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Information Disclosure Costs and the Choice of Financing Source*

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Small- and medium-size, high-quality, entrepreneurial firms may prefer bilateral to multilateral financing arrangements, in order to avoid disclosure of private information which might leak to competitors. In the presence of a cost differential between these forms of financing, the higher quality firms (those with more to lose from disclosure) prefer bilateral financing. The cost differential prevents competitors from unambiguously inferring that these firms are hiding information. *Journal of Economic Literature* Classification Numbers: D82, G21, G32, K22. © 1995 Academic Press, Inc.

1. INTRODUCTION

Bilateral and multilateral financing arrangements differ in the degree and cost of information disclosure. In multilateral arrangements the borrowing firm is required to provide detailed documentation, or even to be audited, in order to convince the various lenders that it is creditworthy. Bilateral arrangements, on the other hand, are often characterized by a close relationship between the borrowing firm and the lender, and there-

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fore require less disclosure of verifiable information. Consequently, bilateral financing is less costly.

The information disclosed by a firm during multilateral financing will inevitably become available to third parties, in particular to the firm's competitors, and may trigger an undesirable reaction on their part. By contrast, a bilateral financing transaction entails less, possibly zero, leakage of information. This is another reason why bilateral financing may seem more attractive than multilateral financing.

The purpose of this paper is to offer an explanation for multilateral financing, notwithstanding the noted drawbacks. The explanation centers around the following unraveling effect (Grossman and Hart, 1980; Grossman, 1981; Milgrom, 1981). When competitors learn that a bilateral financing arrangement has been completed, they infer that the borrowing firm is attempting to conceal private information, e.g., "good news" about the value of an innovation, and they react accordingly. In equilibrium, firms with sensitive information—those with the most to lose if their private information is disclosed—borrow from a single lender. The cost differential between the two forms of financing prevents competitors from unambiguously inferring that these firms are hiding information. Firms with less-sensitive information borrow from several lenders, disclosing their information in verifiable form, in order not to be perceived as trying to hide sensitive information.[1] Since it is reasonable to assume that profitability is positively correlated with the sensitivity of the private information, we have the following empirical implication: Other things equal, firms using bilateral financing are more profitable than those using multilateral financing. This is in contrast to Diamond (1991) and Rajan (1992), where high-quality (low-risk) firms prefer arm's length financing to bank financing. The reasons for the difference will be explained later.

The industrial structure in which the model is embedded is one with a small innovator that may cause damage (of uncertain magnitude) to an established product market competitor who is observing the innovator's financing decision. The central role played in the model by the cost of communicating information renders the model relevant for firms that are not too small to consider multilateral financing arrangements, but are not so large that disclosure costs are a trivial consideration. The model is therefore most relevant for small- and medium-size firms (say up to 500 workers and with less than 25 million dollars in assets), without sufficient internal sources of financing, which are innovators in the marketing sense (striving to expand into new products and new market segments), in the growth sense (striving to expand into new geographical areas or to in-

[1] The effect of a fixed cost of disclosure on the outcome of a "game of persuasion" was first pointed out by Javanovic (1982). See also Verrecchia (1983).

crease market share), or in the technological sense (engaged in some form of research and development (R&D)).

Small- and medium-size firms are entrepreneurial and contribute significantly to the process of innovation. For example, Leyden and Thompson argue that "small business is more likely to strive for the unexpected, 'leap-frog' product innovations. . . . According to the US Office of Management and Budget, businesses employing less than 1000 employees accounted for roughly half of the nation's innovations between 1953 and 1973."[2]

The idea that (bilateral) bank financing may be driven by the desire for confidentiality was first pointed out by Campbell (1979), who focused on the tension between equity and debt holders. Assuming that the terms of debt are renegotiable, Campbell argued that equity owners, represented by management, may prefer to borrow from a bank in order to conceal favorable news from debt owners.

Campbell did not address the possibility of inference on the part of interested third parties when they learn that a bank loan has been granted. In fact, most of the literature on the choice between various forms of financing focuses on the tension between the issuers of securities and those who purchase them, and assumes that there is no tension between the issuers of securities and third parties. This is particularly true for Diamond (1991) and Rajan (1992) where, since monitoring and control rights are of little importance for low-risk firms, they prefer arms' length financing to bank financing. The present paper reverses the above assumptions. Controlling for riskiness and creditworthiness, that is, assuming away the tension between the issuers of securities and those who purchase them, the paper focuses solely on the effect of an interested third party.[3]

There is a growing literature, initiated by Bhattacharya and Ritter (1983), which studies situations where both effects are present, namely where there is simultaneous signaling to the product market and to the capital market, and where firms can control disclosure. Bhattacharya and Ritter focus on a separating equilibrium of their model. Typically, these models exhibit separating as well as pooling equilibria (e.g., Gertner *et al.*, 1988).[4]

[2] Chapter 2, p. 23, in Storey (1983). See also Cross (Chap. 4, Table 4.6, p. 105, in Storey (1983), quoted from work by Townsend and Henwood), who reports that during the period 1945–1980, 17–40% of the innovations in the United Kingdom were made by small firms with less than 500 workers; and Kleinknecht (1987), who reports that approximately 22% of the R&D in Holland is performed by small firms with fewer than 500 workers.

[3] The interested third party may be a regulator, the tax authority, or the firm's own labor union. See Rice (1990).

[4] Other applications centered around two-audience signaling include Poitevin (1989), Glazer and Israel (1990), Darrough and Stoughton (1990), and Chen (1994).

A related paper is that of Bhattacharya and Chiesa (1993) which, building on ideas developed in Bhattacharya and Ritter (1983), compares the performance of "centralized" and "decentralized" financing regimes. In a centralized regime a borrower obtains credit from one bank. By assumption, there can be no leakage of information to competitors under such an arrangement. In a decentralized regime borrowers obtain credit from several banks, and each bank finances several projects. There can be circumstances (determined endogenously) where the private information of a borrower is revealed by a bank to a product market competitor who has borrowed from the same bank. The possibility of such information leakage affects the borrower's financing choice. Bhattacharya and Chiesa find that when firms cannot affect their probability of success by investing in private-knowledge-enhancing activities (R&D), multilateral financing arrangements are in general superior to bilateral arrangements. When firms can sufficiently influence their probability of success, free riding by firms may render multilateral financing nonviable.[5]

A major difference between the present paper and that of Bhattacharya and Chiesa is that in their model, firms do not make direct inferences about each other's private information, nor do they take actions which may cause direct damage to each other. The only decisions every firm makes is whether to invest in private-knowledge-enhancing activities and whether to enter a bilateral or a multilateral credit arrangement.

A model is presented in the next section. Section 3 considers equity financing and the choice between private and public financing. I then turn to the empirical implications of the analysis, arguing that the model's theoretical predictions provide a new explanation for documented empirical regularities. The relation of the model to the literatures on venture capital and on initial public offerings is then discussed. Section 4 concludes.

2. THE MODEL

There are two firms, Firm X is big and well established. Firm Y is smaller and younger, and is about to undertake a project requiring an outlay of $c > 0$. Having no funds, it needs to borrow the entire amount.

[5] For a different approach to the comparative performance of "centralized" and "decentralized" financing regimes see Dewatripont and Maskin (1990), who argue that the former are more vulnerable to renegotiation problems, and hence may exhibit greater inefficiencies. Proceeding with this idea, Detragiache (1994) models the choice between private versus public borrowing (the former being more easily renegotiated in insolvency states) and compares alternative bankruptcy regimes.

Before borrowing, firm Y observes the realization θ of the random variable $\tilde{\theta}$. I shall refer to such a firm as being of type θ. This variable affects the profits of both firms. Firm X does not observe θ and has a prior, atomless, distribution of $\tilde{\theta}$ on $[\underline{\theta}, \bar{\theta}] \subset \mathbf{R}_+$, with a strictly increasing cumulative distribution function, which is known to firm Y.

Firm Y can borrow c from a single or several lenders. A decision by firm Y of type θ to borrow from a single lender is denoted $y(\theta) = B$, for "bilateral." If firm Y borrows from several lenders, it is required to disclose θ in an ex post verifiable manner. Consequently, it is assumed that lying is impossible. Firm X observes firm Y's action. Thus, if firm Y decides to borrow from several lenders, firm X learns θ. A decision by firm Y of type θ to borrow from several lenders is denoted $y(\theta) = (M, \theta)$, where M stands for "multilateral."

If firm Y decides to borrow from a single lender, firm X forms a conjecture regarding the set of types to which firm Y could belong. Firm X's beliefs are summarized by the map $C(y)$,

(i) $C(M, \theta) = \{\theta\}$,
(ii) $C(B) = \{\theta \in [\underline{\theta}, \bar{\theta}] | y(\theta) = B\}$, nonempty,

where $C(B)$ is conjectured by firm X. Denote firm X's expectation of firm Y's type, as a function of firm Y's observed action, by

$$\hat{\theta}(y) = E[\tilde{\theta} | \tilde{\theta} \in C(y)], \tag{1}$$

i.e., $\hat{\theta}(M, \theta) = \theta$ and $\hat{\theta}(B) = E[\tilde{\theta} | \tilde{\theta} \in C(B)]$. Equipped with these beliefs, firm X chooses an action $x(\hat{\theta}) \in \mathbf{R}_+$. The action is chosen optimally by firm X as part of its profit maximization, and causes damage to Y.

Denote the profit function of firm Y of type θ, net of the initial outlay c, but not of any fixed costs of borrowing, by $Y(x, \theta)$. Assume that for all $x \in \mathbf{R}_+$ and all $\theta \in [\underline{\theta}, \bar{\theta}]$,

$$Y > 0,\ Y_1 < 0,\ Y_2 > 0,\ Y_{11} \geq 0,\ Y_{12} \geq 0, \tag{2}$$

and for all $\theta \in [\underline{\theta}, \bar{\theta}]$

$$Y_1[x(\theta), \theta]x'(\theta) + Y_2[x(\theta), \theta] \geq 0, \tag{3}$$

where $x(\theta)$ is X's optimal action, when it knows Y's type. Assumption (2) ensures that in the absence of transactions costs to borrowing, firm Y will always want to produce (revenue always exceeds the outlay c). The significance of the assumptions on the second derivatives of Y's profit function is that the marginal ability of firm X's action to hurt firm Y of a given

type is decreasing, and that firm X's action becomes less harmful at the margin the "higher" the type of firm Y (recall that $Y_1 < 0$).[6]

Risk is ignored and bankruptcy is ruled out by assumption, say because the firm in question has assets in place which can be used, in extremis, to repay loans. Fraud, i.e., borrowing c but not producing, is also ruled out; imagine that the penalty for fraud as well as the probability of detection are high. This, and the fact that Y's profits are always positive, means that the loan will always be repaid.[7] Hence, there is no informational tension of relevance between the borrowing firm and the lenders. This allows me to assume that a single lender charges the same interest rate as a consortium of lenders.

Let firm X's profit function, when firm Y is of type θ, be

$$X(x, \theta) = \theta f(x) - g(x), \tag{4}$$

satisfying

$$X_{11} < 0, \qquad X_{12} > 0. \tag{5}$$

Firm X maximizes expected profits, so we can write its objective function as

$$X(x, \hat{\theta}) = \hat{\theta} f(x) - g(x), \tag{6}$$

where $\hat{\theta}$ is as defined in (1). As $x'(\hat{\theta}) = -X_{12}/X_{11}$, we have

$$x'(\hat{\theta}) > 0, \tag{7}$$

which implies that firm Y would like to conceal high values of θ. Both profit functions are continuous and twice continuously differentiable.

Summarizing, firm Y observes θ and then chooses $y(\theta)$. Firm X observes y, updates its prior regarding firm Y's type, and chooses x. Then firm Y's production takes place, and θ becomes publicly known. Finally, profits are realized.

The industrial structure. Implicit in the above is an assumption of imperfect competition between an established firm (X) and an innovator (Y). Information between the established firm and the innovator is asymmetric in the following sense. The innovator knows the value of a parameter, θ, which affects the profits of the established firm. For example, θ could represent the profitability of operating in a new market—a particu-

[6] The assumptions on the second derivatives of Y's profit function are not necessary in order to prove existence of equilibrium and will be used later for other purposes.

[7] Recall that Y's profits were defined as being net of the outlay c.

lar niche or geographical region—with which firm Y is well acquainted. If firm Y discloses that it plans to use the proceeds in order to expand productive capacity, then firm X learns that profitability in this market is high and diverts resources to it in order to compete with firm Y. Thus, firm Y would like to reveal low realizations of θ, "bad news," and to conceal "good news." In the notation used above, when firm X's best estimate of $\tilde{\theta}$ is $\hat{\theta}$, it chooses a scale of operations in the new market, $x(\hat{\theta})$, at a cost $g(x(\hat{\theta}))$, which generates an expected revenue of $\hat{\theta}f(x(\hat{\theta}))$, where f and g satisfy $f > 0$, $f' > 0$, $g > 0$, $g' > 0$, and $f'' \leq 0$, $g'' \geq 0$, with at least one strict inequality.

Alternatively, we can think of firm Y as being an innovator that has just developed a new product of quality θ. The product is a substitute for firm X's product, and firm Y would like to catch firm X by surprise. Releasing good news during the process of a multilateral financing arrangement may trigger an undesired reaction from firm X. For example, firm X may launch a marketing campaign, offer discounts, and invest in customer relations. Such "loss-reducing" measures will weaken the impact of firm Y's innovation. The longer firm Y can conceal its success prior to launching the new product, the better off it expects to be.[8] In terms of the above notation, when firm X chooses a response $x(\hat{\theta})$, the expected damage to firm X is $\hat{\theta}f(x(\hat{\theta}))$, where $f < 0$. Also, $f' > 0$, $g > 0$, $g' > 0$, and $f'' \leq 0$, $g'' \geq 0$, with at least one strict inequality. The maximization of firm X's profit function is in fact the minimization of a loss function. As in the previous example, firm Y would like to conceal good news about its product quality, in order to minimize firm X's reaction.

The fixed cost of borrowing. Let $k(n)$ be the cost of communicating information in a verifiable way to a consortium of n lenders. It is assumed that $k(1) \geq 0$ and that $k'(\cdot) > 0$. The first assumption says that it may cost something to communicate information to a single lender. The second reflects the fact that the larger the number of lenders, the greater the amount of information that needs to be communicated, and the harder it becomes to make the information verifiable. This assumption also may reflect a loss of flexibility on the part of the borrowing firm as a result of the need to coordinate its moves with several lenders. The number of lenders n is assumed to be exogenously given. For notational convenience we let

$$\Delta_n \equiv k(n) - k(1) > 0. \tag{8}$$

[8] Firm X also may react by investing heavily in the development of a more advanced product in order to "leapfrog" firm Y as fast as possible. This will reduce firm Y's future profits. Although the dynamic aspect of this story is not explicitly modeled, its essence is captured by the model.

In order to ensure that the cost differential Δ_n is not prohibitive, attention is restricted to values of Δ_n such that

$$\Delta_n < \bar{\Delta} \equiv Y[x(\underline{\theta}), \underline{\theta}] - Y[x(E\bar{\theta}), \underline{\theta}]. \tag{9}$$

Definition of equilibrium. A Bayesian perfect Nash equilibrium consists of (i) a decision rule $y(\theta)$ for every type of firm Y whether to borrow from one or from several lenders; (ii) a belief $C(y)$ by firm X regarding firm Y's type, for $y = (M, \theta)$ and $y = B$; and (iii) an action choice rule for firm X, $x(\hat{\theta})$, as a function of its beliefs regarding firm Y's type, such that:

(a) For every y, $x[\hat{\theta}(y)]$ solves $\max_x X[x, \hat{\theta}(y)]$;

(b) for every $\theta \in [\underline{\theta}, \bar{\theta}]$, $y(\theta)$ maximizes $Y[x(\hat{\theta}(y)], \theta]$, less the fixed cost of borrowing; and

(c) $C(M, \theta) = \{\theta\}$ and $C(B) = y^{-1}(B)$, i.e., firm X's conjecture is correct.

This definition says that both firms optimize given their information, and that firm X's beliefs about firm Y's type are confirmed by firm Y's action.[9]

Equilibrium. The Proposition below establishes that an equilibrium exists and that it must satisfy the following property: Types with sensitive information, above some value θ_e, borrow from a single lender, whereas types lower than θ_e borrow from several lenders (see Fig. 1). The average type that borrows from a single lender, $\hat{\theta}$, is the average of the set $[\theta_e, \bar{\theta}]$. In equilibrium, when firm X learns that firm Y has borrowed from a single lender, firm X chooses action $x(\hat{\theta})$. The value $\hat{\theta}$ must be such that the profit function of firm Y when borrowing from one lender, $Y[x(\hat{\theta}), \theta]$, intersects the profit function when borrowing from several lenders, $Y[x(\theta), \theta] - \Delta_n$, precisely at θ_e, confirming firm X's conjecture that the average type that borrows from one lender is $\hat{\theta}$. Note that the profits of each and every firm that uses bilateral financing are higher than the profits of any firm that uses multilateral financing.

PROPOSITION. *For $\Delta_n \in (0, \bar{\Delta})$ an equilibrium exists which must satisfy*: (i) $y(\theta) = (M, \theta)$ *for* $\theta \in [\underline{\theta}, \theta_e)$ *and* $y(\theta) = B$ *for* $\theta \in [\theta_e, \bar{\theta}]$, *where* θ_e *is some element of* $(\underline{\theta}, \bar{\theta})$, *and* (ii) $C(M, \theta) = \{\theta\}$ *and* $C(B) = [\theta_e, \bar{\theta}]$.

The proof, which appears in the Appendix, builds on the following intuition. Let the profit function for a firm that borrows from several lenders intersect the profit function for a firm that borrows from one lender at θ_e. Consider firm Y of type θ_e, and suppose that its type increases slightly. In

[9] The need for restrictions on off-equilibrium beliefs does not arise since in equilibrium the set of firms that chooses bilateral financing is nonempty. Therefore, deviations by firms that in equilibrium choose multilateral financing are not detectable. Deviations by firms that in equilibrium choose bilateral financing are detectable, but since these firms are required to disclose their type after deviating, the beliefs of firm X are well defined.

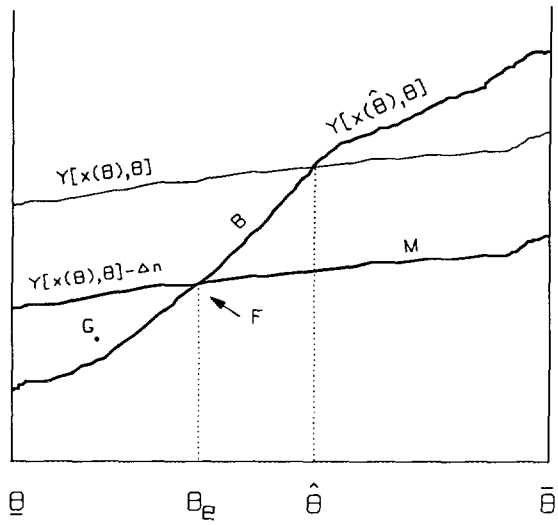

FIG. 1. The equilibrium.

and of itself, this tends to raise firm Y's profits. If the firm borrows from several lenders, its type is known to firm X, implying that a higher θ entails a stronger action on the part of firm X, an effect which works against the increase in Y's profits. On the other hand, if firm Y borrows from a single lender, firm X's action is fixed. Thus, the firm of type slightly higher than θ_e prefers to borrow from a single lender. The same is true for firms of higher type.

In equilibrium, the firms that borrow from a single lender, and are of type higher than $\hat{\theta}$, are hiding their private information since they are perceived as being of type $\hat{\theta}$, but are in fact of higher type. The rest of the firms that borrow from a single lender, those of type lower than $\hat{\theta}$ (but higher than θ_e), would prefer firm X to know their type, but the gain from credibly disclosing is less than the cost Δ_n. The firm of type θ_e is indifferent between the two financing arrangements. The firms using multilateral financing can be thought of as "signaling" to firm X that they are of low type. The cost of doing so is Δ_n.

Remark. As Δ_n approaches zero, the equilibrium in the Proposition approaches the equilibrium with complete unraveling (as in Milgrom, 1981), where $\theta_e = \bar{\theta}$. All types prefer multilateral financing, for fear of being perceived as having information that is more sensitive than it actually is.

Discussion and empirical implications. The innovator's choice between bilateral and multilateral financing is based on the following consid-

erations. Bilateral financing is less costly but, being confidential, may induce a strong response from the competitor who believes the innovator's quality to be higher than it in fact is. Multilateral financing, on the other hand, is more costly, but entails credible disclosure of private information. Therefore, the lowest quality innovators ($\theta < \theta_e$) will find it worthwhile to bear the extra cost of multilateral financing in order not to be perceived as being of high quality. The highest quality innovators ($\theta \geq \hat{\theta}$) clearly prefer bilateral financing as they are perceived as being of lower quality than they in fact are. For these innovators, bearing the cost of multilateral financing *and* inducing a stronger response on the part of the competitor is an unequivocally inferior choice. The medium-quality innovators ($\theta_e \leq \theta < \hat{\theta}$) would prefer the competitor to know their type, but the gain from credibly disclosing it is less than the cost of doing so.[10]

The model thus makes the following prediction for firms whose securities are traded on a public stock exchange. The announcement of a bilateral financing arrangement should trigger a positive stock price response, reflecting shareholders' (correct) conjecture that management must be "on to something good," and is attempting to hide this information from competitors.

Suppose that decisions in firm Y are made by a risk-neutral manager with compensation tied to the firm's profits, say a fraction λ of profits. Since the manager maximizes $\lambda Y(x, \theta)$, the interests of Y's shareholders and the manager are perfectly aligned. Shareholders want the manager to conceal "good news" in order for profits and the stock price to be high. In fact, they delegate to the manager the right to maintain secrecy at his discretion, trusting that the degree of secrecy is optimal. This logic may fail if the manager is not risk-neutral or if his compensation is not a fixed fraction of profits. Another crucial assumption is that firm X reacts to firm Y's action, and only then are profits and the stock price determined. If firm X were not able to observe firm Y's action, and responded only to information revealed by the stock price, the incentives of a manager with compensation tied to the stock price would change. He would want to reveal "good news" to shareholders and, at the same time, to conceal the news from competitors.[11]

Uniqueness and comparative statics. The cutoff value θ_e, in the equilibrium characterized in the Proposition, is not in general unique. The assumptions in (2) on the second derivatives of Y's profit function, and the following additional assumptions ensure, the uniqueness of θ_e:

$$x''(\hat{\theta}) \leq 0, \tag{10}$$

[10] Note that multilateral financing enables an innovator to communicate information to a competitor without violating antitrust law.

[11] I thank an editor for raising the issue of managerial compensation.

$$\frac{d}{d\theta} E(\tilde{\theta} | \tilde{\theta} \in [\theta, \bar{\theta}]) < 1 \qquad \text{for all } \theta \in (\underline{\theta}, \bar{\theta}). \tag{11}$$

Assumption (10) is in fact an assumption on third derivatives of firm X's profit function. Assumption (11) is satisfied, for example, by the uniform distribution, in which case $(d/d\theta)\, E(\tilde{\theta} | \tilde{\theta} \in [\theta, \bar{\theta}]) = \frac{1}{2}$. The proof of uniqueness is given in the Appendix.

The above assumptions allow us to do unambiguous comparative statics with respect to Δ_n. An increase in Δ_n can be a consequence of higher costs of disclosure or of an increase in n, the number of lenders in the multilateral financing consortium. An increase in Δ_n shifts down the curve $Y[x(\theta), \theta] - \Delta_n$. In general, the effect on $Y[x[E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}])], \theta]$ is not as clear. We need to find a new value of θ_e such that $Y[x[E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}])], \theta]$ intersects $Y[x(\theta), \theta] - \Delta_n$ at θ_e. The additional assumptions we have just made ensure that the bilateral financing curve shifts upward, so that the new value of θ_e is smaller than before. In Fig. 1, this is a transition from point F to point G. The proof is in the Appendix.

Remark. $Y(x, \theta) = u(\theta) - v(x)$ with $u(\cdot)$ and $v(\cdot)$ strictly increasing, concave, with $u(\cdot)$ not too concave, satisfies the assumptions on the derivatives of $Y(x, \theta)$ in (2). For example, $Y(x, \theta) = \theta - v(x)$.

3. EXTENSIONS AND RELATED ISSUES

Equity financing. The model applies equally well to the choice between bilateral and multilateral private placements of equity. High-quality firms may prefer to place equity with one investor, rather than with several, in order to avoid leakage of information to competitors. In terms of the model, this simply means that c should be regarded as the funds provided by the investor in exchange for a fraction of the ownership. As the interests of firm Y and the investor are perfectly aligned, $Y(x, \theta)$ can be thought of as their joint profit function. The analysis is then unchanged.[12]

Public versus private offerings. The model is also applicable to the choice between public and private financing. Public offerings of securities (debt or equity) can be thought of as multilateral financing arrangements. When the number of lenders and investors is small, private placements of securities (including bank loans) can be paralleled with bilateral financing. Firms issuing securities on a stock exchange must disclose a substantial amount of private information in order to induce investors to purchase

[12] In this formulation the profit function is not net of c. This detail has no effect on the analysis.

their securities.[13] By issuing securities privately, a firm can considerably reduce the amount of information which is disclosed to third parties. Finally, the cost of raising money publicly is higher than the cost of doing so privately.[14]

The main result of the model is that high-quality, innovative firms will issue securities privately in order to conceal private information from product market competitors. Consistent with this prediction are the observations that the ratio of R&D expenditures to sales is higher for privately financed firms than for publicly financed firms (Carey *et al.*, 1993, Table 1, p. 17) and that high R&D expenditures are a good predictor of the probability of choosing private financing (MacKie-Mason, 1990, Table 3.7, p. 90). Bhagat and Welch (1993) found no effect of cash flow on R&D expenditures for a sample of publicly traded firms in different industries and of varying size. In contrast, Himmelberg and Petersen (1994), using a sample of 179 small firms in high-tech industries, report a large, positive, and highly significant effect of cash flow on R&D expenditures. The discrepancy between the two sets of results for these very different samples is consistent with the model of this paper (although in the model the alternative to public financing is private financing, not internal funds.)

Announcement effects. Considerable evidence supports a positive stock price response to the announcement of private placements of equity and debt, as well as bank loans, in line with the model's prediction. See Wruck (1989) for placements of equity, and Lummer and McConnell (1989), Szewczyk and Varma (1991), Preece and Mullineaux (1994), Wansley *et al.* (1993), and Billett *et al.* (1993) for placements of debt and bank loans. There are exceptions. Mikkelson and Partch (1986) and James (1987) find a positive stock price response for bank loans, but Mikkelson and Partch find no significant response, and James finds a negative response (although significantly different from zero only at the 10% level), for nonbank private placements of debt. See also James and Wier (1988). Banning and James (1989) and Vora (1991) find no significant abnormal return for private placements of debt. I have not found a study which

[13] Furthermore, they are required to disclose information by law. In the United States, for example, before issuing a security on one of the stock exchanges, a firm is required to submit a registration statement to the Securities Exchange Commission, which includes "information about the proposed financing, and the firm's history, existing business, and plans for the future (Brealey and Myers, 1991, pp. 343–344). The information disclosed includes the exact amount raised and the planned use of the proceeds. In essence, the disclosure requirements for firms issuing debt and equity are the same.

[14] Evidence for the high cost of public offerings can be found in Blackwell and Kidwell (1988) and in Ritter (1987). James (1987) and Blackwell and Kidwell (1988) provide evidence of economies of scale in public securities offerings. Therefore, for small firms flotation costs constitute a large fraction of the proceeds. In the case of debt financing, it is true that in the real world bank rates tend to be higher than bond rates. I attribute this to differences in riskiness: Firms which borrow from banks are, on average, more risky. This feature is assumed away here in order to highlight the effect I want to focus on.

reports a negative and highly significant stock price response to a nonpublic offering of securities.

A widely accepted theoretical explanation of the positive stock price response to private financing arrangements stresses the information produced during a private placement of securities. Financial intermediaries are better equipped than the public at large to assess the quality of borrowers (Ramakrishnan and Thakor, 1984), banks enjoy economies of scale in the monitoring of borrowers (Diamond, 1984), and private placement agreements include nonstandard covenants (Smith and Warner, 1979) and also involve monitoring (Zinbarg, 1975). A related explanation is that private placements create large blockholders of securities. As a result, monitoring of management by securities holders improves.[15] The public interprets, therefore, a private placement of securities, or a bank credit agreement, as a certification of the issuer by the buyer of the securities.

According to this view, firms of varying riskiness will self-select as follows: Low-risk firms will issue securities publicly, whereas high-risk firms will seek private financing, subjecting themselves to monitoring (Diamond, 1991; Rajan, 1992). If such a firm has previously issued securities publicly, the price of these securities will rise when the public learns that the firm has committed to being monitored. By contrast, the model in this paper assumes that all firms belong to the same risk class, predicting that in a given risk class, the high-quality firms will seek private financing in order to avoid disclosure of proprietary information. Both explanations are consistent with a positive stock price response to an announcement of a private offering.

The timing of initial public offerings. There is a growing literature seeking to explain why firms go public. Pagano (1993) argues that entrepreneurs go public in order to share risk. By doing so, they also increase risk-sharing opportunities for others. Holmström and Tirole (1993) emphasize the monitoring role of the stock market. By exploiting the information incorporated in stock prices, shareholders can design more efficient managerial compensation schemes. Zingales (1992) regards going public as a strategic move by the initial owner, prior to the sale of the company. By selling a fraction of the company to dispersed owners, the initial shareholder can extract more surplus from a subsequent potential buyer. Lee *et al.* (1991) observe that initial public offerings are more prevalent when investors in the stock market are optimistic. The model in the present paper suggests that young, innovative, private firms may be reluctant to go public, fearing the reaction of established competitors to the disclosed information.[16]

[15] See Wruck (1989) for references pertaining to this view.

[16] A related idea has been suggested by Green and Scotchmer (1990) who observe that filing for patent protection entails disclosure of technical information which might help competitors in their research efforts. As a result, innovators may be reluctant to file for patent protection and in some cases may suppress small technical advances.

Venture capital. Bhattacharya and Chiesa (1993) point out that their theory of endogenous choice by entrepreneurs of bilateral, privacy-preserving financing arrangements can serve as an explanation for venture capital financing in the early stage for high-technology firms. The same is true here. High-quality firms may prefer to place equity with venture capitalists in order to avoid leakage of information to competitors. The outlay, c, should be regarded as the "seed money" provided by the venture capitalist in exchange for a fraction of the ownership.

Thus, one special role of venture capital in financial markets is the provision of equity financing, *confidentially*. Of course, this is not the only, and most likely not even the major, role of venture capital. See Barry *et al.* (1990) and Sagari and Guidotti (1992) for a discussion of venture capital, and Chan *et al.* (1990) for a model of a venture capitalist as a monitor and producer of information.

4. CONCLUDING REMARKS

Bilateral financing arrangements can be viewed as attempts by small, innovative firms to conceal information from competitors, as was originally pointed out by Campbell (1979). Proceeding with this idea, it has been shown that even if competitors use all available information incorporated in the decision not to use multilateral financing, concealing *some* information is still possible as long as there is a cost difference between the two modes of financing. Hence, other things equal, we should expect high-quality firms to use bilateral financing.

The model developed also may help explain the choice between bilateral private financing and public financing. According to the "private providers of capital as monitors" approach (Diamond, 1984; Ramakrishnan and Thakor, 1984), firms perceived as highly risky are rejected by investors on the stock market and are forced to accept the tighter control of private providers of capital. By contrast, in the model presented here, *it is the stock market which is rejected by firms* that are reluctant to disclose proprietary information.

APPENDIX

Proof of the proposition. From (2) and (7) we have that if $Y[x(\theta), \theta] - \Delta_n$ and $Y[x(\hat{\theta}), \theta]$ intersect, the former has a strictly lower slope at the intersection point. It follows that the two schedules can intersect at most once, and that if they do, the set of types for which $Y[x(\theta), \theta] - \Delta_n < Y[x(\hat{\theta}), \theta]$, i.e., the set of types who use bilateral financing, is of the form

$[\theta_e, \bar{\theta}]$. We now establish the existence of such a θ_e. Consider

$$Y[x(\theta), \theta] - \Delta_n = Y[x[E(\tilde{\theta} | \tilde{\theta} \in [\theta, \bar{\theta}])], \theta]. \tag{12}$$

When $\theta = \underline{\theta}$, the left-hand side of (12) is larger than the right-hand side, as $Y[x(\underline{\theta}), \underline{\theta})] - \Delta_n - Y[x(E\tilde{\theta}), \underline{\theta}] = \bar{\Delta} - \Delta_n > 0$. When $\theta = \bar{\theta}$, the left-hand side of (12) is smaller than the right-hand side, as $Y[x(\bar{\theta}), \bar{\theta}] - \Delta_n < Y[x(\bar{\theta})], \bar{\theta}]$. By continuity, there is $\theta_e \in (\underline{\theta}, \bar{\theta})$ satisfying (12). This establishes that if firm X conjectures that the set of types who use bilateral financing is of the form $[\theta_e, \bar{\theta}]$ (which we have shown must be the case), then (i) the two profit functions intersect at some θ_e; (ii) firm X chooses action $x(\hat{\theta})$, based on its conjecture that $\hat{\theta} = E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}])]$; and (iii) types in $[\theta_e, \bar{\theta}]$ (and only these types) use bilateral financing, confirming X's conjecture. ■

Proof of uniqueness. In equilibrium, the set of types who use bilateral financing, $[\theta_e, \bar{\theta}]$, is characterized by θ_e, which must satisfy $Y[x(\theta_e), \theta_e] - \Delta_n = Y[x[E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}])], \theta_e]$. Totally differentiating both sides of this equation with respect to θ_e, we get

$$\begin{aligned}
\frac{d}{d\theta_e} LHS &= Y_1[x(\theta_e), \theta_e]x'(\theta_e) + Y_2[x(\theta_e), \theta_e] \\
&< Y_1[x[E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}])], \theta_e]x'(E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}])) \\
&\quad \times \frac{d}{d\theta_e} E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}]) + Y_2[x[E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}])], \theta_e] \\
&= \frac{d}{d\theta_e} RHS,
\end{aligned}$$

which implies that there can be at most one value of θ_e which satisfies the equality. ■

Comparative statics. Totally differentiating $Y[x(\theta_e), \theta_e] - \Delta_n = Y[x[E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}])], \theta_e]$ with respect to Δ_n yields, using assumptions (2), (10), and (11),

$$\begin{aligned}
\frac{d\theta_e}{d\Delta_n} &= \{Y_1[x(\theta_e), \theta_e]x'(\theta_e) + Y_2[x(\theta_e), \theta_e] \\
&\quad -[Y_1[x[E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}])], \theta_e]x'[E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}])] \\
&\quad \times \frac{d}{d\theta_e} E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}]) + Y_2[x[E(\tilde{\theta} | \tilde{\theta} \in [\theta_e, \bar{\theta}])], \theta_e]]\}^{-1} \\
&< 0.
\end{aligned}$$

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