The Interaction Between Product Market Competition and the Financing of Entrepreneurial Ventures

Jean-Etienne de Bettignies and Anne Duchêne

June 17, 2010

Abstract

This paper examines the link between product market competition and entrepreneurs’ choice between bank financing and venture capital (VC) financing. We argue that this link is bi-directional: on the one hand, the financing choice affects the competitive behavior of the firm and of its rival. On the other hand, product market competition, measured as the degree of substitutability between products, also has an impact on the financing choice itself: it favors bank financing over VC financing. We derive the industry equilibrium and show that as the degree of competition increases, firms tend to switch from VC financing to bank financing. We discuss the empirical implications of the model and their connection with the empirical literature.

*Bettignies: Queen’s School of Business, Queen’s University, Kingston, Ontario K7L 3N6, Canada. Tel: 613-533-6343. Email: jdebettignies@business.queensu.ca. Duchêne: Lebow School of Business, Drexel University, Philadelphia, PA 19104-2875, USA. Tel: 215-895-6990. Email: ad493@drexel.edu.

†We thank Ingela Alger, Patrick Bolton, Gilles Chemla, Jean Dermine, Landis Gabel, Bob Gibbons, Denis Gromb, Thomas Hellmann, Rich Mathews, Joel Peress, Antoine Renucci, Joel Shapiro, Lars Stole, Tim Van Zandt, Jano Zabojnik, and seminar participants at Carleton University, European University Institute, INSEAD, Queen’s University, Université Paris-Dauphine, the IIOC 2009 (Boston), and the EFMA Meetings 2009 (Milan), for helpful comments.
1 Introduction

What factors affect the entrepreneur’s choice between venture capital (VC) and bank financing? In practice it is sometimes suggested that entrepreneurs prefer bank-provided debt financing over venture capital, and thus would always choose bank financing as long as it is feasible, i.e. 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). This paper suggests that another key factor might affect the VC/bank financing tradeoff: product market competition. Indeed we show that competition improves the attractiveness of bank financing over venture capital (VC) financing; and that entrepreneurs will gradually switch from VC financing to bank financing as competition intensifies.

We propose a two-period, incomplete contracting model, with two entrepreneurs seeking financing to start their own venture and compete against each other in the product market, along a Hotelling (1929) line. At the beginning of the game each entrepreneur can choose between bank financing and VC financing. Under bank financing, the contract that emerges as optimal is a standard debt contract that specifies a debt repayment to be made at date 1. If the entrepreneur is successful in the first period, she can make the debt repayment, retains complete control over the venture, and hence has full incentives to exert high cost reducing effort in the second period. In case of failure, the entrepreneur loses control of the venture, which is then managed without effort by the financier (or a substitute manager) in the second period. Under VC financing, the optimal contract is one where entrepreneur and investor share ownership and control over the venture regardless of the outcome of the first period, with the entrepreneur exerting positive but low effort in the second period.

The tradeoff between the two types of financing, then can be broadly described as follows: On the one hand, conditional on short term (date 1) failure, VC financing has the advantage, since the entrepreneur retains some control and exerts some effort, creating more value than under bank financing, where zero effort is exerted following default. On the other hand, conditional on short term success, bank financing has the advantage, since the entrepreneur avoids default, retaining full ownership and strong incentives; and creating more value than under VC financing, where profit
sharing with the VC reduces her incentives and her effort.

We show that the link between product market competition and the financing choice is bi-directional: On the one hand, the financing choice affects the competitive behavior of the firm and of its rival. In particular, debt financing leads to lower short-term price-cost margins, as the rival lowers price for predatory purposes, and the firm itself lowers price for default prevention purposes. But conditional on short-term success (no default), debt financing may enable the firm to obtain a higher price-cost margin in the medium-term, as the entrepreneur retains full ownership of the venture and has maximum incentives for efficiency-improving, cost-reducing effort.

On the other hand - and perhaps more importantly - product market competition, measured by the degree of substitutability between products, also has an impact on the financing choice itself: it favors bank financing over VC financing, by increasing bank financing’s advantage following short-term success, and by decreasing its disadvantage following short term failure. We derive the industry equilibrium and show that as the degree of competition increases, firms tend to switch from VC financing to bank financing. We also present the empirical implications of our model and discuss their relationship to the empirical literature.

There already exists a fairly large theoretical literature on the impact of debt financing on the competitive behavior of rivals in the product market.¹ 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 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’s (2000) and Povel and Raith’s (2004) brought together strategic elements of Brander and Lewis’ Cournot approach and optimal contracting elements of Bolton and Scharfstein (1990).²


²There also exists a small literature on venture capital and start-up financing in a competitive context. Note in particular Inderst and Mueller (2004), who 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. And Fulghieri and Sevilir (2009) study how market conditions affect the composition of a VC’s portfolio (in particular the trade-off between larger/smaller portfolios and diversified/concentrated portfolios).
More recently, a new theoretical literature has emerged that examines entrepreneurs’ choice between VC financing and bank financing more specifically. Factors affecting this financing tradeoff are shown to include intellectual property protection and “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).\footnote{Other tradeoffs have been examined in the entrepreneurial finance literatures; e.g. the entrepreneur’s choice between venture capital and angel financing (Chemmanur and Chen, 2006), or between private and public ownership (Boot, Gopalan, and Thakor, 2006). See also Renucci (2008), who examines bargaining with a venture capitalist when bank financing is an option.}

These two literatures have evolved in parallel, largely without intersecting: the debt and competition literature does not explicitly address the entrepreneur’s choice between bank financing and venture capital, and the VC/bank literature does not take product market competition into account. Indeed - and this is the first contribution of this paper, we build a simple model of VC/bank financing choice, which we nest into a duopoly framework of product market competition, thus providing a valuable link between the two literatures.

A second and more important contribution of this paper has to do with the way in which the relationship between financing and product market competition is examined: Unlike most prior work, which as mentioned above focuses on the impact of debt on the competitive behavior of rivals in the product market, we also examine how the degree of competition in the industry affects the entrepreneur’s financing choice in the first place.\footnote{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.}

One exception in the prior literature - and 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;” 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 generates a different outcome: Here, product market competition leads to less VC financing and more bank financing, not the other way round.

The paper is organized a follows: Section 2 describes a simple version of the model where competition is assumed away. This is to serve as a benchmark in the remainder of the paper. Section 3...
presents the duopoly version of the model described in section 2. Sections 4 and 5 examine the impact of financing on competitive behavior, and the effects of competition on the financing choice. Section 6 discusses empirical implications, and section 7 concludes. All proofs are in the appendix.

2 A Simple Model of Bank Financing Versus VC Financing

We start with a simple model of bank financing versus VC financing, where product market competition is assumed away. This model uses elements of Bettignies (2008), but in a simpler framework that can then be nested in a duopoly setting in Section 3.

2.1 Description and Timing of the Game

We consider an entrepreneur \(e\) and a financier \(f\), both risk-neutral. Entrepreneur \(e\) is wealth-constrained with no initial wealth, and is soliciting a (small) cash investment \(K\) from financier \(f\) to start her venture, which is to last for two periods.\(^5\) The timing of the game is:

At date 0, \(e\) makes a take-it-or-leave-it contractual offer to \(f\).\(^6\) The contract (to be defined more specifically below) stipulates that outlay \(K\) is to be transferred from \(f\) to the venture at date 0, and specifies the credible way in which \(f\) is to receive non-negative expected payoff (net of \(K\)) from the investment, thus ensuring his participation (assuming zero cost of capital).

At date 1, with probability \(X\) a profit opportunity \(P\) arises. Otherwise the firm makes zero profit.

At the beginning of the second period, \(e\) can choose to remain involved in the venture at personal cost \(\varepsilon\), with \(\varepsilon \rightarrow 0.\(^7\) In that case she exerts effort \(q = q^h, q^l\). High effort \(q^h\) is exerted at personal cost \(c\), while low effort \(q^l\) is exerted at no cost. Effort is an observable but non-verifiable - and thus non-contractible - investment embodied in physical (rather than in human) capital.\(^8\) If \(e\) chooses not to remain involved in the venture in period 2, the venture is run by a substitute manager who produces

---

\(^5\)For clarity purposes, throughout the text we refer to entrepreneurs as female and to financiers as male. Also for clarity, we use capital letters to describe first period variables, and small cap letters to describe second period variables.

\(^6\)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).

\(^7\)The participation cost \(\varepsilon\) simply captures the entrepreneur’s opportunity cost of remaining involved in the venture. It is explicitly defined here mainly for technical reasons: it simplifies the determination of dominating strategies in Lemmas 1 and 2.

\(^8\)Investments in human capital increase the size of the end-of-period payoff only if the agent remains involved in the venture. If the agent leaves the venture, he/she takes his/her human capital with her. In contrast, investments embodied in physical capital increase the size of the end-of-period payoff whether or not the agent remains involved with the venture. The reason for our focus on physical capital investments should become clear below.
These effort levels reduce the second period marginal cost of production in the second period: \( mc = a - q \).

At date 2, with probability \( x \) a profit opportunity \( p(q) \) arises. A lower marginal cost of production increases the profit opportunity and hence \( dp/dq > 0 \).

2.2 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 by a court, and thus they cannot be contracted upon. To quote Bolton and Scharfstein (1996, p.5), “this assumption is meant to capture the idea that managers have some ability to divert corporate resources to themselves at the expense of outside investors,” and that “such perk consumption and investment may be difficult to distinguish from appropriate business decisions and thus impossible to control through contracts.” This has two important consequences. First, the entrepreneur and the financier must bargain over profit opportunities \( P \) and \( p(q) \) as they arise at the end of periods 1 and 2, respectively. Second, the contract designed at date 0 can only specify the - possibly contingent - allocation of property rights over the venture, which can be of three types. Under entrepreneur control (E), \( e \) has full ownership of the venture and complete control over the physical assets of the venture. At the other end of the ownership spectrum, under financier control (F), it is \( f \) who owns the venture and controls the physical assets. Finally, under joint control (J), \( e \) and \( f \) jointly own the venture and share control over the physical assets.

We posit that a key difference between periods 1 and 2 has to do with the importance of physical capital relative to human capital in generating profits. Indeed we assume that in period 1 profits depend mainly on access to the entrepreneur’s human capital: At the very beginning of the lifecycle of the venture, it is the entrepreneur’s talent and her own conceptualization of the idea that is crucial for the success of the venture. However as time goes by, the venture comes to rely more and more on physical capital for its continued success. We capture this idea by assuming that, in contrast to period 1, in period 2 profits depend primarily on access to the physical assets of the venture.

---

\(^9\) We normalize the substitute manager’s effort to zero to capture the cost of not of having the original entrepreneur - who conceived the venture idea and understands it very well - remain involved in the venture.

\(^10\) We use a discrete effort choice rather than a continuous one for simplicity. Though we conjecture that qualitatively similar results could be obtained with a continuous effort choice, making this assumption would significantly reduce the tractability of the algebra in the model with competition described in Section 3.

\(^11\) Physical capital is to be understood broadly here, encompassing all assets that are “nonhuman.” As discussed in Hart (1995, p.56), “[t]hese might be ‘hard’ assets such as machines, inventories, and buildings, or ‘softer’ assets such as patents, client lists, files, existing contracts, or the firm’s name or reputation.”
As discussed immediately below, this distinction has an effect on the importance of property rights allocation in the two periods.

### 2.2.1 Impact of Property Rights in Period 2

In period 2, when physical capital is important relative to human capital, property rights greatly affect the bargaining outcome. Under *entrepreneur control (E)*, entrepreneur $e$, who as mentioned has complete control over the physical assets of the venture, can generally extract 100% of realized profits at date 2. This is consistent with Nash bargaining where - in case negotiations break down - $e$ can simply exclude $f$ from accessing the venture and continue to enjoy all rents. Financier $f$ cannot interfere and gets nothing. Conversely, under *financier control (F)*, it is $f$ who can preclude $e$ from accessing the venture in case bargaining break down, and who in equilibrium extracts all rents. Entrepreneur $e$ gets nothing.

Finally, under *joint control (J)*, we follow Aghion and Tirole (1994) and Hart (1995, p.69) in assuming that bargaining results in $e$ and $f$ obtaining fractions $\lambda$ and $1 - \lambda$ of realized profits, respectively. This is consistent with Nash bargaining where - in case negotiations break down - in the legal battle that would follow the court would grant $e$ (resp. $f$) full control of the physical assets - and hence full access to the profit opportunity$^{13}$ - with probability $\lambda$ (resp. $1 - \lambda$).

The impact of the allocation of property rights on entrepreneurial effort exertion and expected profits in period 2 is quite obvious. Since the marginal impact of $e$’s effort on expected profits is positive; and since the share of expected profits extracted by $e$ under joint control is higher than under investor control, but lower than under entrepreneur control, incentives to exert effort should vary accordingly.$^{14}$ The following lemma follows from this intuition:

**Lemma 1** There exists a set of mappings $q \rightarrow p(q)$ and of values for parameters $q_h$, $q_l$, $\lambda$, $\varepsilon$ and $c$, such that the following strategies are strictly dominating for $e$: $q_h$ under entrepreneur control, $q_l$ under joint control, and “no participation” under investor control.

We focus on profit opportunity functions $p(q)$ and on parameters $q_h$, $q_l$, $\lambda$, $\varepsilon$ and $c$, such that lemma 1 holds, and accordingly we can express second period expected profits as follows:

---

$^{12}$See Section 2.3 for a discussion of an exception under VC financing.

$^{13}$If the court grants full control over physical assets to $e$, then we are effectively back in the entrepreneur control case, and $e$ extracts all realized profits.

$^{14}$See Section 6 for a discussion of empirical evidence on the positive impact of ownership on entrepreneurial effort.
<table>
<thead>
<tr>
<th>Profit Opportunity</th>
<th>E Control</th>
<th>J Control</th>
<th>F control</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p^h = p(q^h)$</td>
<td>$p^l = p(q^l)$</td>
<td>$p^0 = p(0)$</td>
<td></td>
</tr>
</tbody>
</table>

Table I: Expected profit as a function of control rights allocation.

For simplicity we assume $K \leq \min \{xp^0, (1 - \lambda)xp^l\}$, which ensures, as discussed in section 2.3 below, that the project can be undertaken under both bank financing and venture capital financing. The likely impact of relaxing this assumption is discussed in section 7.

2.2.2 Impact of Property Rights in Period 1

In contrast to period 2, in period 1 profits depend primarily on $e$’s human capital, a plausible assumption at the beginning of the lifecycle of a startup. As argued in Hart (1995, pp. 56-57), in that case the allocation of property rights over the venture is not relevant, because regardless $e$ can divert the entire realized profit $P$ at date 1. For convenience we assume that by default the entrepreneur owns the venture in period 1.

2.3 Bankers and Venture Capitalists

Entrepreneur $e$ can seek financing from one of two types of investors: a venture capitalist or a banker. The key characteristic of the banker in our model is that - unlike the venture capitalist - he has neither industry-specific expertise nor a deep understanding of the technical and managerial aspects of the venture. We argue that this lack of expertise effectively makes joint control - which captures the idea of an equity investment by the financier paired with substantial managerial oversight - unavailable under bank financing. Indeed, under joint control, if bargaining were to break down and $e$ and $f$

---

15 As discussed in Bettignies (2008), the assumption of costlessly diverted interim profits greatly simplifies the model by ensuring that property rights affect the distribution (and size) of end-of-game profits, but not of interim profits. It also helps highlight the importance of debt contracts, which are designed to provide incentives to the entrepreneur to return some of these interim profits to the investor, by stripping her of control rights, and hence of access to date 2 profits, if she defaults on interim payments. This assumption is common in models where debt plays an important role (Bolton and Scharfstein 1990, 1996; Hart and Moore 1998). In contrast, if property rights do matter at date 1 in the same way as they do at date 2, $e$ can use property rights to commit to return interim profits to the investor: she may choose investor-control until date 1 (along with a payment from $f$ at date 0), followed by entrepreneur-control or joint control. In other words, $e$ may prefer to sell the venture to $f$ with equity investing for her after date 1.

16 In practice, commercial banks typically do not take equity stakes in the startups that they finance. There are historical reasons for that in the US: From 1933 until 1999, the Glass-Steagall Act legally prevented commercial banks from making such investments. The Act was repealed in 1999, and while commercial banks now do make equity investments in large corporations, they still generally refrain from taking equity stakes in startups. The banks that do make such investments in startups do so via a VC-type division of the bank or a captive VC fund. In such investments, the financier effectively behaves much more like a typical venture capitalist than like a typical banker.
were to go to court, f’s lack of expertise would certainly hinder his ability to make a good case for
gaining full control over physical assets\footnote{For example, it is difficult for one to make a good case for
gaining control over intellectual property (which is included
in the physical asset category; see footnote 11) when one does not have expertise about that type of intellectual property.} and full access to realized profits, resulting in the court siding
with e with high probability. To capture this idea explicitly, we assume \( \lambda = 1 \) under bank financing.\footnote{In contrast, under financier control, the banker’s lack of expertise has no effect, and he is able to extract all rents. This simplifying assumption can be easily justified on the grounds that under financier control, the banker has full
ownership of, and control over, the venture, and hence there is no scope for the entrepreneur to obtain any benefit by
going to court, even if she has an expertise advantage over the banker. In any case, qualitatively similar results would
be obtained if we assumed instead more generally that with bank financing, under joint control e and f split the surplus
\( \lambda_1/(1-\lambda_1) \), with \( \lambda_1 > \lambda \) and under financier control e and f split the surplus \( \lambda_2/(1-\lambda_2) \), with \( \lambda_2 < \lambda_1 \).} Accordingly, bargaining in equilibrium leads to e extracting all rents and leaving nothing to f: joint
control is identical to entrepreneur control. Thus, under bank financing, only entrepreneurial control and financier control are available as contractual tools for the entrepreneur.

Following Hart and Moore (1998) and Bolton and Scharfstein (1990, 1996), we know that in such
a framework it is optimal for e to offer a simple debt contract to f. The date 0 contract specifies 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.

Thus, in our model, following failure at date 1, e cannot make the debt repayment and must
default; and the investor takes control over the assets in period 2 (there is no scope for renegotiation,
since e has no cash with which to renegotiate). As mentioned above, f hires a replacement manager
to run the venture, who exerts zero effort, yielding payoff \( xp^0 \). If e is successful in selling her product
at date 1, she repays \( D \) and retains control over the venture in period 2. In that case she has high
incentives to exert effort, and her expected payoff in period 2 is \( xp^h \).

Since e has full bargaining power at date 0, she sets \( D \) so as to extract all rents from f, i.e.
such that \( XD + (1-X)xp^0 - K = 0 \). Note that since \( K \leq xp^0 \), e has no incentive for strategic
default, and the debt contract just described is renegotiation-proof and feasible.\footnote{Suppose first that \( K > xp^0 \). Then to ensure a non-negative payoff for f, e must promise a debt repayment \( D > xp^0 \).
But in that case, e may be tempted to strategically default in the good state. In that event, financier control is inefficient
since - as shown above - it yields higher cost (and hence lower expected profit) than entrepreneur control. As a result
renegotiation would occur: e would pay \( xp^h \) to f - assuming she has full bargaining power in renegotiation - and retain
full control of the venture. Naturally, f anticipate that he will get at most \( xp^h \) from this investment (\( xp^h \) in the bad
state, and at most \( xp^0 \) in the good state), which is less than \( K \), and hence f would refuse to finance the project in the
first place. If \( K \leq xp^h \), however, there exists an equilibrium \( D \leq xp^0 \) such that 1) e has no incentive for strategic default,
and 2) f gets a non-negative expected payoff: the equilibrium debt contract is feasible. (If e has less than full bargaining
power in renegotiation, she has weaker default incentives; and hence \( K \leq xp^0 \) still works.)} From a date 0
point of view, e’s expected payoff from bank financing is the total surplus generated by the venture:
\[ X \left[ P + (xp^h - c) \right] + (1-X)xp^0 - K. \]
Under venture capital (VC) financing, joint control is feasible; but it is entrepreneur control which is effectively unavailable to \( e \). Indeed, the key characteristic of venture capitalists here is that - given their level of expertise and their social networks - they may be able to extract ex post rents even when \( e \) owns the venture and control its physical assets (i.e. under entrepreneur control). For instance, in case of a bargaining break down they may be able to successfully “steal” the entrepreneur’s idea - as suggested previously by Ueda (2004) - with some probability, say \( 1 - \lambda \). In that case, the Nash bargaining equilibrium split would be the same as under joint control. Thus, \( e \) anticipates that under VC financing entrepreneur control essentially boils down to joint control, and designs a contract with the two available property rights allocations: investor control and joint control.

It immediately follows that the optimal contract is for \( e \) to offer the following equity-type contract to \( f \):\(^{20}\) joint control regardless of the state of the world, in exchange for payment \( K + T \) at date 0, with \( T \) chosen so as to leave no ex ante rents to the financier, i.e. such that \( (1 - \lambda) x p^f - K - T = 0 \).\(^{21}\) Since \( K \leq (1 - \lambda) x p^f \), there exists a \( T \geq 0 \) such that this equality holds. From a date 0 point of view, \( e \)’s expected payoff from VC financing is the total surplus generated by the venture: \( X [P + x p^f] + (1 - X) x p^f - K \).

Comparing \( e \)’s expected payoffs, it is easy to see that she will choose bank financing over VC financing if and only if (iff):

\[
X \left[ \left( x p^h - c \right) - x p^f \right] + (1 - X) \left[ x p^f - x p^0 \right] \geq 0. \tag{1}
\]

On the one hand, conditional on short term failure, VC financing has the advantage, since the entrepreneur retains some control and exerts some effort, creating more value than under bank financing, where zero effort is exerted following default. On the other hand, conditional on short term success, bank financing has the advantage, since the entrepreneur avoids default, retaining full ownership and strong incentives; and creating more value than under VC financing, where profit sharing with the VC

\(^{20}\)Even though in our model an equity contract per se would not yield any payoff to the investor (since by assumption cash flows are not verifiable), joint control (with equity) generates a stream of payoffs to the investor which is similar to the one typically obtained in a standard voting equity contract. For that reason we call this the “equity-type” contract. Focusing on the property and control rights associated with equity (joint control), rather than the cash flow rights, enables us to introduce an equity-like contract in the model, all the while keeping our assumption of non-verifiability of cash flows, necessary for debt to be emerge as optimal under bank financing.

\(^{21}\)To understand the optimality of this contract, note first that since \( e \) can use date 0 transfer \( T \) to extract all ex ante rents, she chooses the optimal contract that maximize total surplus. Since joint control leads to more effort - and hence, \( ceteris paribus \), more profit - than investor control, it is optimal to assign joint control regardless of the state of the world.
reduces her incentives and her effort.

Another way to express this tradeoff, which will be useful in the next section, is in terms of minimum expected returns and expected bonuses from short term success. Under bank financing, e’s expected payoff can be rearranged as the sum of two factors - \( M_b + B_b \) - where \( M_b = xp^0 - K \) and \( B_b = X [P + (xp^h - c) - xp^0] \). \( M_b \) captures the minimum expected return: even if the venture is unsuccessful in the first period and generates no revenue, e can still expect at least \( M_b \) in the second period. \( B_b \) captures the expected bonus from short term success: it represents the expected payoff over and above the minimum expected return, if the venture is successful in the first period. For e, this occurs with probability \( X \) and consists of the date 1 payoff \( P \) and of the second period surplus \( s_b = (xp^h - c) - xp^0 \).22 Similarly, under VC financing, e’s expected payoff can be rearranged as \( M_v + B_v \), i.e. as the sum of a minimum expected return \( M_v = xp^l - K \) and of an expected bonus from short term success \( B_v = XP \). (Note that here the second period surplus \( s_v = xp^l - xp^l = 0 \).) With this notation, the condition for choosing bank financing over VC financing can be re-written as:

\[
(B_b - B_v) - (M_v - M_b) \geq 0. \tag{2}
\]

**Proposition 1** Bank financing is superior to VC financing if and only if its advantage in terms of expected bonus from short term success more than offsets its disadvantage in terms of minimum expected return.

### 3 A Duopoly Model of Bank Financing and VC Financing

#### 3.1 Two Competing Ventures

We now nest our simple financing framework into a duopoly model of competition in the product market. There are two identical pairs of players, each composed of an entrepreneur \( e_i \) and a financier \( f_i, i = 1, 2 \). As before there are two periods. The two entrepreneurs compete in price in the first period, and in cost-then-price in the second period.

The two startups are located at each end of a Hotelling (1929) line and compete in both periods. Venture 1 is located at \( x = 0 \) while venture 2 is at \( x = 1 \). There is a unique consumer who is uniformly

---

22Note the difference between expected bonus and surplus in our model: the surplus \( s \) is included in the expected bonus, \( B = X (P + s) \).
distributed along the Hotelling line. Located at ψ, the consumer incurs a transport cost $t\psi$ for travelling to firm 1, and a cost $t(1-\psi)$ for visiting firm 2. In each period, the consumer enjoys conditional indirect utility $V_1 = y - p_1 - t\psi$ from product 1 and $V_2 = y - p_2 - t(1-\psi)$, 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, and in the remainder of the paper we use the degree of substitutability between products, $\theta = 1/t$, as our measure of the toughness of competition, to use Sutton’s (1992, p.9) terminology.

The timing of the game is the same as before, except that we must now take into account competition in each period:

At date 0, $e_i$ makes a take-it-or-leave-it contractual offer to $f_i$. At the same time, $e_i$ also decides on the price $P_1$ to be charged in the first period. The marginal cost in period 1 is constant and normalized to zero.

At date 1, with probability $X_i$ firm $i, i = 1, 2$, is the one selected by the consumer, in which case a profit opportunity $P_i$ arises. In that case firm $j, j \neq i$ sells nothing and makes zero profit. (With probability $1 - X_i = X_j$ firm $j$ generates profit $P_j$ while firm $i$ makes zero profit.)

At the beginning of the second period, if $e_i$ is still involved in the venture at that point, she exerts effort $q_i = q_i^h, q_i^l$; otherwise the venture is run by a substitute manager who produces zero effort. These efforts reduce second period marginal costs: $mc_i = a - q_i$. After observing each other’s efforts/costs, $e_1$ and $e_2$ compete in price, setting prices $p_1$ and $p_2$ respectively.

At date 2, with probability $x_i$ firm $i, i = 1, 2$, is the one selected by the consumer, in which case a profit opportunity $p_i$ arises. In that case firm $j, j \neq i$ sells nothing and makes zero profit.

### 3.2 Property Rights Again

At date 0, the only three possible allocations of property rights over the venture are entrepreneur control (E), financier control (F), and joint control (J). The effect of property rights on entrepreneurial effort is similar to the effect we discussed in the simple model of Section 2. To see this, we proceed by backward induction. Once marginal costs have been determined, $e_1$ and $e_2$ compete in price. The optimal price in the second period for $e_i, i = 1, 2$ can be expressed as $p_i \in \arg \max x_i(p_i, p_j, \theta)[p_i - a + q_i]$,
where expected demand follows from the Hotelling specification: \( x_i = [1/2 + \theta (p_j - p_i)]/2 \).\(^{23}\) Taking first-order conditions for \( p_i \) and \( p_j \), and substituting back into the expected profit function yields the following expression for venture \( i \) second period expected profits:

\[
\pi_i(q_i - q_j, \theta) = \left[ \frac{1}{2} + \frac{\theta (q_i - q_j)}{6} \right] \left[ \frac{1}{\theta} + \frac{(q_i - q_j)}{3} \right],
\]

where expected demand is \( x_i = 1/2 + \theta (q_i - q_j)/6 \), and price-cost margin is \( \bar{p}_i = p_i - a + q_i = 1/\theta + (q_i - q_j)/3 \).

Clearly the marginal impact of \( e_i \)'s effort on expected profits is positive: Effort increases both expected demand, and the equilibrium price-cost margin. Since the share of expected profits extracted by \( e_i \) under joint control is higher than under investor control, but lower than under entrepreneur control, incentives to exert effort should vary accordingly. The following lemma captures this intuition:

**Lemma 2** For values of \( \theta \in \Theta, \Theta = (0, 3/2q^h] \), there exists a set of values for parameters \( q^h, q^l, \lambda, \varepsilon \) and \( c \), such that the following strategies are dominant for \( e_i, i = 1, 2 \): \( q^h \) under entrepreneur control, \( q^l \) under joint control, and “no participation” under investor control.

In the remainder of the paper we focus on values of \( \theta \in \Theta \) and on parameters \( q^h, q^l, \lambda, \varepsilon \) and \( c \), such that lemma 2 holds;\(^{24}\) and accordingly second period expected profits can be expressed as follows:

<table>
<thead>
<tr>
<th>( e_j ) ( e_i )</th>
<th>E Control</th>
<th>J Control</th>
<th>F control</th>
</tr>
</thead>
<tbody>
<tr>
<td>E Control</td>
<td>( \pi_i(q^h, q^h, \theta) )</td>
<td>( \pi_j(q^h, q^h, \theta) )</td>
<td>( \pi_i(0, q^h, \theta) )</td>
</tr>
<tr>
<td></td>
<td>( \pi_i(q^l, q^h, \theta) )</td>
<td>( \pi_j(q^h, q^l, \theta) )</td>
<td>( \pi_j(q^h, 0, \theta) )</td>
</tr>
<tr>
<td>J Control</td>
<td>( \pi_i(q^h, q^l, \theta) )</td>
<td>( \pi_j(q^h, q^l, \theta) )</td>
<td>( \pi_i(0, q^l, \theta) )</td>
</tr>
<tr>
<td></td>
<td>( \pi_j(q^l, q^h, \theta) )</td>
<td>( \pi_j(q^l, q^l, \theta) )</td>
<td>( \pi_j(q^l, 0, \theta) )</td>
</tr>
<tr>
<td>F Control</td>
<td>( \pi_i(q^h, 0, \theta) )</td>
<td>( \pi_j(q^l, 0, \theta) )</td>
<td>( \pi_i(0, 0, \theta) )</td>
</tr>
<tr>
<td></td>
<td>( \pi_j(0, q^h, \theta) )</td>
<td>( \pi_j(0, q^l, \theta) )</td>
<td>( \pi_j(0, 0, \theta) )</td>
</tr>
</tbody>
</table>

Table II: Efforts and expected profits as function of control right allocation

\(^{23}\)The consumer located at \( \psi \) is indifferent between firms 1 and 2 if and only if \( V_1 = V_2 \), or \( y - p_1 - t\psi = y - p_2 - t(1 - \psi) \). Solving for \( \psi \), we get the expected demands for firms 1 and 2, respectively: \( x_1 = \psi \) or \( x_1 = (1/2 + (p_2 - p_1)/2t) = (1/2 + \theta (p_2 - p_1) /2) \), and \( x_2 = (1 - \psi) \).

\(^{24}\)Note that we can make \( \Theta \) arbitrarily large or small, depending on what we assume about parameter \( q^h \).
As before, we assume that by default $e_i, i = 1, 2$, owns the venture in period 1 and costlessly diverts the entire realized profit $P_i$ at date 1. Again, we place an upper bound on $K$ to ensure the feasibility of contracts under bank financing and VC financing: $K \leq \min (\pi_i (0, q^h, \theta), (1 - \lambda) \pi_i (q', q^h, \theta))$, for all $\theta \in \Theta$.

### 3.3 Two types of Financier

Clearly, since the timing and payoff structure is the same in this duopoly model as it was in section 2, the types of contract offered remain the same also: The debt-type contract offered under bank financing and the equity-type contract offered under VC financing are still optimal here. However the type of contract chosen will affect how ventures compete with one another; and will itself be affected by the exogenous degree of competition in the industry. This is the focus of our analysis in the remainder of this paper.

### 4 Financing Choice When Rival Chooses VC Financing

We start by considering the optimal financing choice for $e_i$ given that $e_j, j \neq i$, chooses VC financing. We examine bank financing and VC financing in turn, proceeding by backward induction.

#### 4.1 Bank Financing

##### 4.1.1 Second Period Competition

Consider first the case where venture $i$ is successful at date 1. In that case $e_i$ repays $D_i$ to $f_i$ and retains ownership of the venture, exerting high effort and generating marginal cost $mc_i = a - q^h$. In contrast $e_j$, who is facing joint control, exerts low effort, generating marginal cost $mc_j = a - q'$. Given these marginal costs, price-cost margins $\bar{p}_i (q^h, q', \theta) = 1/\theta + (q^h - q') / 3$ and $\bar{p}_j (q', q^h, \theta) = 1/\theta + (q' - q^h) / 3$ and expected profits $\pi_i (q^h, q', \theta) - c$ and $\pi_j (q', q^h, \theta)$ can easily be obtained from expression (3).

If venture $i$ is unsuccessful at date 1, $e_i$ cannot repay $D_i$ and must default. Consequently $f_i$ obtains ownership of the venture and puts in place a replacement manager who produces zero effort, generating marginal cost $mc_i = a$. As before, $e_j$ still faces marginal cost $mc_j = a - q'$. Here price-cost margins can be expressed as $\bar{p}_i (0, q', \theta) = 1/\theta - q'/3$ and $\bar{p}_j (q', 0, \theta) = 1/\theta + q'/3$, with expected
profits \( \pi_i (0, q^l, \theta) \) and \( \pi_j (q^l, 0, \theta) \).

### 4.1.2 First Period Competition

Proceeding by backward induction, at date 0 \( e_i \) and \( e_j \) choose price \( P_{ibv} \) and debt repayment \( D_{ibv} \), and price \( P_{jvb} \) and transfer \( T_{jvb} \), respectively, to maximize their expected payoffs.\(^{25}\) The optimal strategy for \( e_i \) and \( e_j \) is to choose prices to maximize total expected surplus, and to use \( D_{ibv} \) and \( T_{jvb} \), respectively, to extract all ex ante rents. Accordingly, first period prices ought to maximize the following programs:

\[
\begin{align*}
\max_{P_{ibv}} & \quad X_{ibv} \left[ P_{ibv} + \left( \pi_i \left( q^h, q^l, \theta \right) - c \right) \right] + \left[ 1 - X_{ibv} \right] \pi_i \left( 0, q^l, \theta \right), \\
\max_{P_{jvb}} & \quad X_{jvb} \left[ P_{jvb} + \pi_j \left( q^l, 0, \theta \right) \right] + \left[ 1 - X_{jvb} \right] \pi_j \left( q^l, q^h, \theta \right),
\end{align*}
\]

where first period expected demand again follow from the Hotelling specification (see footnote 23):

\[
X_i = \left[ 1/2 + \theta \left( P_j - P_i \right) / 2 \right] \quad \text{and} \quad X_j = 1 - X_i.
\]

Venture \( i \)'s maximization program for the first period is different from the static maximization which occurs in the second period. Here, as discussed, venture \( i \)'s marginal cost, and hence its expected profit in the second period, depend on the outcome of the first period. Indeed, entrepreneurs \( e_i \) and \( e_j \) understand that there is a surplus to be gained from selling the product in the first period. For \( e_i \), success in the first period allows her to gain a cost advantage \( q^h - q^l \) over rival \( e_j \), leading to an expected net profit \( \pi_i \left( q^h, q^l, \theta \right) - c \); whereas failure to sell in the first period would mean default, and a cost disadvantage \( q^l \) in the second period, with an expected net profit \( \pi_i \left( 0, q^l, \theta \right) \). Thus, venture \( i \)'s “surplus from continuation” is \( s_{ibv} = \left( \pi_i \left( q^h, q^l, \theta \right) - c \right) - \pi_i \left( 0, q^l, \theta \right) \).

For \( e_j \), there is an incentive for predation. A bad outcome for venture \( i \) in the first period is a good outcome for \( e_j \): it means a cost advantage \( q^l \), and an expected net profit \( \pi_j \left( q^l, 0, \theta \right) \). Vice versa she suffers a cost disadvantage \( q^h - q^l \) and expects a net profit \( \pi_j \left( q^l, q^h, \theta \right) \) when venture \( i \) is successful in the first period. We can thus express venture \( j \)'s “surplus from predation” as \( s_{jvb} = \pi_j \left( q^l, 0, \theta \right) - \pi_j \left( q^l, q^h, \theta \right) \). Now we can re-write (4) in terms of surplus from continuation and surplus

\(^{25}\)The first subscript identifies the venture, the second identifies that firm’s financing choice (“b” for “bank” and “v” for “VC”), and the third identifies the rival’s financing choice.
Lemma 3

Under bank financing, a larger cost advantage leads to higher profits. We will refer back to these observations below. In sum: for venture marginal costs. Second, note that maximization in the second period, simply interpreting surpluses (3). The reason is simple: the maximization of the bonus in the first period is equivalent to profit maximization in the second period, simply interpreting surpluses $s_{ibe}(\theta)$ and $s_{jvb}(\theta)$ as negative marginal costs. Second, note that $e_i$’s bonus is strictly increasing in the surplus differential $s_{ibe}(\theta) - s_{jvb}(\theta)$, while $e_j$’s bonus is strictly decreasing in that surplus differential: A bigger surplus advantage for venture $i$ is equivalent to a larger cost advantage, and leads to a bigger bonus for the same reason a larger cost advantage leads to higher profits. We will refer back to these observations below. In sum:

Lemma 3 Under bank financing, $e_i$’s equilibrium payoff can be expressed as the sum $M_{ibe}(\theta) + B_{ibe}(s_{ibe}(\theta) - s_{jvb}(\theta), \theta)$ of a minimum expected return $M_{ibe}$ and an expected bonus from short-term success $B_{ibe}$. Similarly, $e_j$’s equilibrium payoff can be expressed as $M_{jvb}(\theta) + B_{jvb}(s_{jvb}(\theta) - s_{ibe}(\theta), \theta)$. 

\[
\max_{P_{ibe}} X_{ibe} (P_{ibe}, P_{jvb}, \theta) [P_{ibe} + s_{ibe}(\theta)] + \pi_i \left( 0, q^i, \theta \right),
\]

\[
\max_{P_{jvb}} X_{jvb} (P_{jvb}, P_{ibe}, \theta) [P_{jvb} + s_{jvb}(\theta)] + \pi_j \left( q^j, q^h, \theta \right),
\]

where as in the simple model of section 2, the entrepreneurs’ payoffs can be expressed as the sum of a minimum expected return and an expected bonus from short-term success: Indeed $\pi_i \left( 0, q^i, \theta \right) = M_{ibe}(\theta)$ and $\pi_j \left( q^j, q^h, \theta \right) = M_{jvb}(\theta)$ capture the minimum expected returns for ventures $i$ and $j$, respectively; and $X_{ibe} [P_{ibe} + s_{ibe}] = B_{ibe}$ and $X_{jvb} [P_{jvb} + s_{jvb}] = B_{jvb}$ capture the expected bonus from short term success for ventures $i$ and $j$, respectively.

One can easily derive the optimal first period prices $P_{ibe} = 1/\theta - (2s_{ibe}(\theta) + s_{jvb}(\theta)) / 3$ and $P_{jvb} = 1/\theta - (2s_{jvb}(\theta) + s_{ibe}(\theta)) / 3$, and the resulting expected demands, or probabilities of short-term success, $X_{ibe} = 1/2 + \theta (s_{ibe}(\theta) - s_{jvb}(\theta)) / 6$ and $X_{jvb} = 1/2 + \theta (s_{jvb}(\theta) - s_{ibe}(\theta)) / 6$. Substituting these back into expected bonus functions, we obtain:

\[
B_{ibe} (s_{ibe}(\theta) - s_{jvb}(\theta), \theta) = \left[ 1/2 + \theta (s_{ibe}(\theta) - s_{jvb}(\theta)) / 6 \right] \left[ 1/\theta + (s_{ibe}(\theta) - s_{jvb}(\theta)) / 3 \right],
\]

\[
B_{jvb} (s_{jvb}(\theta) - s_{ibe}(\theta), \theta) = \left[ 1/2 + \theta (s_{jvb}(\theta) - s_{ibe}(\theta)) / 6 \right] \left[ 1/\theta + (s_{jvb}(\theta) - s_{ibe}(\theta)) / 3 \right].
\]

Two points should be stressed here. First, note that the expressions for these bonuses as functions of surpluses are isomorphic to the expressions of expected profits as functions of efforts depicted in (3). The reason is simple: the maximization of the bonus in the first period is equivalent to profit maximization in the second period, simply interpreting surpluses $s_{ibe}(\theta)$ and $s_{jvb}(\theta)$ as negative marginal costs. Second, note that $e_i$’s bonus is strictly increasing in the surplus differential $s_{ibe}(\theta) - s_{jvb}(\theta)$, while $e_j$’s bonus is strictly decreasing in that surplus differential: A bigger surplus advantage for venture $i$ is equivalent to a larger cost advantage, and leads to a bigger bonus for the same reason a larger cost advantage leads to higher profits. We will refer back to these observations below. In sum:
4.2 VC Financing

This type of financing is very simple. In the second period, joint control is the state-independent allocation of property rights, and both $e_i$ and $e_j$ exert effort $q^l$, yielding marginal cost $mc_i = mc_j = a - q^l$, have the same price-cost margins $\bar{p}_i (q^l, q^l, \theta) = \bar{p}_j (q^l, q^l, \theta) = 1/\theta$, and obtain the same expected profit, which can easily be obtained from Table II: $\pi_i (q^l, q^l, \theta) = \pi_j (q^l, q^l, \theta)$. This is so regardless of success or failure at date 1.

At date 0, $e_i$ and $e_j$ choose prices to maximize the following program of total expected profits, using $T_i$ and $T_j$ to extract all rents:

$$\begin{align*}
\max_{P_{ivv}} & \quad X_{ivv} (P_{ivv}, P_{jvv}, \theta) P_{ivv} + \pi_i (q^l, q^l, \theta), \\
\max_{P_{jvv}} & \quad X_{jvv} (P_{jvv}, P_{ivv}, \theta) P_{jvv} + \pi_j (q^l, q^l, \theta),
\end{align*}$$

(8)

where $\pi_i (q^l, q^l, \theta) = M_{ivv} (\theta)$, and $\pi_j (q^l, q^l, \theta) = M_{jvv} (\theta)$ represent minimum expected payoffs; and where $X_{ivv} (P_{ivv}, P_{jvv}, \theta) P_{ivv} = B_{ivv} (P_{ivv}, P_{jvv}, \theta)$ and $X_{jvv} (P_{jvv}, P_{ivv}, \theta) P_{jvv} = B_{jvv} (P_{jvv}, P_{ivv}, \theta)$ represent expected bonuses. Expected bonuses here are equal to first period profits (since as in the simple model of section 2, under VC financing there are no second period surpluses $s$), and hence this boils down to simple static profit maximization, yielding $P_{ivv} = P_{jvv} = 1/\theta$, $X_{ivv} = X_{jvv} = 1/2$, and $B_{ivv} (\theta) = B_{jvv} (\theta) = 1/2\theta$. Thus:

**Lemma 4** Under VC financing, $e_i$‘s equilibrium payoff can be expressed as the sum $M_{ivv} (\theta) + B_{ivv} (\theta)$ of a minimum expected return $M_{ivv}$ and an expected bonus from short-term success $B_{ivv}$. Similarly, $e_j$‘s expected equilibrium payoff can be expressed as $M_{jvv} (\theta) + B_{jvv} (\theta)$.

4.3 Impact of Financing Choice on Competitive Behavior

The foregoing analysis makes it clear that the financing choice has an impact on the competitive behavior of the rivals. Note that rival $j$‘s first period price is lower under bank financing than under VC financing: $P_{jvb} < P_{jvv}$. This is the predatory behavior to which we referred earlier: when $e_i$ chooses bank financing, $e_j$ has an additional incentive to lower the price, in an attempt to induce date 1 failure and default for $e_i$, because it would result in a predation surplus $S_{jvb}$ for $e_j$, a surplus which is not present under VC financing where there is no problem of default.

Venture $j$‘s predatory behavior towards bank financed venture $i$ is similar to that of internally
financed venture “A” towards debt financed venture “B” in Bolton and Scharfstein’s (1990) model.\textsuperscript{26} However, they model competition and predation in the simplest way possible and assume that venture \textit{B} “sits quietly” while venture \textit{A} preys in the first period: Venture \textit{A} can unilaterally increase the probability of the bad state occurring for venture \textit{B}.\textsuperscript{27} In contrast we propose a richer model of competition and predation. Venture \textit{i} as well as venture \textit{j} make (pricing) decisions in the first period. Thus, under bank financing, while venture \textit{j} lowers prices for predatory purposes, venture \textit{i} also lowers prices for default prevention purposes: \( P_{ibv} < P_{ivv} \). Indeed, the first point to note is that here both firms charge lower prices in the first period when venture \textit{i} chooses bank financing.

The second noteworthy point is that the net effect of these pricing choices on the probability of short term success for venture \textit{i} is ambiguous, and this probability need not necessarily be lower under bank financing than under VC financing, in contrast to Bolton and Scharfstein. Indeed, if \( s_{ibv} > s_{jvb} \) bank-financed venture \textit{i} has more to gain from first period success than its rival \textit{j}, and equilibrium first period prices reflect this: \( P_{ibv} < P_{jvb} \). In that case, venture \textit{i}’s probability of short-term success under bank financing is \( X_{ibv} > 1/2 \), i.e. higher than under VC, where \( X_{ivv} = 1/2 \).

Finally, note that the financing choice also has an impact on second period prices: Conditional on succeeding in the first period, in the second period venture \textit{i} charges a higher price (controlling for cost) under bank financing than under VC financing, \( \bar{p}_{i} (q^h, q^l, \theta) > \bar{p}_{i} (q^l, q^l, \theta) \); Condition on being successful in the first period, bank financing enables \( e_{i} \) to retain full control over the venture, and hence generates strong incentives. This in turn leads to lower cost and to higher price-cost margins. Thus, three results emerge here:

**Proposition 2** Comparing bank financing with VC financing for \( e_{i} \), we find that: 1) First period prices for ventures \textit{i} and \textit{j} are both lower under bank financing than under VC financing; 2) Venture \textit{i}’s probability of short-term success need not be lower under bank financing - despite predatory behavior by \( e_{j} \) - than under VC financing, indeed it may be higher; 3) Conditional on succeeding in the first period, second period prices for venture \textit{i} are higher under bank financing than under VC financing.

A final point to underline here is that these dynamic incentive issues - venture 1’s incentive to avoid

\textsuperscript{26}Bad short term performance and consequent default for debt-financed firms \textit{i} and \textit{B} means higher expected profit for firms \textit{j} and \textit{A}. Consequently, firms \textit{j} and \textit{A} have an incentive to prey on their externally financed rival, and will attempt to increase the probability of failure of firms \textit{i} and \textit{B}. In a somewhat different context, Mathews and Robinson (2008) recently showed that a firm’s organizational structure, rather than its financing, might invite predatory behavior from rivals (using capital raising rather than pricing).

\textsuperscript{27}The only way venture \textit{B} can affect venture \textit{A}’s predatory behavior and its impact is by changing the terms of the initial debt contract in an attempt to reduce incentives to prey.
liquidation and venture 2’s incentives to prey - are related to the literature on the strategic effects of
debt pioneered by Brander and Lewis (1986)\textsuperscript{28}. They argue that debt is a commitment device which
shifts a venture’s reaction curve. In a “strategic substitutes” model, debt allows a venture to commit
to higher output, thus inducing a reduction in output by its rival, and higher payoff for the leveraged
venture.\textsuperscript{29} As confirmed by Showalter (1995), in a model with “strategic complements”, debt allows
a venture to commit to higher prices by shifting its reaction curve upwards. This induces the rival to
raise prices too - with a movement along its reaction curve - thus increasing the leveraged venture’s
payoff.

In contrast in our model, debt has the opposite effect: it commits the venture to charging lower
prices in the first period, in order to minimize the likelihood of default; it shifts the venture’s reaction
curve downwards. Moreover it also shifts the rival’s reaction curve, reflecting its increased incentives
to prey. The firms’ expected payoff depend on the relative shifts of the reaction curves, which are
themselves functions of second period surpluses. In the second period, debt increases prices - condi-
tional on not defaulting in period 1 - a result similar to Showalter (1995), but for different reasons: here increased efficiency enables the entrepreneur to raise the price-cost margin.

4.4 Impact of Competition on the Financing Choice

We now turn to one of the primary issues addressed in this paper: The impact of competition θ on
the attractiveness of bank financing compared to VC financing for \(e_i\). Bringing together Lemmas 3
and 4, we can express this relative attractiveness in equilibrium as follows:

\[
[B_{i\text{be}} (s_{i\text{be}} (θ) - s_{j\text{be}} (θ), θ) - B_{i\text{vv}} (θ)] - [M_{i\text{vv}} (θ) - M_{i\text{be}} (θ)] \geq 0.
\] (9)

It is easy to see that the minimum expected return is lower under bank financing than under VC
financing: \(M_{i\text{vv}} (θ) = \pi_i (q_i, q_i, θ) > \pi_i (0, q_i, θ) = M_{i\text{be}} (θ)\). Intuitively, under VC financing \(e_i\) will
always exert least quality effort \(q_i\) in period 2; while under bank financing in the worst case scenario
(default), the equilibrium effort exerted is zero.

\textsuperscript{28}See also Maksimovic (1988), Poitevin(1989), Glazer (1994), Showalter (1995), Faure-Grimaud (2000), and Povel and
\textsuperscript{29}Faure-Grimaud (2000) and Povel and Raith (2004) introduce contractual incompleteness and optimal contracting
elements from Bolton and Scharfstein (1990) into Brander and Lewis’ (1986) Cournot oligopoly framework, and find that
debt may actually commit the firm to reduce output.
As for the bonus from short-term success, it could be either higher, or lower, under bank financing than under VC financing, depending on the relative sizes of \( s_{ibv}(\theta) \) and \( s_{jvb}(\theta) \). This is different from the simple model described in section 2, where the bonus differential was always strictly positive. Here, if by choosing bank financing, venture \( i \) can gain a surplus advantage over venture \( j \), i.e. if \( s_{ibv}(\theta) - s_{jvb}(\theta) > 0 \), then it will obtain a higher expected bonus than under VC financing, where both firms are on equal footing. Conversely if venture \( i \) has a surplus disadvantage relative to venture \( j \) under bank financing, then its expected bonus will be higher with VC financing.\(^{30}\)

The difference \( s_{ibv}(\theta) - s_{jvb}(\theta) \) simplifies to \( \theta q^h (q^h - 2q^j) / 9 - c \). Clearly, when \( 2q^j < q^h \), \( s_{ibv} - s_{jvb} < 0 \) for all values of \( \theta \in \Theta \), in which case \( B_{ibv}(s_{ibv}(\theta) - s_{jvb}(\theta), \theta) < 0 \) and bank financing is always strictly dominated by VC financing. In the analysis that follows, we assume that \( 2q^j \) is sufficiently small relative to \( q^h \) to have \( s_{ibv}(\theta) - s_{jvb}(\theta) > 0 \) for at least some values of \( \theta \in \Theta \). Thus:

**Proposition 3**  As in the simple model of section 2, bank financing is superior to VC financing if and only if its (possible) advantage in terms of expected bonus from short-term success more than offsets its disadvantage in terms of minimum expected return.

To understand the effects of competition on the tradeoff depicted in (9), note that both \( M_{ivv}(\theta) - M_{ibv}(\theta) \) and \( B_{ibv}(s_{ibv}(\theta) - s_{jvb}(\theta), \theta) - B_{ivv}(\theta) \) can be expressed as, or are isomorphic to,\(^{31}\) differences between two profit functions. We must therefore start by examining how competition affects profit differentials. This is the purpose of the next subsection.

### 4.4.1 Preliminary Remarks: Business Stealing and Rent Reduction Effects

Consider expression (3). These second period expected profits for venture \( i \) can be written as a function of venture \( i \)'s cost advantage over venture \( j \), \( \Delta_i = q_i - q_j \) and of the degree of competition \( \theta \): \( \pi_i(\Delta_i, \theta) = x_i(\Delta_i, \theta) \bar{p}_i(\Delta_i, \theta) \). Competition affects expected profits in two ways: \( d\pi_i/d\theta = (dx_i/d\theta) \bar{p}_i + (d\bar{p}_i/d\theta) x_i \). First, by making demand more elastic, competition enables the cost leader to increase her demand advantage over her higher cost rival. Thus, through this *business stealing effect*, competition favors \( e_i \) if and only if she is cost leader: \( (dx_i/d\theta) \bar{p}_i > 0 \) if and only if \( \Delta_i > 0 \). Second, as competition increases - transport cost falls - consumers can “travel” more easily and become more

\(^{30}\)Formally, \( B_{ibv}(s_{ibv}(\theta) - s_{jvb}(\theta), \theta) - B_{ivv}(\theta) = \frac{s_{ibv}(\theta) - s_{jvb}(\theta)}{3}(1 + \frac{\theta(s_{ibv}(\theta) - s_{jvb}(\theta))}{6}) \). Following Lemma 2, \( 1 + \frac{\theta(s_{ibv}(\theta) - s_{jvb}(\theta))}{6} \geq 0 \), so \( B_{ibv}(s_{ibv}(\theta) - s_{jvb}(\theta), \theta) \geq B_{ivv}(\theta) \) if and only if \( s_{ibv}(\theta) - s_{jvb}(\theta) \geq 0 \).

\(^{31}\)See our discussions immediately preceding Lemmas 3 and 4.
sensitive to prices, forcing firms to compete more fiercely and to lower their margins (prices). This *rent-reduction effect* of competition unambiguously reduces expected profits: 

\[ (d\bar{p}_i/d\theta) x_i < 0. \]

Now suppose marginal costs change, leading to a new cost difference \( \Delta'_i = q'_i - q'_j \), with \( \Delta_i, \Delta'_i \leq 0 \) but \( \Delta'_i > \Delta_i \): The cost advantage (resp. disadvantage) is higher (resp. lower) under \( \Delta'_i \) than under \( \Delta_i \). The resulting new expected profit can be written \( \pi'_i (\Delta'_i, \theta) \), and hence the impact of the change in marginal costs on venture \( i \)'s expected profit can be expressed as:

\[
\pi'_i (\Delta'_i, \theta) - \pi_i (\Delta_i, \theta) = x'_i (\Delta'_i, \theta) \bar{p}'_i (\Delta'_i, \theta) - x_i (\Delta_i, \theta) \bar{p}_i (\Delta_i, \theta). \tag{10}
\]

Note that both \( M_{ivv} (\theta) - M_{ibv} (\theta) \) and \( B_{ibv} (s_{iibv} (\theta) - s_{jbv} (\theta), \theta) - B_{ivv} (\theta) \) can be expressed in this way. To examine the impact of competition on the change in profits resulting from a change in marginal costs, we differentiate with respect to \( \theta \):

\[
\frac{d}{d\theta} (\pi'_i - \pi_i) = \left[ \frac{dx'_i}{d\theta} \bar{p}'_i - \frac{dx_i}{d\theta} \bar{p}_i \right] + \left[ \frac{d\bar{p}_i}{d\theta} x'_i - \frac{d\bar{p}_i}{d\theta} x_i \right],
\]

where the first and second squared brackets capture the Differential Business Stealing (DBS) and the Differential Rent Reduction (DRR), respectively.

To understand the signs of the DBS and DRR, and the net impact of competition on the profit differential, let us depict the business stealing effect \( (dx_i/d\theta) \bar{p}_i \) and the rent reduction effect \( (d\bar{p}_i/d\theta) x_i \) graphically as functions of competitive advantage \( \Delta_i \) in Figure 1:

[Insert Figure 1 here]

Figure 1 illustrates three key results: First, the rent-reduction effect of competition is decreasing in venture \( i \)'s competitive advantage. This result comes from a combination of two things: i) The marginal impact of competition on equilibrium prices is independent of competitive advantage \( (d^2\bar{p}_i/d\theta d\Delta_i = 0) \); and 2) Having a bigger competitive advantage leads to a larger expected demand \( (dx_i/d\Delta_i = 0/\theta > 0) \). This in turn implies that the negative “demand-weighted” impact of a price fall on expected profits will grow stronger as \( \Delta_i \) increases. The implication of this first result is simple: the DRR effect of competition on the profit differential must be negative.

The second key result illustrated in Figure 1 is that the business stealing effect of competition is generally increasing in \( \Delta_i \). This result comes from the fact that \( d^2x_i/d\theta d\Delta_i > 0 \): The impact of
competition on the amount of business that $e_i$ can steal from her rival is increasing in venture $i$’s competitive advantage. The immediate implication, then, is that the DBS effect of competition on the profit differential must be generally positive.

Finally, Figure 1 underlines the contrast between the linearity of the rent-reduction effect and the convexity of the business stealing effect. This is important because it suggests that for a given $\Delta_i' - \Delta_i$, the DBS effect will increase with the size of $\Delta_i$ and $\Delta_i'$ (due to convexity), while the DRR will not (due to linearity). As a result, the impact of competition on the profit differential will be positive if and only if $\Delta_i$ and $\Delta_i'$ are sufficiently large. Indeed, one can show that $d(\pi_i' - \pi_i)/d\theta \geq 0$ if and only if $\Delta_i + \Delta_i'$ is positive.

Interestingly, $\Delta_i + \Delta_i'$ can be expressed as $(mc_j' - mc_i') - (mc_i - mc_j)$, i.e. as the difference between venture $i$’s cost advantage over venture $j$ ex post and its cost disadvantage relative to its rival ex ante. When this difference is positive (resp. negative), competition increases (resp. decreases) the profit differential. Consider for example the case where $e_i$ is at cost disadvantage relative to $e_j$ ex ante, but “catches up” to be on equal footing with her rival ex post. In this case $(mc_j' - mc_i') - (mc_i - mc_j) < 0$, the DBS is not strong enough to offset the DRR, and competition reduces the profit differential. Conversely, suppose that $e_i$ and $e_j$ are on equal footing regarding marginal costs ex ante, but that $e_i$ “distances” herself from her rival by gaining a cost advantage ex post. In that case $(mc_j' - mc_i') - (mc_i - mc_j) > 0$, the DBS dominates the DRR, and competition increases the profit differential. We summarize these results in the following lemma:

**Lemma 5** The differential expected profit $\pi_i' - \pi_i$ associated with a change in the rivals’ marginal costs is 1) negatively affected by the DRR effect of competition: $(d\pi_i'/d\theta) x_i' - (d\pi_i/d\theta) x_i < 0$; 2) generally positively affected by the DBS effect of competition: $(dx_i'/d\theta) \bar{p}_i' - (dx_i/d\theta) \bar{p}_i > 0$; and 3) overall positively affected by competition if and only if venture $i$’s cost advantage ex post is larger than its disadvantage ex ante - $(mc_j' - mc_i') - (mc_i - mc_j) > 0$ - in which case DBS dominates DRR.

We can now use the results of lemma 5 to examine the impact of competition on financing.

---

32 More formally, $d[(dx_i/d\theta) \bar{p}_i]/d\Delta_i$ can be expressed as $(d^2 x_i/d\theta d\Delta_i) \bar{p}_i + (dx_i/d\theta) (d\bar{p}_i/d\Delta_i)$. The first factor is the one highlighted in the text and is always positive. The second factor, which capture the impact of the increase in $\bar{p}_i$ associated with an increase in $\Delta_i$, is positive if $\Delta_i \geq 0$ and negative otherwise. In the former case the second factor reinforces the first one. In the latter case, the second factor mitigates the first one; but the first positive effect generally dominates, except for very low values of $\Delta_i$, as verified in the appendix.
4.4.2 Competition and Minimum Expected Return Differential

The minimum expected return differential $M_{ivv}(\theta) - M_{ibv}(\theta)$, where $M_{ivv}(\theta) = \pi_i(q^i, q^j, \theta)$ and $M_{ibv}(\theta) = \pi_i(0, q^j, \theta)$, captures the advantage of VC financing over bank financing: Following failure at date 1, while bank financing leaves venture $i$ at a cost disadvantage relative to venture $j$, VC financing enables venture $i$ to catch up with its rival. As discussed above, this is situation where the DBS is relatively weak, too weak to offset the DRR, and overall competition has negative impact on this differential:

**Proposition 4** The minimum expected return differential, $M_{ivv}(\theta) - M_{ibv}(\theta)$, decreases with the degree of competition. More formally, $d(M_{ivv}(\theta) - M_{ibv}(\theta)) / d\theta < 0$.

4.4.3 Competition and Bonus from Short-Term Success Differential

The impact of competition on the bonus differential - $B_{ibv}(s_{ibv}(\theta) - s_{jbv}(\theta), \theta) - B_{ivv}(\theta)$ - can be expressed as follows:

\[
\frac{d(B_{ibv}(s_{ibv}(\theta) - s_{jbv}(\theta), \theta) - B_{ivv}(\theta))}{d\theta} = \frac{\partial(B_{ibv}(s_{ibv}(\theta) - s_{jbv}(\theta), \theta) - B_{ivv}(\theta))}{\partial\theta} \\
+ \frac{\partial B_{ibv}(s_{ibv}(\theta) - s_{jbv}(\theta), \theta)}{\partial(s_{ibv}(\theta) - s_{jbv}(\theta))} \frac{\partial(s_{ibv}(\theta) - s_{jbv}(\theta))}{d\theta}. 
\]  

(11)

To understand the sign of the impact of competition, note first that $B_{ibv}(s_{ibv}(\theta) - s_{jbv}(\theta), \theta) - B_{ivv}(\theta)$ also represents an expected profit differential of the form described in (10), this time with $\Delta^i = s_{ibv}(\theta) - s_{jbv}(\theta)$ and $\Delta_j = 0$, i.e. where surpluses replace marginal costs.

The first partial derivative on the right-hand side of (11) can easily be shown to be strictly positive. Consider for instance the case where $s_{ibv}(\theta) - s_{jbv}(\theta) \geq 0$. In that case, under VC financing venture $i$ enjoys the same surplus (zero) as venture $j$, and under bank financing it enjoys a strictly higher surplus than venture $j$; and hence choosing bank financing over VC financing enables $e_i$ to gain an advantage over and distance herself from her rival. As discussed above, in such situations the DBS is strong enough to offset the DRR, and in turn this results in $\partial(B_{ibv}(s_{ibv}(\theta) - s_{jbv}(\theta), \theta) - B_{ivv}(\theta)) / d\theta > 0.33$

The second partial derivative on the right-hand side of (11) is also strictly positive: As discussed above, the bigger the surplus advantage of venture $i$ over venture $j$ under bank financing, $s_{ibv}(\theta) - s_{jbv}(\theta)$.

33Similarly, if $s_{ibv}(\theta) - s_{jbv}(\theta) < 0$, $B_{ibv}(s_{ibv}(\theta) - s_{jbv}(\theta), \theta) - B_{ivv}(\theta)$ is now negative: it is VC financing which yields the bigger bonus from short-term success. But here it is DRR which dominates DBS; so the bonus differential shrinks, and we still get $\partial(B_{ibv}(s_{ibv}(\theta) - s_{jbv}(\theta), \theta) - B_{ivv}(\theta)) / d\theta > 0$. 

23
Finally, note that \( s_{ibv}(\theta) = (\pi_i(q^h, q^l, \theta) - c) - \pi_i(0, q^l, \theta) \) and \( s_{jvb} = \pi_j(q^l, 0, \theta) - \pi_j(q^l, q^h, \theta) \) are expected profit differentials of the form described in (11). Recalling that \( q^h \gg 2q^l \), it then follows immediately that in the case of \( s_{ibv}(\theta) \) (resp. \( s_{jvb} \)) venture \( i \)'s (resp. \( j \)'s) ex post cost advantage is larger (resp. smaller) than its ex ante disadvantage, and hence the DBS is (resp. not) strong enough to offset the DRR effect of competition. Accordingly, \( ds_{ibv}(\theta)/d\theta > 0 \) and \( ds_{jvb}(\theta)/d\theta < 0 \), which in turn implies \( d(s_{ibv} - s_{jvb})/d\theta > 0 \). From the foregoing discussion the next proposition immediately follows:

**Proposition 5** The bonus differential, \( B_{ibv}(s_{ibv}(\theta) - s_{jvb}(\theta), \theta) - B_{ivv}(\theta) \), increases with product market competition. More formally, \( d(B_{ibv}(s_{ibv}(\theta) - s_{jvb}(\theta), \theta) - B_{ivv}(\theta))/d\theta > 0 \).

Bringing Propositions 4 and 5 together, it then follows that when rival \( j \) plays VC financing, competition unambiguously increases the attractiveness of bank financing relative to VC financing. The broad intuition is simple: The advantage of VC financing over bank financing, which occurs following failure at date 1, involves catching up with one’s rival (in terms of marginal costs); while the advantage of bank financing over VC financing, which occurs following success at date 1, involves distancing one’s rival. Competition, which tends to reduce the benefit from catching up and to increase the benefit from distancing, unambiguously favors bank financing. More specifically, we show in the appendix that:

**Proposition 6** For sufficiently low values of \( q^l \) and \( \lambda \), there exists a threshold level of competition \( \theta^* \in \Theta \), such that bank financing is optimal when \( \theta \geq \theta^* \), and VC financing is optimal when \( \theta < \theta^* \). Otherwise, VC financing is optimal for all \( \theta \in \Theta \).

In the remainder of the paper we assume that \( q^l \) and \( \lambda \) are sufficiently low for \( \theta^* \in \Theta \), and discuss what would happen otherwise whenever relevant.

### 5 Competition and Industry Equilibrium

Before determining the industry equilibrium in financing choice as a function of the degree of competition \( \theta \), the optimal financing choice for \( e_i \) given that \( e_j \) chooses bank financing must be considered.

Unsurprisingly, the intuitions and results in this case are qualitatively similar to the intuitions and results obtained in the case where \( e_j \) chooses VC financing, which we described in detail in Section
4. For practical purposes, and to avoid redundancies, here in the main text we simply state the main results, and refer the reader to section A.1 in the appendix for details, where all related results are explicitly derived:

**Proposition 7** The results of the model when rival $j$ chooses bank financing are qualitatively similar to the results obtained when rival $j$ chooses VC financing. In particular: 1) First period prices for ventures $i$ and $j$ are both lower when $e_i$ chooses bank financing rather than VC financing; 2) Venture $i$’s probability of short-term success need not be lower under bank financing - despite predatory behavior by $e_j$ - than under VC financing, indeed it may be higher; 3) Conditional on succeeding in the first period, second period prices for venture $i$ are higher under bank financing than under VC financing; 4) For sufficiently low values of $\lambda$ and $d^l$, there exists a threshold $\theta^{**} < \theta^*$ such that bank financing is optimal when $\theta \geq \theta^{**}$, and VC financing is optimal otherwise.

The main result of the paper then follows directly from propositions 6 and 7: Product market competition gradually shifts the industry equilibrium from more VC-provided equity financing to more bank-provided debt financing. We depict this result graphically in Figure 2, and state it more formally in the following proposition:\footnote{If parameters were such that $\theta^* \in \Theta$ didn’t exist (see Proposition 6), the industry equilibrium results would be qualitatively similar: When $\theta \leq \theta^{**}$, both entrepreneurs choose VC financing. Otherwise, either both entrepreneurs choose VC financing, or both choose bank financing.}

[Insert Figure 2 here]

**Proposition 8** If competition is weak ($\theta \leq \theta^{**}$), the only (subgame-perfect Nash) equilibrium is one where both entrepreneurs choose VC financing. When competition is moderate ($\theta^{**} \leq \theta < \theta^*$), two equilibria can arise: either both entrepreneurs choose VC financing, or both choose bank financing. Finally, when competition is strong ($\theta \geq \theta^*$), the only equilibrium is one both entrepreneurs choose bank financing.

### 6 Empirical Implications

#### 6.1 Bank Financing Versus VC Financing

Our model highlights a simple tradeoff between bank financing and VC financing, and yields the following empirical prediction:
PREDICTION 1: Conditional on short term success, bank financing provides stronger entrepreneurial incentives, and superior effort and performance. Conditional on short term failure, it is VC financing which provides stronger entrepreneurial incentives, and superior effort and performance.

This prediction has three implications. First, it rests on the idea 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, Moskowitz and Vissing-Jorgensen (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 entrepreneurial effort 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 profits, and hence has “first-best” incentives, certainly stronger incentives than under VC financing where she must inevitably relinquish a significant fraction of profits to the venture capitalist.\(^{35}\)

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 profits, 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, even though in practice venture capitalists are known to be aggressive in that regard. Our goal here is to capture what we view as a compelling \textit{distinction} between debt contracts and equity-type contracts, namely that even a firm with good long term prospects is more likely to fail under bank financing, where for instance temporary cash flows shortages might be enough to lead to default and liquidation, than under VC financing, where such inefficient liquidations would not occur.\(^{36}\) 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 \textit{and} VC financing. Even in this richer environment, our prediction would still hold: incentives following

\(^{35}\)In practice, even if the entrepreneur has not yet repaid the debt entirely, as long as short term success ensure a small probability of default in the future, she essentially retains first-best incentives.

\(^{36}\)Recall that in our model short term failure says nothing about the intrinsic quality of the venture, and indeed both the banker and the venture capitalist know that loss of entrepreneurial control in the second period is inefficient. But while VC financing’s equity-type contract avoids the problem, bank financing’s debt contract unavoidably leads to loss of entrepreneurial control, and to inefficiency.
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.\footnote{One could also argue that in our model, VC financing appears insensitive to performance, despite the fact that empirical evidence suggests otherwise (e.g. Kaplan and Strömberg, 2003). This could also be addressed with a third state of the world like the one just described, but this would add little insight into the \textit{comparison} between bank financing and VC financing, which is our focus here.}

### 6.2 Product Market Competition and Financing Strategy

In a recent influential paper, Hellmann and Puri (2000) empirically examined the interaction between
product market and financing strategy in the context of entrepreneurial ventures, showing in particular
that VC-financed ventures are significantly faster in bringing a product to market. Our model suggests
a complementary interaction between product market and financing strategy, and indeed generates
several novel empirical implications for this interaction:

\textit{PREDICTION 2: Product market competition should increase the probability that entrepreneurs
choose bank-provided debt finance over equity financing provided by venture capitalists.}

This prediction is consistent with the recent work of Cosh, Cumming and Hughes (2009), who find
that entrepreneurs are more likely to choose bank financing, and less likely to choose VC financing, as
the number of competitors increases. Moreover, the probabilities of seeking bank financing and VC
financing are negatively and positively affected, respectively, by the degree of industry innovativeness.
To the extent that product markets in innovative industries are less competitive than in less innovative
industries (innovative products open up new markets with few competitors and/or more differentiated
products), this is also consistent with our prediction.

Unfortunately, little other work has been done so far on the interaction between product market
competition and financing strategy in entrepreneurial settings. However, this interaction has been
studied in the corporate finance literature, and Prediction 2 is also consistent with such findings. For
example, Titman and Wessel (1988) find that debt levels are negatively related to product unique-
ness - which is a good measure of the degree of horizontal differentiation $t$ (and therefore of lack of
competition $\theta = 1/t$) used in our model. Also in that literature, Kovenock and Phillips (1995) find
that recapitalization and increased debt financing are more likely in more concentrated industries.
Consistency between our prediction and their results are somewhat more ambiguous. If the indus-
tries from which their data is drawn are characterized by high barriers to entry and a relatively fixed number of firms - as is implicitly assumed in our interpretation of Cosh et al.’s (2009) result on the number of competitors - then Kovenock and Phillips’ result suggests that firms in less competitive industries use more debt, which is inconsistent with prediction 1. On the other hand, if the industries examined have relatively low barriers to entry this result could suggest that concentration actually reflects high competition (low rents to be had and hence few firms entering), implying a relationship between competition and debt financing that is consistent with our prediction. Looking more closely at the (commodity) industries from which the data is drawn - broadwoven fabrics, mattresses, paper products, polyethylene, flat glass, fiberglass, gypsum, car and consumer batteries, and tractor trailer - these do not seem to be subject to particularly high entry barriers.

Finally, Prediction 1 is consistent with the recent work of Baggs and Brander (2006) in the trade literature: Using Canadian data related to the Canada-US Free Trade Agreement, they document that increased competition in the form of an exogenous reduction in import tariffs increases leverage.

**PREDICTION 3:** If an entrepreneur chooses bank financing rather than VC financing, she will charge a lower price in the short-term, but, conditional on not defaulting, a higher price (controlling for cost) in the medium term.

The empirical evidence on the effects of financing on pricing seems somewhat ambiguous: On the one hand, Phillips (1995) and Zingales (1997) find that leverage is associated with price reductions in the gypsum and trucking industries, respectively. And Chevalier (1995), who examines supermarket prices in local markets following supermarket leveraged buyouts (LBOs), finds that prices fall following LBOs, at least in market in which rivals have low leverage. On the other hand, Phillips (1995) documents a positive relationship between leverage and prices in the fiberglass insulation, tractor trailer, and polyethylene chemical industries; and Chevalier’s (1995) aforementioned results are actually overturned (prices rise with leverage) in markets where rivals are also highly leveraged.

What can we make of these results? Prediction 2 suggests that after important financing decisions, the response in terms of pricing decisions may vary over time, and therefore timing issues should perhaps be taken more explicitly into account in empirical studies on the topic. We hope our model will help stimulate further empirical research aimed at elucidating these ambiguities.

---

38 This point was made previously in Povel and Raith (2004), and in Sutton (1992).
Prediction 4: Conditional on being unsuccessful in the short-term, debt-financed firms are more likely to exit (default in our model) than firms financed with VC equity (which in our model don’t default), but the actual impact of debt on market share in the short run need not be negative and indeed could be higher.

The first part of this prediction is consistent with Chevalier (1995) and Kovenock and Phillips (1997), who find a positive association between leverage and exit. The second part of this prediction is consistent with Phillips (1995), who finds that the impact of leverage on market share depends on the industry: It is positive in the gypsum industry, but negative in the other aforementioned industries.

More generally, Prediction 3 underlines the importance of disentangling the impact of leverage on firm performance, from the link between performance and exit. Leverage may, for strategic or other reasons, lead to worse performance, and this in turn may lead to more exit. But given any performance level, a debt-financed firm is more likely to exit, if it cannot meet its debt obligations, while an equity-financed firm does not have such obligations to meet. Further research aimed at disentangling these two issues would be, in our opinion particularly interesting.

7 Conclusion

This paper examines the link between product market competition and entrepreneurs’ choice between bank financing and VC financing. We show that under bank financing a debt-type contract emerges as optimal, while under VC financing the entrepreneur designs a simple equity-type contract. We argue that the link between competition and contractual choice is bi-directional: On the one hand, the financing choice affects the competitive behavior of the firm and of its rival. In particular, debt financing leads to lower short-term prices, as the rival lowers price for predatory purposes and the firm itself lowers price for default prevention purposes. But conditional on short-term success (no default), debt financing my enable the firm to charge a higher price (controlling for cost) in the medium-term, as the entrepreneur retains full ownership of the venture and has maximum incentives for efficiency improving effort.

On the other hand, product market competition, measured as the degree of substitutability between products, also has an impact on the financing choice itself: it favors bank financing over VC financing. We derive the industry equilibrium and show that as the degree of competition increases, firms tend to switch from VC financing to bank financing.
In order to provide clear insights and tractable results, we presented a highly stylized model of financing and competition, and at least two of our assumptions deserve a brief explanation. First, we assumed a competitive environment based on Hotelling’s (1929) well known contribution. This parametrization of competition seemed the natural choice for our purpose: The “transport cost” $t$ which represents the degree of horizontal differentiation in the industry, helps us capture - through $\theta = 1/t$ - a perfect measure of the exogenous degree of competition which is the most central parameter in our study. Moreover, the Hotelling model has the additional advantage of being the simplest and most tractable framework to deal with, relative to other candidate modeling choices offering such an exogenous measure of competition. Despite the structure we impose on the model, we believe that the main forces at work in our model - namely the offsetting impacts of (differential) business stealing and rent reduction - would be present in other models of competition. Indeed, qualitatively similar results can be obtained in other address models - e.g. Salop (1979), which also exhibits linear rent-reduction and convex business stealing - as well as in logit models.

Another important modeling assumption is the initial financing requirement for the venture $K$, is relatively small. This serves two simplifying purposes. First, it ensures that the entrepreneur has no incentive to strategically default when bank debt is used (see footnote 19); and second, it ensures that the contracts associated with bank financing and VC financing are both feasible for all $\theta \in \Theta$. In practice however, product market competition tends to reduce rents, and thus in turn may affect the ex ante efficiency of the various contracts, making some feasible and others not. While an extension of the model to include potential strategic defaults and an analysis of ex ante efficiency in the context of competition is beyond the scope of this paper, we look forward to incorporating these elements in future research.

A Appendix

A.1 Derivation of Equilibrium when $e_j$ Chooses Bank Financing

Here we examine the optimal financing choice for $e_i$ given that $e_j$ chooses bank financing, using the same as in section 4.

Bank Financing

In the second period, given that both entrepreneurs have chosen bank financing, each retains ownership,
if and only if the consumer chooses her product in period 1. So if the consumer has chosen product \( i \) at date 1, then \( e_i \) exerts effort \( q^h \) and \( e_j \) exerts zero effort in period 2, leading to price-cost margins \( \overline{p}_i (q^h, 0, \theta) = 1/\theta + q^h/3 \) and \( \overline{p}_j (0, q^h, \theta) = 1/\theta - q^h/3 \), respectively. Net expected profits are \( \pi_i (q^h, 0, \theta) - c \) and \( \pi_j (0, q^h, \theta) \), respectively. Otherwise, it is \( e_i \) who exerts zero effort and \( e_j \) who exerts effort \( q^h \), resulting in margins \( \overline{p}_i (0, q^h, \theta) = 1/\theta - q^h/3 \) and \( \overline{p}_j (q^h, 0, \theta) = 1/\theta + q^h/3 \), and in net expected profits \( \pi_i (0, q^h, \theta) \) and \( \pi_j (q^h, 0, \theta) - c \), respectively.

Moving backward to a first period point of view, the minimum expected return for venture \( i \), which occurs following failure in the first period, is \( M_{ibb} (\theta) = \pi_i (0, q^h, \theta) \). In contrast, following success in the first period would enable \( e_i \) to obtain \( P_{ibb} \) at date 1, plus a surplus from continuation \( s_{ibb} = (\pi_i (q^h, 0, \theta) - c) - \pi_j (0, q^h, \theta) \). Indeed the expected bonus from short term success for venture \( i \) is \( B_{ibb} = X_{ibb} [P_{ibb} + s_{ibb}] \). First period prices maximize the following objective function, \( X_{ibb} (P_{ibb}, P_{jbb}, \theta) [P_{ibb} + s_{ibb} (\theta)] + M_{ibb} (\theta) \).

Objectives and equilibrium choices are the same for \( e_j \). Thus we get equilibrium first period prices \( P_{ibb} = 1/\theta - s_{ibb} = 1/\theta - s_{jbb} = P_{jbb} \), probability of date 1 success \( X_{ibb} = X_{jbb} = 1/2 \), and expected bonuses \( B_{ibb} = B_{jbb} = 1/2\theta \).

VC Financing

This situation is symmetric to the one studied in section 4.1. If venture \( i \) is successful at date 1, the second period marginal costs generated are \( mc_i = a - q^l \) and \( mc_j = a \), leading to margins \( \overline{p}_i (q^l, 0, \theta) = 1/\theta + q^l/3 \) and \( \overline{p}_j (0, q^l, \theta) = 1/\theta - q^l/3 \), and to expected profits \( \pi_i (q^l, 0, \theta) \) and \( \pi_j (0, q^l, \theta) \), respectively. If venture \( i \) is unsuccessful at date 1, the second period marginal costs generated are \( mc_i = a - q^h \) and \( mc_j = a - q^h \), leading to margins \( \overline{p}_i (q^l, q^h, \theta) = 1/\theta - (q^h - q^l)/3 \) and \( \overline{p}_j (q^l, q^h, \theta) = 1/\theta + (q^h - q^l)/3 \), and to expected profits \( \pi_i (q^l, q^h, \theta) \) and \( \pi_j (q^l, q^h, \theta) - c \), respectively. Thus, venture \( i \)'s “surplus from predation” is \( s_{ivb} = \pi_i (q^l, 0, \theta) - \pi_i (q^l, q^h, \theta) \), and venture \( j \)'s “surplus from continuation” is \( s_{jvb} = (\pi_j (q^l, q^l, \theta) - c) - \pi_j (0, q^l, \theta) \).

Minimum expected returns for ventures \( i \) and \( j \) are \( M_{ivb} (\theta) = \pi_i (q^l, q^h, \theta) \) and \( M_{jvb} (\theta) = \pi_j (0, q^l, \theta) \), respectively. Expected bonus from short term success for ventures \( i \) and \( j \) are \( B_{ivb} = X_{ivb} [P_{ivb} + s_{ivb}] \) and \( B_{jvb} = X_{jvb} [P_{jvb} + s_{jvb}] \), respectively. First period prices, which maximize these expected surpluses, can easily be derived: \( P_{ivb} = 1/\theta - (2s_{ivb} (\theta) + s_{jvb} (\theta)) / 3 \) and \( P_{jvb} = 1/\theta - (2s_{jvb} (\theta) + s_{ivb} (\theta)) / 3 \). Substituting these prices back into expressions for expected bonus, we get:

\[
B_{ivb} (s_{ivb} (\theta) - s_{jvb} (\theta), \theta) = [1/2 + \theta (s_{ivb} (\theta) - s_{jvb} (\theta)) / 6] [1/\theta + (s_{ivb} (\theta) - s_{jvb} (\theta)) / 3], \quad (12)
\]

\[
B_{jvb} (s_{ivb} (\theta) - s_{jvb} (\theta), \theta) = [1/2 + (s_{jvb} (\theta) - s_{ivb} (\theta)) / 6] [1/\theta + (s_{jvb} (\theta) - s_{ivb} (\theta)) / 3],
\]
where in each case the first and second square brackets represent the probabilities of date 1 success, and the sums of first period price and second period expected surpluses, respectively.

Competition and Financing Choice

At the start of the game, \(e_i\) chooses bank financing over VC financing if and only if:

\[
[B_{ibb}(\theta) - B_{ivb}(\theta)] - [M_{ivb}(\theta) - M_{ibb}(\theta)] \geq 0
\]

(13)

For the same reasons as in section 4, the minimum expected return is lower under bank financing than under VC financing (\(M_{ivb}(\theta) > M_{ibb}(\theta)\)). And the bonus from short-term success is again higher under bank financing than under VC financing (\(B_{ibb}(\theta) > B_{ivb}(\theta)\)) if and only if \(s_{jbv}(\theta) - s_{ivb}(\theta) > 0\). Here, the larger \(s_{jbv}(\theta) - s_{ivb}(\theta)\) is, the bigger venture \(i\)'s disadvantage under VC financing, and the lower \(B_{ivb}(\theta)\), which in turn increases the bonus differential \(B_{ibb}(\theta) - B_{ivb}(\theta)\). Indeed, the tradeoff is qualitatively the same as before: bank financing dominates VC financing if and only if its benefit in terms of expected bonus more than offsets its cost in terms of minimum expected return, i.e. if and only if \(B_{ibb} - B_{ivb} \geq M_{ivb} - M_{ibb} > 0\).

The impact of the financing choice on competitive behavior is similar to the case discussed in section 4: 1) Predatory behavior leads venture \(j\) to lower its first period price under bank financing (\(P_{jbb} < P_{jbv}\)), and for default prevention purposes, venture \(i\) also lowers its price under bank financing (\(P_{ibb} < P_{ivb}\)); 2) Venture \(i\)'s probability of short-term success is higher under bank financing than under VC financing if and only if \(s_{jbv}(\theta) - s_{ivb}(\theta) > 0\), for the reasons discussed immediately above; 3) Conditional on succeeding in the first period, second period prices for venture \(i\) are higher under bank financing than under VC financing (\(\overline{p_i}(q^h, 0, \theta) > \overline{p_i}(q^l, 0, \theta)\)).

What about the impact of competition on the financing choice? Consider first the minimum expected return differential: \(M_{ivb}(\theta) - M_{ibb}(\theta) = \pi_i(q^l, q^h, \theta) - \pi_i(0, q^h, \theta)\). Using the results of lemma 5, following failure at date 1, venture \(i\) will have a higher marginal cost on average than its rival \(j\): \((\Delta_i + \Delta_j')/2 < 0\). As a result, the DRR dominates the DBS, and overall competition has negative impact on this differential: \(d(M_{ivb}(\theta) - M_{ibb}(\theta))/d\theta < 0\).

The impact of competition on the bonus differential - \(B_{ibb}(\theta) - B_{ivb}(s_{jbv}(\theta) - s_{ivb}(\theta), \theta)\) - can be
expressed as follows:

\[
\frac{d(B_{ibb}(\theta) - B_{ivb}(s_{jbv}(\theta) - s_{ivb}(\theta), \theta))}{d\theta} = \frac{\partial B_{ivb}(s_{jbv}(\theta) - s_{ivb}(\theta), \theta)}{\partial \theta} - \frac{\partial B_{ivb}(s_{jbv}(\theta) - s_{ivb}(\theta), \theta)}{\partial(s_{jbv}(\theta) - s_{ivb}(\theta))} \frac{\partial(s_{jbv}(\theta) - s_{ivb}(\theta))}{\partial \theta}.
\]

(14)

Here, the impact of competition on the bonus differential \( B_{ibb}(\theta) - B_{ivb}(s_{jbv}(\theta) - s_{ivb}(\theta), \theta) \) is ambiguous.

As expected, the second and third partial differentials on the right-hand side of (14) are negative and positive, respectively. However, unlike in the first case we examined, the first partial derivative here is negative. The intuition remains similar to the first case: if \( s_{jbv}(\theta) - s_{ivb}(\theta) > 0 \), the bonus differential is positive, but the average surplus in venture \( i \) is smaller than in venture \( j \): \( (s_{ibb} + s_{ivb})/2 < (s_{jib} + s_{jiv})/2 \). As a result the DBS effect of competition is more than offset by the DRR, giving a negative net effect of competition. For similar reasons, if \( s_{jbv}(\theta) - s_{ivb}(\theta) < 0 \), the bonus differential is negative and decreases with competition.

As a result of this ambiguity, it is difficult to show that competition has a monotonously positive impact on the net benefit from bank financing over VC financing. However it is possible to show the existence of a threshold level of \( \theta^* \) such that bank financing is optimal if and only if \( \theta > \theta^* \) (see proof of Proposition 7).

A.2 Proof of Lemma 1

Strategy \( q^h \) is a dominant strategy for \( e \) under entrepreneur control if and only if:

\[
xp(q^h) - c \geq xp(q^l) \tag{15}
\]

\[
xp(q^h) - c \geq xp(q^0) \tag{16}
\]

Moreover, \( q^l \) is a dominant strategy for \( e \) under joint control if and only if:

\[
\lambda xp(q^l) \geq \lambda xp(q^h) - c \tag{17}
\]

\[
\lambda xp(q^l) \geq \lambda xp(q^0) \tag{18}
\]
Finally, “no participation” is a dominant strategy for e under investor control if and only if

\[ 0 \geq -c \]  \hspace{1cm} (19)

\[ 0 \geq 0 \]  \hspace{1cm} (20)

Clearly (19) and (20) hold. Consider a strictly increasing function \( p(q) \), and a probability \( x \), such that \( xp(q') \geq 0 \). Then: 1) (18) holds for all \( \lambda \in [0, 1] \); 2) there exists a \( c \leq xp(q^h) - xp(q') \) such that (15) holds; 3) This implies that (16) holds; 4) given \( x, p(q), q^h, q', \) and \( c \), there exists a \( \lambda \) sufficiently small for (17) to hold. □

A.3 Proof of Proposition 1

Follows directly from the text. □

A.4 Proof of Lemma 2

If \( e_i \) exerts effort \( q_i \) and \( e_j \) exerts effort \( q_j \), venture \( i \)'s gross expected profit is

\[
\pi_i(q_i, q_j, \theta, 2) = \left[ \frac{1}{2} + \frac{\theta (q_i - q_j)}{6} \right] \left[ \frac{1}{2} + \frac{(q_i - q_j)}{3} \right] \\
= \frac{1}{2\theta} + \frac{(q_i - q_j)}{3} + \frac{\theta (q_i - q_j)^2}{18}
\]

Therefore, \( q^h \) is a dominant strategy for \( e_i \) under entrepreneur control if and only if:

\[
\frac{1}{2\theta} + \frac{(q^h - q_i)}{3} + \frac{\theta (q^h - q_i)^2}{18} - c \geq \frac{1}{2\theta} + \frac{(q' - q_i)}{3} + \frac{\theta (q' - q_i)^2}{18} \\
\frac{1}{2\theta} + \frac{(q^h - q_i)}{3} + \frac{\theta (q^h - q_i)^2}{18} - c \geq \frac{1}{2\theta} - \frac{q_i}{3} + \frac{\theta q_i^2}{18}
\]

Moreover, \( q' \) is a dominant strategy for \( e_i \) under joint control if and only if:

\[
\lambda \left[ \frac{1}{2\theta} + \frac{(q' - q_j)}{3} + \frac{\theta (q' - q_j)^2}{18} \right] \geq \lambda \left[ \frac{1}{2\theta} + \frac{(q^h - q_j)}{3} + \frac{\theta (q^h - q_j)^2}{18} \right] - c \\
\lambda \left[ \frac{1}{2\theta} + \frac{(q' - q_j)}{3} + \frac{\theta (q' - q_j)^2}{18} \right] \geq \lambda \left[ \frac{1}{2\theta} - \frac{q_j}{3} + \frac{\theta q_j^2}{18} \right]
\]
Finally, “no participation” is a dominant strategy for $e_i$ under investor control if and only if

$$0 \geq -c$$  \hspace{1cm} (25)$$

$$0 \geq 0$$  \hspace{1cm} (26)$$

So $q^h$ is a dominant strategy under entrepreneur control, $q^l$ is a dominant strategy under joint control, and “no participation” is a dominant strategy under investor control for $e_i$, $i = 1, 2$ if constraints 23 to 26 are satisfied.

A sufficient condition for constraint (24) to hold is:

$$\frac{q^l}{3} + \frac{\theta q^l (q^l - 2q^h)^2}{18} \geq 0$$

$$\iff \frac{6}{18} \left[ \frac{6}{\theta} - (q^h - 2q^l) \right] \geq 0,$$

which holds if and only if

$$\frac{6}{\theta} \geq q^h - 2q^l$$  \hspace{1cm} (27)$$

If constraints (21) and (24) hold, then constraint (22) holds. Constraints (25) and (26) always hold. Therefore, we must only check that constraints (21) and (23) both hold in addition to constraint (27). Constraint (21) can be rewritten as:

$$\frac{(q^h - q^l)}{3} + \frac{\theta (q^h - q^l) (q^h + q^l - 2q_j)}{18} \geq c$$  \hspace{1cm} (28)$$

Constraint (23) can be rewritten as:

$$\lambda \left[ \frac{(q^h - q^l)}{3} + \frac{\theta (q^h - q^l) (q^h + q^l - 2q_j)}{18} \right] \leq c$$  \hspace{1cm} (29)$$

So constraints (21) and (23) both hold if and only if

$$\lambda \left[ \frac{(q^h - q^l)}{3} + \frac{\theta (q^h - q^l) (q^h + q^l - 2q_j)}{18} \right] \leq c \leq \frac{(q^h - q^l)}{3} + \frac{\theta (q^h - q^l) (q^h + q^l - 2q_j)}{18}$$  \hspace{1cm} (30)$$

A sufficient condition for constraint (30) to hold is to set $q_j = 0$ on the left hand side and $q_j = q^h$ on the right.
hand side. Then for constraint (30) to hold, we must have:

\[
\frac{(1 - \lambda) (q^h - q^l)}{3} - \frac{\theta ((q^h - q^l)^2 + \lambda (q^h - q^l) (q^h + q^l))}{18} \geq 0
\]

\[
\iff \frac{(q^h - q^l) [6 (1 - \lambda) - \theta (q^h - q^l) - \theta \lambda (q^h + q^l)]}{18} \geq 0
\]

\[
\iff \frac{6}{\theta} (1 - \lambda) - \left( q^h - q^l \right) - \lambda \left( q^h + q^l \right) \geq 0
\]

Let $\theta \leq \frac{3}{2q^h}$. Then

\[
\frac{6}{\theta} (1 - \lambda) - \left( q^h - q^l \right) - \lambda \left( q^h + q^l \right) \geq 4q^h (1 - \lambda) - q^h + q^l - \lambda q^h - \lambda q^l
\]

\[
= q^h (3 - 5\lambda) + q^l (1 - \lambda) \geq 0 \forall \lambda \leq \frac{3}{5}
\]

So if $\theta \leq \frac{3}{2q^h}$ and $\lambda \leq \frac{3}{5}$, there exists a $c$ such that (30) holds $\forall q^h, q^l$. Moreover, if $\theta \leq \frac{3}{2q^h}$, then (27) always holds. In that case, all incentive constraints from 21 to 26 hold. □

A.5 Proof of Lemma 3

Follows directly from the text. □

A.6 Proof of Lemma 4

Follows directly from the text. □

A.7 Proof of Proposition 2

1) $P_{ibv}(\theta) = \frac{1}{\theta} - \frac{2s_{ibv}(\theta) + s_{jvb}(\theta)}{3}$ and $P_{iev}(\theta) = \frac{1}{\theta}$, so $P_{ibv} \geq P_{iev}$ if and only if $2s_{ibv}(\theta) + s_{jvb}(\theta) \geq 0$, which is true given our assumptions. □

2) $X_{ibv} \geq X_{iev}$ if and only if $\frac{1}{2} + \frac{\theta (s_{ibv}(\theta) - s_{jvb}(\theta))}{6} \geq \frac{1}{2} \iff s_{ibv}(\theta) - s_{jvb}(\theta) \geq 0$. □

3) The price (controlling for cost) charged by venture $i$ is $p_i - mc_i = \frac{1}{\theta} + \frac{q_i - q^l}{3}$. Under bank financing, following success, $e_i$ exerts effort $q^h$, while $e_j$ exerts effort $q^l$. Therefore, $p_i - mc_i = \frac{1}{\theta} + \frac{q^h - q^l}{3}$. Under VC financing, both $e_i$ and $e_j$ exert effort $q^l$, so $p_i - mc_i = \frac{1}{\theta}$. □
A.8 Proof of Proposition 3

Follows directly from the text. □

A.9 Proof of Lemma 5

1) Since \( \frac{dp_i}{d\theta} = \frac{dp'_i}{d\theta} = -\frac{1}{b^2}, \frac{dp'_i}{d\theta} x'_i - \frac{dp_i}{d\theta} x_i = -\frac{1}{b^2} (x'_i - x_i) = -\frac{(\Delta'_i - \Delta_i)}{b^2} \leq 0 \) because \( \Delta'_i \geq \Delta_i \), □

2) \( \frac{dp'_i}{d\theta} P_i - \frac{dp_i}{d\theta} P_i = \frac{\Delta'_i}{b} (\frac{1}{b} + \frac{\Delta'_i}{3}) + \frac{\Delta_i}{b} (\frac{1}{b} + \frac{\Delta_i}{3}) = \frac{(\Delta'_i - \Delta_i)}{6} (\frac{1}{b} + \frac{\Delta_i + \Delta'_i}{3}) \geq 0 \), since \( \frac{1}{b} + \frac{\Delta_i + \Delta'_i}{3} \geq 0 \forall \theta \leq \frac{3}{2b^2} \).

\[ \begin{align*}
3) \quad \frac{d\pi_i}{d\theta} - \frac{d\pi}{d\theta} & = (\Delta'_i - \Delta_i) \left( \frac{1}{b} + \frac{\Delta'_i}{3} \right) - \frac{\Delta'_i - \Delta_i}{6} \left( \frac{\Delta_i + \Delta'_i}{3} \right) \geq 0 \text{ if and only if } \Delta_i + \Delta'_i \geq 0. \quad \square
\end{align*} \]

A.10 Proof of Proposition 4

\[ M_{ivv} - M_{ibv} = \pi_i(q^j, q^l, \theta) - \pi(0, q^j, \theta) = \frac{1}{2b} - \left( \frac{1}{2} - \frac{\theta q^j}{6} \right) \left( \frac{1}{b} - \frac{q^j}{4} \right) = \frac{q^j}{3} - \frac{\theta(q^j)^2}{18}. \] It follows that as \( \theta \) increases, \( M_{ivv} - M_{ibv} \) decreases. □

A.11 Proof of proposition 5

Following footnote 30, \( \frac{\partial(B_{ibv}(s_{ibv}(\theta) - s_{jvb}(\theta), \theta) - B_{ivv}(\theta))}{\partial \theta} = \frac{(s_{ibv}(\theta) - s_{jvb}(\theta))^2}{18} \geq 0. \)

Moreover, \( \frac{\partial(B_{ibv}(s_{ibv}(\theta) - s_{jvb}(\theta), \theta) - B_{ivv}(\theta))}{\partial(s_{ibv}(\theta) - s_{jvb}(\theta)))} = \frac{1}{3} + \frac{\theta(s_{ibv}(\theta) - s_{jvb}(\theta))}{9} \geq 0 \) according to Lemma 2. Finally, \( \frac{\partial(s_{ibv}(\theta) - s_{jvb}(\theta))}{\partial \theta} = q^h(q^h - 2q^l) \geq 0 \) if \( q^h \geq 2q^l \). Therefore, \( \frac{d(B_{ibv}(s_{ibv}(\theta) - s_{jvb}(\theta), \theta) - B_{ivv}(\theta))}{d\theta} \geq 0. \quad \square \)

A.12 Proof of Proposition 6

Let us define \( z(\theta) \) as the difference between venture \( i \)’s continuation surplus and the predation surplus of venture \( j \): \( z(\theta) = s_{ibv}(\theta) - s_{jvb}(\theta) \), which simplifies to \( z(\theta) = \frac{\theta q^h(q^h - 2q^l)}{9} - c. \)

If \( z(\theta) < 0, B_{ibv} - B_{ivv} < 0 \) so \( B_{ibv} - B_{ivv} - [M_{ivv} - M_{ibv}] < 0 \) and \( e_i \) prefers VC financing over bank financing. Suppose now that \( z(\theta) \geq 0 \) (which implies \( q^h \geq 2q^l \) and \( \theta \geq \frac{9c}{q^h(q^h - 2q^l)} \)). \( e_i \) prefers bank over VC if and only if

\[ [B_{ibv} - B_{ivv}] - [M_{ivv} - M_{ibv}] \geq 0 \iff (z(\theta))^2 + \frac{6z(\theta)}{\theta} - q^l \left( \frac{6}{\theta} - q^l \right) \geq 0 \]

Let \( f(\theta) \) be equal to the left hand side of this inequality: \( f(\theta) = (z(\theta))^2 + \frac{6z(\theta)}{\theta} - q^l \left( \frac{6}{\theta} - q^l \right) \). According to Proposition 4 and Proposition 5, this function is increasing with \( \theta \). When \( \theta \) is such that \( z(\theta) = 0, f(z^{-1}(0)) \leq 37 \).
0. When $\theta = \frac{3}{2q^h}$,

$$f\left(\frac{3}{2q^h}\right) = \left(\frac{q^h - 2q^l}{6} - c\right)^2 + 4q^h\left(\frac{q^h - 2q^l}{6} - c\right) - 4q^hq^l + (q^l)^2$$

$$= \frac{1}{36}[40(q^l)^2 - 4q^l(49q^h - 6c) + 25(q^h)^2 - 156cq^h + 36c^2].$$

(31)

There are two solutions to $f\left(\frac{3}{2q^h}\right) = 0$, $q^l$ and $q^l$ with $0 \leq q^l \leq \frac{q^h}{2} \leq q^l$. Therefore, $f\left(\frac{3}{2q^h}\right) \geq 0$ if and only if

$$q^l \leq q^l = \frac{q^h}{2} - \frac{3}{20}[\sqrt{239(q^h)^2 + 108q^h c - 36c^2} - (13q^h - 2c)].$$

(33)

If (33) is satisfied, there exists a $\theta^* \in \Theta$ such that when $e_j$ chooses VC financing, $e_i$ prefers bank over VC financing if and only if $\theta \geq \theta^*$. For $c = \frac{43q^h}{9}$ (which is the highest possible value for the lower bound defined in (30)), (33) is satisfied if and only if $q^l \leq \frac{q^h}{2} - \frac{3q^h}{20}[\sqrt{239 + 48\lambda - \frac{64\lambda^2}{9} - (13 - \frac{8\lambda}{9})}].$ The right hand side of this inequality is a decreasing function of $\lambda$, going from $0.13q^h$ to $-3.81q^h$ as $\lambda$ varies from 0 to 3/5 (the upper bound of $\lambda$ is defined in the proof of Lemma 2).

Otherwise, $e_i$ prefers VC financing. □

A.13 Proof of Proposition 7

Note that this proof is based on the results of section A.1.

1) $P_{ivb}(\theta) = \frac{1}{\bar{q}} - \frac{2s_{ivb}(\theta) + s_{jvb}(\theta)}{3}$ and $P_{ibb}(\theta) = \frac{1}{\bar{q}} - s_{ibb}$, so $P_{ibb} < P_{ivb}$ if and only if $3s_{ibb} \leq 2s_{ivb}(\theta) + s_{jvb}(\theta)$. It is easy to show that $s_{ibb} = \pi(q^h, 0, \theta) - \pi(0, q^h, \theta)$ is strictly superior to both $s_{ivb}(\theta) = \pi(q^l, 0, \theta) - \pi(q^l, q^h, \theta)$ and $s_{jvb}(\theta) = \pi(q^h, q^l, \theta) - \pi(0, q^l, \theta)$, which in turn implies $s_{ibb} > 2s_{ivb}(\theta) + s_{jvb}(\theta)$ and $P_{ibb} < P_{ivb}$. The proof that $P_{jbb} < P_{ivb}$ is almost identical and is omitted here. □

2) $X_{ibb} \geq X_{ivb}$ if and only if $\frac{1}{2} \geq \frac{1}{\bar{q}} + \frac{\theta(s_{ivb}(\theta) - s_{jvb}(\theta))}{6} \Leftrightarrow s_{ivb}(\theta) - s_{jvb}(\theta) \leq 0$. □

3) The price (controlling for cost) charged by venture $i$ is $p_i - mc_i = \frac{1}{\bar{q}} + \frac{q^h}{3}$. Under bank financing, following success, $e_i$ exerts effort $q^h$, while $e_j$ exerts zero effort. Therefore, $p_i - mc_i = \frac{1}{\bar{q}} + \frac{q^h}{3}$. Under VC financing, both $e_i$ exerts effort $q^l$ and $e_j$ exerts zero effort, so $p_i - mc_i = \frac{1}{\bar{q}} + \frac{q^l}{3} \leq \frac{1}{\bar{q}} + \frac{q^h}{3}$. □

4) If $z(\theta) < 0$, $39B_{bb}(\theta) - B_{ivb}(\theta) < 0$ so $[B_{ibb} - B_{ivb} - M_{ivb} - M_{ibb}] < 0$ and $e_i$ prefers VC financing over bank financing. Suppose now that $z(\theta) \geq 0$ (which implies $q^h \geq 2q^l$) and $\theta \geq \frac{9c}{q^h(q^l - 2q^l)}$. $e_i$ prefers

---

\(^{39}\)We define $z(\theta)$ at the beginning of the Proof of Proposition 6.
bank over VC if and only if

\[ [B_{ibb}(\theta) - B_{inv}(\theta)] - [M_{inv}(\theta) - M_{ibb}(\theta)] \geq 0 \iff z(\theta)^2 - \frac{6}{17} z(\theta) + q'(6) - 2q^h + q' \leq 0 \quad (34) \]

Let \( g(\theta) \) be equal to the left hand side of inequality 34. Using the fact that \( \frac{dz(\theta)}{d\theta} = \frac{z(\theta) + c}{\theta} \), we can write \( g'(\theta) \) as:

\[ g'(\theta) = 2z(\theta) z^c \theta + \frac{6(c + q')}{\theta} \]

It is easy to check that \( g''(\theta) \geq 0 \), so \( g'(\theta) \) is increasing with \( \theta \), with \( g'(\frac{3}{2q^r}) \leq 0 \). Therefore, \( g(\theta) \) decreases as \( \theta \) increases. When \( \theta \) is such that \( z(\theta) = 0 \), \( g(z^{-1}(0)) \geq 0 \). When \( \theta = \frac{3}{2q^r} \),

\[ g\left(\frac{3}{2q^h}\right) = \left(\frac{q^h - 2q^l}{6} - c\right)^2 - 4q^h\left(\frac{q^h - 2q^l}{6} - c\right) + 2q^h q' + (q')^2 \]

\[
= \frac{1}{36}[40q'(29q^h + 6c) - 23(q^h)^2 + 132cqq^h + 36c^2)]
\]

There are two solutions to \( g\left(\frac{3}{2q^h}\right) = 0 \), \( q^l \) and \( q^l \), with \( q^l < 0 \leq q^l \leq q^h \). Therefore, \( g\left(\frac{3}{2q^h}\right) \leq 0 \) if and only if

\[ q^l \leq q = \frac{q^h}{2} - \frac{3}{20}[-\sqrt{119(q^h)^2 - 108q^h c - 36c^2} + 13q^h + 2c]. \quad (37) \]

If (37) is satisfied, there exists a \( \theta^{**} \in \Theta \) such that when \( e_j \) chooses bank financing, \( e_i \) prefers bank over VC financing if and only if \( \theta \geq \theta^{**} \). For \( c = \frac{4\lambda q^h}{9} \) (which is the highest possible value for the lower bound defined in (30)), (37) is satisfied if and only if \( q^l \leq q^h \leq \frac{q^h}{2} = 3\left[13 + \frac{9\lambda}{20} - \sqrt{119 - 48\lambda} - \frac{64\lambda^2}{9}\right] \). The right hand side of this inequality is a decreasing function of \( \lambda \), going from 0.81q to 0.13q as \( \lambda \) varies from 0 to 3/5 (the upper bound of \( \lambda \) is defined in the proof of Lemma 2).

We now prove that \( \theta^{**} \leq \theta^* \). Let \( \hat{\theta} \) be such that \( f(\hat{\theta}) = g(\hat{\theta}) \), which leads to \( \hat{\theta} = \frac{18(q^l + c)}{q^l(2q^l - q^h)} \). Therefore,

\[ f(\hat{\theta}) = \frac{z^2(\hat{\theta}) - q^l(q^h - q^l)}{2q^l - q^h - \frac{3q^l(q^l + c)(q^h - 3c - 5q^l)}{(2q^l - q^h)^2}} \]

Then \( f(\hat{\theta}) \leq 0 \quad \forall q^l \leq q^h \).

**References**


\[40 g'(\frac{3}{2q^r}) \] is a decreasing function of \( q^l \), with \( g'(\frac{3}{2q^r}) \leq 0 \) when \( q^l = \frac{q^h}{2} \).


Figure 1: Business stealing and rent-reduction effects of competition as functions of firm i’s competitive (cost) advantage $\Lambda_i$.

Consider a given $\Delta_i’ - \Delta_i$. Due to the linearity of the rent reduction effect, the DRR remains the same for all values of $\Delta_i$ and $\Delta_i’$. Due to the convexity of the business stealing effect, the DBS increases with values of $\Delta_i$ and $\Delta_i’$. Indeed, for sufficiently high values of $\Delta_i$ and $\Delta_i’$, the DBS dominates the DRR and hence competition has a positive effect on the profit differential.
Figure 2: Equilibrium financing choices evolve with the degree of product market competition. At low levels of competition, both entrepreneurs choose VC financing. At moderate levels of competition, two pure-strategy Nash equilibria exist: either both entrepreneurs choose VC financing, or both choose bank financing. At high levels of competition, both entrepreneurs choose bank financing.