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Anticompetitive Financial Contracting: The Design of Financial Claims

GIACINTA CESTONE and LUCY WHITE*

ABSTRACT

This paper presents the first model where entry deterrence takes place through *financial* rather than *product-market* channels. In existing models, a firm's choice of financial instruments deters entry by affecting product market behavior; here entry deterrence occurs by affecting the credit market behavior of investors towards entrant firms. We find that to deter entry, the claims held on incumbent firms should be sufficiently risky, that is, *equity*. This contrasts with the standard Brander and Lewis (1986) result that *debt* deters entry. This effect is more marked the less competitive the credit market is—so *more credit market competition spurs more product market competition*.

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, p. 272)

THIS PAPER PRESENTS THE FIRST MODEL in which 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

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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.

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 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*, and 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).

The logic of our result is very straightforward. The *form* of the financial contract between 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-detering claim is in fact *equity* (or, equivalently, risky debt). This in contrast to the Brander–Lewis result that *debt* deters entry by inducing tougher behavior in the product market. 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,¹ abstract from any financial market effects of

¹The 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) and Spagnolo (2000) look at the impact of debt on collusive outcomes. Aghion, Dewatripont and Rey (1998), 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 and 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

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 Italy, where competition in financial markets is very limited and has never been encouraged. Moreover, historical evidence suggests that our model can also be applied to the 19th century United States.

In an extension of the model, we show that the desire for financial entry deterrence is most important 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*. Conversely, it is difficult to promote product market competition if financial markets are very concentrated. This suggests that there should perhaps be more antitrust coordination between the regulators of financial and product markets than is currently the norm. 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 in funding its industry (e.g., specialized knowledge leading to lower cost of funds). 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 this paper is as follows. Section I studies the basic model of financial contracting between an incumbent firm and a monopoly investor. Section I.A sets out the model and gives some basic intuition for our results. Section I.B examines the second-best financial contract in these circumstances 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 I.C, and Section I.D provides some discussion. Section II extends the basic model to the case where there is imperfect competition in the credit market. Section III sets out explicitly the empirical implications of the theory and suggests some possible tests to distinguish it from other theories. Section IV concludes.

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), Phillips (1995), Chevalier and Scharfstein (1996), 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).

I. A Simple Model of a Monopoly Investor

A. 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.

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 that 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.² In Section II, 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 $1 + r$, with $r = 0$.³

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 probability e_i and R^L (failure) with probability $(1 - e_i)$, where $R^H > I > R^L > 0$.⁴

²The 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 reasons why some financial markets are indeed uncompetitive, we refer the reader to the later discussion in Section II.

³Since 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 Cestone and White (2000).

⁴In 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.

Competition reduces the probability of success by Δ .⁵ 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.⁶ 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.⁷ 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: At time $t = 1$, Firm 1 offers a contract to the investor. The investor accepts or rejects. If he accepts, then Firm 1 picks a level of effort $e \in [\Delta, 1]$. The effort decision is pure moral hazard, not observed by the investor. At $t = 2$, in order to get funded and enter the product market, Firm 2 makes a take-it-or-leave-it offer to the investor.⁸ To make the problem interesting, we assume that Firm 2 can be

⁵In Gorman and Sahlman (1989), 34 percent 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). 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 setup.

⁶In earlier work (available from the authors) we set out some stylized examples as to when such an assumption might be taken literally. Here we make it mainly for modeling 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, e.g., Hart (1983), Martin (1993)). 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, then 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.

⁷We make this assumption for simplicity only. It allows us to abstract away from the usual trade-off between risk bearing and incentives in the entrepreneur's problem in order to better focus on the investor's Coasian commitment problem. Allowing for entrepreneurial risk aversion would not affect the qualitative results.

⁸In the particular model we analyze, the timing of the first entrepreneur's effort decision and the financier's decision as to whether to fund the second firm could be reversed without affecting the results. This is because the additive structure we have chosen means that the marginal returns to entrepreneurial effort are independent of whether there is competition or not. However, in a more general model this would not be the case. Then if we reversed the order of the effort and financing decisions in the model and let the returns to entrepreneurial

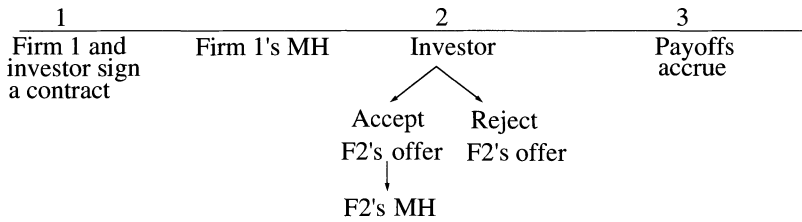


Figure 1. Sequence of events.

funded only if Firm 1 has already been funded.⁹ 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 $e_2 \in [\Delta, 1]$. At $t = 3$, payoffs are realized according to the entrepreneur(s)' level(s) of effort and to whether the investor has funded one or both firms. Figure 1 summarizes the sequence of events.

Contracts: Financial contracts simply state a rule for splitting the cash flow. More precisely, a contract is a pair of real numbers $\{R_f^L, R_f^H\}$ 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 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.¹⁰ 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.

effort be *lower* in the presence of competition, the investor's commitment problem would become less severe: in funding Firm 2 he would trigger less effort from Firm 1, reducing the value of his investment there. Conversely, if effort was *more* important at the margin in the presence of competition, the effect we highlight in this paper would become stronger. We thank an anonymous referee for pointing this out.

⁹ We make this assumption 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, thus, a 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.

¹⁰ 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, noncompeting 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.

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

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

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, then 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. 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.¹¹ In equilibrium, Firm 1 will anticipate this opportunistic behavior, so the investor would like to commit not to fund Firm 2. We will refer to this commitment problem as *the investor's Coase problem*, by analogy to the new foreclosure doctrine and the problem of durable goods monopoly.¹² Thus in what follows we will refer to successful financial entry deterrence as having solved the investor's Coase problem.¹³

¹¹Two 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. For an analysis of the case where contingent contracts can be written, see Gonzalez-Maestre and Granero (1999).

¹²The Coase problem is so-named for Ronald Coase's (1972) seminal discussion of the commitment problem faced by a durable good monopolist. We provide some discussion of the parallels between the oversupply of goods in input markets and in durable goods monopoly in section I.D (see also Rey and Tirole (forthcoming)). In this paper, we extend the analogy to the oversupply of funds by financial markets.

¹³Notice 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 *overfunding*. The investor always has incentives to supply more than the ex ante optimal amount of credit to the downstream firms.

B. The Optimal Contract without Potential Entrants

B.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:

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

We will refer to the solution to this program as the *second best* optimum, and denote the associated effort level by e^{sb} .¹⁴ 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 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.

As one would expect from the security design literature, 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.¹⁵ 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

¹⁴ The (first best) optimal financial contract would solve

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

The first best level of effort e^* is thus defined by $R^H - R^L \equiv \Psi'(e^*)$. Given the risk neutrality of the contracting parties, this could be achieved if effort was observable or if the limited liability constraints did not bind.

¹⁵ For a detailed derivation of this result in a more general model, see Innes (1990).

$D^{sb} \equiv R^H - \Psi'(e^{sb})$. 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.

B.2. Why Lack of Commitment Yields a Coase Problem

When the investor cannot commit to denying 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, Firm 2 wants to enter Firm 1's market and produce a competing product. If we define $\mathbf{v}_2(e_2)$ as Firm 2's pledgeable income, then Firm 2's contract offer to the investor must satisfy the following participation constraint $(IR)_2$:¹⁶

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

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

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

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. Competition reduces the probability of success of Firm 1, but the investor's claim is affected by Firm 2's entry only to the extent that his claim is risky, that is, if $R^H - \Psi'(e^{sb}) > R^L$. The riskier the investor's claim, the less will he be tempted to accept Firm 2's offer. *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) 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, 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

¹⁶ Firm 2's contract offer $\{R_{f2}^L, R_{f2}^H\}$ 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 : $\mathbf{v}_2(e_2) \equiv R^L + (e_2 - \Delta)(R^H - R^L - \Psi'(e_2))$

income that Firm 2 can promise to the investor, then we can show the following lemma.

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

$$V_2 - I > \Delta(R^H - R^L - \Psi'(e^{sb})) \quad (1)$$

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. This is because the marginal cost of such efforts Ψ' will be lower, so the entrepreneur can receive a lower payoff and the investor a higher payoff in the case of success. In the following, it will be useful to define $e^{cp}(V_2)$ 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 V_2 . Thus $e^{cp}(V_2)$ is implicitly defined by $V_2 - I \equiv \Delta(R^H - R^L - \Psi'(e^{cp}))$.

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

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

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.¹⁷

As a consequence of assumption (2), we can see that there will be a threshold value $\hat{e}$ for effort between $\underline{e}$ and e^{sb} that would make Firm 1 exactly indifferent between solving the problem and not solving it, that is, the value of Firm 1 with

¹⁷ 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). The only difference this would make is that the extent to which the Coase problem is solved would be limited by what is feasible (i.e., the problem cannot be solved for any values of firm 2 above $I + \Delta(R^H - R^L - \Psi'(\underline{e}))$) rather than by what is optimal, as we assume below. In other words, without condition (2), the investor would wish to solve the Coase problem for a wider range of parameters.

second best effort e^{sb} and competition will be exactly equal to its value with effort $\hat{e}$ and no competition:

$$(e^{sb} - \Delta - \hat{e})(R^H - R^L) - \Psi(e^{sb}) + \Psi(\hat{e}) \equiv 0. \quad (3)$$

This effort level $\hat{e}$ will coincide with that necessary to solve the Coase problem precisely when the value of Firm 2 is $\hat{V}_2$, where $\hat{V}_2$ is defined as $\hat{V}_2 \equiv I + \Delta(R^H - R^L - \Psi'(\hat{e}))$. Equivalently, in terms of the notation introduced above, we have $\hat{e} \equiv e^{cp}(\hat{V}_2)$. Thus if the value of Firm 2 is $\hat{V}_2$, then 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-detering financial contract and consider under what conditions it is optimal to solve the Coase problem.

C. Excluding Firm 2

The optimal contract offered to the investor when he cannot commit not to fund competitors is the solution to the following program:

$$\begin{aligned} & \text{Max}_{R_f^H, R_f^L, e} \left[eR_f^H + (1-e)R_f^L - \Psi(e) \right] \\ (\text{IR}) \quad & e(R^H - R_f^H) + (1-e)(R^L - R_f^L) \geq I \\ (\text{IC}) \quad & R_f^H - R_f^L = \Psi'(e) \\ (\text{IC}_I) \quad & \Delta(R^H - R^L - \Psi'(e)) \geq V_2 - I \\ (\text{LL}) \quad & R_f^L \geq 0, R_f^H \geq 0. \end{aligned}$$

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.

PROPOSITION 1 (SOLVING THE COASE PROBLEM): *Assume that at $t = 2$ Firm 2 will ask for funding to compete with Firm 1. Then, provided $V_2 \leq \hat{V}_2$, 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, that is, 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

$$\Delta(R^H - R^L - \Psi'(e^{cp})) = V_2 - I$$

where $e^{cp} = e^{cp}(V_2)$ is a decreasing function of V_2 .

The above contract is indeed optimal provided that Firm 2 is not too valuable. We defined $\hat{V}_2$ as the maximal level of V_2 such that the Coase problem is worth solving. When $V_2 > \hat{V}_2$, 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 $V_2 \leq \hat{V}_2$, it is optimal to distort the financial contract away from the second best to deter Firm 2's entry. Hence, $e^{cp} = e^{cp}(V_2) \leq e^{sb}$. Notice that $V_2 \leq \hat{V}_2$ and assumption (2) imply $e^{cp}(V_2) \geq e(\hat{V}_2) \geq \underline{e}$: When it is optimal to solve the Coase problem, this is also feasible.

Finally, we derive the optimal financial contract when $V_2 \leq \hat{V}_2$. 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 $e^{sb}(e)$ is the larger (smaller) root to $v(e) = I$. Hence, from $e^{cp} \in (\underline{e}, e^{sb})$ it follows that

$$v(e^{cp}) \equiv e^{cp}(R^H - R^L - \Psi'(e^{cp})) + R^L > v(e^{sb}) \equiv I.$$

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 must internalize sufficiently 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 V_2 , Firm 1 offers the investor the second best contract and the Coase problem is left unsolved.¹⁸ Conversely, when V_2 is not too high, effort is reduced so as to solve the Coase problem. In this case, because 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 "anticompetitive" financial contract are described in the following corollary.

COROLLARY 1 (ANTICOMPETITIVE 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 anticompetitive arrangement,*

¹⁸ The fact 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.

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 in Firm 1:

$$s \equiv 1 - \frac{\Psi'(e^{cp})}{R^H - R^L}$$

Proof: See the Appendix.

To solve the Coase 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.¹⁹ As 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 V_2 implies a more serious commitment problem for the investor.

D. Discussion and Related Literature

As already discussed in the Introduction, our result has an obvious relation to 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.

D.1. Relation with Durable Goods and Foreclosure

As already mentioned, there is a close analogy between our financial contracting result, the problem of durable goods monopoly, and the upstream monopolist's Coase problem envisioned by the foreclosure doctrine. In each case, the monopolist has difficulty committing to restrict 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 instead of selling. 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 analog to leasing is to integrate vertically with the

¹⁹ 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 fails if debt claims are senior to entrepreneurial wages, since 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.

first downstream firm so as to internalize its loss of profits from competition.²⁰ In our context, where the monopolist supplies capital downstream, equity-holding plays the role of vertical integration.

D.2. Reputation as a Potential Solution to the Coase Problem

Since the pioneering work of Macaulay (1963), we know that businesses commonly try to solve contracting problems through noncontractual means, very often by taking advantage of repeated interaction for reputation building. Thus an important question arises as to what extent the Coase problem can be solved through reputation,²¹ thereby rendering the provision of financial incentives unnecessary. In our setting, it is clear that an investor would wish to cultivate a reputation for not funding direct competitors to firms in his portfolio in order to be able to strike better deals with other firms in the future.

For a reputation mechanism to help solve the Coasian overfunding problem, entering firms must be able to observe whether previous firms failed because their main investor introduced competition or for other (unrelated) reasons. Making this distinction may not be a trivial exercise.²² Note moreover that a peculiarity of the Coase problem as compared to other settings where reputation mechanisms may operate is that the agents required to inflict the punishment for bad behavior are *not* generally the agents who have been hurt by the investor's cheating.²³ So it is not clear that those who are in a position to inflict costly punishment actually have any incentive to do so.²⁴ Thus simple repetition (e.g., a com-

²⁰ 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, as well as more discussion of the relation to the durable goods literature.

²¹ We thank an anonymous referee for raising this issue.

²² As we argue below, making this kind of distinction may be particularly difficult for firms entering into new industries, which frequently fail for a whole host of reasons. Even when it is clear ex post that a venture capitalist funded two competing firms, it may not be clear whether the venture capitalist acted opportunistically or whether the firms' products developed in unforeseen ways ex post and this was an honest mistake on the venture capitalist's part. To the extent that "punishment" is noisy in this way, it may be worthwhile providing financial incentives (equity).

²³ Although venture capitalists do deal with some "serial" or "repeat" entrepreneurs, the probability of any given entrepreneur seeking venture capital finance for a second *unrelated* venture is probably too small to provide general discipline. Venture capitalists do often participate in a sequence of rounds of funding the *same* firm, which potentially gives the entrepreneur an opportunity to retaliate against a VC who funds a competitor by excluding it from subsequent rounds. However, this punishment may not be very effective for the VC if the introduction of competition has turned the firm into a relatively unattractive investment in any case. Hence, one would have to rely on other entrepreneurs to observe and punish deliberate acts of overfunding.

²⁴ To be clear: For a reputation mechanism to work in the durable goods case, 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 our model (and, respectively, in the foreclosure case), if the investor (upstream monopolist) hurts (downstream) Firm 1 by lending (selling) to (downstream) Firm

plete information infinite-period setup, as is standard in models of collusion) is not enough to generate reputation here; there must, in addition, be some form of incomplete information about the monopolist's type.²⁵

A formal incomplete-information model is outside the scope of this paper. But this is certainly not to deny that reputation is important in practice. On the contrary, finance is arguably one of the economic sectors where reputation is perhaps most important, and there is an extensive literature examining the importance of reputation for borrowers generally (e.g., Diamond 1991) and for specific financial intermediaries. Carter and Manaster (1990) show, for example, that using a prestigious underwriter can reduce IPO underpricing, and Chemmanur and Fulghieri (1994) provide a formal theoretical model for why this should be so. Megginson and Weiss (1991) show that venture capitalist shareholding can have the same effect, as well as reducing direct IPO costs such as underwriter fees. They argue that one strong reason for this is that the venture capitalists bring firms to IPO relatively frequently, so that they can establish a reputation for not selling lemons to underwriters and uninformed investors.

In general, we believe that the financial and reputation instruments can work hand-in-hand to solve the Coase problem and need not be used in exclusion to one another. One would expect to see more use of high-powered financial incentives for the venture capitalist at times when the temptation to "cash in" on one's reputation is greater (e.g., in "cold" periods, when the time lag until the next deal is probably longer).

Similarly, more risky claims should be held by financiers with worse reputations. These might include financiers who are newly established, those with low market share or with financial difficulties (leading to short time horizons), or those that are suspected of having funded competing firms in the past.

One should also note that 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

2, then Firm 2 must participate in the punishment of the investor (monopolist), even though it has gained at Firm 1's expense from the investor's (monopolist's) action.

²⁵ Note that the question of reputation has been hardly tackled in either the durable goods or the foreclosure literature, where it is equally pertinent. Ausubel and Deneckere (1992) study a multiperiod incomplete information model of durable goods monopoly. White (2003) examines a single-period incomplete-information model of foreclosure, showing how the incompleteness of information can have the perverse effect of turning oversupply into undersupply of the input by some monopolist types. In neither of these models does the introduction of incomplete information entirely resolve the Coase problem.

²⁶ See *The Economist* (2000), which asks why it is that venture capital firms do not grow larger: "The biggest firms now have so much money to manage that they are turning some investors away."

D.3. The Financing of Start-Up Industries

Our paper is also related to the corporate finance literature examining the instruments used to finance start-up firms. One might expect such industries to 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 (1999) and Kaplan and Strömberg (2003)). Our paper can provide an explanation for this puzzling fact. *The use of equity in such industries can be seen as a response to the Coase problem.* Two features of new industries make them particularly vulnerable to the Coase problem. First, the riskiness of start-ups means that few investors are willing to provide capital to such firms, so difficulty in obtaining funding may constitute a barrier to entry in the product market. Second, successful entry into an emerging industry is often easier than entry into a mature industry, so the temptation to fund competitors is greater.

Existing explanations for the use of equity in these industries 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 (see, e.g., Repullo and Suarez (1999) and Casamatta (2003)). Our model has different empirical implications from these. For example, existing theories tend to imply that *less experienced* venture capitalists—for whom monitoring and advising start-ups is more costly—should hold more high-powered claims if they are to have enough incentive to perform these functions. Whereas our model suggests the opposite: more high-powered claims should be held by *more knowledgeable* and specialized investors since they suffer from a more serious commitment problem.

An important class of investors in start-ups and new industries is 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 some 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 (see, e.g., Cornelli and Yosha (2003)). In 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 I.B. 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 I.C. 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, as in Schmidt (2003).^{27,28}

D.4. Banking Regulation

Finally, our result is relevant 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.²⁹ 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 would suggest that, given that U.S. 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 anticompetitive 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 nineteenth 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 19th and

²⁷ Our model might seem to go against the conventional wisdom that venture capitalists are very competitive. We deal with this criticism (see Cestone and White (2000)), 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.

²⁸ 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.

²⁹ For a model which argues that on the contrary, limited bank equity-holding in incumbent firms may be *procompetitive*, see Arping (1999).

³⁰ See *The Economist* (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 U.S. banking, this is unlikely. DeLong (1991) sounds a more cautionary note, suggesting that the benefits of financial market power are greater when equity-holding is possible, so that allowing equity-holding might increase the tendency to concentration of financial markets. For a useful overview of the costs and benefits of reform, see Saunders (1994), especially pp. 239–240.

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 (Frydman et al. (1993), Gordon (1994)).

³² A concise description of the role of large equity-holding banks in Belgian, German, and Italian industrialization can be found in DaRin and Hellman (2002).

early 20th century United States and Germany, as compared to the United Kingdom, which had fragmented financial and industrial sectors.³³

Of course, the foregoing analysis is predicated on the assumption that the promotion of competition is welfare-enhancing. 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, for example, it may be good policy to allow venture capitalists to hold equity in young innovative firms, while 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 should not be assessed by taking only a *partial equilibrium* approach, that is, abstracting from any interaction with other markets, as has been traditional in the banking literature (e.g., Petersen and Rajan (1994, 1995) or Matutes and Vives (1996)). The antitrust monitoring of financial and product markets should thus be better coordinated.³⁶

II. 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 this section, we show that the main insights from the monopoly case are robust to the introduction of *imperfect* competition in the credit market. When the first investor can be bypassed and funding obtained from alternative sources, *some* competitors may indeed enter

³³ For the classic analysis of Germany, see Gerschenkron (1962). Davis (1966) provides several case studies of emerging industries in 19th century United States and United Kingdom to argue that in the United States "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" (p. 264). Conversely, in England, "because the capital markets were better" (p. 266), industries "did not become unduly concentrated (p. 271)." For more evidence on the United States see DeLong (1991).

³⁴ In a particularly severe case of overfunding (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 To make the point further, note that in the interests of simplicity we implicitly suppressed the participation constraint for the first entrepreneur in our model. But it is possible that the first entrepreneur does not obtain enough rents from entering the industry compared to his reservation wage from employment elsewhere unless the Coase problem is not solved, in which case the industry would not emerge without equity finance. In this case, equity finance is clearly desirable.

³⁶ 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 antitrust authority. Moreover, in managing competition between banks, the typical trade-off considered is that between competition and prudential behavior 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.

the product market in equilibrium. We show that *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 such as venture capital, stock, and bond markets are underdeveloped). Central banks often deliberately limit the severity of competition in banking on the grounds that there is a trade-off between encouraging competition and prudent behavior. There may also be political economy reasons for the concentration of credit markets, such as lobbying by incumbent firms (see Rajan and Zingales (forthcoming) for theory and evidence on this point) and corruption of public officials. Several papers have emphasized differential information among investors as an 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 that *ex post* competition between financiers is imperfect. For concreteness, we therefore assume that the following *ex post informational asymmetry* arises between investors. 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 the profitability of late entrants. We view this as a particularly plausible mechanism through which asymmetries can arise, and as we will see below, it leads to an interesting “winner’s curse” effect for outside investors.³⁷ It should be clear, however, that the precise choice among the different reasons for imperfect competition is not very important for our results.

A. The Model

We extend our basic model to allow for competition in the market for funds. Two investors compete to fund the first entrant into the industry. Investor 1 has cost of funds $r_1 = 0$, while Investor 2’s cost of funds is $r_2 \geq 0$.³⁸ We identify Firm 1’s financier with Investor 1.³⁹

We now let the value of Firm 2 be unknown at date 1: V_2 (as before, the maximal income that Firm 2 may pledge to its financier) is uniformly distributed on $[0, \bar{V}]$,

³⁷ 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. If some information (e.g., about the profitability of the industry, demand for the product, etc.) is transferable across firms in the same industry, then lending relationships with incumbent firms may also allow inside investors to build up some monopoly power vis à vis entrant firms.

³⁸ Thus we allow the case where Investors 1 and 2 are *ex ante* identical, $r_1 = r_2$. Our anticompetitive 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.

³⁹ This is without loss of generality, since when $r_2 \geq r_1$, Firm 1 is always funded by Investor 1 in equilibrium (subject to a relabeling when the investors are *ex ante* identical, $r_2 = r_1$).

where $\frac{\bar{V}}{2} = E[V_2] > I$. The introduction of a continuum of potential entrant “types” allows 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

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

which is the analog of the earlier condition (1): if Investor 1 holds (risky) debt D^{sb} in the first firm, he will be tempted to fund at least 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 assumption: Between $t=1$ and $t=2$, Investor 1 learns the value of 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 costlessly the value of V_2 . Investor 2, however, who has not yet had any contact with the industry, remains ignorant about the realized value of 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 $\{R_f^L, R_f^H\}$ with Firm 1 is in force, then Investor 1 is willing to fund Firm 2 provided

$$V_2 > \Delta\left((R^H - R_f^H) - (R^L - R_f^L)\right) + I = \Delta(R^H - R^L - \Psi'(e)) + I.$$

In other words, any given financial contract with Firm 1 is associated with a threshold value $\tilde{V}(e) = \Delta(R^H - R^L - \Psi'(e)) + I$ such that the optimal policy for Investor 1 at date 2 is to fund those entrants who can pledge an income $V_2 > \tilde{V}(e)$, and not fund entrants with $V_2 \leq \tilde{V}(e)$.

Note, however, 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 $1 - \tilde{V}(e)/\bar{V}$ (this can be thought of as the number of competitors that Investor 1 is expected to fund at $t=2$) associated with the “entry deterrence” threshold $\tilde{V}(e)$. As one would expect from the basic model, a riskier claim (i.e., a lower entrepreneurial effort) will be associated with a higher $\tilde{V}(e)$ and thus a tighter entry deterrence policy.

As in the basic model, Firm 1 would like to deter all competitors, if it were possible to write this directly into the contract.⁴⁰ But as before, in the absence of commitment, reducing entry has the cost of reducing effort. But entry deterrence is still not as easy as before, because even if the financial contract with Investor 1 is designed so that Investor 1 will deny funding to all entrants, there is still the possibility that Investor 2 will provide funding. We now investigate this possibility.

⁴⁰ Note that this direct commitment would now require that Firm 1 contracts with both potential investors.

B. 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 ($E[V_2] > I$), 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 $V_2 \leq \tilde{V}(e)$. Hence, Investor 2 will agree to fund Firm 2 if and only if the following condition holds:⁴¹

$$E[V_2 | V_2 \leq \tilde{V}(e)] \equiv \int_0^{\tilde{V}(e)} V_2 \frac{1}{\tilde{V}(e)} dV_2 > I(1 + r_2) \quad (4)$$

that is,

$$\tilde{V}(e) > 2I(1 + r_2). \quad (5)$$

To put this result in words, suppose that Investor 1 solves the Coase problem for a wide range of realizations of values of Firm 2 ($\tilde{V}(e)$ high, close to $\bar{V}$). 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 he is willing to fund Firm 2 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), $\tilde{V}(e) \leq 2I(1 + r_2)$, or else it would be inefficiently reducing effort without gaining from any reduced entry.⁴²

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

$$\begin{aligned} & \text{Max}_{R_f^H, R_f^L, e} \left[eR_f^H + (1 - e)R_f^L - \Psi(e) - \left(1 - \frac{\tilde{V}(e)}{\bar{V}} \right) \Delta(R_f^H - R_f^L) \right] \\ (\text{IR}) \quad & e(R^H - R_f^H) + (1 - e)(R^L - R_f^L) \geq I \end{aligned}$$

⁴¹ Notice that we do not need to 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 that Investor 1 sets $\tilde{V}(e) \leq 2I$.

⁴² Looking at it the other way, if Investor 1 solves the Coase problem only for low realizations of Firm 2's value ($\tilde{V}(e)$ low) then observing that Investor 1 is unwilling to fund Firm 2 is a very 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.

$$\begin{aligned}
(\text{IC}) \quad & R_f^H - R_f^L = \Psi'(e) \\
(\text{IC}_I) \quad & \tilde{V}(e) = \Delta[(R^H - R_f^H) - (R^L - R_f^L)] + I \\
(\text{CC}) \quad & \tilde{V}(e) \leq 2I(1 + r_2) \\
(\text{LL}) \quad & R_f^L \geq 0, R_f^H \geq 0.
\end{aligned}$$

The last term in the objective function is the impact of competition on Firm 1's expected payment (remember that $1 - \tilde{V}(e)/\bar{V}$ is the expected entry rate).⁴³ 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 $\mathbf{V}_2 \in [0, \bar{V}]$, Firm 2 is *not* funded; the financial claim and effort level would be exactly as in Lemma 1.

C. 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,⁴⁴ which boils down to the continuous version of the basic problem analyzed in Section I.C. The optimal contract will trade 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

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

The term in square brackets represents the direct effect on Firm 1's rent of an increase in effort, and the other term displays the *indirect* effect of a higher effort: as e is increased, $\frac{1}{\bar{V}} \Delta \Psi'(e)$ extra competitors are funded, leading to a loss of rent per competitor equal to $\Delta \Psi''(e)$. Intuitively, when $N(e^{sb}) < 0$, the second term dominates the first, and 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 $\mathbf{V}_2 \leq \hat{\mathbf{V}}_2$ 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.⁴⁵

⁴³ This effect does not appear in the investor's (IR) constraint, as the investor anticipates that later entrants who get funded will offer him a rent that just offsets the effect of competition on his claim in Firm 1.

⁴⁴ Later we will check when this is indeed the case.

⁴⁵ Obviously, it may be the case that $N(e^{sb})$ is nonnegative, in which case effort is not reduced below e^{sb} and the Coase problem is optimally left unsolved, as in the basic model when V_2 was too high. 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. Note however, that 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 $e^{sb} \cong e^*$). In other words, incumbents that are more likely to face a Coase problem are also more willing to solve it.

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 2: *Assume that at $t = 2$, Firm 2 can be funded only 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: $\tilde{V}(\xi^{cp}) \in (\tilde{V}(e^{sb}), \bar{V}]$.*

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 $r_2 \geq [\tilde{V}(\xi^{cp})/2I] - 1$, 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 I.C. 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.⁴⁶ We now turn to the more interesting case where Investor 2's cost of funds is lower and so does place limits on the scope for financial entry deterrence.

D. Anticompetitive Financial Contracting and Credit Market Competition

When alternative sources of finance are available to new entrants, Firm 1 has less leeway in deterring entry. For $r_2 < [\tilde{V}(\xi^{cp})/2I] - 1$, the " ξ^{cp} -contract" described in Proposition 2 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, that is, $2I(1 + r_2)$. Loosely speaking, Firm 1 does not want to set a threshold above this level, because Investor 2 would then fund all entrants, a disastrous outcome. Nor does Investor 1 want to set a threshold below this, because Investor 1 is then funding additional entrants which would not be funded by Investor 2 (and Proposition 2 tells us that since there is no competition from Investor 2 in this range, this is not optimal).

⁴⁶ 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 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).

Thus, when the (CC) constraint binds, the optimal level of effort is equal to $e_{r_2} > \xi^{cp}$, where $\tilde{V}(e_{r_2}) = 2I(1 + r_2)$. 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 $2I(1 + r_2) < \tilde{V}(e^{sb})$), the scope for anticompetitive financial contracting disappears completely.⁴⁷ 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 $V_2 > I$ himself. This defines three regions of increasingly severe credit market competition, which we summarize in the following proposition.

PROPOSITION 3: *Assume that $N(e^{sb}) < 0$ 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:*

- *Weak Competition:* $r_2 \geq [\tilde{V}(\xi^{cp})/2I] - 1$:
Effort is equal to ξ^{cp} and the entry rate is $1 - [\tilde{V}(\xi^{cp})/\bar{V}]$;
- *Effective Competition:* $r_2 \in \left[\frac{\tilde{V}(e^{sb})}{2I} - 1, \frac{\tilde{V}(\xi^{cp})}{2I} - 1 \right)$:
Effort is equal to $e_{r_2} \in (\xi^{cp}, e^{sb})$ defined by $\tilde{V}(e_{r_2}) \equiv 2I(1 + r_2)$, and is decreasing in r_2 . The entry rate is $1 - [2I(1 + r_2)/\bar{V}]$;
- *Strong Competition:* $r_2 < [\tilde{V}(e^{sb})/2I] - 1$:
Effort is equal to e^{sb} and Investor 1 funds all entrants with $V_2 > I$.

The results of Proposition 3 are illustrated in Figures 2 and 3. In each figure, 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 2), and the level of entry which occurs (Figure 3). 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 the 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 into product market, and so product markets too become more*

⁴⁷ Depending on the parameters of the model, this (strong competition) region may not exist since $r_2 \geq r_1$.

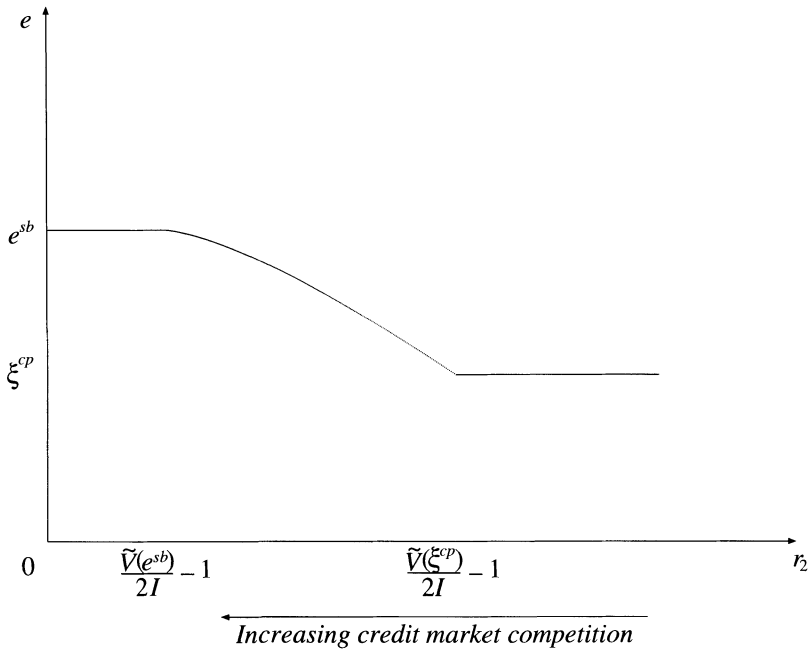


Figure 2. The effect of credit market competition on entrepreneurial effort.

competitive. Moreover, as financial markets become more competitive, incumbent firms exert more effort and earn fewer rents.

III. Empirical Predictions

Our model yields the following two empirically testable predictions. First, the competitiveness of financial and product markets should be positively correlated, both across countries and over time. Second, this correlation will be mediated through large equity stakes. The less competitive financial markets are, the more high-powered and important is the stake that incumbent financiers wish to hold in the profits of incumbent firms, because it is more worthwhile to solve the Coase problem. Hence our theory implies that there should be a three-way correlation between product and financial market competition and the holding of large equity stakes. This implication distinguishes it from an alternative hypothesis that would attribute the correlation of competitiveness between the two sectors merely to a common governmental attitude towards competition.⁴⁸ However, notice that financial regulation can affect the ease with which incumbent financiers are able to hold significant equity stakes when they wish to do so. The strictness

⁴⁸ Note also that competition in the two sectors is usually regulated by different bodies (see footnote 36).

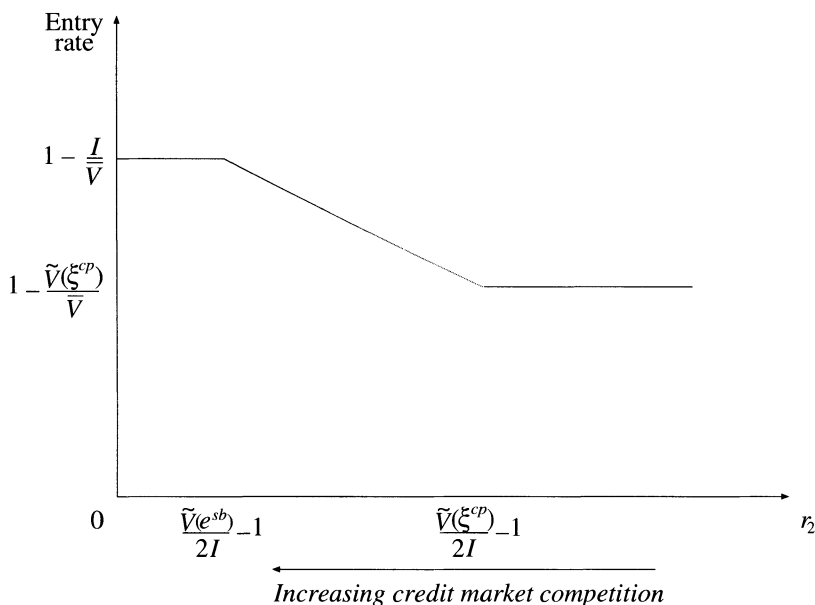


Figure 3. Industry entry rate as a function of credit market competition.

of any rules limiting equity-holding is therefore likely to provide an essential control in any regression correlating product and financial market competition.⁴⁹

An interesting test which is related to our work has been performed by Rajan and Zingales (forthcoming). They are concerned with the reverse implication to that set out here. They suggest that lobbying by product or financial market incumbents could lead the government to restrict financial market development. However, lobbying for concentration of domestic financial markets will be less profitable when there is strong foreign competition (in either product or financial markets). They argue that this explains their empirical finding that financial development is greater when there is more international trade and more capital flows. But their empirical findings are also consistent with our theory.⁵⁰ Rajan

⁴⁹ For example, in the United States “the decline of financial capitalism [in the mid-late 1930s] saw the creation of the Securities and Exchange Commission and the forcible divorce of bankers who had the capital to take substantial long term positions in firms from their places on boards of directors from which they could easily monitor managerial performance” (DeLong (1991 p. 231)). This regulation thus reduced the attractiveness of holding large stakes and almost certainly led to an increase in product market competition in the United States. In Germany, in contrast, regulation allows banks holding large stakes to exercise substantial control, so they are not deterred from holding profit-sensitive claims and might thus be tempted to intervene to reduce industrial competition as they did in the late 19th century. Another aspect of the issue is that in countries such as Italy where the pyramiding of share-ownership is common, it is much easier for incumbent financiers to hold significant equity stakes in firms without running up against wealth constraints.

⁵⁰ The empirical literature testing the Brander–Lewis result (see footnote 1) typically finds that debt *softens* competition between incumbents. This is not inconsistent with our sugges-

and Zingales focus on the political economy aspect and do not propose any precise mechanism through which financial market concentration is beneficial to incumbents (rather, they present several informal arguments). Our focus, on the other hand, is precisely to supply such a mechanism: thus the two analyses are complementary.

To determine the empirical relevance of our theory in this context, one should test for the operation of the precise mechanism through which we suggest the extension of market power operates, that is, the holding of significant equity stakes by incumbent financiers. Interestingly, Rajan and Zingales (forthcoming) do indeed find some indirect evidence that suggests that ours may be one mechanism at work, since they show that the sensitivity of financial market development to trade is greater in civil law countries, which tend to be those with concentrated equity-holding (La Porta et al. (1998)). In common law countries, minority investor protection is better, so it should be easier for entrants to raise funds from dispersed investors, and more difficult for incumbents to financially deter entry. Thus in common law countries one would expect to find that the effect of trade on financial development is much less pronounced.

A way to distinguish our theory empirically would be to test the same hypothesis across industries within a country, since Rajan and Zingales' (forthcoming) hypothesis operates only at a cross-country level.⁵¹ There is less benefit to deterring domestic entry in industries where product market competition comes largely from foreign firms. Hence our model predicts that one would see less equity issue and less concentrated equity-holding in these industries. This correlation should be important only in economies where financial market competition (and the ability of domestic entrants to borrow abroad) is limited.

IV. Conclusion

In this paper, we have drawn attention to a new channel through which entry deterrence can operate. Previous work has focused first 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 such product market behavior (Brander and Lewis (1986)). In this paper, we show that when capital markets are imperfectly competitive, there is an alternative

tion that equity finance toughens competition between incumbents and entrants. However, these existing studies all focus on competition between incumbent firms rather than entry, and on markets where funding possibilities are not obviously scarce. So this evidence is not directly relevant to our hypothesis. To distinguish our theory from other theories of the interaction between product and financial markets, one needs to test the comparative statics of credit market competition, since none of the other theories have anything to say on this issue (see, however, Spagnolo (2000)). In particular, one should demonstrate that the extent to which equity toughens competition between entrants and incumbents is greater in markets where funding for entry is difficult to obtain.

⁵¹ In Section I.D, we briefly outlined a further test of our model for the specific case of venture capital contracts.

way to prevent entry which has nothing to do with altering product market behavior. Instead it relies on altering investors' incentives so 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 Coasian commitment problem. The solution is to make sure that the investor's stake in the incumbent firm is sufficiently sensitive to the incumbent firm's ex post performance so that the investor no longer gains from introducing competition. In other words, to deter entry, the incumbent 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. First, previous intuitions about the interactions between product and financial markets are shown to no longer hold true. In particular, in our setup, it is *equity* that is the entry-detering claim, whereas in previous analyses relying on product market incentives, it was always *debt* finance that constituted aggressive behavior.⁵² We showed how our model could be applied to the funding of start-up industries and the design of venture capital claims on firms, to help understand why start-ups are often financed through equity or convertibles. We also discussed the policy implications of our model 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 other policy goals.

Finally, we extended our result to the case of imperfect competition among investors. 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

⁵² This was true in a remarkable variety of circumstances, 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 (1989a), 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 financing. 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.

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.

Appendix: Proofs

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

$$\begin{aligned} & \text{Max}_{R_f^H, R_f^L, e} [eR_f^H + (1-e)R_f^L - \Psi(e) - I] \\ (*) \quad & e(R^H - R^L - \Psi'(e)) + R^L - R_f^L = I \\ (LL) \quad & R_f^L \geq 0. \end{aligned}$$

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 $(R^H - R^L - \Psi'(e^{sb})) \equiv (I - R^L + R_f^L)/e^{sb} > 0$
- 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, then 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

$$\frac{\partial e^{sb}}{\partial I} = \frac{1}{v'(e^{sb})} < 0. \quad \text{Q.E.D.}$$

Proof of Corollary 1: Suppose the investor holds debt D^s and an equity share s . Then his payoff in case of failure is

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

Analogously, his payoff in case of success is:

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

Therefore, the optimal return-splitting rule is being implemented. Q.E.D.

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

$$\begin{aligned}
&\text{Max}_{R_f^L, e} \left[R_f^L + e\Psi'(e) - \Psi(e) - \left(1 - \frac{\tilde{V}(e)}{\bar{V}}\right) \Delta\Psi'(e) \right] \\
&(\text{IR}) \quad e[R^H - R^L - \Psi'(e)] + R^L - R_f^L = I \\
&(\text{IC}_I) \quad \tilde{V}(e) = \Delta[R^H - R^L - \Psi'(e)] + I \\
&(\text{LL}) \quad R_f^L \geq 0.
\end{aligned}$$

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

$$\begin{aligned}
\frac{\partial L}{\partial e} &= R^H - R^L - \Psi'(e) - \left(1 - \frac{\tilde{V}(e)}{\bar{V}}\right) \Delta\Psi''(e) - \frac{\Delta^2}{\bar{V}} \Psi'(e)\Psi''(e) + \\
&\quad + (\lambda - 1)[R^H - R^L - \Psi'(e) - e\Psi''(e)] = 0 \\
\frac{\partial L}{\partial \lambda} &= e[R^H - R^L - \Psi'(e)] + R^L - R_f^L - I = 0 \\
\frac{\partial L}{\partial R_f^L} &= 1 - \lambda \leq 0 \quad \text{and} \quad (1 - \lambda)R_f^L = 0.
\end{aligned}$$

Define

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

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

In principle, there are two possible solutions to the problem: Either $e = e^{sb}$ and $R_f^L = 0$, or $e = \xi^{cp} < e^{sb}$ and $R_f^L > 0$. Under the assumption $N(e^{sb}) < 0$, however, e^{sb}

cannot be a solution. Suppose it is so. Then it must be that:

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

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

The optimal profit sharing rule is derived, as in the proof of Proposition 1, by setting $R_f^L = \xi^{cp}(R^H - R^L - \Psi'(\xi^{cp})) + R^L - I > 0$, so that no rent is left to the investor. By (IC), $R_f^H = R_f^L + \Psi'(\xi^{cp})$.

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

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