DISCUSSION PAPER SERIES

No. 3182

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Giacinta Cestone and Lucy White

FINANCIAL ECONOMICS

Centre for Economic Policy Research

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Available online at: www.cepr.org/pubs/dps/DP3182.asp

ISSN 0265-8003

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Giacinta Cestone, Institut d'Anàlisi Econòmica (CSIC), Barcelona and CEPR
Lucy White, Nuffield College, University of Oxford and CEPR

Discussion Paper No. 3182
January 2002

Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

CEPR Discussion Paper No. 3182

January 2002

ABSTRACT

Anti-Competitive Financial Contracting: The Design of Financial Claims*

This Paper presents the first model where entry deterrence takes place through financial rather than product-market channels. In standard models of the interaction between product and financial markets, a firm's use of financial instruments deters entry by affecting product market behaviour, whereas in our model entry deterrence occurs by affecting the credit market behaviour of investors towards entrant firms. We find that in order to deter entry, the claims held on incumbent firms should be sufficiently risky, ie equity, in contrast to the standard Brander-Lewis (1986) result that debt deters entry. We show that this effect is more marked the less competitive is the credit market, implying that more credit market competition spurs more product market competition. The model can be used to shed light on the mode of financing of start-up industries and the policy debate on the separation of banking as to whether banks should be permitted to hold equity in firms.

JEL Classification: G30
Keywords: coase problem, equity, over-funding and venture capital

Giacinta Cestone
Institut d'Anàlisi Econòmica (CSIC)
Campus UAB
08193 Bellaterra
Barcelona
SPAIN
Tel: (34 93) 580 6612
Fax: (34 93) 580 1452
Email: giacinta.cestone@uab.es

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Lucy White
Nuffield College
Oxford University
Oxford
OX1 1NF
Tel: (44 1865) 278 518
Fax: (44 1865) 278 621
Email: lucy.white@economics.ox.ac.uk

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=148708

*This Paper is produced as part of a CEPR Research Network on 'The Industrial Organisation of Banking and Financial Markets in Europe', funded by the European Commission under the Training and Mobility of Researchers Programme (Contract No: ERBFMRX-CT98-0222)

Submitted 09 January 2002

"The difficulties inherent in acquiring external finance in the United States in the nineteenth century provide an explanation for the basis of the fortunes of certain American entrepreneurs and suggest at least one reason why the economy was characterized by increasing concentration in the growth sectors" Lance Davis (1966).

1 Introduction

This paper presents the first model where entry deterrence takes place through *financial* rather than *product-market* channels. This is a new form of entry deterrence which has not previously been considered, but which is nonetheless potentially important in countries and industries where funding opportunities are relatively scarce. In standard models of the interaction between product and financial markets, the focus has always been on how a firm's use of financial instruments affects *its own product market behavior*, and thus its rival's optimal response. By contrast, in this paper we show that even if financial contracts are completely neutral in their impact on product market behavior, they have an impact on *the behavior of investors*, and thus affect the funding opportunities of potential entrants in this way.

One might think that with imperfectly competitive financial markets, the problem of financial entry deterrence would be trivial: investors (who share in the surplus generated by investment) should deny funding to entrants to limit industrial competition. In fact, matters are not so simple, as the following stylized example demonstrates. Suppose a monopoly investor signs a contract in which he agrees to supply the monopoly amount of capital to a single firm, in return for safe debt in that firm. (Holding safe debt is of course desirable since it maximizes the entrepreneur's incentives to exert effort.) A problem arises because the investor is well-informed about the industry and his return in the funded firm is safe and unaffected by changes in profitability - so the investor will be tempted to fund *another* firm to enter the industry. Of course, knowing that the investor will be tempted to supply a second firm ex-post, the first firm will not accept the same terms ex-ante, so the investor's profits are reduced by his lack of commitment. This commitment problem is known as the "Coase problem" by analogy to the commitment problem that arises in durable goods monopoly, which was first studied by Coase (1972).[1]

The logic of our result is very straightforward. The *form* of the financial contract between

[1]For a useful discussion of the parallels between the oversupply of goods in input markets and in durable goods monopoly see Rey and Tirole (forthcoming). In this paper we extend the analogy to the oversupply of funds by financial markets.

the incumbent firm and its investor will affect the investor's willingness to provide funds to entrant firms, by making his returns more or less sensitive to the effect of product market competition. The solution to the Coase problem is to make the investor's claim sufficiently sensitive to the profits of the incumbent firm that he has a *financial* incentive not to fund the second firm. In effect, recognizing the possibility that a knowledgeable investor could fund several firms in an industry changes financial contract design from a one-sided to a two-sided moral hazard problem, where the entrepreneur's incentives must be traded off against those of the investor.

We show that the entry-deterring claim is in fact *equity* (or, equivalently, risky debt), in contrast to the Brander-Lewis result that *debt* induces tougher behavior in the product market, and so deters entry. The difference in results comes from the different channels through which entry deterrence occurs. Brander and Lewis (1986) - and the literature on the interaction between product and financial markets which has followed them[2] - abstract from any financial market effects of the design of claims, and concentrate on product market effects. We do the reverse. Our model is in some ways a new formulation of the "deep pocket" argument. An incumbent can shorten an entrant's pocket by borrowing money which would otherwise be invested in his rival. Which approach is the most relevant in practice is largely an empirical question. We believe that there are some situations where difficulty in obtaining funding *per se*, rather than fear of aggressive behavior by an incumbent, is the factor which prevents firms from entering the market. This is certainly the case in some Eastern European countries, and countries such as in Italy, where competition in financial markets is very limited and has never been encouraged. Moreover, historical evidence suggests that our

[2]The literature on the interaction between product and financial markets is quite extensive; here we just mention a few papers. The impact of capital structure on incumbent product market behavior has been analyzed by Showalter (1995), who extends the Brander-Lewis model to price competition, Maksimovic (1988) who looks at the impact of debt on collusive outcomes; and Aghion, Dewatripont and Rey (1998) who show how the extent of outside finance can affect whether firms compete in strategic substitutes or complements. Fudenberg and Tirole (1986), Poitevin (1989a) and Bolton and Scharfstein (1990) are instead mainly concerned with the design of financial claims *on the entrant*; they show how agency problems in financial markets can leave entrant firms vulnerable to predation. Gertner, Gibbons and Scharfstein (1988) analyze the conflicts that arise when capital structure is used to signal to the product as well as the capital market. Poitevin (1989b) and Bhattacharya-Chiesa (1995) depart from the norm in considering lenders' rather than product market incentives. They show that coordination on a common lender can help coordinate on mutually desirable outcomes for the industry, but do not consider the design of claims. Empirical evidence of financial market effects on product markets is provided by Chevalier (1995), Chevalier and Scharfstein (1996), Phillips (1995) and Zingales (1998). A related literature looks at the effect of executive compensation schemes on product market incentives (for theory and evidence, see Lemmon (1997) and Aggarwal and Samwick (1999), and the references cited therein).

model can also be applied to the nineteenth century United States.[3]

In an extension of the model, we show that the salience of the problem of financial entry deterrence is greatest when competition in financial markets is most limited. This leads us to the empirical prediction and important policy implication that *financial market competition spurs product market competition*, and conversely, that it is difficult to promote product market competition if financial markets are very concentrated. This suggests that there should be more anti-trust coordination between the regulators of financial and product markets than is currently the norm.[4] Empirically, the link between financial and product market competition should be stronger in economies where regulation permits financiers to hold equity-like (i.e. profit-sensitive) claims in incumbent firms.

The model can thus also shed light on the debate as to whether banks should be permitted to hold equity in firms. In situations where there are ample alternative sources of funding for entrants, equity-holding by banks is likely to do little damage. But where funding sources are imperfectly competitive, an incumbent firm will generally disadvantage its rivals by selling equity to a bank with a comparative advantage (e.g. specialized knowledge leading to lower cost of funds) in funding its industry. Thus one may wonder about the wisdom of the prescription of a universal banking system for Eastern European countries (see Frydman et al 1993 for further discussion).

The plan of the paper is as follows. Section 2 sets out the basic model. Section 3 examines the second-best financial contract between the incumbent firm and the investor, and explains why financial entry deterrence will not generally be possible under such a contract. The entry deterring (third best) contract is set out in section 4. Section 5 extends the basic model to the case where there is imperfect competition in the credit market. Section 6 concludes.

2 The Model

In this section we set out a simple model which highlights the main intuitions of the paper.

[3]See Davis (1966) and DeLong (1990).

[4]In most countries, the typical regulatory structure is that competition between banks is monitored by the central bank, whereas competition in product markets is monitored by the anti-trust authority. Moreover, in managing competition between banks, the typical trade-off considered is that between competition and prudential behaviour by banks (competition increases efficiency, but the reduction in rents may tempt banks into more risky behavior.) The spillover effects from competition between financiers onto enhanced competition in industry have, up until now, been neglected.

2.1 Basic structure

An entrepreneur has the opportunity to enter a new and profitable industry. At a subsequent stage, a second entrepreneur may enter the same industry and compete with the first entrant. An investment I_i is needed in order to enter the industry and produce. Having no internal funds, each entrepreneur must borrow I_i from an external investor.[5]

For ease of exposition, in this basic model we assume that only one investor can finance this industry. This assumption is not essential to our results, which would hold provided competition to fund the second entrant is not perfect. However, it greatly simplifies the analysis and the drawing of parallels to the Coase problem in input supply markets and durable goods monopoly, where the assumption of a monopolistic supplier is standard.[6] In section 5 we analyze the more realistic case where two investors compete to finance early entrants in the industry, and yet the investor who has funded the first entrant (say, Firm 1) enjoys an informational advantage over the second investor in funding a late entrant (say, Firm 2).

We assume that entrepreneurs make take-it-or-leave-it offers to the investor, who has cost of funds r=1.[7]

Project:

Once started, each firm's project is subject to moral hazard. After the project is financed, entrepreneur i chooses a level of effort $e_i \in [\Delta, 1]$, which is not observed by the investor. Entrepreneurial effort raises the probability of success, which also depends on whether the firm enjoys a monopoly position or it competes with the other firm.

Under monopoly, if effort e_i is exerted then the project yields R^H (success) with proba-

[5] For evidence that entrepreneurs are indeed constrained in setting up and running firms by their ability to borrow, see Holz-Eakin et al (1994) and Evans and Jovanovic (1989).

[6] The simplification from imperfect competition to monopoly is standard in the foreclosure and durable goods literature (see Gul 1987 for a notable exception in the case of durable goods). The incentive to exclude clearly depends on the idea that there is *imperfect* competition between investors, since otherwise an entrant denied funding will simply accept an identical offer from another investor. For evidence that some financial markets are indeed uncompetitive, we refer the reader to the later discussion in section 5.

[7] Since there is bilateral monopoly between the investor and the firms, we could equally well allow the investor to make take-it-or-leave it offers. The main insight of the model is robust to any distribution of bargaining power. We let the entrepreneur make the offers here because this is both simpler and more congruent with the existing agency literature (see, e.g. Nachman and Noe 1994). The additional complication which arises in the case when the investor has some or all of the bargaining power is that then the latter is concerned not only with maximizing industry net present value but also with extraction of agency rents. This means that although a Coase Problem arises, the investor will not always choose to solve it if the entrepreneurs have poor outside options, but may instead prefer to introduce competition as a way to reduce the frequency with which he must reward good performance. We discuss this in more detail in an earlier version of this paper (Cestone and White 2000).

bility e_i and R^L (failure) with probability $(1 - e_i)$, where $R^H > I > R^L > 0$.[8]

Competition reduces the probability of success by Δ.[9] That is, under duopoly, effort e_i induces a probability of success of just $(e_i - \Delta)$ for firm i. Moreover, firm j's effort does not affect i's probability of success and vice versa.[10] This is the simplest possible way of capturing the idea that competition shifts probability mass from high revenue to low revenue outcomes.

Preferences:

All agents are risk-neutral. Firms 1 and 2 are identical. Entrepreneur i's von Neumann-Morgenstern utility function is

$$U(R_{fi}, e_i) = R_{fi} - \Psi(e_i)$$

where R_{fi} is the expected monetary payment Firm i receives after revenues are realized. Effort e_i costs $\Psi(e_i)$ to the entrepreneur. Thus, were he to receive a flat payment, he would exert the lowest possible effort. The function $\Psi(\ \cdot\ )$ satisfies: $\Psi' > 0, \Psi'' > 0, \Psi''' > 0$, $\Psi(\Delta) = \Psi'(\Delta) = 0$, $\Psi'(1) = +\infty$.

For notational simplicity, we will omit the subscript 1 when referring to Firm 1: therefore Firm 1's return, effort and investment cost will be R_f , e and I throughout.

Timing:

t=1 Firm 1 offers a contract to the investor. The investor accepts or rejects. If he accepts,

[8] In a sample of 49 venture capitalists, Gorman and Sahlman (1989) report that most venture-backed companies that have failed to meet expectations still manage to "squeeze out a stable, independent existence", which supports our assumption that $R^L > 0$. The interest of the assumption $R^L > 0$ is that it becomes possible to distinguish between debt and equity, which are equivalent if there are no returns to divide in the failure state.

[9] In Gorman and Sahlman (1989), 34% of the venture capitalist respondents cited competition as a factor contributing to financed companies' failure. For more general evidence that competition reduces the probability of survival, see Freeman and Hannan (1989), or Carroll and Hannan (1989). See also the next footnote. Similar results can be obtained when competition reduces revenues in case of success; but the analysis is considerably more cumbersome, so we use this simpler set-up.

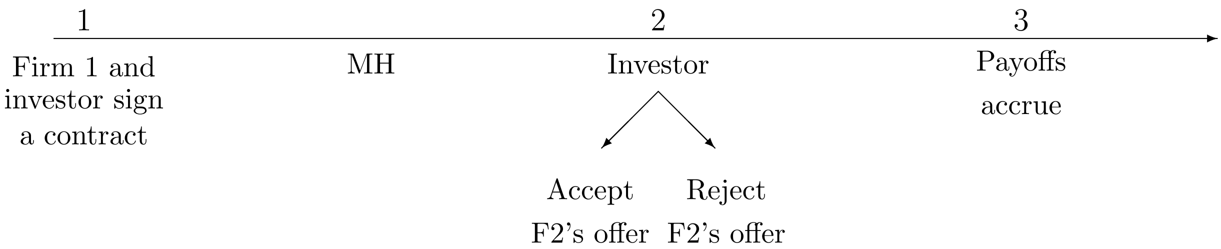
[10] See Cestone (1999) for some stylized examples as to when such an assumption might be taken literally. Here we make it mainly for modelling purposes. It has several advantages, including allowing us to be agnostic on whether competition increases or reduces optimal effort by managers (on which the literature is inconclusive - see Hart 1983, Martin 1993, Schmidt 1997). A probably more realistic alternative would be to assume that firm i's probability of success is reduced by firm j's effort (although this is not obvious since some efforts, such as advertising, may be mutually beneficial). In this case, a different type of entry deterrence becomes possible. If Firm 1 commits to a high effort, Firm 2's entry becomes more and more unprofitable *per se*. This is the standard form of entry deterrence, just like accumulation of capital à la Spence (1977) and Dixit (1979, 1980). Rather than repeating standard arguments, we work with the simpler case where efforts are neither complements nor substitutes in order to focus attention on the new form of entry deterrence.

then Firm 1 picks a level of effort $e \in [\Delta, 1]$. The effort decision is pure moral hazard, not observed by the investor.

t=2 In order to get funded and enter the product market, Firm 2 makes a take-it-or-leave-it offer to the investor. In order to make the problem interesting, we assume that Firm 2 can be funded only if Firm 1 has already been funded.[11] The investor decides whether to accept or not. We assume that when indifferent the investor does *not* agree to fund Firm 2. If Firm 2 receives funding, then it picks an effort level $e_2 \in [\Delta, 1]$.

t=3 Payoffs are realized according to the entrepreneur(s)' level(s) of effort and to whether the investor has funded one or both firms.

The timing of the model is summarized in the following figure:



Contracts:

Financial contracts simply state a rule for splitting the cash-flow. More precisely, a contract is a pair of real numbers $\left\{R_f^L, R_f^H\right\}$ specifying the entrepreneur's payoff in case of failure and success. Any firm is protected by limited liability; therefore $R_f^L \geq 0$ and $R_f^H \geq 0$. We assume that it is impossible to write an *exclusive dealing* contract, imposing some form

[11] We make this assumption in order to avoid a trivial solution to the Coase problem, which would be for the investor to reject any offer from Firm 1 and wait to fund Firm 2. This trivial solution is in any case an artefact of the simple sequential structure of the game, and would not arise if the game were simultaneous, or if, for example, Firm 1 could come back to the investor with a new proposal after Firm 2 has been funded. Our assumption is a thus shortcut which allows us to get at the main point of the analysis without the more complicated apparatus (in particular, dealing with out-of-equilibrium beliefs) which a simultaneous or more dynamic model would necessitate. See McAfee and Schwartz (1994) for a useful discussion of these issues in the context of input supply markets.

of punishment for the investor contingent on whether he funds the new entrant Firm 2. Very likely, such a contract would be illegal and thus not enforceable.[12] Moreover, since Firm 1's success and failure are both consistent with either competition or monopoly, the parties cannot circumvent this legal constraint by contracting on revenues.

2.2 Entry deterrence and the Coase problem

The industry has the same structure as in the foreclosure literature. The investor plays the role of an upstream monopolist, providing downstream firms with an essential input to the production process (i.e. money or capital); there is potential competition in the downstream industry, but it can develop only if both firms have access to funding.

The investor can accept a contract offer from one or both firms. If only one firm is funded, it then enjoys a monopoly position; otherwise, the two firms compete in the product market, which makes expected industry-wide profits lower. We assume: $\forall e \in [\Delta; 1]$

$$eR^H + (1-e)R^L - \Psi(e) - I > 2\left[(e-\Delta)R^H + (1-e+\Delta)R^L - \Psi(e) - I\right]$$

that is, for any level of effort, expected industry profits are higher under monopoly than under duopoly. Therefore it is clearly optimal for the first entrepreneur and the investor to arrange between them to let just one firm enter the industry and to deny funding to other firms - any other strategy would result in reduced industry surplus to be split among more parties. From the point of view of the investor, this is clearly a matter of *financial entry deterrence*: if he does not offer funding to the second firm, the latter cannot enter. But in fact, achieving such an outcome is not so simple.

Readers familiar with the foreclosure literature in industrial organization will guess that the investor faces a commitment problem in not funding Firm 2. After having funded Firm 1, the investor may have an incentive to behave opportunistically and also let Firm 2 enter the industry. To be more specific, assume Firm 1 is naïve and signs a financial contract expecting to enjoy a monopoly position; it may then be ex-post optimal for the investor to expropriate Firm 1 by funding Firm 2 as well. In equilibrium Firm 1 will anticipate this opportunistic behavior, so the investor would like to commit not to fund Firm 2. This commitment problem is what - by analogy to the new foreclosure doctrine and the problem

[12] An alternative reason why a contract which is directly contingent on Firm 2's existence is not used lies in the difficulty of verifying whether Firm 2 is indeed competing with Firm 1. An exclusive dealing clause would then be inefficient in that it might discourage funding of valuable, non-competing firms. More generally, we believe that because the legal process is time-consuming and costly, parties may prefer to use financial rather than legal incentives to prevent competition emerging.

of durable goods monopoly - we will refer to as *the investor's Coase problem.*[13] Thus in what follows we will refer to successful financial entry deterrence as having solved the investor's Coase problem.[14]

Two features of our model are crucial for the Coase problem to arise: first, when Firm 1 offers the financial contract to the investor, it does not observe whether Firm 2 is being funded or not (note that contracting need not be sequential; the Coase problem would also arise with simultaneous *and secret* contracts). Second, the contract between the investor and Firm 1 cannot be made contingent on whether Firm 2 is funded.

3 The optimal contract without potential entrants

3.1 The commitment case

Before dealing with the investor's Coase problem, we solve the benchmark case where Firm 1 faces no threat of entry by potential competitors. This is equivalent to assuming that the investor can credibly commit not to fund any other firm in the industry when he accepts Firm 1's offer. In this case the optimal financial contract for Firm 1 solves:

$$\begin{aligned}
&Max_{R_f^H, R_f^L, e} \left[eR_f^H + (1-e)R_f^L - \Psi(e)\right] \\
&(IR) \qquad e(R^H - R_f^H) + (1-e)(R^L - R_f^L) \geq I \\
&(IC) \qquad R_f^H - R_f^L = \Psi'(e) \\
&(LL) \qquad R_f^L \geq 0,\ R_f^H \geq 0
\end{aligned}$$

We will refer to the solution to this program as the *second best* optimum, and denote the associated effort level by e^{sb}.[15] R_f^L and R_f^H are the borrowing firm's payoffs in case of failure and success. (IR) is the investor's participation constraint and (IC) is the firm's incentive

[13] The Coase problem is so-named for Ronald Coase's (1972) seminal discussion of the commitment problem faced by a durable good monopolist.

[14] Notice that although economists are accustomed to thinking in terms of credit-rationing, from the industry point of view what the investor faces here is a problem of *over-funding*. The investor always has incentives to supply more than the ex-ante optimal amount of credit to the downstream firms.

[15] If effort were observable then the (first best) optimal financial contract would solve:

$$\begin{aligned}
&Max_{R_f^L, R_f^H, e} \left[eR_f^H + (1-e)R_f^L - \Psi(e)\right] \\
&(IR) \quad e(R^H - R_f^H) + (1-e)(R^L - R_f^L) \geq I \\
&(LL) \quad R_f^L \geq 0,\ R_f^H \geq 0
\end{aligned}$$

The first best level of effort e^* is thus defined by: $R^H - R^L \equiv \Psi'(e^*)$.

constraint. (LL) is the limited liability constraint. The solution to this program is described in the following Lemma:

Lemma 1 *In the absence of potential competitors, the investor's optimal claim is debt:* $R_f^L = 0$ *and* $R_f^H = \Psi'(e^{sb})$*, where* e^{sb}*, the second best effort, is the largest root of the equation:* $e(R^H - R^L - \Psi'(e)) = I - R^L$.

The effort level e^{sb} *is decreasing in* $I - R^L$*. Moreover,* $e^{sb} < e^*$*, where* e^* *is the first best effort.*

Proof. See the appendix ■

The interpretation of this result is straightforward: as the security design literature has pointed out, the optimal financial contract minimizes agency costs by having the entrepreneur paid only in case of success, which boils down to giving a debt claim to the investor.[16] The entrepreneur's shares of returns in the cases of failure and success are, respectively, 0 and $\Psi'(e^{sb})$. This can be interpreted as a debt contract specifying a reimbursement $D^{sb} \equiv R^H - \Psi'(e^{sb})$. Note that debt is always risky, as $e^{sb} < e^*$ implies $D^{sb} \equiv R^H - \Psi'(e^{sb}) > R^L$. Not surprisingly, the investor's debt claim is relatively risky for high levels of I and becomes safer as I decreases: lower levels of I allow the entrepreneur to get more high-powered incentives for himself, which correspond to a safer claim for the investor.

3.2 Why lack of commitment yields a Coase problem

When the investor cannot commit to deny funding to subsequent new-entrant firms, it can be shown that the first entrepreneur may do better than offering the contract derived in Lemma 1 above.

Suppose the above debt contract is signed at stage 1. At stage 2, a second entrepreneur wants to enter Firm 1's market and produce a competing product. However, Firm 2 has no funds: to enter the market it must borrow from the only investor who can finance the industry - that is, Firm 1's financier. If we define $\mathbf{v}_2(e_2)$ as Firm 2's pledgeable income, Firm 2's contract offer to the investor must satisfy the following participation constraint $(IR)_2$:[17]

$$\mathbf{v}_2(e_2) - I + (e^{sb} - \Delta)(R^H - \Psi'(e^{sb})) + (1 - e^{sb} + \Delta)R^L >$$

[16] For a detailed derivation of this result, see Innes (1990).

[17] Firm 2's contract offer $\left\{R_{f2}^L; R_{f2}^H\right\}$ maximizes the firm's net present value subject to the participation constraint $(IR)_2$, the $(IC)_2$ constraint: $R_{f2}^H - R_{f2}^L = \Psi'(e_2)$, and limited liability: $R_{f2}^L \geq 0$, $R_{f2}^H \geq 0$. By setting $R_{f2}^L = 0$ (which holds at the optimum) and $R_{f2}^H = \Psi'(e_2)$ (by incentive compatibility), we obtain the expected income pledged to the investor as a function of effort e_2: $\mathbf{v}_2(e_2) \equiv R^L + (e_2 - \Delta)(R^H - R^L - \Psi'(e_2))$.

$$e^{sb}(R^H - \Psi'(e^{sb})) + (1 - e^{sb})R^L$$

The left-hand side is the net return from funding Firm 2, *plus* the value of the investor's claim in Firm 1 when the contract $\{R_f^L = 0, R_f^H = \Psi'(e^{sb})\}$ is in force *and* Firm 2 is funded. The right-hand side is the value of the investor's claim in Firm 1 when the same contract holds and Firm 2 is *not* funded. The constraint can be rearranged as:

$$(IR)_2 \qquad \mathbf{v}_2(e_2) - I > \Delta(R^H - R^L - \Psi'(e^{sb}))$$

When deciding whether to fund Firm 2, the investor trades off the additional payoff $\mathbf{v}_2(e_2) - I$ from funding Firm 2 with the reduced value of his claim in Firm 1 induced by market competition. As competition reduces the probability of success of Firm 1, the investor's claim is affected by Firm 2's entry only if the claim is risky, that is, if $R^H - \Psi'(e^{sb}) > R^L$. Also, the riskier the investor's claim, the less will he be tempted to accept Firm 2's offer. The above reasoning underlines the first important insight of our paper: *if an investor holds sufficiently safe debt in a firm then he will be willing to fund the firm's rivals.*

Now, will Firm 2 find a deal that Firm 1's financier is willing to accept? In other words, will an investor's "Coase problem" indeed arise, whereby the investor (ex-post) optimally floods the industry with financial funds whenever he holds the (second best) debt claim in the first entrant? Note that in order to persuade the investor to finance him, Firm 2 is able to offer the investor up to $\max_{e_2} \mathbf{v}_2(e_2)$. For ease of exposition in the following, we assume that if the investor is indifferent to funding Firm 2 or not, then he does not do so. If we define $\mathbf{V}_2 \equiv \max_{e_2} \mathbf{v}_2(e_2)$, the largest pledgeable income that Firm 2 can promise to the investor, then we can state the following:

Lemma 2 *Suppose Firm 1 sells debt D^{sb} to the investor. Then, if the following condition holds:*

$$\mathbf{V}_2 - I > \Delta(R^H - R^L - \Psi'(e^{sb})) \tag{1}$$

at t=2 there exists at least one contract offer that the investor is willing to accept from Firm 2.

Anticipating that the investor will be tempted to supply a second firm ex-post, ex-ante the first entrepreneur looks for a contractual solution to eliminate the investor's opportunism. As we are interested in analyzing this contractual response to the Coase problem, in what follows we assume that condition (1) holds. Notice that although a Coase problem arises at effort e^{sb}, it may not arise for lower efforts, because the marginal cost of such efforts Ψ' will be lower, so the entrepreneur can receive a lower and the investor a higher pay-off in the case of success. In the following, it will be useful to define $e^{cp}(\mathbf{V}_2)$ as the maximum effort which can be induced from the entrepreneur without the investor being tempted to fund rival firms for any given value of $\mathbf{V}_2$. Thus $e^{cp}(\mathbf{V}_2)$ is implicitly defined by: $\mathbf{V}_2 - I = \Delta(R^H - R^L - \Psi'(e^{cp}))$.

For convenience, we will also make the following assumption. Let $\underline{e}$ be the smaller root of $e(R^H - R^L - \Psi'(e)) = I - R^L$ (recall that e^{sb} is defined as the larger root). $\underline{e}$ is thus the smallest possible effort compatible with Firm 1's financier breaking even, so contracts inducing effort $e < \underline{e}$ are not feasible. Then we assume that:

$$(e^{sb} - \Delta - \underline{e})(R^H - R^L) - \Psi(e^{sb}) + \Psi(\underline{e}) \geq 0 \tag{2}$$

Condition (2) guarantees that the value to Firm 1 associated with solving the Coase Problem with effort $\underline{e}$ is smaller than the value associated with not solving it and having probability of success $e^{sb} - \Delta$. So under this assumption, if solving the Coase problem requires reducing effort as low as the lowest feasible effort $\underline{e}$, then Firm 1 prefers to leave it unsolved and write the second best contract. This rules out the possibility that Firm 1 would like to solve the Coase problem but is unable to do so because this would require inducing an effort level below $\underline{e}$. Assumption (2) thus implies that when it is optimal to solve the Coase problem, it is possible to do so.[18]

In the light of condition (2), we can see that there will be a threshold value $\widehat{e}$ for effort between $\underline{e}$ and e^{sb}, which would make Firm 1 exactly indifferent between solving the problem and not solving it:

$$(e^{sb} - \Delta - \widehat{e})(R^H - R^L) - \Psi(e^{sb}) + \Psi(\widehat{e}) = 0 \tag{3}$$

This effort level will coincide with that necessary to solve the Coase problem precisely when the value of Firm 2 is $\widehat{\mathbf{V}}_2$, where $\widehat{\mathbf{V}}_2$ is defined as $\widehat{\mathbf{V}}_2 \equiv I + \Delta(R^H - R^L - \Psi'(\widehat{e}))$. Equivalently, in terms of the notation introduced above, we have $\widehat{e} \equiv e^{cp}(\widehat{\mathbf{V}}_2)$. Thus if the value of Firm 2 is $\widehat{\mathbf{V}}_2$, Firm 1 will be exactly indifferent between solving the Coase problem and not solving it. With these tools, we are now in a position to construct the entry deterring financial contract and consider under what conditions it is optimal to solve the Coase problem.

[18] Condition (2) is not important for our qualitative results: we make this assumption only to reduce the number of cases we need to consider. The same flavor of results would go through if we assumed the converse of condition (2), except that then the highest value of Firm 2 for which the Coase problem is solved would be given by what is feasible (i.e. $I + \Delta(R^H - R^L - \Psi'(\underline{e}))$) rather than by what is optimal, as is done in the proof below.

4 Excluding Firm 2

We have seen that an investor's Coase problem arises whenever his claim satisfies condition (1). If the innovating firm wants to preserve its monopolistic rent, it must take into account the investor's future opportunistic behavior when solving for the optimal contract. This boils down to making the investor's claim more sensitive to the effect of competition on Firm 1's profit.

More formally, the optimal contract offered to the investor is the solution to the following program:

$$Max_{R_f^H, R_f^L, e} \left[eR_f^H + (1-e)R_f^L - \Psi(e) \right]$$
$$(IR) \qquad e(R^H - R_f^H) + (1-e)(R^L - R_f^L)) \geq I$$
$$(IC) \qquad R_f^H - R_f^L = \Psi'(e)$$
$$(IC_I) \qquad \Delta(R^H - R^L - \Psi'(e)) \geq \mathbf{V}_2 - I$$
$$(LL) \qquad R_f^H \geq 0,\ R_f^L \geq 0$$

This program may be referred to as the *third best* optimum: when a potential entrant exists, the optimal contract must also satisfy the investor's incentive compatibility constraint (IC_I). The third best solution is described in the following:

Proposition 3 – ***Solving the Coase Problem*** – *Assume that at t=2 Firm 2 will ask for funding to compete with Firm 1. Then - provided* $\mathbf{V}_2 \leq \widehat{\mathbf{V}}_2$ *- the optimal financial contract signed by Firm 1 at t=1 induces a level of effort* $e^{cp} < e^{sb}$ *and sets the following profit-sharing rule:* $R_f^L = b > 0$*;* $R_f^H = b + \Psi'(e^{cp})$*, where* $b \equiv e^{cp}(R^H - R^L - \Psi'(e^{cp})) + R^L - I$*.*

Proof. We assumed that condition (1) holds. Hence, the contract specified in Lemma 1 fails to satisfy (IC_I), and thus cannot be a solution to the above program. If the Coase problem is to be solved, the firm must make the investor's claim riskier, i.e. reduce $R_f^H - R_f^L$. By (IC), this requires inducing an effort level e^{cp} strictly lower than e^{sb}. Clearly, effort is reduced only until the incentive constraint holds as an equality. Therefore e^{cp} is uniquely defined by:

$$\Delta(R^H - R^L - \Psi'(e^{cp})) = \mathbf{V}_2 - I$$

where $e^{cp} = e^{cp}(\mathbf{V}_2)$ is a *decreasing* function of $\mathbf{V}_2$.

The above contract is indeed optimal provided Firm 2 is not too valuable. We defined $\widehat{\mathbf{V}}_2$ as the maximal level of $\mathbf{V}_2$ such that the Coase problem is worth solving. When $\mathbf{V}_2 > \widehat{\mathbf{V}}_2$

solving the Coase problem requires such a large reduction in effort that the second best contract allowing Firm 2's entry yields a higher net present value for Firm 1. Conversely, for any $\mathbf{V}_2 \leq \widehat{\mathbf{V}}_2$ it is optimal to distort the financial contract away from the second best one and deter Firm 2's entry. Hence, $e^{cp} = e^{cp}(\mathbf{V}_2) < e^{sb}$. Notice that $\mathbf{V}_2 \leq \widehat{\mathbf{V}}_2$ and assumption (2) imply: $e^{cp}(\mathbf{V}_2) \geq e(\widehat{\mathbf{V}}_2) \geq \underline{e}$: when it is optimal to solve the Coase problem, this is also feasible.

Finally, we derive the optimal financial contract when $\mathbf{V}_2 \leq \widehat{\mathbf{V}}_2$. From the firm's (IC) constraint it follows that $R_f^H = R_f^L + \Psi'(e^{cp})$. Therefore, we are left with choosing the optimal level of R_f^L. We know that the expected pledgeable income $v(e) \equiv e(R^H - R^L - \Psi'(e)) + R^L$ is concave in e and that e^{sb} ($\underline{e}$) is the larger (smaller) root to $v(e) = I$. Hence, from $e^{cp} \in \left(\underline{e}, e^{sb}\right)$ it follows: $v(e^{cp}) \equiv e^{cp}(R^H - R^L - \Psi'(e^{cp})) + R^L > v(e^{sb}) \equiv I$. When Firm 1 chooses to solve the Coase problem, the optimal contract must set $R_f^L > 0$ so that no rent is left to the investor: $R_f^L = e^{cp}(R^H - R^L - \Psi'(e^{cp})) + R^L - I > 0$. ■

In interpreting this result, notice that when the Coase problem arises, the financial contract must solve a double-sided moral hazard problem. The entrepreneur is faced with a trade-off. To commit to high levels of effort he would like to bear most of the risk. On the other hand, the investor has to bear sufficient risk to be prevented from funding the second firm. In other words, the investor must internalize the loss of profits induced by increased competition, which pushes towards a less high-powered incentive scheme for the entrepreneur. The Coase problem can thus be solved only at the expense of less entrepreneurial effort. When Firm 2's pledgeable income is very high, solving the Coase problem is more costly than letting competition in. Hence, for high values of $\mathbf{V}_2$, Firm 1 offers the investor the second best contract and the Coase problem is left unsolved.[19] Conversely, when $\mathbf{V}_2$ is "not too high", effort is reduced so as to solve the Coase problem. In this case, as the agency rent is reduced, the entrepreneur requires a payment even in the low state in order to appropriate all the project's surplus.

The optimal contract for which we have just solved is simply a profit-sharing rule. We now ask how this rule can be implemented through existing financial instruments. It turns out that the third best contract is more equity-like than the second best contract defined in the previous section. The features of the "anti-competitive" financial contract are described in the following:

[19]That sometimes the Coase problem is optimally left unsolved is not surprising, given the binary nature of the investor's decision in the double sided moral hazard problem. In the next section we look at a more continuous model.

Corollary 4 – ***Anti-Competitive Equity Financing*** – *An entrepreneur wanting to build a "financial barrier to entry" in the product market designs the investor's financial claim in order to solve the Coase problem. In the optimal anti-competitive arrangement, the investor holds a combination of safe debt and equity. He is entitled to the debt reimbursement* $D^s \equiv R^L - \frac{b(R^H - R^L)}{\Psi'(e^{cp})}$*, and also owns an equity share* $s \equiv 1 - \frac{\Psi'(e^{cp})}{R^H - R^L}$ *in Firm 1.*

Proof. Suppose the investor holds debt D^s and an equity share s. Then his payoff in case of failure is:

$D^s + s\left(R^L - D^s\right) \equiv R^L - \frac{b(R^H - R^L)}{\Psi'(e^{cp})} + \left(1 - \frac{\Psi'(e^{cp})}{R^H - R^L}\right)\left(R^L - R^L + \frac{b(R^H - R^L)}{\Psi'(e^{cp})}\right)$

$\equiv R^L - b.$

Analogously, his payoff in case of success is:

$D^s + s(R^H - D^s) \equiv R^L - \frac{b(R^H - R^L)}{\Psi'(e^{cp})} + \left(1 - \frac{\Psi'(e^{cp})}{R^H - R^L}\right)\left(R^H - R^L + \frac{b(R^H - R^L)}{\Psi'(e^{cp})}\right)$

$\equiv R^H - b - \Psi'(e^{cp}).$

Therefore, the optimal return-splitting rule is being implemented. ■

This result is quite intuitive: an investor holding fairly safe debt in Firm 1 will always want to fund Firm 2, as his claim is insensitive to the effects of competition. Also, the temptation to expropriate Firm 1 by funding Firm 2 will be stronger the higher is $\mathbf{V}_2$, the best offer he may receive from Firm 2. To solve this problem, the entrepreneur must sell the investor a riskier claim (i.e. one which is more sensitive to changes in Firm 1's profits). So he sells a combination of debt and equity. As $\mathbf{V}_2$ increases, the equity stake is increased and the investor gets most of his return from his equity-holding. This is because a larger $\mathbf{V}_2$ implies a more serious commitment problem for the investor.[20]

4.1 Discussion

As already discussed in the introduction, our result has an obvious relation with the large and growing body of work on the interaction between product and financial market decisions. In this section we draw out the relation of our result to several other strands of literature.

Relation with Durable Goods and Foreclosure

As we have already emphasized, there is a close analogy between our financial contracting result, the problem of durable goods monopoly, and the upstream monopolist's Coase

[20] One may argue that an alternative way to implement the optimal financial contract is to sell a debt claim $D = R^H - \Psi'(e^{cp}) - b$ to the investor, while paying a wage b to the entrepreneur plus a bonus $\Psi'(e^{cp})$ in case a high return accrues. Notice however that the bonus wage-plus debt interpretation is incorrect if debt claims are senior to entrepreneurial wages, as in this case the debt-holder is entitled to the whole return R^L in case of failure. We thank a referee for raising this issue.

problem envisioned by the foreclosure doctrine. In each case, the monopolist has difficulty committing to a policy of restricting supply and looks for a financial means of doing so. A durable goods monopolist maximizes profits by selling the monopoly quantity of goods to the highest-value consumers. Having done so, however, he is tempted to reduce the price to make more sales to those consumers who have not yet bought. Anticipating this, the higher value consumers will not be willing to pay the higher price for the good. To solve this problem, the monopolist does better by leasing the good each period.[21] In the foreclosure literature, after selling the monopoly quantity of input to one downstream firm, the monopolist is tempted to sell more (the best response quantity) to a second downstream firm. In this case, the analogue to leasing is to integrate vertically with the first downstream firm so as to internalize its loss of profits from competition.[22] In our context, where the monopolist supplies capital downstream, equity-holding plays the role of vertical integration.

An important question which arises in each of these three different settings is to what extent the Coase problem can be solved through reputation,[23] rendering the provision of a direct financial incentive unnecessary. In particular, one might imagine that an investor would wish to cultivate a reputation for not funding competitors to the firms which he funds in order to be able to strike better deals with other firms which may come to him for funding in the future. This question has been hardly tackled in either the durable goods or the foreclosure literature. Note that in general it is not trivial to set up a formal model of the reputation mechanism. One might consider using a complete information infinite period game, as would be standard in a model of collusion, for example. But in these settings, those agents hurt by the incumbent's cheating are not generally the same agents required to inflict the punishment, so it is not obvious that the latter actually have any incentive to inflict costly punishment.[24] Setting up a reputational model where there is incomplete

[21]The original intuition is due to Coase (1972).

[22]This result was first discovered by Hart and Tirole (1990). See Rey and Tirole (forthcoming) for a survey of other solutions to the Coase problem in this context.

[23]We thank an anonymous referee for raising this point.

[24]To be clear: in the durable goods case, for a reputation mechanism to work, if the monopolist charges early consumers the monopoly price and then reduces the price to later consumers, it is the later consumers who must punish, even though it is the early consumers who are hurt. (The late consumers gain from the monopolist's cheating, yet are required to inflict punishment.) Similarly, in the foreclosure case, if the monopolist hurts downstream firm 1 by overselling to downstream firm 2, downstream firm 2 must participate in the punishment of the monopolist, even though it has gained at firm 1's expense from the monopolist's defection. In the context examined in this paper, it may be even more difficult to solve the Coase problem through reputation alone because it may be difficult for firms which are considering contracts offered by the investor to determine his reputation, i.e. they cannot observe whether the failure of firms he funded previously was due to competition or other reasons, such as bad luck or low effort.

information about the monopolist's type shows more promise, but is outside the scope of this paper.[25] In general, we believe that the financial and reputational instruments can work hand-in-hand and need not be used in exclusion to one another. One would expect to see more use of high-powered financial incentives at times when the temptation to "cash in" on one's reputation is greater, or by financiers with worse reputations. Moreover, financial incentives and reputation probably do not exhaust the possible mechanisms that financiers can exploit to try to solve the Coase problem. For example, a lack of available funds might serve as a further commitment not to finance too many competitors (see Dewatripont and Maskin (1995) for the same idea in a different context); this idea may explain why venture capitalists remain small.[26]

The Financing of Start-Up Industries

A third strand of related literature is the corporate finance literature examining the instruments used to finance start-up firms. One might expect that such industries suffer from severe problems of asymmetric information, with investors being uncertain of whether they are being sold a lemon. Standard considerations might then suggest that the entrepreneurs running such firms might want to signal their value by issuing debt rather than equity (see, e.g. Myers-Majluf 1984). However, this is not what is observed: many fast growing start-up industries are financed by equity or equity-like securities (see, e.g. Gompers 1997 and Kaplan and Strömberg 2000). Our paper can provide an explanation for this puzzling fact. Existing explanations for the use of equity have pointed to the need to reduce excessive risk-taking by the entrepreneur, or to provide a (venture capital) investor with incentives to monitor and actively support start-ups.[27] However, we argue that the use of equity in such industries can often be seen as a response to the Coase problem. Two features of new industries make them particularly vulnerable to the Coase problem. Firstly, the riskiness of start-ups means that few investors are willing to provide capital to such firms, so difficulty in obtaining funding

[25]See Ausubel and Deneckere (1992) for a multi-period incomplete information model of durable goods monopoly. White (2000) makes a start on a single period incomplete information model of foreclosure, showing how the incompleteness of information can have the perverse effect of turning over-supply into under-supply of the input by some monopolist types.

[26]See *The Economist* (May 25th, 2000), reporting that "the biggest firms now have so much money to manage that they are turning some investors away".

[27]For financial contracting models focussing on the monitoring and advising role of (venture capital) investors, see Repullo and Suarez (1999) and Casamatta (2001). These theories imply that venture capitalists with less expertise in advising start-ups should hold more high-powered claims to be given enough incentives to monitor and advise. Conversely, our paper suggests that investors who are *more* specialized and knowledgeable about the firms they fund suffer from a more serious commitment problem - and so should hold riskier claims.

may constitute a barrier to entry in the product market. Secondly, successful entry into an emerging industry is often easier than entry into a mature industry, so the temptation to fund competitors is greater.

An important class of investors in start-ups and new industries are venture capitalists. In fact, venture capitalists very often fund early stage start-up firms through convertible debt or convertible preferred securities, with a substantial fraction of conversions occurring *automatically* on attainment of a sales or other performance target. Until now, the reason why conversion occurs *automatically* has been something of a puzzle. Existing models motivate convertibility as a means of providing *entrepreneurs* with the correct incentives, so conversion is always in the venture capitalist's interest ex post, making the *compulsion* to convert redundant. In an extension of our theory (Cestone and White 2000), we show that convertibility can also be used to motivate *venture capitalists* (in particular, not to fund competing firms). In essence, the idea is that when an industry is just starting up, its prospects for success are very uncertain, so the venture capitalist is not tempted to fund competing firms and should hold debt so as to provide the entrepreneur with maximum incentives to exert effort, as in section 3.1. However, once certain performance targets have been attained, it becomes much clearer that the industry will be profitable and then the venture capitalist is much more tempted to fund more firms in the industry. At this point, the venture capitalist's claim must be converted into equity to reduce his incentive to fund competitors, as in section 4. Notice that here, unlike in previous work on the topic, conversion is not necessarily in the venture capitalist's interest ex post, so compulsion may well be necessary.[28,29]

Banking Regulation

Finally, our result is of relevance to the literature on banking regulation. In particular, it suggests that if one wishes to promote product market competition, one might want to limit equity holding by investors. For example, until very recently equity-holding by banks in the United States has been limited by the Glass-Steagall Act. The analysis in the next section

[28]Our model might seem to go against the conventional wisdom that venture capitalists are very competitive. We deal with this criticism at greater length in our earlier work, arguing that VCs are informationally and geographically differentiated, lend in syndicates, and do not compete strongly in so-called 'cold' periods (see Gompers and Lerner (2000)). Here we refer the reader to the next section, which shows that our results are robust to imperfect competition between investors.

[29]One might argue that since each individual venture capitalist in a funding syndicate has only a small stake in any given firm, he may not suffer a very large absolute loss on his holding in this firm if he funds a competing firm even if his claim is quite high-powered. However, the syndicate as a whole may well suffer a large loss, so that "arm twisting" and the associated prospect of repeated interaction among investors may be enough to prevent any individual venture capitalist succumbing to the temptation. (See our discussion of reputation above.) We thank a referee for raising this point.

would suggest that - given that US financial markets are fairly competitive - the lifting of these restrictions should give little cause for concern.[30] However, in countries where the financial sector is concentrated, and banks are a major source of funding for industry, it is clear that allowing banks to control substantial equity stakes in incumbent firms could have the anti-competitive consequence of making them reluctant to fund new entrants. It is alleged that this is exactly what occurred in Eastern Europe after liberalization, for example.[31] The Italian and German economies at the turn of the last century provide examples of the same phenomenon.[32] Historically, equity holding by a relatively concentrated banking sector has been held responsible for the emergence of concentrated industrial sectors in nineteenth and early twentieth century United States and Germany, as compared to the United Kingdom, which had fragmented financial and industrial sectors.[33]

Interestingly, Rajan and Zingales (2001) argue persuasively that in many twentieth century economies industrial incumbents have formed powerful interest groups to hamper financial development through the political process, in a subtle and disguised attempt to protect the value of their rents. Note that this kind of behavior is only worthwhile for incumbents if the lack of development of the financial sector allows incumbents to limit entry, as we argue in this paper. If economies are open to international competition, then entrant firms might come from abroad anyway, so there is less reason for incumbents to hinder financial development. Thus our theory is entirely consistent with Rajan and Zingales' empirical results.

Of course, the foregoing welfare analysis is predicated on the assumption that the pro-

[30]See *The Economist* (Feb 1st 1997), which asks whether pressure to reform the Glass-Steagall Act "might not ...recreate the cartels of [J.P.] Morgan's day?", but concludes that given the competitiveness of US banking, this is unlikely. For a useful overview of the costs and benefits of such a reform, see Saunders (1994, especially pp.239-40).

[31]Entrant firms in Eastern Europe face severe funding shortages because there is little competition in the banking industry, and little opportunity for outside funding (Pissarides 1998). Moreover, existing banks tend to be biased towards funding only incumbent firms (Gordon 1994, p59, Frydman et al 1993). In these circumstances it might be advisable for these countries to avoid bank equity holding, rather than encouraging bank debt-equity swaps in the old state industries, as has sometimes been the case.

[32]A concise description of the role of large equity-holding banks in Belgian, German and Italian industrialization can be found in Da Rin and Hellman (1998). It is clear that by holding equity, these banks (in contrast to the debt-holding British banks of the time, for example), had a very active interest in the profitability of the firms they funded, and worked to limit competition between them.

[33]For the classic analysis of Germany, see Gerschenkron (1962). Davis (1966) provides several case studies of emerging industries in 19th century U.S. and U.K. to argue that in the U.S. "some firms were more successful than others in their search for 'informal finance', and the successful firms grew at the expense of their less fortunate competitors. As a result, industrial concentration increased in the affected industries." Conversely, in England, "because the capital markets were better", industries "did not become unduly concentrated". For more evidence on the United States, see Segliman (1982) and De Long (1990).

motion of competition is desirable. In a limited set of circumstances, it may instead be desirable to limit entry in order to provide rents, to avoid excess entry and spur innovation by early entrants, for example.[34] Thus it may be desirable to allow venture capitalists to hold equity in young innovative firms, whilst preventing banks from holding (too much) equity in older established firms.[35] Whatever the desirability of competition in any particular circumstance, the implication of our work is that the impact of credit market competition cannot be assessed only by taking a *partial equilibrium* approach, i.e. abstracting from any interaction with other markets, as has been traditional in the banking literature.[36] The anti-trust monitoring of financial and product markets should be better coordinated.

5 Imperfect competition among investors

So far in this paper we have assumed that there is one investor who is the unique source of funds for the industry. In that case, if the sole investor has appropriate financial incentives to deny funding to Firm 2, the latter will not be able to enter the industry and compete. But what if there are other potential investors to whom Firm 2 can turn? In this section we show that the main insights from the monopoly case are robust to the introduction of competition in the credit market, as long as that competition is *imperfect*. We show that when the first investor can be bypassed, and funding obtained from alternative sources, *some* competitors may enter the product market in equilibrium. We establish new results on the interaction between financial contracting, product market competition and credit market competition. In particular, we are able to show that (other things being equal) *stronger competition in the credit market will cause stronger competition in the product market.*

Imperfect competition in the credit market can arise for many reasons, among which are regulation of bank entry and economies of scale in banking, especially in countries where other sources of finance (venture capital, stock and bond market) are undeveloped. Central Banks often deliberately limit the severity of competition in banking on the grounds that

[34] In a particularly severe case of over-funding (probably from a social as well as an industry point of view), Sahlman and Stevenson (1985) document "the six year long parade of venture capital investors into an emerging segment of the computer data storage industry. In all, 43 start-ups were funded in an industry segment that could be expected in the long run to support perhaps four."

[35] For simplicity, we have in the foregoing model implicitly assumed that the participation constraint for the first entrepreneur is not binding. But it is possible that if the Coase problem is not solved, the first entrepreneur may not obtain enough rents from entering the industry compared to his reservation wage from employment elsewhere, in which case the industry would not emerge without equity finance.

[36] See for instance Petersen and Rajan (1994, 1995) or Matutes and Vives (1996).

there is a trade-off between encouraging competition and prudent behavior.[37] There may also be political economy reasons for the concentration of credit markets, including lobbying by incumbents (see Rajan and Zingales (2001) for theory and evidence on this point) and corruption of public officials. Several papers have emphasized differential information among investors as a very important source of imperfect competition between them (see, e.g. Sharpe, 1990 and Rajan, 1992). This latter observation is important, because it implies that even if there is ex ante perfect competition between investors, ex post, competition will be imperfect. For the results of our basic model to go through in this wider setting, we require only this weak form of imperfect competition, so for concreteness, we will focus on the following *ex post informational asymmetry* between investors. We assume that in the process of lending to an early entrant, an investor becomes knowledgeable about the industry, thereby gaining an informational advantage over other investors about potential late entrants.[38] The reason for this focus is two-fold. Firstly we view this as a particularly plausible mechanism through which asymmetries can arise. Secondly, as we will see below, it leads to an interesting 'winner's curse' effect for outside investors. It should be clear, however, that the precise choice among the different reasons for imperfect competition is not very important for our results.

5.1 The model

We extend our basic model to allow for competition in the market for funds. Two investors compete to fund early entrants in the industry. Investor 1 has cost of funds $r_1 = 0$, while Investor 2's cost of funds is $r_2 \geq 0$.[39] We identify Firm 1's financier with Investor 1.[40]

The value of Firm 2 is unknown at date 1: $\mathbf{V}_2$ (the maximal income that Firm 2 may pledge to its financier) is uniformly distributed on $\left[0, \overline{V}\right]$, where $\frac{\overline{V}}{2} = E[\mathbf{V}_2] > I$. Introducing

[37] An early paper to make this point was Bhattacharya (1982).

[38] The idea is similar to the Sharpe and Rajan papers cited above, which argue that lending relationships generate informational asymmetries between inside banks and outside lenders, thus favoring the creation of ex-post monopoly power vis à vis borrowing firms. We believe that some information (e.g. about the profitability of the industry, demand for the product, etc.) is transferable across firms in the same industry, so that lending relationships with incumbent firms may also allow inside investors to build up some monopoly power vis à vis entrant firms.

[39] Thus we allow the case where investors 1 and 2 are ex ante identical, $r_1 = r_2$. Our anti-competitive financial contracting result will still hold because of the informational asymmetry that will arise ex post after one of the two investors funds firm 1. We allow r_2 to vary because this is a simple way to study how Firm 1's contract changes when competition in the credit market becomes less intense.

[40] This is without loss of generality, since when $r_2 \geq r_1$ Firm 1 is always funded by Investor 1 at equilibrium (subject to a relabelling when the investors are ex ante identical, $r_2 = r_1$).

a continuum of potential entrants will allow us to compute the industry entry rate and study how it varies as a function of financial contracts and thus of credit market competition. To guarantee that a Coase problem arises, we assume:

$$\overline{V} > \Delta(R^H - R^L - \Psi'(e^{sb})) + I \tag{1'}$$

which is the analogue of earlier condition (1): if Investor 1 holds debt D^{sb} in the first firm, he will be tempted to fund *the most profitable entrants* at date 2. The timing of the game is the same as in the basic model, except that we make the following crucial assumption: between t=1 and t=2, Investor 1 learns the value of $\mathbf{V}_2$. The idea is that during the lending relationship with Firm 1, Investor 1 gains expertise in evaluating the prospects of other (potential) firms in the same industry. Hence, he learns at no cost the value of $\mathbf{V}_2$. Investor 2, however, who has not yet had any contact with the industry, remains ignorant about the realized value of $\mathbf{V}_2$ and will attempt to update the prior distribution by observing Investor 1's behavior.

At t=2, Firm 2 makes a contract offer to Investor 1. If Investor 1 rejects, then Firm 2 makes an offer to Investor 2, who decides whether to accept or not. We assume that whenever indifferent, Investor 2 rejects Firm 2's offer.

Consider first Investor 1's decision on whether to fund Firm 2. If the contract $\left\{R_f^L, R_f^H\right\}$ with Firm 1 is in force, then Investor 1 is willing to fund Firm 2 provided:

$$\mathbf{V}_2 > \Delta((R^H - R_f^H) - (R^L - R_f^L)) + I = \Delta(R^H - R^L - \Psi'(e)) + I \ .$$

In other words, to any given financial contract with Firm 1 is associated a threshold value $\widetilde{V}(e) = \Delta(R^H - R^L - \Psi'(e)) + I$ such that the optimal policy for Investor 1 at date 2 is to fund those entrants who can pledge an income $\mathbf{V}_2 > \widetilde{V}(e)$, and not fund entrants with $\mathbf{V}_2 \leq \widetilde{V}(e)$.

Note that a first difference with the basic model here is that at t=1 the investor does not yet know the value of Firm 2. Hence, when choosing its financial contract at t=1, Firm 1 is choosing an expected entry rate $1 - \frac{\widetilde{V}(e)}{\overline{V}}$ (this can be thought as the number of competitors that Investor 1 is expected to fund at t=2) associated with the 'entry deterrence' threshold $\widetilde{V}(e)$ which the contract induces. As one would expect from the basic model, a riskier claim (i.e., a lower entrepreneurial effort) is associated with a higher $\widetilde{V}(e)$ and thus a tighter 'entry deterrence' policy.

Ideally, Firm 1 would like to deter all competitors.[41] This is not so easy as before, however, because even if the financial contract with Investor 1 is designed so that Investor 1

[41] We verify this fact below.

will deny funding to all entrants, there is still the possibility that Investor 2 will nevertheless provide funding. We now investigate this possibility.

Firm 1's financial contracting problem

Suppose now that Firm 2 has been refused credit by Investor 1. Will Investor 2 decide to fund Firm 2, thus allowing further entry to occur into the product market? Since Firm 2 is ex ante profitable ($E[\mathbf{V}_2] > I$), at least for investors with low cost of funds (r_2 close to r_1), one might think that Investor 2 would always fund Firm 2 and so there would be no point in Investor 1 writing a financial contract to solve his own Coase problem. A closer inspection, however, reveals that Investor 2's decision should depend on the (observable) financial contract between Firm 1 and Investor 1. If Firm 2 has been refused credit by Investor 1, then it must be that $\mathbf{V}_2 \leq \widetilde{V}(e)$. Hence, Investor 2 will agree to fund Firm 2 if and only if:

$$E\left[\mathbf{V}_2|\mathbf{V}_2 \leq \widetilde{V}(e)\right] = \int_0^{\widetilde{V}(e)} V_2 \frac{1}{\widetilde{V}(e)} dV_2 \ > \ I(1+r_2) \tag{3}$$

that is:[42]

$$\widetilde{V}(e) > 2I(1+r_2) \tag{4}$$

To put this result in words, if Investor 1 solves the Coase problem for a wide range of realizations of values of Firm 2 ($\widetilde{V}(e)$ high, close to $\overline{V}$) then Investor 2 learns very little from the observation that Firm 2 has not been funded by Investor 1, he does not update his prior very much and so Firm 2 will be funded if it was ex ante profitable. Note that this fact constrains Investor 1's desire to solve the Coase problem, because there is no point writing a contract with reduced effort to limit entry if those firms which one rejects will in any case receive funding from a competitor. For this reason the solution to Firm 1's financial contracting problem must satisfy the 'competition constraint' (CC): $\widetilde{V}(e) \leq 2I(1+r_2)$, or else it would be inefficiently reducing effort without gaining from any reduced entry.[43]

[42] Thus notice that we need not assume a higher cost of funds for the second investor in order for imperfect competition to arise. Even if $r_2 = r_1 = 0$ Investor 2 - fearing a winner's curse - will reject offers that have been rejected by Investor 1, provided $\widetilde{V}(e) \leq 2I$.

[43] Looking at it from the other way, if Investor 1 solves the Coase problem only for low realizations of Firm 2's value ($\widetilde{V}(e)$ low) then observing that Investor 1 is unwilling to fund Firm 2 is a bad signal about Firm 2's value. Then, Investor 2 does not want to fund Firm 2 because he knows he suffers from a 'winner's curse' effect in funding the firms which have been rejected by the informed financier.

In the light of these considerations, we can write the optimal contract for Firm 1 as the solution to the following program:

$$Max_{R_f^H, R_f^L, e} \quad eR_f^H + (1-e)R_f^L - \Psi(e) - \left(1 - \frac{\widetilde{V}(e)}{\overline{V}}\right)\Delta(R_f^H - R_f^L)$$

$$(IR) \qquad e(R^H - R_f^H) + (1-e)(R^L - R_f^L)) \geq I$$

$$(IC) \qquad R_f^H - R_f^L = \Psi'(e)$$

$$(IC_I) \qquad \widetilde{V}(e) = \Delta[(R^H - R_f^H) - (R^L - R_f^L)] + I$$

$$(CC) \qquad \widetilde{V}(e) \leq 2I(1 + r_2)$$

$$(LL) \qquad R_f^H \geq 0,\ R_f^L \geq 0$$

The last term in the objective function is the impact of competition on Firm 1's expected payment (remember that $1 - \frac{\widetilde{V}(e)}{\overline{V}}$ is the 'expected entry rate').[44] Note first that in case of commitment and in the absence of competition in the credit market, Firm 1's program would not have to satisfy (IC_I) and (CC). The optimal contract would then require that for all $\mathbf{V}_2 \in \left[0, \overline{V}\right]$ Firm 2 is *not* funded; the financial claim and effort level would be exactly as in Lemma 1.

5.2 The optimal contract when the competition constraint does not bind

Let us assume for the moment that Investor 2 has a high cost of funds and *de facto* does not compete to fund Firm 2. Hence, the constraint (CC) does not bind in Firm 1's maximization program,[45] which boils down to the continuous version of the basic problem analyzed in section 4. The optimal contract then trades off the certain reduction in entrepreneurial incentives induced by a riskier claim with the reduced probability of entry due to the investor's financial incentives. This trade-off is captured by the function:

$$N(e) \equiv \left[R^H - R^L - \Psi'(e) - \left(1 - \frac{\widetilde{V}(e)}{\overline{V}}\right)\Delta\Psi''(e)\right] - \frac{\Delta^2}{\overline{V}}\Psi'(e)\Psi''(e)$$

The term in square brackets represents the direct effect on Firm 1's rent of an increase in effort, and the last term displays the *indirect* effect of a higher effort: as e is increased, $\frac{1}{\overline{V}}\Delta\Psi'(e)$ extra competitors are funded, leading to a loss of rent per competitor equal to

[44] This effect does not appear in the investor's (IR) constraint, as the investor anticipates that late entrants who get funded will offer him a rent that just offsets the effect of competition on his claim in Firm 1.

[45] Later we will check when this is indeed the case.

$\Delta\Psi''(e)$. Intuitively, when $N(e^{sb}) < 0$, the marginal benefit of reducing entry offsets the marginal cost of diminishing effort. It is thus optimal to reduce effort below e^{sb}. The condition $N(e^{sb}) < 0$ is the continuous analog of condition $\mathbf{V}_2 \leq \widehat{\mathbf{V}}_2$ in the basic model: Firm 1 will decide to solve the Coase problem provided that this does not require too large a reduction in effort.[46]

Under the above condition, Firm 1's contract has the same qualitative features as the third best contract derived in the basic model: if product market competition is costly enough, the investor's claim is made riskier so as to limit the number of entrants he will fund at t=2. This is summarized in the following Proposition, where the effort level ξ^{cp} is the continuous model analog of e^{cp}:

Proposition 5 *Assume that at t=2 Firm 2 can only be funded by Investor 1. Then, if the condition $N(e^{sb}) < 0$ holds, the optimal financial contract for Firm 1:*

- *induces a level of effort $\xi^{cp} < e^{sb}$ defined by: $N(\xi^{cp}) = 0$;*
- *sets a profit sharing rule: $R_f^L = \beta > 0$; $R_f^H = \beta + \Psi'(\xi^{cp})$, where $\beta \equiv \xi^{cp}(R^H - R^L - \Psi'(\xi^{cp})) + R^L - I$;*
- *ensures that the Coase problem is at least partially solved: $\widetilde{V}(\xi^{cp}) \in (\widetilde{V}(e^{sb}), \overline{V}]$.*

Proof. See the appendix. ■

The above contract is the solution to Firm 1's program provided (CC) does not bind, that is, when r_2 satisfies: $r_2 \geq \frac{\widetilde{V}(\xi^{cp})}{2I} - 1$, so competition between investors is weak. The result is the continuous analog of proposition 1: the possibility of entry and the Investor's lack of commitment leads Firm 1 to choose a more equity-like contract than would otherwise be desirable, for the reasons already discussed in section 4. A difference with the basic model is that now the level of entry deterrence is continuous, rather than a zero-one decision. This means that typically some entry will occur at the optimum, a more realistic outcome than the stark result of the basic model.[47] We now turn to the more interesting case where Investor 2 has a lower cost of funds and *effectively* further limits the scope for financial entry deterrence.

[46] Obviously, it may well be the case that $N(e^{sb})$ is non-negative, hence effort is not reduced below e^{sb} and the Coase problem is optimally left unsolved. This will happen whenever e^{sb} is already low, so that the benefit of reduced entry is more than offset by the cost of diminished managerial incentives. However, at high levels of e^{sb} the condition $N(e^{sb}) < 0$ is likely to hold, as is condition $(1)'$ (e.g. they both hold for $e^{sb} \cong e^{\star}$). In other words, incumbents that are more likely to face a Coase problem are also more willing to solve it.

[47] This is also in line with evidence that investors do sometimes succumb to the temptation to fund competing firms. For example, amongst the syndicate of venture capitalists funding Osborne Computer

5.3 Anti-competitive financial contracting and credit market competition

When alternative sources of finance become available to new entrants, Firm 1 has less leeway in deterring entry. For $r_2 < \frac{\widetilde{V}(\xi^{cp})}{2I} - 1$, the '$\xi^{cp}$-contract' described in Proposition 5 fails to satisfy the (CC) constraint (if this contract were in force, Investor 2 would agree to fund Firm 2). Intuitively, it is then optimal for Firm 1 to write a contract enforcing the maximum entry threshold compatible with credit market competition, i.e. $2I(1+r_2)$. Loosely speaking, Firm 1 does not want to set a threshold above, because then Investor 2 would fund all entrants, a disastrous outcome. It does not want to set a threshold below this, because then Investor 1 is funding additional entrants which would not be funded by Investor 2, and Proposition 5 tells us that since there is no competition from Investor 2 in this range, this is not optimal.

Thus, when the (CC) constraint binds, the optimal level of effort is then equal to $e_{r_2} > \xi^{cp}$, where $\widetilde{V}(e_{r_2}) = 2I(1+r_2)$. Notice that this effort level is decreasing in r_2. When competition in the credit market becomes tougher (i.e. r_2 is lower), Firm 1 sells Investor 1 a safer claim inducing a more accommodating attitude towards entering firms. As a consequence, more high-powered incentives can be provided to Firm 1's entrepreneur, leading to a higher effort.

Finally, for very low levels of r_2 (i.e. when $2I(1 + r_2) < \widetilde{V}(e^{sb})$), the scope for anti-competitive financial contracting disappears completely. Even if Firm 1 writes a contract inducing its second-best level e^{sb}, Investor 2 will fund Firm 2 anyway. So Investor 1 (who is weakly more efficient than Investor 2) might as well fund any entrant with $\mathbf{V}_2 > I$ himself.

This defines three regions of increasingly severe credit market competition, which we summarize in the following proposition.

Proposition 6 *Assume $N(e^{sb}) < 0$ holds. Then, when competition in the credit market becomes more intense, Firm 1 sells a safer claim to its investor (implying a higher entrepreneurial effort) and allows him to fund more entrants. In particular, for decreasing levels of r_2 three regions arise:*

- $r_2 \geq \frac{\widetilde{V}(\xi^{cp})}{2I} - 1$*: effort is equal to ξ^{cp} and the entry rate is $1 - \frac{\widetilde{V}(\xi^{cp})}{\overline{V}}$;*
- $r_2 \in \left[\frac{\widetilde{V}(e^{sb})}{2I} - 1, \frac{\widetilde{V}(\xi^{cp})}{2I} - 1\right)$*: effort is equal to $e_{r_2} \in \left(\xi^{cp}, e^{sb}\right)$ defined by $\widetilde{V}(e_{r_2}) \equiv 2I(1 + r_2)$, and is decreasing in r_2. The entry rate is $1 - \frac{2I(1+r_2)}{\overline{V}}$;*

Corporation were Sevin, Rosen Partners, and First Century Partnership. Sevin, Rosen Partners was also the lead investor in Compaq Computer Corporation, a competitor to Osborne. First Century Partnership was also an investor in Gavilan Computer Corporation, a portable computer manufacturer (Silver, 1984 p.58).

- $r_2 < \frac{\widetilde{V}(e^{sb})}{2I} - 1$: *effort is equal to* e^{sb} *and Investor 1 funds all entrants with* $\mathbf{V}_2 > I$.

The results of Proposition 6 are illustrated in figures 1 and 2 below. In both figures, we plot Investor 2's cost of funds r_2 on the x-axis. On the y-axis, we plot the effort level associated with Firm 1's optimal choice of financial contract (Figure 1), and the level of entry which occurs (Figure 2). For very high r_2, there is no effective competition and Firm 1 sets a low effort to solve the Coase problem as in the basic model, so there is little entry. For intermediate r_2, the competition constraint binds, and Firm 1 must allow enough entry that Investor 2 is discouraged from funding the rejected entrants because their quality is too low. In this region, there will be more entry and more effort as Investor 2 becomes more competitive. Finally, when r_2 is very low, there is no way for Firm 1 to block entry so he simply chooses second best effort e^{sb}. Thus the central result of this section is the following important policy implication. *As financial markets become more competitive, there is more entry; product market markets become more competitive. Moreover, as financial markets become more competitive, incumbent firms exert more effort and earn fewer rents.*

6 Conclusion

In this paper we have drawn attention to a new channel through which entry deterrence can operate. Previous work has focused firstly on the product market moves which a firm can make to discourage entry (Spence (1977) and Dixit (1980)) and then considered how financial commitments could be used to induce to such product market behavior (Brander and Lewis (1986)). In this paper, we show that when capital markets are imperfectly competitive, there is an alternative way to prevent entry which has nothing to do with altering product market behavior. Instead it relies on altering investors' incentives in order that they are unwilling to fund entrant firms.

Our basic model simplified matters by considering the case of a monopoly investor. We showed that even in the monopoly case, when financial entry deterrence should in principle be easiest, ensuring that the investor does not fund competing firms is not a trivial matter as the investor will face a commitment problem in doing so. The solution is to make sure that the investor's stake in the first firm is sufficiently sensitive to the first firm's ex post performance that he no longer gains from introducing competition. In other words, to deter entry, the first firm must be funded by equity, even at the cost of reducing the entrepreneur's incentives to exert effort.

We also discussed how the problem of financial entry deterrence is analogous to oversupply of inputs to downstream firms in the foreclosure (vertical integration) literature and to oversupply of durable goods to consumers in the durable goods monopoly literature. Applying the logic of these results to financial markets provides several new insights, however. Firstly, previous intuitions about the interactions between product and financial markets are shown to no longer hold true. In particular, in our set-up it is *equity* that is the entry deterring claim, whereas in previous analyses relying on product market incentives, it was always *debt* finance that constituted aggressive behavior.[48]

Secondly, we extended our result to the case of imperfect competition among investors. Indeed, we showed that even if investors are perfectly competitive ex ante, the informational asymmetries generated by credit relationships with incumbents can give 'inside' lenders market power over entrant firms. Thus there is a tendency towards industrial concentration. This tendency will be stronger the greater the degree of informational asymmetry ex post, and the smaller the degree of competition between financiers ex ante. We thus generate the most important result of our paper: *lack of competition in financial markets can translate into lack of competition in product markets.* It is surprising that such an important implication has previously received so little attention in the literature. The result confirms economists' previous intuition as to the centrality of the efficient operation of financial markets to a well-functioning economy.

Thirdly our model has potentially strong implications for the regulation of bank equity-holding in economies where financial markets are not well developed and banks play an important role. In such economies equity-holding by banks should be limited - unless the welfare gains from competition are to be subordinated to goals of faster growth which may come from monopoly power.

Fourthly, we showed how our model could be applied in two related settings, the funding of start-up industries and the design of venture capital claims on firms, to explain why start-ups are often financed through equity or convertibles.

[48]This was true in a remarkable variety of cicumstances: no matter whether competition was in strategic substitutes (Brander and Lewis, 1986), or complements (Showalter 1995), or potential collusion (Maskimovic 1988). The exception is Poitevin (1989), where an equity-financed incumbent has an advantage over the debt-financed entrant in predatory price wars. But there the focus was on the design of the entrant's claim, which (because of asymmetric information) gives him "short pockets"; the incumbent deterred entry by threatening a price war. Here instead, we have emphasized how the design of the incumbent's claim deters entry by making it difficult for entrant to get finance. The design of the entrant's claim and the behavior of the incumbent in the event of entry - central to the Poitevin result - are largely irrelevant here.

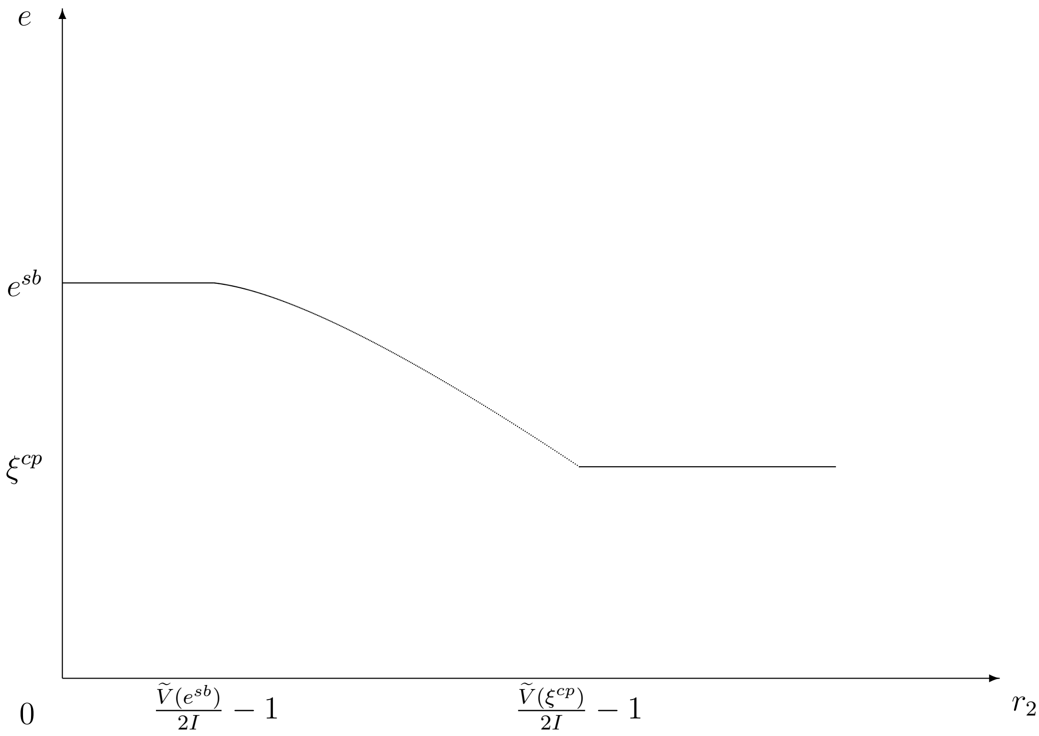


Figure 1: Credit market competition affects entrepreneurial incentives.

References

[1] Aggarwal, R.K and Samwick, A.A. (1999) "Executive Compensation, Strategic Competition, and Relative Performance Evaluation: Theory and Evidence", *Journal of Finance*, 54: 1999-2043.

[2] Aghion P., M. Dewatripont, P. Rey (1998), "Agency Costs, Firm Behavior and the Nature of Competition", *Document de Travail n. 77, IDEI*, Université de Toulouse.

[3] Ausubel, L. and R. Deneckere (1992), "Durable Goods Monopoly with Incomplete Information" *Review of Economic Studies*, 59: 795-812.

[4] Arping, S. (1999), "Is Bank Industrial Ownership Anti-Competitive?", unpublished manuscript, HEC Université de Lausanne.

[5] Bhattacharya, S. (1982), "Aspects of Monetary and Banking Theory and Moral Hazard", *Journal of Finance*, 37: 371-384.

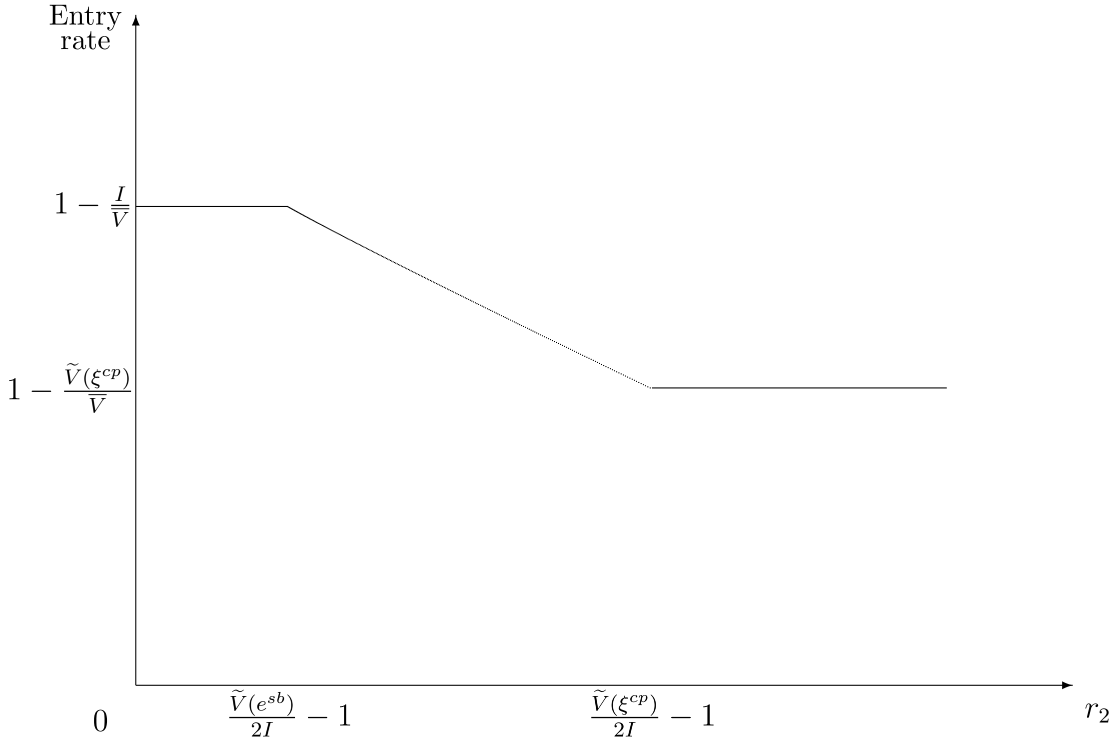


Figure 2: Industry entry rate as a function of credit market competition.

[6] Bhattacharya, S. and G. Chiesa (1995), "Proprietary Information, Financial Intermediation, and Research Incentives", *Journal of Financial Intermediation*, 4: 328-357.

[7] Biais, B. and C. Casamatta (1999), "Optimal Leverage and Aggregate Investment", *Journal of Finance,* 54: 1291-1323.

[8] Bolton, P. and D. Scharfstein (1990), "A Theory of Predation Based on Agency Problems in Financial Contracting", *American Economic Review*, 80: 93-106.

[9] Brander, J.A. and T.R. Lewis (1986), "Oligopoly and Financial Structure: the Limited Liability Effect", *American Economic Review*, 76: 956-970.

[10] Carroll, G.R. and M.T. Hannan (1989), "Density Delay in the Evolution of Organizational Populations: A Model and Five Empirical Tests", *Administrative Science Quarterly*, 34: 411-430.

[11] Casamatta (2000), "Financing and Advising: Optimal Financial Contracts with Venture Capitalists", unpublished manuscript, Université de Toulouse.

[12] Cestone, G. (1999), *On the Anti-Competitive Use of Financial Arrangements*, doctoral dissertation, Università Cattolica di Milano .

[13] Cestone, G. and L. White (2000) "On the Anti-Competitive Potential of Financial Arrangements", *UAB-IAE Working Paper* no. 453, Institut d'Anàlisi Econòmica (CSIC), Barcelona.

[14] Chevalier, J. (1995), "Capital Structure and Product-Market Competition: Empirical Evidence from the Supermarket Industry", *American Economic Review*, 85: 415-435.

[15] Chevalier, J. and D. Scharfstein (1996), "Capital-Market Imperfections and Countercyclical Markups: Theory and Evidence", *American Economic Review*, 86: 703-725.

[16] Coase, R. (1972), "Durability and Monopoly", *Journal of Law and Economics*, 15: 143-149.

[17] Cornelli, F. and O. Yosha (1997), "Stage Financing and the Role of Convertible Debt", *CEPR Discussion Paper* no. 1735.

[18] DaRin, M. and T. Hellmann (2001) "Banks as a Catalyst for Industrialization," *Stanford Graduate School of Business Working Paper* no. 1398.

[19] Davis, L. (1966), "The Capital Markets and Industrial Concentration: The U.S. and U.K., a Comparative Study", *The Economic History Review*, 19: 255-272.

[20] DeLong, B. (1990), "Did Morgan's Men Add Value? An Economist's Perspective on Financial Capitalism", *NBER Working Paper* n. 3426.

[21] Dewatripont, M. and E. Maskin (1995) "Credit and Efficiency in Centralized and Decentralized Economies", *Review of Economic Studies*, 62: 541-555.

[22] Dixit, A. (1979), "A Model of Duopoly Suggesting a Theory of Entry Barriers", *Bell Journal of Economics*, 10: 20-32.

[23] Dixit, A. (1980), "The Role of Investment in Entry Deterrence", *Economic Journal*, 90: 95-106.

[24] Evans, D.S. and B. Jovanovic (1989) "An Estimated Model of Entrepreneurial Choice under Liquidity Constraints" *Journal of Political Economy*, 95: 808-27.

[25] Freeman J. and M.T. Hannan (1989), *Organizational Ecology*, Harvard University Press, Cambridge, Massachusetts.

[26] Frydman, R. Phelps, E.S., Rapaczynski, A. and A. Schleifer (1993) "Needed Mechanisms of Corporate Governance and Finance in Eastern Europe" *Economics of Transition*, 1: 171-207.

[27] Fudenberg, D. and J. Tirole (1986), "A Signal-Jamming Theory of Predation", *Rand Journal of Economics,* 17: 366-376.

[28] Gerschenkron, A. (1962) "Economic Backwardness in Historical Perspective", Cambridge, MA: Harvard University Press.

[29] Gertner, Gibbons and Scharfstein (1988) "Simultaneous Signalling to the Capital and Product Markets", *Rand Journal of Economics,* 19: 173–190.

[30] Gompers, P. (1997), "A Clinical Examination of Convertible Securities in Venture Capital Investments", unpublished manuscript, Harvard University.

[31] Gompers, P. and J. Lerner (2000) "Money chasing deals? The impact of fund inflows on private equity valuation", *Journal of Financial Economics,* 55: 281-325.

[32] Gorman, P. and W.A. Sahlman (1989), "What do Venture Capitalists Do?", *Journal of Business Venturing*, 4: 231-248.

[33] Gordon, R. H. (1994) "Fiscal Policy during the Transition in Eastern Europe" Chapter 9 in O.J. Blanchard, K.A. Froot and J.D. Sachs eds. "The Transition in Eastern Europe" University of Chicago Press, Chicago Vol 2, p.37-69.

[34] Gul, F. (1987), "Noncooperative Collusion in Durable Goods Oligopoly ", *Rand Journal of Economics*, 18: 248-254.

[35] Hart, O. (1983) "The Market Mechanism as an Incentive Scheme" *Bell Journal of Economics,* 14: 366-382.

[36] Hart, O. and J. Tirole (1990) "Vertical Integration and Market Foreclosure" Brookings Papers on Economic Activity, 205-85.

[37] Holz-Eakin, D., D. Joulfaian and H.S. Rosen (1994) "Sticking it Out: Entrepreneurial Survival and Liquidity Constraints" *Journal of Political Economy*, 102: 53-75.

[38] Innes, R. (1990), "Limited Liability and Incentive Contracting with Ex Ante Action Choices", *Journal of Economic Theory*, 52: 45-67.

[39] Kaplan, S.N. and P. Strömberg (2000), "Financial Contracting Theory Meets the Real World: An Empirical Analysis of Venture Capital Contracts", *CEPR Discussion Paper* no. 2421.

[40] Lemmon, M.L. (1997), "Innovative Activity and the Strategic Use of Managerial Incentives" unpublished manuscript, Arizona State University.

[41] Martin, S. (1993), "Endogenous Firm Efficiency in a Cournot Principal-Agent Model," *Journal of Economic Theory,* 59: 445-50.

[42] Maksimovic, V. (1988), "Capital Structure in Repeated Oligopolies", *Rand Journal of Economics,* 19: 389-407.

[43] Matutes, C. and X. Vives (1996), "Competition for Deposits, Fragility and Insurance", *Journal of Financial Intermediation*, 5: 184-216.

[44] McAfee and Schwartz (1994) "Opportunism in Multilateral Vertical Contracting: Nondiscrimination, Exclusivity, and Uniformity" *American Economic Review*, 84: 210-230

[45] Myers, S. and N. Majluf (1984), "Corporate Financing and Investment Decisions when Firms have Information Investors do not have" *Journal of Financial Economics*, 13: 187-221.

[46] Nachman, D.C. and T.H. Noe (1994), "Optimal Design of Securities under Asymmetric Information", *Review of Financial Studies*, 7:1-44.

[47] Petersen, M.A. and R.G. Rajan (1994), "The Effect of Credit Market Competition on Lending Relationships", *Quarterly Journal of Economics*, 110: 407-443.

[48] Petersen, M.A. and R.G. Rajan (1995), "The Effect of Credit Market Competition on Lending Relationships: Evidence from Small Business Data", *Journal of Finance*, 49: 3-37.

[49] Phillips, G.M. (1995), "Increased Debt and Industry Product Markets: An Empirical Analysis" *Journal of Financial Economics*, 37: 189-238.

[50] Pissarides, F. (1998) "Is Lack of Funds the Main Obstacle to Growth: the EBRD's Experiences with Small and Medium-Sized Businesses in Central and Eastern Europe" *EBRD Working Paper* no 33.

[51] Poitevin, M. (1989a), "Financial Signalling and the Deep-Pocket Argument", *Rand Journal of Economics,* 20: 26-40.

[52] Poitevin, M. (1989b), "Collusion and the Banking Structure of a Duopoly", *Canadian Journal of Economics,* 22: 263-277.

[53] Rajan, R.G. (1992), "Insiders and Outsiders: The Choice between Informed and Arm's-Length Debt", *Journal of Finance*, 47: 1367-1400.

[54] Rajan, R.G. and L. Zingales (2001), "The Great Reversals: The Politics of Financial Development in the 20th Century", unpublished manuscript, University of Chicago.

[55] Repullo, R. and J. Suarez (1999), "Venture Capital Finance: A Security Design Approach", *CEPR Discussion Paper n. 2097.*

[56] Rey, P. and J. Tirole (forthcoming), "A Primer on Foreclosure", unpublished manuscript, IDEI, Toulouse, forthcoming *Handbook of Industrial Economics.*

[57] Sahlman, A. and H. Stevenson (1985), "Capital Market Myopia", *Journal of Business Venturing*, 1: 7-30.

[58] Saunders, A. (1994), "Banking and Commerce: An Overview of the Public Policy Issues", *Journal of Banking and Finance*, 18: 231-254.

[59] Segliman, J. (1982) "The Transformation of Wall Street: A History of the Securities and Exchange Commission and Modern Corporate Finance" Boston: Houghton Mifflin.

[60] Schmidt, K. (1997) "Managerial Incentives and Product Market Competition" Review of Economic Studies 64: 191-213.

[61] Showalter, D. (1995), "Oligopoly and Financial Structure: A Comment", *American Economic Review*, 85: 647-653

[62] Sharpe, S.A. (1990), "Asymmetric Information, Bank Lending and Implicit Contracts: A Stylized Model of Customer Relationships", *Journal of Finance*, 45: 1069-1087.

[63] Silver, A.D. (1984), "Who's Who in Venture Capital", New York: Wiley and Sons.

[64] Spence, A.M. (1977), "Entry, Capacity, Investment and Oligopolistic Pricing", *Bell Journal of Economics*, 8: 534-544.

[65] White, L. (2000), "Foreclosure with Incomplete Information", mimeo, Nuffield College, Oxford.

[66] Zingales, L. (1998), "Survival of the Fittest or Survival of the Fattest? Exit and Financing in the Trucking Industry", *Journal of Finance*, 53: 905-938.

Appendix

Proof of Lemma 1 Define the first best effort e^* as the solution to $R^H - R^L = \Psi'(e)$. The optimal contract for the firm sets the investor's (IR) binding. Using this fact and combining (IR) and (IC), the second best program can be rewritten as:

$$
\begin{array}{ll}
Max_{R_f^L,e} & \left[eR^H + (1-e)R^L - \Psi(e) - I\right] \\
(*) & e(R^H - R^L - \Psi'(e)) + R^L - R_f^L = I \\
(LL) & R_f^L \geq 0
\end{array}
$$

Note that, as the entrepreneur's utility is equal to the net present value of the firm, effort is optimally set equal to the highest possible level compatible with the investor breaking even.

- Let us first prove that $e^{sb} < e^*$. This is immediate as the constraints $(*)$ and $R_f^L \geq 0$, and the assumption $I > R^L$ imply: $(R^H - R^L - \Psi'(e^{sb})) \equiv \frac{I - R^L + R_f^L}{e^{sb}} > 0$.
- Define: $v(e) \equiv e(R^H - R^L - \Psi'(e)) + R^L$. For a given pair $\{e, R_f^L\}$, the income pledged to the investor is $v(e) - R_f^L$. At the optimum, it is always $v'(e) < 0$: if not, by increasing effort slightly Firm 1 would both increase its net present value and relax the investor's (IR). This implies that whenever $R_f^L > 0$, the entrepreneur can do better by increasing e (which reduces $v(e)$) and reducing R_f^L so as to keep the investor's (IR) binding. Hence, at the optimum $R_f^L = 0$ and $v(e) = I$. By the assumptions $\Psi'' > 0$ and $\Psi''' > 0$, $v(e)$ is concave and $v(e) = I$ has two roots: e^{sb} is optimally set equal to the larger one.
- Finally, from $v(e^{sb}) \equiv I$ and $v'(e^{sb}) < 0$, applying the implicit function theorem, we obtain: $\frac{\partial e^{sb}}{\partial I} = \frac{1}{v'(e^{sb})} < 0$.

Proof of Proposition 5 When competition to fund Firm 2 is not effective, Firm 1's financial contracting program can be written as:

$$
\begin{array}{ll}
Max_{R_f^L,e} & R_f^L + e\Psi'(e) - \Psi(e) - \left(1 - \frac{\widetilde{V}(e)}{\overline{V}}\right)\Delta\Psi'(e) \\
(IR) & e[R^H - R^L - \Psi'(e)] + R^L - R_f^L = I \\
(IC_I) & \widetilde{V}(e) = \Delta[R^H - R^L - \Psi'(e)] + I \\
(LL) & R_f^L \geq 0
\end{array}
$$

Let L be the Lagrangian of this problem and λ the Lagrangian multiplier associated to the (IR) constraint. The first order conditions are:

$$\frac{\partial L}{\partial e} = R^H - R^L - \Psi'(e) - \left(1 - \frac{\widetilde{V}(e)}{\overline{V}}\right)\Delta\Psi''(e) - \frac{\Delta^2}{\overline{V}}\Psi'(e)\Psi''(e) +$$
$$+(\lambda - 1)\left[R^H - R^L - \Psi'(e) - e\Psi''(e)\right] = 0$$

$$\frac{\partial L}{\partial \lambda} = \; e[R^H - R^L - \Psi'(e)] + R^L - R^L_f - I = 0$$

$$\frac{\partial L}{\partial R^L_f} = 1 - \lambda \leq 0 \quad \text{and} \quad (1-\lambda)R^L_f = 0$$

Define:

$$N(e) \equiv R^H - R^L - \Psi'(e) - \left(1 - \frac{\widetilde{V}(e)}{\overline{V}}\right)\Delta\Psi''(e) - \frac{\Delta^2}{\overline{V}}\Psi'(e)\Psi''(e)$$

and assume $N(e^{sb}) < 0$. Notice that, as $N'(e) < 0$, this condition holds when e^{sb} is sufficiently high (in particular it is always true for $e^{sb} \cong e^{\star}$).

In principle, there are two possible solutions to the problem: either $e = e^{sb}$ and $R^L_f = 0$, or $e = \xi^{cp} < e^{sb}$ and $R^L_f > 0$. Under the assumption $N(e^{sb}) < 0$, however, e^{sb} cannot be a solution. Suppose it is so. Then it must be:

$$\frac{\partial L}{\partial e}(e^{sb}) = N(e^{sb}) + (\lambda - 1)v'(e^{sb}) = 0$$

From $N(e^{sb}) < 0$ and $v'(e^{sb}) < 0$ (see Lemma 1's proof), it follows $\lambda < 1$, which contradicts the condition $(1-\lambda) \leq 0$. Therefore, the optimal solution is $e = \xi^{cp} < e^{sb}$, $R^L_f > 0$, $\lambda = 1$, where ξ^{cp} is implicitly defined by $N(\xi^{cp}) \equiv 0$.

The optimal profit sharing rule is derived, as in Proposition 3's proof, by setting $R^L_f = \xi^{cp}(R^H - R^L - \Psi'(\xi^{cp})) + R^L - I > 0$ so that no rent is left to the investor. By (IC), $R^H_f = R^L_f + \Psi'(\xi^{cp})$.

By inducing an effort ξ^{cp} strictly smaller than e^{sb}, Firm 1's contract implies an entry threshold $\widetilde{V}(\xi^{cp}) > \widetilde{V}(e^{sb})$: fewer competitors are allowed to get funded with respect to the benchmark second best contract, which means that the Coase problem is (at least partially) solved. Notice that, unless $\widetilde{V}(\xi^{cp}) = \overline{V}$, the probability of entry $1 - \frac{\widetilde{V}(\xi^{cp})}{\overline{V}}$ is strictly positive, or in other words, industry over-funding occurs probabilistically at equilibrium.