>42</sup> See also Titman and Wessels (1988), who find a positive correlation between equity financing and the level of R&D expenditures; Kortum and Lerner (2000), who show that firms that receive VC financing innovate more; Hellmann and Puri (2000), who find that firms pursuing an innovator rather than an imitator strategy are more likely to obtain VC financing and that obtaining VC is associated with the ability to secure a first-mover advantage.



and Brander (2006) use Canada–United States Free Trade Agreement data to show that increased competition, measured as an exogenous reduction in import tariffs, increases leverage. More recently, Beiner et al. (2011) find significantly higher leverage ratios for firms operating in more competitive environments.<sup>43</sup>

To the extent that competition can be adequately captured by market concentration, Prediction 5 suggests that managers should be less likely to choose debt over equity financing in more concentrated markets. Since market concentration tends to be associated with higher profitability (Azzam 1997, Slade 2004), this is indeed consistent with the negative correlation between leverage and profitability documented in much previous empirical work (Titman and Wessels 1988, Rajan and Zingales 1995, Fama and French 2002).

In this paper we offer novel insights into the workings of the connections among product market competition, venture risk, and entrepreneurial finance, and we propose several new, empirically testable predictions. We hope that our model will instigate further empirical interest and can serve as a theoretical basis for new empirical work, in what we view as a fruitful avenue for future research.

## 7. Conclusion

Empirical evidence suggests possible connections among venture risk, product market competition, and the financing of start-ups. Because of a lack of theoretical work on the subject, however, the microeconomic foundations necessary for more systematic empirical analysis of these possible interactions were missing. In this paper we fill this gap. We propose a general theory of entrepreneurial finance in imperfectly competitive environments that (i) can be used to explain these connections, (ii) suggests that venture risk and product market characteristics may be important factors to take into account in empirical work on entrepreneurial finance, and (iii) yields new empirical predictions that we hope will spur further empirical work on the subject.

Our model highlights a simple trade-off between the two types of financing whereby bank financing yields stronger incentives and greater entrepreneurial effort than VC financing but is more sensitive to negative shocks affecting the venture, potentially leading to inefficient liquidation. Two main results, both consistent with available empirical evidence, emerge from this simple trade-off. First, riskier ventures, which are more sensitive to negative shocks, ought

to be VC-financed, whereas for safer ventures bank financing is optimal. Second, product market competition, by increasing the marginal product of entrepreneurial effort, raises the advantage of superior effort associated with bank financing, thus increasing the appeal of bank financing relative to VC financing.

In order to provide clear insights and tractable results, we propose a highly stylized model of financing and competition. In the online supplement to this paper (available on the authors' websites), we address robustness concerns by proposing a number of extensions to the main model, including allowing for competition in the first period, for effort by the venture capitalist, for verifiable profits, for staged financing, for mixed strategies in contracting, for entrants with either high or low marginal cost, and for product market competition between two entrepreneur–financier pairs. We find that the main results of our model continue to hold in a variety of environments. Yet there is still more interesting work to be done on the interactions among competition, venture risk, and the financing of new ventures. For example, it would be interesting to consider the bank/VC financing trade-off in an infinite-horizon setting rather than in the simpler two-period setting we chose here; that is an extension beyond the scope of this paper but one we look forward to tackling in future work.

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## Appendix

### A.1. Proofs of Propositions 1, 2, 3, and 4

These proofs follow directly from the text.

### A.2. Proof of Lemma 1

**A.2.1. Example 1: Hotelling Model.** The two start-ups are located at each end of a Hotelling (1929) line and compete in both periods. Venture 1 is located at  $x=0$  and venture 2 is at  $x=1$ . There is a unique consumer who is uniformly distributed along the Hotelling line. Located at  $\phi$ ,

<sup>43</sup> See also Fosu (2013), who shows that the benefits of leverage are improved by product market competition, measured by the Boone indicator (using panel data consisting of 257 South African firms over the period from 1998 to 2009).



the consumer incurs a transport cost  $t\phi$  for traveling to firm 1, and a cost  $t(1-\phi)$  for visiting firm 2. In each period, the consumer enjoys conditional indirect utility  $V_1 = y - p_1 - t\phi$  from product 1 and  $V_2 = y - p_2 - t(1-\phi)$ , where  $y$  represents income, and chooses the product that gives the highest utility. In this paper we measure the degree of competition as the degree of substitutability between the two competing products. Conveniently, on a Hotelling line, the transport cost  $t$  captures the degree of product differentiation, so we use the degree of substitutability between products,  $\theta = 1/t$ , as a measure of the toughness of competition, to use Sutton's (1992, p. 9) terminology.

The equilibrium profit of firm  $i$  is  $\Pi_i(c_i, c_j, \theta) = (1/(2\theta)) \cdot (1 + (\theta(c_j - c_i))/3)^2$ . The profits for the different outcomes are  $\Pi^s(\theta) = 1/(2\theta)$  and  $\Pi^h(\theta) = 1/(2\theta)(1 + \theta(\bar{c} - \underline{c})/3)^2$ . This yields  $\Pi^h(\theta) - \Pi^s(\theta) = ((\bar{c} - \underline{c})/6)(2 + \theta(\bar{c} - \underline{c})/3)$ . It is straightforward that  $d\Pi^s(\theta)/d\theta = -1/(2\theta^2) < 0$ , and  $d(\Pi^h(\theta) - \Pi^s(\theta))/d\theta = (\bar{c} - \underline{c})^2/18 > 0$ .  $\square$

**A.2.2. Example 2: Salop Model.** The market is represented by a unit circumference. There is a mass 1 of consumers who are uniformly distributed along the circumference of the circle on which  $n$  firms are located symmetrically. Firm 1 produces at constant marginal cost  $c_i$ . Locations in the market are indexed by  $z \in [0, 1)$ . Each consumer buys either one unit of output or no output at all. A consumer located at point  $d$  buying a unit of output from firm  $i$  derives utility  $u(d, i) = v - p_i - tD(d, i)$ , where  $v$  is the common valuation of output,  $p_i$  is the price that firm  $i$  charges,  $D(z, i)$  is the shortest arc length separating consumer  $d$  from firm  $i$ , and  $t \geq 0$  is the transport cost per unit of distance. The demand for firm  $i$  is given by  $D_i(p_i, p_{i-1}, p_{i+1}) = 1/n - p_i/t + (p_{i-1} + p_{i+1})/(2t)$ . Profits are maximized for  $p_i = t/(2n) + c_i/2 + (p_{i-1} + p_{i+1})/4$ , which yields to the unique Bertrand equilibrium price  $p_i^*(c_i, c_j) = t/n + \sum_{k=0}^{n-1} b_k c_{i-k}$ , where  $b_k = [(2 + \sqrt{3})^k + (2 + \sqrt{3})^{n-k}]/[\sqrt{3}((2 + \sqrt{3})^n - 1)]$ .<sup>44</sup> When the venture's  $n-1$  competitors have a cost  $\bar{c}$  ( $c_j = \bar{c} \forall j \neq 1$ ), the equilibrium price is  $p_i^*(c_i) = t/n + c_i + (\bar{c} - c_i)(1 - b_0)$ , where  $b_0 = [1 + (2 + \sqrt{3})^n]/[\sqrt{3}((2 + \sqrt{3})^n - 1)]$ . Therefore the profits for the different outcomes are  $\Pi^s(\theta) = 1/(\theta n^2)$  and  $\Pi^h(\theta) = (1/\theta)(1/n + \theta(\bar{c} - \underline{c})(1 - b_0))^2$ , where  $\theta = 1/t$  measures the degree of competition in the market. This yields  $\Pi^h(\theta) - \Pi^s(\theta) = (\bar{c} - \underline{c})(1 - b_0)(2/n + \theta(\bar{c} - \underline{c})(1 - b_0))$ . It is straightforward that  $d\Pi^s(\theta)/d\theta = -1/(\theta^2 n^2) < 0$ , and  $d(\Pi^h(\theta) - \Pi^s(\theta))/d\theta = (\bar{c} - \underline{c})^2(1 - b_0)^2 > 0$ .  $\square$

**A.2.3. Example 3: Constant Elasticity of Substitution (CES) (Dixit-Stiglitz) Model.** Assume that the two start-ups face demand of the form  $p_i(q_i, q_j) = (1/q_i^{1-\theta})/(q_i^\theta + q_j^\theta)$  with  $0 < \theta < 1$ . This demand function is derived from a CES utility function  $u(q_1, q_2) = (q_1^\theta + q_2^\theta)^{1/\theta}$ , where  $\theta$  measures the degree of substitutability between the goods of firms 1 and 2. Firm  $i$  has a marginal cost  $c_i$ . In this example, competition increases as  $\theta$  increases so goods become closer substitutes. The profit of firm  $i$  can be written as  $\Pi_i(c_i, c_j, \theta) = (1 + (1 - \theta)(c_i/c_j)^\theta)/((1 + (c_i/c_j)^\theta)^2)$ . The profits for the different outcomes are  $\Pi^s(\theta) = (2 - \theta)/4$ , and  $\Pi^h(\theta) = (1 + (1 - \theta)c^\theta)/(1 + c^\theta)^2$ , where  $c = \bar{c}/\underline{c} < 1$ . It is straightforward that  $d\Pi^s(\theta)/d\theta = -1/4 < 0$ . Moreover,  $d(\Pi^h(\theta) - \Pi^s(\theta))/d\theta = (1/(4(1 + c^\theta)^3))(-4c^\theta(\ln c)(1 + \theta + (1 - \theta)c^\theta) + (1 + c^\theta)(1 - c^\theta)^2) > 0$ .  $\square$

**A.2.4. Example 4: Logit Model.** Consider a market with  $N$  consumers and two firms. Each consumer in the market purchases one unit of just one of the two products that the firms offer. A consumer chosen at random from the population of  $N$  consumers has a conditional indirect utility function  $V_i = M - p_i + \varepsilon_i$  for  $i = 1, 2$ . The parameter  $M$  stands for consumers' income,  $p_i$  is the price of good  $i = 1, 2$ , and  $\varepsilon_i$  represents consumers' idiosyncratic tastes about good  $i$  (horizontal differentiation). The purchase probability for product  $i$  is the probability that a randomly selected consumer derives the largest utility from purchasing it. In the absence of an outside (no-purchase) option, the expected demand of firm  $i$  is given by the following logit formula (see Anderson et al. 1992)  $d_i(p) = \exp(-p_i/\mu)/(\exp(-p_1/\mu) + \exp(-p_2/\mu))$ . If  $\mu = 0$ , goods are perfect substitutes, but if  $\mu = \infty$ , goods are independent. So competition increases as  $\mu$  decreases. Therefore we use  $\theta = 1/\mu$  as a measure of the toughness of competition. Firms compete in price, which leads to equilibrium prices such that  $p_i = c_i + 1/\theta + (1/\theta)(\exp(-\theta p_i)/\exp(-\theta p_j))$ . Profits for the different outcomes are the following:  $\Pi^s(\theta) = N/\theta$  and  $\Pi^h(\theta) = (N/\theta)(\exp(-\theta p_1^*)/\exp(-\theta p_2^*))$ , where  $p_1^*$  and  $p_2^*$  are the equilibrium prices when  $c_1 = \underline{c}$  and  $c_2 = \bar{c}$ .<sup>45</sup> It follows directly that  $d\Pi^s(\theta)/d\theta < 0$ .

In what follows we show that  $d(\Pi^h(\theta) - \Pi^s(\theta))/d\theta > 0$ . Let  $X = \exp(-\theta p_1^*)/\exp(-\theta p_2^*)$ . Since  $\bar{c} > \underline{c}$ ,  $p_1^* < p_2^*$  so  $X > 1$ . Moreover,  $\ln X = \theta(p_2^* - p_1^*) = \theta(\bar{c} - \underline{c}) + 1/X - X$ . By differentiating this equality with respect to  $\theta$ , we obtain  $(dX/d\theta)(X^2 + X + 1)/X^2 = \bar{c} - \underline{c}$ . We have  $\Pi^h(\theta) - \Pi^s(\theta) = N((X - 1)/\theta)$ , so  $(1/N)d(\Pi^h(\theta) - \Pi^s(\theta))/d\theta = -(X - 1)/\theta^2 + (1/\theta)(dX/d\theta) = -(X - 1)/\theta^2 + X^2(\ln X + X - 1/X)/(\theta^2(X^2 + X + 1)) = (X^2 \ln X - X + 1)/(\theta^2(X^2 + X + 1)) > 0 \forall X > 1$ . Therefore,  $d(\Pi^h(\theta) - \Pi^s(\theta))/d\theta > 0$ .  $\square$

**A.2.5. Example 5: Switch from Cournot to Bertrand.** Let us analyze a shift from a Cournot duopoly to a Bertrand duopoly, where Bertrand competition is often seen as more competitive than Cournot competition. Assume that the two ventures face a demand of the form  $P = a - Q$ .

Under a Cournot duopoly, the equilibrium profit of venture  $i$  is  $\Pi_i(c_i, c_j) = (a - 2c_i + c_j)^2/9$ . The profits for the different outcomes are  $\Pi_C^s = (a - \bar{c})^2/9$  and  $\Pi_C^h = (a - 2\underline{c} + \bar{c})^2/9$ . Under a Bertrand duopoly, the equilibrium profit of venture  $i$  is  $\Pi_i(c_i, c_j) = 0$  if  $p_i > p_j$  and  $\Pi_i(c_i, c_j) = (p_i - c_i)(a - p_i)$  if  $p_i < p_j$ . The profits for the different outcomes are  $\Pi_B^s = 0$  and  $\Pi_B^h = (\bar{c} - \underline{c})(a - \bar{c})$ .

As competition increases, we switch from Cournot competition to Bertrand competition. Since  $\Pi_C^s > \Pi_B^s$ ,  $\Pi^s$  decreases. Moreover,  $\Pi_C^h - \Pi_C^s = (4/9)(\bar{c} - \underline{c})(a - \bar{c})$  whereas  $\Pi_B^h - \Pi_B^s = (\bar{c} - \underline{c})(a - \bar{c})$ , so  $\Pi^h - \Pi^s$  increases.  $\square$

### A.3. Proof of Proposition 5

Let us define  $\Delta \equiv \Pi^h(\theta) - \Pi^s(\theta)$ ,  $\Delta' \equiv d(\Pi^h(\theta) - \Pi^s(\theta))/d\theta$ , and  $\Pi^{s'} \equiv d\Pi^s(\theta)/d\theta$ . We know from the main text that  $\gamma_b = \Delta/k$  and  $\gamma_{vc} = (1 - \lambda)\Delta/k$ , which immediately implies  $\gamma_b - \gamma_{vc} = \lambda\Delta/k$  and  $d\gamma_{vc}/d\theta = (1 - \lambda)\Delta'/k$ .

<sup>45</sup> More specifically, these equilibrium prices are  $p_1^* = \underline{c} + 1/\theta + (1/\theta)(\exp(-\theta p_1^*)/\exp(-\theta p_2^*))$  and  $p_2^* = \bar{c} + 1/\theta + (1/\theta)(\exp(-\theta p_2^*)/\exp(-\theta p_1^*))$ .

<sup>44</sup> See Lin and Wu (2013) for the proof.

Using expression (8), and substituting the relevant expressions above, we can express the impact of competition on the upside of bank financing as follows:

$$\begin{aligned}\frac{d[V_b(\theta) - V_{vc}(\theta)]}{d\theta} &= (\gamma_b - \gamma_{vc})\Delta' - \lambda \frac{d\gamma_{vc}}{d\theta} \Delta \\ &= \frac{\lambda^2}{k} \Delta \Delta' > 0.\end{aligned}\quad (10)$$

For a given degree of competition  $\theta$ , the associated threshold venture risk level  $R_1^*(\theta)$  can be expressed as

$$\begin{aligned}R_1^*(\theta) &= 1 - \frac{V_{vc}(\theta) - L}{V_b(\theta) - L} = 1 - \frac{\Pi^s + \gamma_{vc}\Delta - (k/2)\gamma_{vc}^2 - L}{\Pi^s + \gamma_b\Delta - (k/2)\gamma_b^2 - L} \\ &= \frac{(\lambda^2/(2k))\Delta^2}{\Pi^s + (1/(2k))\Delta^2 - L}.\end{aligned}\quad (11)$$

Since we know from (7) that  $dV_b/d\theta = \Pi^{s'} + \gamma_b\Delta' = \Pi^{s'} + \Delta\Delta'/k$ , we can express the downside of bank financing as

$$\frac{dV_b}{d\theta} R_1^*(\theta) = \left[ \Pi^{s'} + \frac{\Delta\Delta'}{k} \right] \left[ \frac{(\lambda^2/(2k))\Delta^2}{\Pi^s + (1/(2k))\Delta^2 - L} \right]. \quad (12)$$

Subtracting (12) from (10) and simplifying yields

$$\frac{d[V_b(\theta) - V_{vc}(\theta)]}{d\theta} - \frac{dV_b}{d\theta} R_1^*(\theta) = A[2(\Pi^s - L)\Delta' - \Delta\Pi^{s'}],$$

with

$$A = \frac{(\lambda^2/(2k))\Delta^2}{\Pi^s + (1/(2k))\Delta^2 - L} > 0. \quad (13)$$

Clearly, the results of Lemma 1, namely  $\Delta' > 0$  and  $\Pi^{s'} < 0$ , are sufficient to ensure a strictly positive impact of competition on the appeal of bank financing relative to VC financing.  $\square$

#### A.4. Relaxing the Regularity Condition (1)

Throughout the paper we have imposed a regularity condition (1) on the model:  $I \leq \lambda_{\min}\Pi^s(\theta_{\max})$ . As discussed in §4, this condition is sufficient to ensure that for all  $\theta \in [\theta_{\min}, \theta_{\max}]$ , (a) VC financing is feasible for all  $\lambda \in [\lambda_{\min}, 1]$ ; (b) there exists an  $R_{\max}(\theta) = 1 - (I - L)/(V_b(\theta) - L) > 0$  such that bank financing is feasible iff  $R_1 \in [0, R_{\max}(\theta)]$ ; and (c) there exists a threshold level of venture risk  $R_1^*(\theta) = 1 - (V_{vc}(\theta) - L)/(V_b(\theta) - L) < R_{\max}(\theta)$  such that bank financing is optimal for all  $R_1 \leq R_1^*(\theta)$ , and VC financing is optimal otherwise. We now relax this condition.

Recall that VC financing is feasible iff  $I \leq \lambda\Pi_2(\gamma_{vc}(\theta), \theta)$ , and that bank financing is feasible iff  $I \leq (1 - R_1)V_b(\theta) + R_1L$ . Note that for any  $\lambda \in [\lambda_{\min}, 1]$  and  $\theta \in [\theta_{\min}, \theta_{\max}]$ , we have

$$\lambda\Pi_2(\gamma_{vc}(\theta), \theta) < V_{vc}(\theta) < V_b(\theta). \quad (14)$$

Thus, for given values of  $I$ ,  $\lambda$ , and  $\theta$ , there are three cases to examine.

Case 1.  $I > V_b(\theta)$ .

Bank financing is not feasible: there exists no venture risk  $R_1 \geq 0$  such that  $I \leq (1 - R_1)V_b(\theta) + R_1L$ . VC financing is not feasible either, since (14) implies that if  $I > V_b(\theta)$  then  $I > \lambda\Pi_2(\gamma_{vc}(\theta), \theta)$ . Hence the venture is not financed in the first place.

Case 2.  $\lambda\Pi_2(\gamma_{vc}(\theta), \theta) < I \leq V_b(\theta)$ .

Bank financing is feasible: there exists a  $R_{\max}(\theta) = 1 - (I - L)/(V_b(\theta) - L) \geq 0$  such that bank financing is feasible iff  $R_1 \in [0, R_{\max}(\theta)]$ . On the other hand,  $\lambda\Pi_2(\gamma_{vc}(\theta), \theta) < I$  implies that VC financing is not feasible in that case. Thus, ventures with risk  $R_1 \leq R_{\max}(\theta)$  are bank financed, and ventures with risk  $R_1 > R_{\max}(\theta)$  are not financed.

Case 3.  $I \leq \lambda\Pi_2(\gamma_{vc}(\theta), \theta) < V_b(\theta)$ .

Bank financing is feasible for all ventures with  $R_1 \in [0, R_{\max}(\theta)]$  and  $R_{\max}(\theta) = 1 - (I - L)/(V_b(\theta) - L) > 0$ . VC financing is also feasible since  $I \leq \lambda\Pi_2(\gamma_{vc}(\theta), \theta)$ . Moreover, note that since  $I \leq \lambda\Pi_2(\gamma_{vc}(\theta), \theta)$  and  $\lambda\Pi_2(\gamma_{vc}(\theta), \theta) < V_{vc}(\theta)$  (see expression (14)), we must have  $I < V_{vc}(\theta)$ , which in turn implies  $R_1^*(\theta) = 1 - (V_{vc}(\theta) - L)/(V_b(\theta) - L) < R_{\max}(\theta)$ . Thus the results in Case 3 are the same as in the main model. When both bank financing and VC financing are available and  $e$  faces a “real”<sup>46</sup> financing choice, (1) for low-risk ventures ( $R_1 \leq R_1^*(\theta)$ ), bank financing is optimal, whereas for high risk ventures ( $R_1 > R_1^*(\theta)$ ) VC financing is optimal; (2) the relative appeal of bank financing increases with competition ( $\partial R_1^*/\partial\theta > 0$ ).

Note that bank financing is strictly more feasible than VC financing in our Model, a feature consistent with the empirical evidence discussed in §2, which suggests that banks are a much more frequent capital provider than venture capitalists.

This feature comes in part from our assumption that  $f$  has full bargaining power in renegotiation. This assumption enables  $e$  to commit to a relatively large debt repayment at date 1, making bank financing more feasible at date 0. If we allow  $e$  to have some bargaining power in renegotiation, then the more bargaining power she has in renegotiation, the lower her ability to commit to debt repayments, and the lower her ability to borrow from a bank in the first place. Alternatively, the venture capitalist may be able to extract rents in the first period as well as in the second period (in the model we assume that the venture capitalist extracts rents in the second period only). In both of these cases, the feasibility of VC financing relative to bank financing would increase, and an additional (fourth) case may emerge whereby for some values of  $I$ ,  $\lambda$ , and  $\theta$ , only VC financing may be available to the entrepreneur. While one cannot rule out the possibility that this would occur at higher values of  $\theta$ , one cannot tell a priori for which values of  $\theta$  this would be more likely to occur. In any case, the main results of the model, which pertain to the scenario where both sources of financing are available, as described in Case 3 above, continue to hold.

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<sup>46</sup> In contrast to Cases 1 and 2 where  $e$  faces either one choice or no choice at all.

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