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# Growth Firms and Relationship Finance: A Capital Structure Perspective

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**Abstract.** We analyze how relationship finance, such as venture capital and relationship lending, affects growth firms' capital structure choices. We show that relationship investors that obtain a strong bargaining position because of their privileged information about the firm optimally cash in on their dominance by pushing it to finance follow-up investments with equity. The firm underinvests if its owner refuses to accept the associated dilution. However, this problem is mitigated if the firm's initial relationship financing involves high leverage or offers initial investors preferential treatment in liquidation. By contrast, if initial investors are unlikely to gain a dominant position, firms optimally lever up only in later rounds. Our implications for relationship and venture capital financing highlight that the degree of investor dominance is of key importance for growth firms' capital structure decisions.

**History:** Accepted by Gustavo Manso, finance.

**Keywords:** financial contracting • relationship financing • dominant investors • equity financing • growth firms

## 1. Introduction

The corporate finance literature commonly assumes that investors compete away their profits when offering financing to firms. This assumption seems reasonable for large public firms and firms with established track records. However, before reaching such a privileged position, a growth firm might at times find itself dependent on investors who can set financing terms in a way that maximizes their own (and not the firm's) profit. Typical examples are relationship lending and venture capital (VC) financing. Though such investors might initially compete fiercely to finance a growth firm, an early investor's access to information unavailable to outsiders could make the firm dependent on the investor's certification in follow-up financing rounds, giving rise to holdup problems (Boot 2000, Gompers and Lerner 2004).

But what do we know about the effect of relationships on growth firms' capital structure decisions? Consider the standard view that relationship investors cash in on their dominance by increasing the cost of debt in later stages (Rajan 1992). The canonical security design setting (Nachman and Noe 1994) is silent on whether debt financing is still optimal as investor dominance violates one of the key assumptions of this setting that capital markets are competitive. Indeed, our paper's first contribution is to show that when bargaining power shifts to the investor, equity becomes preferable to debt. Hence, in instances in which relationship investors cash in on their dominance, growth firms will move away from debt and issue equity. This result has implications for why VC investors may have a preference for equity in later financing rounds and may push firms toward issuing equity in initial public offerings. It is also consistent with patterns in relationship lending, such as the puzzling evidence that one of the main reasons to issue new equity (for which early investors' certification is key) is to repay existing debt (Leone et al. 2007, Pagano et al. 1998, Schenone 2004, Duarte-Silva 2010).

Our paper's second contribution is to analyze how growth firms design their initial capital structure while still facing competition among investors, that is, prior to being locked in with a relationship investor. Here, our analysis explores the role of debt in relationship lending and how that role is likely to be affected by the development of equity markets. It further sheds light on why early investors' bargaining power is likely to affect the shape of securities used in VC financing. Overall, our paper makes a step toward bridging the gap between the literature on relationship finance and that on optimal capital structure, which have hitherto existed in isolation.

Our model features a penniless growth firm that has the opportunity to invest in a first stage and then scale up in a second stage. The key problem is that by the time of the second investment round all investors are less informed than the owner–manager about the profitability of scaling up, but this disadvantage is lower for an early (i.e., relationship) investor. This allows the initial investor to hold up the firm's owner–manager as outside investors would be reluctant to finance the firm's second investment if the initial investor withholds financing.

Our first main result is that the best way for an early investor to cash in on the dominant position the investor has gained by the second financing round is to push the firm toward issuing (levered) equity in that round. Compared with the canonical security design problem with asymmetric information, the key difference generating this result is that the bargaining power is in the initial investor's hands. Equity gives the relationship investor a claim on the firm's upside, which reduces how much the owner–manager can benefit from having favorable private information about the new investment's profitability.[1] This offers two advantages: (i) it allows the investor to absorb more of the profits from scaling up; (ii) by allowing the investor to internalize more of the value from scaling up, equity makes the investor more interested in inducing the owner–manager to invest when doing so is efficient. Thus, equity reduces the scope for underinvestment.

We show that the preference for equity holds even if the dominant investor does not provide the scaling-up financing the dominant investor's self, but steers the firm toward issuing equity to new investors. In that case, the dominant investor's profit comes from having the investor's outstanding (debt) claim repaid at favorable terms or being made more secure. Overall, this analysis highlights that a relationship investor seeking to cash in on the investor's dominance benefits not only from dictating the terms (as commonly assumed), but also the type of new financing.

Consider, next, how the prospect of becoming locked in to a relationship investor affects the firm's *initial* capital structure decision. We show that initially loading up on high leverage mitigates the underinvestment problem in the scaling-up investment round. The key advantage of initial debt financing is that the owner–manager benefits only if the firm realizes high enough cash flows to repay its existing debt. Hence, compared with other types of initial financing, debt makes the privately informed owner–manager more eager to scale up and accept the dilutive (equity) financing dictated by the dominant investor in that round. Thus, by affecting the owner–manager's outside option of not scaling up, high initial leverage counters the owner–manager's incentive to hide the true value of scaling up in an effort to keep more of that value for the owner–manager's self. This not only helps reduce, but could also sometimes completely solve the underinvestment problem. Ultimately, this benefits the growth firm as, by allowing a relationship investor to profit more from the relationship, it lowers the growth firm's initial cost of debt.

Our model is stylized. Yet considering how the presence of a dominant investor changes the canonical security design predictions could still shed light on the following applications. The first is relationship lending. In this context, we highlight that competitive equity markets not only might not diminish, but might even increase the role of relationship lending. By being able to steer firms toward issuing equity to repay existing debt or make debt more secure, relationship lenders have a particularly profitable channel to cash in on their dominant position.[2] This, in turn, makes them more willing to initially provide cheap credit, increasing the attractiveness of relationship financing for financially constrained firms. Second, our result that (for a given level of external financing) high leverage mitigates rather than exacerbates future underinvestment problems associated with a dominant investor adds to our understanding of why debt investors are perfectly positioned to tap this market. Third, and more broadly, our analysis of how dominant investors affect growth firms' capital structure decisions offers another piece to the puzzle why many firms issue equity in times marred by asymmetric information (Frank and Goyal 2003, Leary and Roberts 2010).

The second application of our model is VC financing, where initial investors also typically have better information compared with outside investors (Megginson and Weiss 1991). By interpreting the sequence of financing contracts as a single renegotiation-proof convertible security, we obtain a contract that resembles the convertible preferred securities predominantly used in U.S. VC financing (Kaplan and Strömberg 2003). Our novel insight here is that such securities help investors deal with the problem of being persistently less informed than the owner–manager in multiple investment rounds. Equally important, our results further stress the key role of investor dominance for the optimal type of VC contacts. In an extension to our model, we show that if investors are unlikely to develop certification and holdup power because of their lack of expertise or experience, the capital structure predictions are strikingly different. In such cases, initially raising equity will be preferred with higher leverage becoming optimal only at later stages. This could help explain the corresponding empirical evidence of (Kaplan et al. 2007), which has raised questions about the universal optimality of U.S.-style VC financing.

### 1.1. Related Literature

Our key contribution is to consider security design in a setting in which an initial investor develops a dominant position—a theme that has hitherto been overlooked in the literature. More broadly, our paper falls into the large literature on capital structure choice and security design under asymmetric information. Our model endogenizes how firms' existing capital structure is chosen to mitigate present as well as future inefficiencies dynamically arising from this problem and investor dominance. One of the novel ideas is that insiders' claims on the firm's existing business act as type-dependent reservation values. This creates so-called countervailing incentives (Lewis and Sappington 1989): On the one hand, the privately informed manager would like to exaggerate the value of the existing business. On the other hand, the manager is afraid that doing so would also overstate the value of the manager's investment opportunity, making the manager appear ready to tolerate more expensive financing. These ideas add new dimensions and results to the classical analysis of financing under asymmetric information, which solely predicts the optimality of debt (Myers and Majluf 1984). We, thus, relate to Boot and Thakor (1993), Fulghieri and Lukin (2001), Vladimirov (2015), Strebulaev et al. (2016), and Fulghieri et al. (2016) who discuss other settings in which equity could dominate debt in the context of asymmetric information.[3]

Our paper also relates to the incomplete contracting literature, which has also analyzed the holdup problem in relationship financing (Rajan 1992) as well as the option-like conversion of financing contracts in venture capital (Schmidt 2003). It also touches upon the discussion of whether long-term financial contracts can help reduce investment inefficiencies (Stulz 1990, Von Thadden 1995), notably also when information asymmetry arises in stages (Axelson et al. 2009). Our key contribution also relative to this literature lies in our focus on optimal financial contracting with a dominant investor.[4] The revelation of information over time and the insight that the firm's initial capital structure can create countervailing incentives to those triggering investment inefficiencies in later financing rounds further distinguishes our paper from a growing body of research that studies the dynamics of firms' optimal capital structure by focusing on dynamic trade-off explanations (Hennessy and Whited 2005, Miao 2005), problems of moral hazard (DeMarzo and Sannikov 2006), and the trade-off between debt financing and risk (Rampini and Viswanathan 2010).

## 2. The Model

We consider a firm run by a penniless owner–manager that has an investment opportunity requiring a cash outlay $I_1 \geq 0$ at $t = 1$. If undertaken, this investment generates cash flows at the final date $t = 2$. The firm would generate cash flows at $t = 2$ also without the new investment. This is because it already has a running business, which has been started following a capital injection $I_0$ from an outside investor at $t = 0$. All players are risk neutral, and we abstract from discounting.

The firm's verifiable cash flow $x$ at $t = 2$ can take on two values, $x_l$ or $x_h$, with $x_l \geq 0$ and $\Delta x := x_h - x_l > 0$. The assumption of only two cash flows is for more transparency only. Our results fully extend to a setting with a continuum of cash flows, following a standard extension of the investment technology as in Nachman and Noe (1994) (see Section 3.2). The likelihood $p_{\phi\theta}$ of realizing the high cash flow depends on two factors: whether the additional capital investment at $t = 1$ is made $\phi = \{Y, N\}$ ("Yes" and "No") and on the firm's underlying profitability $\theta = \{G, B\}$.

The key friction in our setting is that, at $t = 1$, the owner–manager obtains an information advantage about the true likelihood that $\theta = G$. Based on this private information at $t = 1$, the owner—manager's beliefs are $\Pr(\theta = G) = q$ and $\Pr(\theta = B) = 1 - q$. We refer to the owner–manager's private information $q$ as the owner–manager's "type" at $t = 1$. The outside investor only knows that $q$ is distributed according to the CDF $F(q)$ over $q \in [0, 1]$ with $\hat{q} = \int_0^1 q\, dF(q)$. We label state $G$ the good state as we assume that $p_{\phi G} \geq p_{\phi B}$ holds for all $\phi \in \{Y, N\}$, that is, regardless of whether the owner–manager scales up. Furthermore, motivated by our focus on growth firms, we stipulate that

$$p_{YG}/p_{NG} \geq p_{YB}/p_{NB}. \tag{1}$$

That is, relatively to the case of no new investment, additional investment has a larger effect if the firm's prospects are already good.[5] This implies that the NPV of the additional investment is higher when $\theta = G$, $p_{YG} - p_{YB} \geq p_{NG} - p_{NB}$. Assumption (1) is general enough to capture as a special case a one-shot capital raising game in which the outside option of not making the investment is constant ($p_{NG} = p_{NB}$). Then, assumption (1) becomes $p_{YG} \geq p_{YB}$—that is, investing is more efficient in the good state, which corresponds to Nachman and Noe's (1994) setting. Thus, condition (1) allows us to extend and contrast our insights with the canonical model of a growth firm raising capital under asymmetric information.

To limit trivial case distinctions, we assume that the new investment round is efficient only in $\theta = G$ and is a negative NPV investment in state $B$.

$$(p_{YB} - p_{NB})\Delta x < I_1 < (p_{YG} - p_{NG})\Delta x. \tag{2}$$

Hence, there is a cutoff $0 < q_{FB} < 1$ defined by

$$\begin{aligned} &x_l + (p_{YB} + q_{FB}(p_{YG} - p_{YB}))\Delta x - I_1 \\ &\quad = x_l + (p_{NB} + q_{FB}(p_{NG} - p_{NB}))\Delta x \end{aligned} \tag{3}$$

so that a new investment round at $t = 1$ increases the joint surplus only if the type (i.e., the probability of being in $G$) is above $q_{FB}$.

### 2.1. Financial Contracting and Paper Outline

To derive our results in a transparent way, we have broken our model in two. In the first part of the paper, we consider in isolation financial contracting at $t = 1$. Focusing on a relationship finance setting reminiscent of Rajan (1992), we stipulate that the initial (relationship) investor who already has claims $S^0(x)$ on the cash flows generated at $t = 2$ can dictate the terms for additional investment at $t = 1$, provided that the owner–manager goes along with it. Specifically, the main difference from the canonical asymmetric information capital raising game is that the investor is in a position to make a take-it-or-leave-it offer to the owner–manager at $t = 1$ that replaces an initial security $S^0(x)$ for a new security $S^1(x)$ in exchange for the investment of $I_1$. In Section 3.2, we show that our insights apply also when $I_1$ is provided by new investors but the initial investor cashes in on the initial investor's dominant position.

In the second part of the paper, we endogenize the investor's bargaining power at $t = 1$ by developing a dynamic financial contracting framework in which investors compete to offer financing at $t = 0$. In Section 4, we analyze how the efficiency of refinancing at $t = 1$ depends on the initial security $S^0$. We then derive the optimal financing contract $S^0$ at $t = 0$ and discuss renegotiation-proof (convertible) contracts stipulating the terms of all financing already at $t = 0$. In Section 5, we contrast our results with a setting in which the initial investor has no informational advantage vis-à-vis new investors at $t = 1$ and financing is offered competitively also at $t = 1$.

In line with the prior literature, the two main applications of our model are to relationship lending and venture capital financing. In Section 6, we describe our novel empirical predictions for these two applications and relate our results to existing empirical evidence. Section 7 concludes. All proofs are in the appendix.

## 3. Financing from a Dominant Investor

Any security must satisfy $S^t(x) \in [0, x]$. The bounds for $S^t$ reflect that the owner–manager is protected by limited liability and the security cannot specify payouts to the owner–manager over and above the cash produced.[6] To ease exposition, we use the following shorthand notation: $S_l^t := S^t(x_l)$ denotes the repayment for low cash flows, and $\Delta S^t := S^t(x_h) - S^t(x_l)$ the investor's upside. Let

$$p_\phi(q) := p_{\phi B} + q(p_{\phi G} - p_{\phi B}) \quad \text{for } \phi = \{Y, N\} \tag{4}$$

denote the expected probability of the high cash flow, conditional on the type $q$ and the decision $\phi$ whether or not to undertake the scaling-up investment. The gross expected profits for $\phi = \{Y, N\}$ are

$$w_\phi(q) = x_l + p_\phi(q)\Delta x. \tag{5}$$

Under some security $S^t$ these cash flows are shared so that the investor realizes

$$v_\phi(S^t, q) = S_l^t + p_\phi(q)\Delta S^t \tag{6}$$

while the owner–manager obtains

$$u_\phi(S^t, q) = w_\phi(q) - v_\phi(S^t, q). \tag{7}$$

### 3.1. Financing Under Asymmetric Information at $t = 1$

In analyzing the dominant investor's problem of making a take-it-or-leave-it offer at $t = 1$ that replaces the initial contract, we stipulate that the dominant investor offers only a single pooling contract $S^1$. After deriving our main results, we show that offering a menu is never optimal. Note that accepting financing for $I_1$ and investing are effectively simultaneous decisions for the owner–manager.

Denote the set of all types $q$ for whom it is profitable to accept the investor's offer with $\Phi \subseteq [0, 1]$—that is, $u_Y(S^1, q) \geq u_N(S^0, q)$ for $q \in \Phi$. Then, the investor's expected payoff at $t = 1$ is given by

$$\int_\Phi [v_Y(S^1, q) - I_1]\, dF(q) + \int_{[0,1]/\Phi} v_N(S^0, q)\, dF(q), \tag{8}$$

and the investor's objective is to choose $S^1$ to maximize this payoff. If the owner–manager rejects the offer, no new capital is injected, and the original contract stays in place.

The investor's profits are highest when the investment decision is made efficiently and the investor can extract the entire surplus generated from scaling up. Under symmetric information about $q$, this would be possible for any type of financing contract as the investor would be able to tailor this contract to the owner–manager's type. This simple solution is not feasible if the owner–manager has an information advantage over the investor as the investor neither knows the true value added from scaling up nor the true value of the owner–manager's outside option. What is novel in our setting is that this gives rise to two opposing incentives for the owner–manager: the owner–manager could benefit from overstating the value of the owner—manager's outside option while understating the profitability of scaling up as this could lead the investor to offer cheaper financing that leaves the owner–manager more of the benefit from scaling up. The problem is that the owner–manager cannot do both at the same time as both the owner—manager's outside option and the profitability of scaling up increase in $q$.

**3.1.1. First-Best Contract Under Asymmetric Information.** The best the investor can do is to use these opposing incentives to the investor's advantage by making an offer for which they exactly offset each other. Formally, this would require making an offer for which the owner–manager's payoffs from accepting $u_Y(S^1, q)$ and rejecting $u_N(S^0, q)$ are the same for all type realizations:

$$\begin{aligned} &x_l - S_l^1 + p_Y(q)(\Delta x - \Delta S^1) \\ &\quad = x_l - S_l^0 + p_N(q)(\Delta x - \Delta S^0) \quad \forall\, q \in [0, 1]. \end{aligned} \tag{9}$$

Clearly, if the right-hand side, which captures the owner–manager's outside option $u_N(S^0, q)$ were not type-dependent, it would never be possible to satisfy (9) unless the owner–manager relinquishes all claims on the firm's upside, that is, $\Delta S^1 = \Delta x$.

A key insight of our paper is that both financial claims, $S^1$ and $S^0$, determine whether or not the owner–manager benefits from scaling up the firm. Since scaling up means that the likelihood of achieving the high cash flow increases, that is, $p_Y(q) > p_N(q)$, satisfying (9) requires reducing the sensitivity of the owner–manager's residual claim to the high cash flow state and, thus, to the owner–manager's private information. The owner–manager can be compensated for this with a higher claim in the low cash flow state.

Formally, if there is a security $\hat{S} = \{\hat{S}_l, \Delta\hat{S}\}$ that satisfies (9) for all types $q$, for this security it will hold that $(\partial/\partial q) u_Y(\hat{S}, q) = (\partial/\partial q) u_N(S^0, q)$. From this condition, we obtain

$$\Delta\hat{S} = \Delta x - \left(\frac{p_{NG} - p_{NB}}{p_{YG} - p_{YB}}\right)(\Delta x - \Delta S^0). \tag{10}$$

Furthermore, since all types are indifferent between investing and not investing, this holds also for type $q = 0$. We can use this to express $\hat{S}_l$ from (9) as

$$\hat{S}_l = S_l^0 - p_{NB}(\Delta x - \Delta S^0) + p_{YB}(\Delta x - \Delta\hat{S}) \tag{11}$$

$$= S_l^0 - \left(\frac{p_{YG}p_{NB} - p_{YB}p_{NG}}{p_{YG} - p_{YB}}\right)(\Delta x - \Delta S^0), \tag{12}$$

where the second equality follows after plugging in from (10). As anticipated, expression (10) shows that the new security $\hat{S}$ needs to give the owner–manager a smaller claim on the upside (i.e., the investor takes $\Delta\hat{S} > \Delta S^0$) compared to the owner–manager's existing financial claim to make the owner–manager's expected payoff equal to the owner–manager's outside option of not making the new investment round.[7] It compensates the owner–manager for this with a higher claim on the downside (i.e., the investor takes $\hat{S}_l < S_l^0$).

**3.1.2. Second-Best Contract.** Offering a security $\hat{S}$ might not be possible, however. Formally, this occurs if a new security that extracts all surplus and satisfies (12) would require promising the owner–manager a higher payoff in the low cash flow state than produced by the firm (i.e., setting $S_l^1 < 0$). This would violate the condition that securities cannot offer a negative repayment to the investor in the low state. Clearly, this problem is most pronounced in the special case in which the owner–manager's outside option is not type dependent ($p_{NG} = p_{NB}$).

Suppose that (12) is indeed negative. Let the unique point of intersection of $u_Y(S^1, q)$ and $u_N(S^0, q)$ be denoted by $q^*$:[8]

$$u_Y(S^1, q^*) = u_N(S^0, q^*). \tag{13}$$

Thus, the set of owner–manager types who accept a refinancing offer with $S^1$ at $t = 1$ becomes $\Phi = [q^*, 1]$: the owner–manager prefers to accept $S^1$ if and only if $q \geq q^*$ and strictly so if $q > q^*$. All types $q > q^*$ who accept $S^1$ now receive an *information rent* of size

$$u_Y(S^1, q) - u_N(S^0, q), \tag{14}$$

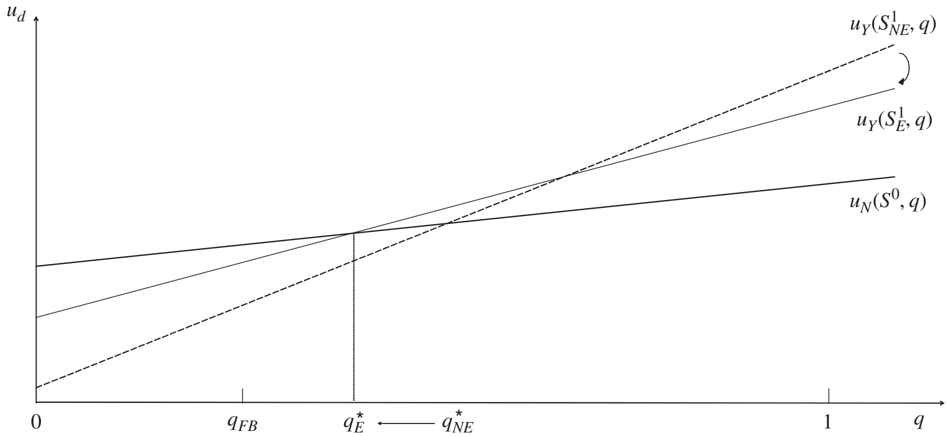
which defines how much their expected payoff from accepting is above their outside option of not scaling up.

Analogous to the first-best case, this rent is minimized when the owner–manager's residual claim becomes less sensitive to the owner–manager's private information. This is achieved by reducing the owner–manager's claim on the upside from scaling up ($\Delta x - \Delta S^1$) in exchange for increasing the owner–manager's claim in the low cash flow state ($x - S_l^1$). Naturally, when the constraint $S_l^1 \geq 0$ becomes binding, it is optimal to set $S_l^1$ to its minimal value of zero and give the investor only a participation on the upside. Such a "levered" equity contract (with $S_l^1 = 0$ and $\Delta S^1 > \Delta S^0$) becomes then the uniquely optimal security at the refinancing stage.

The key property that makes equity financing optimal is that it allows the investor to absorb more of the firm's success. This, in turn, gives the owner–manager less opportunity to benefit from favorable private information, reducing the owner–manager's information rent, and increasing the investor's profit.[9] The second important benefit of using equity financing is that it reduces the scope for underinvestment. This is because the investor's financing offer maximizes the investor's profit by trading off inducing efficient investment with minimizing the owner–manager's information rent. Hence, by allowing the investor to internalize more of the value of scaling up, equity makes the investor more interested in offering financing that induces the efficient investment decision and mitigates the risk of underinvestment. As we shall see in Section 4, this increases firm value from an ex ante perspective.

Figure 1 graphically illustrates the intuition. The bold solid line represents the owner–manager's outside option $u_N(S^0, q)$ from not scaling up under an outstanding claim $S^0$. The dashed line represents the owner–manager's expected payoff from scaling up for some second-period security $S_{NE}^1$, which is not levered equity (e.g., debt). The intersection of the two curves yields the cutoff $q^* = q_{NE}^*$, so that under this security only types $q \geq q_{NE}^*$ will raise financing and scale up. The figure illustrates why any such nonequity contract could not have been optimal for the investor. First, by offering an equity contract, which implements the same cutoff $q_{NE}^*$, the investor would extract more information rent as it would lead to a clockwise rotation of $u_Y(S_{NE}^1, q)$ around $q_{NE}^*$. Second, extracting more rent and, thus, internalizing more of the social surplus, the investor will offer an equity contract $S_E^1$, which not only leads to such a clockwise rotation, but also to a lower,

**Figure 1.** Financing Under Asymmetric Information when a Dominant Investor Dictates the Financing Terms




*Notes.* The owner–manager's rent is the distance between the owner–manager's expected payoff from making the new investment, $u_Y(S^1, q)$, and the owner–manager's outside option of forgoing the investment, $u_N(S^0, q)$. Levered equity makes $u_Y(S^1, q)$ flatter in $q$ and helps to reduce this rent while also reducing the scope for underinvestment.

more efficient cutoff $q^*_E < q^*_{NE}$. Thus, levered equity helps to make the manager's expected payoff $u_Y(S^1, q)$ as flat as possible in the manager's type $q$. This helps to bring this payoff as close as possible to the manager's outside option $u_N(S^0, q)$ and, thus, minimizes the manager's rent.[10] The following proposition summarizes our results for the financing contract offered at $t = 1$ and its implications for the equilibrium cutoff $q^*$.

**Proposition 1.** *If the investor can make a take-it-or-leave-it offer in the new financing round at $t = 1$, the investor offers security $S^1$ that increases the investor's upside participation and decreases the investor's downside protection compared with the investor's initial security $S^0$: $S^1_l \le S^0_l$ and $\Delta S^1 \ge \Delta S^0$.[11] There is a threshold $q^*$, such that this offer is accepted by types $q \in [q^*, 1]$. Furthermore, the following holds*:

(i) *The first-best security $S^1 = \hat{S}$, as characterized in (10)–(11), is feasible and uniquely optimal if (12) is positive. In this case, the refinancing decision is always efficient*: $q^* = q_{FB}$.

(ii) *Otherwise, the investor offers levered equity with $S^1_l = 0$, and there is underinvestment*: $q_{FB} < q^* < 1$.

**Proof.** See appendix.

To formally pin down $q^* > q_{FB}$, we substitute $\Phi = [q^*, 1]$ into the investor's objective function (8) and use that $S^1_l = 0$ from Proposition 1. We also use that from the owner–manager's indifference condition (13), we can obtain $\Delta S^1$ as an increasing function of the induced cutoff $q^*$.[12] Intuitively, this reflects that more expensive financing discourages investment (higher $q^*$). Differentiating the investor's expected profit (8) with respect to $q^*$ and simplifying terms using (7), we obtain the following first-order condition with regards to $q^*$:

$$\frac{d\Delta S^1}{dq^*}\int_{q^*}^{1}\frac{dv_Y(S^1, q)}{d\Delta S^1}\,dF(q) - [w_Y(q^*) - w_N(q^*)]f(q^*) = 0. \tag{15}$$

The first term in (15) captures the benefits from reducing the information rent for all $q > q^*$ while the resulting loss in surplus following an increase in $q^*$ is captured by the second term in (15). Expression (15) implies immediately that if $\hat{S}$ is not feasible (and as a result $d\Delta S^1/dq^* > 0$), we must have $w_Y(q^*) > w_N(q^*)$ and, hence, $q^* > q_{FB}$.

### 3.2. Discussion: New Investors, Menus, and Robustness

**3.2.1. Raising Financing from New Investors.** Our results extend to raising new financing from new investors, provided that the initial investor goes along with it. To show this, we stick to our present assumption that the dominant initial investor steers the firm toward the type and amount of new financing to be raised. In case the firm raises more than $I_1$ to repay its existing investor, we denote the cash paid to the initial investor with $C$. Note that such a cash repayment could also be interpreted as a safe debt claim with a face value of $C$. Allowing for the general case that new financing includes replacing the initial investor's claim for a new one or cash, we denote the fresh risky claims of the new and the old investor at $t = 1$ by $S^1_{New}$ and $S^1_{Old}$ and the combined outstanding risky claim by $S^1 = S^1_{Old} + S^1_{New}$. Again, financing is obtained for all types $q \ge q^*$ where the cutoff $q^*$ is defined by $u_Y(S^1, q^*) = u_N(S^0, q^*)$. To be acceptable for the new investor, these securities must satisfy

$$\int_{q^*}^{1}[v_Y(S^1_{New}, q) - I_1 - C]\frac{dF(q)}{1 - F(q^*)} \ge 0. \tag{16}$$

If certification by the initial investor can guarantee access to a competitive market for fresh financing, this participation constraint holds with equality.[13] If either the owner–manager or the new investor rejects the respective offer, no refinancing takes place.

We can see now that our characterization results fully survive also when $I_1$ is raised from new investors. Using condition (16) to plug into the initial (dominant) investor's objective function, we obtain

$$\int_0^{q^*} v_N(S^0, q)\, dF(q) + \int_{q^*}^1 [v_Y(S^1_{old}, q) + C]\, dF(q)$$
$$= \int_0^{q^*} v_N(S^0, q)\, dF(q) + \int_{q^*}^1 [v_Y(S^1, q) - I_1]\, dF(q),$$

which is identical to that in Section 3. Thus, regardless of whether the initial investor stays with the firm obtaining a safe debt claim with face value $C$, cashes out $C$, or obtains a new (risky) claim $S^1_{old}$ (or any combination of these alternatives), the qualitative results from Proposition 1 remain unchanged.

**Proposition 2.** *Suppose that the owner–manager raises $I_1$ from a new investor at $t = 1$. Regardless of whether the old dominant investor cashes out or stays invested, the (total) outstanding risky claims $S^1$ is the same as in Proposition 1.*

**3.2.2. Menu of Contracts.** Though the investor could alternatively offer a menu of contracts to discriminate among different types $q$, the investor would not find it optimal to do so as the investor's expected payoff is higher when offering a simple pooling (levered) equity contract $S^1$ to the owner–manager. The reason is that any nondegenerate menu of contracts would have to include also a nonequity security (which will be taken up by higher types). However, such securities will leave the owner–manager with a higher information rent than a pooling equity contract and are, thus, not optimal for the investor.

**Proposition 3.** *In the new financing round at $t = 1$, it is not optimal for the investor to offer a (nondegenerate) menu instead of only a single contract $S^1$.*

**Proof.** See appendix.

**3.2.3. Distributional Assumptions.** We have shown that the canonical prediction that firms should issue debt financing under asymmetric information ($t = 1$ in our model) critically hinges upon the assumption that the owner–manager can make the contract offer. The result is straightforward to generalize to continuous cash flows.[14] Furthermore, we have already noted that condition (1) captures as a special case the classical (Nachman and Noe 1994) setting in which the owner–manager's outside option is *not* type-dependent. Slightly relaxing condition (1) does not change Proposition 1. Only if $p_{YG}/p_{YB}$ becomes significantly smaller than $p_{NG}/p_{NB}$ (formally, if $((p_{YB}p_{NG} - p_{YG}p_{NB})/(p_{YG} - p_{YB}))\Delta x > x_I$) do our predictions change. In this case, it can be shown that any feasible offer the investor can make will be accepted only by low types $[0, q^*]$ (where $q^* > q_{FB}$) while the higher types $(q^*, 1]$ will forgo the follow-up investment. That is, for any feasible new financing, investment is more useful for firms with a *worse* existing business. Intuitively, this might be a better description of mature firms with decreasing returns to scale. It can be shown that this case is characterized by either a market breakdown for the new investment or the optimality of debt for a dominant investor at $t = 1$ (albeit we would then need to presume that the considered mature firm still depends on relationship finance).[15]

## 4. The Emergence of Relationship Finance and Optimal Financing at $t = 0$

So far, we have broken up the financing problem into two stages and endowed the initial investor with all bargaining power at $t = 1$. Our key contribution in this section is to analyze how security $S^0$, which is chosen in a competitive environment, affects the underinvestment problem at $t = 1$. To endogenize how the initial investor's dominant position arises at $t = 1$, we make two main assumptions. First, we stipulate that, at $t = 0$, when the owner–manager attempts to raise $I_0$ to start the firm, there is a large pool of "fraudulent" or "fly-by-night" entrepreneurs. Such entrepreneurs have essentially defunct projects, yielding zero cash flows regardless of how much capital is invested. While they would sink the initial outlay $I_0$ irreversibly, they would be able to divert any additional capital into fungible assets that they can sell, absconding with the price $\tau I_1$ with $\tau > 0$. The a priori likelihood that the owner–manager's project is not defunct is $0 < \gamma < 1$. Following Rajan (1992), we stipulate that this likelihood is sufficiently small so that investors would not offer financing if contracts do not deter defunct types from seeking financing. The second assumption is that the initial investor learns whether the project is defunct at $t = 1$ only after the owner–manager has provided $I_0$ at $t = 0$, but this is not observed by any other investor. If the owner–manager's project is not defunct, our baseline setting applies. In particular, $q$ is then the probability that $\theta = G$, conditional on the project being nondefunct. The reason we make these two assumptions is that, absent any friction at $t = 0$, a dominant investor setting at $t = 1$ does not arise, and first best can be achieved with various financing contracts.[16]

To close the model, we follow Burkart et al. (1997) by making a third assumption that the owner–manager is essential for scaling up the firm at $t = 2$.[17] This assumption is not necessary for endogenizing investor dominance. However, it slightly simplifies our analysis and makes it consistent with Section 5 in which we compare our results with a setting in which the initial investor has no information advantage vis-à-vis outside investors at $t = 1$. Indeed, the third assumption will shift the bargaining power at $t = 2$ to the owner–manager.

### 4.1. Financial Contracting

We now formally set up the financing problem at $t = 0$. In line with the literature, we stipulate that, in the initially competitive market for capital, investors compete to offer financing to the owner–manager. Consistent with our preceding notation, these offers stipulate that one of two contracts, $S^0$ or $S^1$, applies, depending on whether $I_1$ is invested at $t = 1$. What is key is that, to deter owner–managers of defunct projects from accepting the offer and then absconding with $\tau I_1$, the offer must allow the initial investor to withhold financing at $t = 1$. Given an infinitely small opportunity cost $\varepsilon > 0$ of applying for financing, this deterrence is effective.[18] Furthermore, in the only equilibrium featuring financing at $t = 0$, it is impossible for the owner–manager to raise follow-up financing from new investors at $t = 1$ if the initial investor refuses such financing. Indeed, if raising financing from outside investors at $t = 1$ were possible, it would attract defunct firms at $t = 0$, making financing at the initial stage impossible. Taken together, we have the following implications.

**Lemma 1.** *In an equilibrium in which nondefunct firms receive financing at $t = 0$, the initial investor must retain the unconditional right to withhold financing at date $t = 1$. Firms that are not refinanced by the initial investor do not receive financing from other investors.*

**Proof.** See appendix.

The second part of the lemma highlights that the investor's right to withhold new finance creates scope for holding up the owner–manager of a nondefunct project. At $t = 1$, this allows the initial investor to (privately) make a new take-it-or-leave-it offer to the owner–manager. We allocate all bargaining power to the initial investor by assuming that the initial investor can commit to this offer.[19] Precisely, the initial investor can offer a new contract $\tilde{S}^1$ that, if accepted, is implemented in case the investment is made. The initial investor's threat is that the owner–manager does not receive follow-up financing if the owner–manager rejects the offer, which (by Lemma 1) would imply that the owner–manager is not able to raise financing also from outside investors.[20] From this, it is immediate that for a given contract $\mathbf{S} = \{S^0, S^1\}$, the unique renegotiation offer $\tilde{S}^1$ and the respective outside options are as in Proposition 1. Since such potential renegotiations are expected by both sides and since investors compete at $t = 0$, the most attractive offer an investor can make at $t = 0$, that is, the offer that maximizes the owner–manager's ex ante payoff, solves

$$\max_{\mathbf{S}} \int_0^{q^*(\mathbf{S})} u_N(S^0, q)\, dF(q) + \int_{q^*(\mathbf{S})}^1 u_Y(\tilde{S}^1(\mathbf{S}), q)\, dF(q) \tag{17}$$

subject to the break-even condition

$$\int_0^{q^*(\mathbf{S})} v_N(S^0, q)\, dF(q) + \int_{q^*(\mathbf{S})}^1 (v_Y(\tilde{S}^1(\mathbf{S}), q) - I_1)\, dF(q) \geq I_0. \tag{18}$$

In equilibrium, (18) will be satisfied with equality. Substituting (18) into (17), we have the intuitive result that the optimal offer $S^0$ must maximize ex ante surplus (efficiency). From our preceding results, this equates to minimizing underinvestment at $t = 1$. In the rest of this section, we derive the equilibrium choice of $S^0$.

### 4.2. Role of Initial $(t = 0)$ Financial Structure in Affecting Subsequent $(t = 1)$ Investment Efficiency

The novel insight from this section is that the initial use of debt financing at $t = 0$ increases the owner–manager's profit at $t = 0$ by increasing efficiency at $t = 1$. Specifically, initial debt financing reduces underinvestment at $t = 1$ by exploiting the countervailing effects emerging from the owner–manager's type-dependent outside option. Intuitively, with initial debt financing, the owner–manager makes a profit only if the firm's cash flow is high. This makes the owner—manager's outside option of not scaling up very sensitive to the likelihood $p_N(q)$ of achieving the high cash flow. Hence, compared with other forms of initial financing, a lower type has a less valuable outside option. As a result, the owner—manager's incentive to try to hide the true value from scaling up (to keep more of that value to the owner—manager's self) is weaker, and it is easier for the investor to entice also lower, but still efficient, types to scale up. This reduces the scope for underinvestment.

In Figure 1, debt financing would correspond to making $u_N(S^0, q)$ steeper in $q$. This helps the investor design a second period security that minimizes the owner–manager's interim information rent and maximizes interim inefficiency. Allowing the investor to extract a higher benefit from the relationship at $t = 1$ benefits the owner–manager as the owner–manager receives better financing terms at $t = 0$. In fact, the owner–manager can pocket exactly the difference in expected total firm value.

**Proposition 4.** *Suppose that financing must be raised from the dominant investor at $t = 1$. Then the following holds*:

(i) *Using debt financing ($S_l^0 = x_l$) at $t = 0$ reduces the scope for underinvestment at $t = 1$.*

(ii) *Underinvestment at $t = 1$ occurs even under debt financing at $t = 0$ if $x_l < \hat{x}_l$, where the threshold $\hat{x}_l$ is defined in the appendix.*

**Proof.** See appendix.

Proposition 4 derives the condition when first-best efficiency can be achieved if the owner–manager uses debt financing at $t = 0$. From condition (12), we have that an efficient outcome at $t = 1$ is feasible only if $S_l^0$ is sufficiently high. The condition that $x_l < \hat{x}_l$ simply means that it is easier to make $S_l^0$ higher if its upper bound $x_l$ is higher; that is, if the project's cash flow is relatively safer. Summarizing, we have the following:

**Corollary 1.** *Consider the full game in which investors compete at $t = 0$ and offers must deter defunct projects. Suppose that only the initial investor observes whether or not a project is defunct. In a renegotiation-proof equilibrium, security $S^1$, which describes how cash flows are shared if the new investment $I_1$ is made, is uniquely determined as in Proposition 1 while security $S^0$, which describes how cash flows are shared without a new investment, is debt. Jointly, $S^0$ and $S^1$ are chosen to just satisfy the investor's break-even constraint* (18).

As noted, we can interpret the contracts derived in Propositions 1–4 also as a single renegotiation-proof security. Under this interpretation, the owner–manager issues initially a debt-like contract, which gives the owner–manager the right to raise new financing at $t = 1$, subject to the initial investor's agreement, upon which the initial contract converts to equity. Note that since there are no other outstanding securities in our model, $S^0$ could alternatively be interpreted as vanilla preferred stock. Hence, the overall contract looks like convertible preferred equity. We elaborate on this interpretation in more detail in Section 6.

## 5. Financing When the Initial Investor Does Not Have Bargaining Power at $t = 1$

Our paper's focus is on a setting in which the firm's initial investor becomes better informed about the firm's viability compared with outside investors, which gives the initial investor bargaining power over the firm. A key novel insight is the crucial role played by "countervailing incentives" when designing a firm's initial financial structure so as to reduce the subsequent problem of underinvestment. In the present extension, we show that this concept can be applied more broadly also to firms that are not subject to such investor holdup. The contrasting results in this section are subsequently used to sharpen our empirical predictions.

To make our main point in the most transparent way, we proceed in analogy to our baseline case by assuming that the firm has an outstanding security $S^0$ that has no provisions for second period investment, and we analyze its effect on financial contracting at $t = 1$. The key difference from the previous section is that all investors are equally informed at $t = 1$, implying that the owner–manager cannot be held up by the initial investor. Hence, the initial investor competes with outside investors whose offer $I_1$ stipulates both $I_1$ in return for a security $S_{new}^1$ and buying out the initial investor's security $S^0$ for cash or a new security $S_{old}^1$. The initial investor's outside option is to reject the offers by new investors (put to the investor by the owner–manager), effectively obstructing the second period investment and staying with $S^0$. Hence, the best the investor can do when offering the investor $I_1$ is to offer to replace $S^0$ for a new security $S^1$ that also gives the investor the same as the investor's outside option under no new investment.[21]

Following standard arguments, the unique financing offer (for the joint claim held by new and old investors) made at $t = 1$ is debt, and it leads to overinvestment ($q^* \leq q_{FB}$). The intuition is the same as in Nachman and Noe (1994): since investors just break even, overinvestment results when high types cross-subsidize low types. In these cases, debt minimizes underpricing for the owner–manager with the highest type and is, thus, the most attractive security competing investors can offer.[22] Countervailing incentives at $t = 1$ are now best exploited by issuing levered equity at $t = 0$.

**Proposition 5.** *If the owner–manager does not face a dominant investor at $t = 1$, the owner–manager issues debt, and there is overinvestment at $t = 1$. Issuing levered equity at $t = 0$ helps to reduce this overinvestment problem and reduces the owner-manager's ex ante cost of finance.*

**Proof.** See appendix.

This characterization contrasts sharply with the case in which the initial investor becomes dominant. Issuing levered equity at $t = 0$ now maximally counteracts the owner–manager's incentive to pretend being a higher type at $t = 1$. The reason is that such an exaggeration would imply that the initial investor's *existing* claim is worth more, making it more expensive to buy the initial investor out. This countervailing incentive reduces overinvestment at $t = 1$ and, thus, increases the ex ante value of the firm.[23]

## 6. Empirical Implications

Relationship finance plays a key role in modern corporations (Boot 2000). Yet we know little about how it affects growth firms' capital structure decisions. Prior theory is silent even on the most basic questions about the best way for a relationship investor to cash in on the dominant position the investor gains over the course of the investor's relationship with a growth firm. In this paper, we approach this gap with a model that studies the role of bargaining power in affecting capital structure decisions. Our theory predicts the following:

**Implication 1.** *A growth firm's capital structure decision depends on whether a relationship investor's privileged information vis-à-vis outside investors gives the investor a dominant position. If such a dominance arises and the relationship investor seeks to cash in on it, the investor will push the firm to issue equity.*

Though our model is highly stylized, Implication 1 could be related to some patterns in the data. It offers a new perspective on why VCs may benefit from pressing firms to move toward equity in later rounds and, respectively, from pushing growth firms to issue equity in IPOs (Megginson and Weiss 1991). Furthermore, in the context of relationship lending, we highlight that focusing on whether relationship lenders increase the cost of debt in later stages might not capture the full picture. Indeed, banks only benefit if their expensive loans are repaid. Thus, it seems reasonable to consider not only that banks use their dominant position to increase the cost of debt prior to new equity issues (Schenone 2010, Santos and Winton 2008), but also that a primary reason for and consequence of such equity issues is to repay existing debt (Leone et al. 2007, Pagano et al. 1998).[24] Hence, at least in the context of the growth firms covered by this evidence, VCs and relationship lenders might be cashing in on their dominance in a comparable way.[25]

Implication 1 contrasts with Myers and Majluf's (1984) celebrated prediction that firms should issue debt when facing problems of asymmetric information. However, recent evidence also seems to contradict this prediction (Frank and Goyal 2003, Leary and Roberts 2010, Gomes and Phillips 2012), which has spurred a sizeable body of research. Our main contribution to this body of literature is to show that, under the same distribution assumptions as in the classical setting (Nachman and Noe 1994), the optimal financing result crucially hinges on whether or not the firms face a competitive market for capital.[26]

Expanding on Implication 1, we further predict that active equity markets can increase rather than diminish the role of relationship financing. Such markets offer relationship investors a channel through which they can monetize their dominant position and realize a higher benefit of the relationship by pushing the firm to issue equity to repay or make its debt more secure. In turn, this makes it possible to offer cheaper initial financing, making relationship financing more attractive for financially constrained firms (Propositions 1 and 2). Furthermore, high leverage not only does not exacerbate, but even mitigates underinvestment in follow-up financing rounds in the presence of a relationship investor. This could add to our understanding of why debt investors have historically been well positioned to become major players in the relationship financing business.

**Implication 2.** (i) *Active equity markets can increase the role of relationship financing and opaque firms' access to such financing by offering a channel to relationship investors to monetize their dominant position.* (ii) *Debt investors have a competitive advantage in relationship financing as firms optimally seek to enter relationship financing through debt-like contracts.*

Our model could also be interpreted in the context of venture capital financing. In this context, relationships and the initial investors' privileged information vis-à-vis new investors in new investment rounds (effectively giving rise to certification power) is also of first-order importance (Megginson and Weiss 1991, Cumming 2008). We show that with information asymmetry, arriving in stages, the optimal security resembles convertible preferred equity, which is widely used in U.S. VC financing. Convertible preferred equity initially gives venture capitalists a preferred equity claim (which, absent debt obligations, has the payoff profile of a debt contract) with the option to convert into equity as venture capitalists certify for the firm in later financing rounds and take it to the public equity markets (Kaplan and Strömberg 2003).[27] This is consistent with our results when we interpret the contracts derived in Propositions 1 and 4 as a single renegotiation-proof convertible security. Our novel insight here is that venture capital contracts established in the United States can help deal not only with effort incentives problems, as they have typically been motivated (e.g., Schmidt 2003, Cornelli and Yosha 2003), but also with the problem of investors being persistently less informed about the firm's prospects than insiders.

**Implication 3.** *Financial contracting with venture capital investors is likely to be strongly influenced by whether firms expect to depend on their certification in new financing rounds. If firms depend on such a certification, offering venture capitalists a senior* (*debt-like*) *claim and allowing this contract to convert to equity can help firms raise both initial as well as new rounds of financing in times of strong information asymmetry.*

Our results are also consistent with the fact that such contracts are not so common in countries in which venture capitalists are a relatively new investor class that tends to be inexperienced (Kaplan et al. 2007, Lerner and Schoar 2005). In particular, investors' degree of certification in practice will depend on their involvement and expertise. When initial investors lack experience and, thus, do not have a meaningful advantage relative to outsiders in judging the firm's prospects or when they lack the reputation to certify for the firm when steering it toward raising new external financing, they would not be able to dictate terms as in Proposition 1.[28] In such cases, firms would switch from equity to debt (Proposition 5). Indeed, in countries in which venture capitalists are still a relatively new investor class, VCs are more likely to take common equity in first financing rounds (Kaplan et al. 2007, Lerner and Schoar 2005). Successful firms then issue more senior securities in later rounds (Kaplan et al. 2007).

**Implication 4.** *U.S.-style VC contracts and relationship lending are less likely to emerge in circumstances in which* *investors do not possess a credible certification role, such as when they do not possess a meaningful track record or are not yet sufficiently experienced (specialist). In such cases, initially raising equity and later switching to debt financing will dominate.*

## 7. Conclusion

We propose a theory in which a growth firm develops a relationship with an investor who can later exert substantial bargaining power in new financing rounds. We show that if it is locked in to its relationship investor and effectively depends on the investor's certification when raising new financing, it will issue equity when raising financing under asymmetric information. Equity allows the relationship investor to absorb more of the value from scaling up. Moreover, it helps to reduce the inherent underinvestment problem caused by too expensive financing by making the investor internalize more of the benefit from scaling up. The design of the firm's initial capital structure could further help reduce the underinvestment problem. The key effect that we explore is that underinvestment is reduced and sometimes entirely avoided when exploiting that a firm's existing capital structure can create countervailing incentives to those causing the firm to see new financing as too expensive and forgo new investment. These countervailing incentives emerge from the fact that the firm's outside option of not raising financing also depends on whether the firm is inherently good or bad.

Our model is stylized as its key focus is on the effect of different bargaining power allocations for optimal security design. However, it still offers novel implications for informationally opaque growth firms that enter relationships with banks or venture capitalists. These implications include why relationship lenders may cash in on their dominant position by steering firms toward issuing equity and why, in these circumstances, equity dominates debt in times of asymmetric information, contrary to what is known from prior theory. Furthermore, our model could be extended to a venture capital context and offers insights for why U.S.-style VC contracts might be suitable only if the investor is sufficiently sophisticated to develop an informational advantage vis-à-vis outside investors.

An interesting avenue for future research would be to generalize our model and further explore the role of countervailing incentives in a full-fledged dynamic setting. Furthermore, obtaining initial financing from multiple investors may mitigate or even eliminate the information advantage and, thus, the certification power of any individual investor. With different cost of information acquisition, our dominant investor setting would resurface. However, endogenizing information acquisition would further require taking into account how the size and the type of the investors' stake affect the incentives to acquire information (Boot and Thakor 1993, Fulghieri and Lukin 2001). Novel predictions may also be gained by exploring in more detail how cash hoarding decisions differ between growth and mature firms (Boot and Vladimirov 2019) and what implications that would have for capital structure choices.

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## Appendix

**Proof of Proposition 1.** The proof follows from a sequence of auxiliary results.

**Claim 1.** *The first-best security $\hat{S}$ is feasible if and only if expression (12) is positive.*

**Proof.** Note first that if the initial security $S^0$ is feasible, then from $\Delta x - \Delta S^0 \geq 0$ and from the construction of $\Delta\hat{S}$ in (10) we also have that $\Delta x - \Delta\hat{S} \geq 0$. Further, as condition (1) implies that $p_{YG} - p_{YB} > p_{NG} - p_{NB}$, we have from (10) that $\Delta\hat{S} \geq 0$. To see next that $\hat{S}_l \leq x_l$ holds, we substitute (10) into (11) and obtain

$$\hat{S}_l = S_l^0 - \left(\frac{p_{YG}p_{NB} - p_{YB}p_{NG}}{p_{YG} - p_{YB}}\right)(\Delta x - \Delta S^0). \tag{A.1}$$

This implies from (1) that $\hat{S}_l < S_l^0$ and, thus, also $\hat{S}_l < x_l$, given that $S^0$ was feasible. The remaining condition is, thus, that $\hat{S}_l \geq 0$, which from (A.1) is just that (12) is positive. From this, it also follows that this condition is necessary for $\hat{S}$ to be feasible. Q.E.D.

The next claim establishes that by optimality of $S^1$, the set of owner–manager types that accepts $q \in \Phi$ is always characterized by a cutoff $q^*$. We argue to a contradiction, showing that if there existed a security $S^1$ so that the owner–manager would prefer acceptance for low but *not* for high $q$, then the first-best contract $\hat{S}$ would be feasible, instead. Then, as argued in the main text, it is clearly optimal to offer $\hat{S}$.

**Claim 2.** *If a security $S^1$ satisfying $u_Y(S^1,0) > u_N(S^0,0)$ together with $u_Y(S^1,1) < u_N(S^0,1)$ is feasible, then also the first-best security $\hat{S}$ is feasible.*

**Proof.** Note first that from the assumed inequalities $u_Y(S^1,0) > u_N(S^0,0)$ (owner–manager prefers refinancing for $q = 0$) and $u_N(S^0,1) > u_Y(\hat{S},1)$ (owner–manager prefers no refinancing for $q = 1$), $\Delta\hat{S} < \Delta S^1$ must hold to ensure that the slope of $u_Y(S^1,q)$ is strictly smaller than that of $u_Y(\hat{S},q)$. But then $u_Y(S^1,0) > u_Y(\hat{S},0)$ implies that $S_l^1 < \hat{S}_l$. By the assumed feasibility of $S^1$, we have from this that $\hat{S}_l > 0$ so that (12) is strictly positive. Q.E.D.

From Claims 1 and 2 refinancing takes place whenever $q \geq q^*$ (with $q^* = q_{FB}$ if $\hat{S}$ is feasible). It is straightforward to rule out optimality of the case $q^* = 1$ (zero probability of refinancing). If $q^* < 1$, then the cutoff is pinned down by the requirement that $u_Y(S^1, q^*) = u_N(S^0, q^*)$ (cf. also (13)).

**Claim 3.** *Levered-equity with $S_l^1 = 0$ is the uniquely optimal security for the investor if the first-best security $\hat{S}$ is not feasible.*

**Proof.** We argue to a contradiction. Suppose that, so as to induce some $q^* \in [0,1]$, another security $S^1$ with $S_l^1 > 0$ were optimal. Choose now $\tilde{S}^1 = (0, \Delta\tilde{S}^1)$ so that $u_Y(\tilde{S}^1, q^*) = u_N(S^0, q^*)$, which implies that the owner–manager's acceptance set, $[q^*, 1]$, remains unchanged while at $q^*$ the investor's *conditional* expected payoff does not change: $v_Y(\tilde{S}^1, q^*) = v_Y(S^1, q^*)$. However, as $u_Y(\tilde{S}^1, q^*) = u_Y(S^1, q^*)$ together with $\tilde{S}_l^1 = 0 < S_l^1$ must imply that $\Delta\tilde{S}^1 > \Delta S^1$, we have that $v_Y(\tilde{S}^1, q) - v_Y(S^1, q) > 0$ holds for all $q > q^*$. Thus, provided it is feasible, the investor is indeed strictly better off under the newly constructed contract $\tilde{S}^1$.

It remains to show that $\tilde{S}^1$ is feasible. By the assumed feasibility of $S^1$ and construction of $\tilde{S}^1$, this is the case if $\Delta\tilde{S}^1 \leq \Delta x$. (The other feasibility restrictions on $\tilde{S}^1$ are satisfied by feasibility of $S^1$.) From $u_Y(\tilde{S}^1, q^*) = u_Y(S^1, q^*)$ and $\tilde{S}_l^1 = 0$, we can obtain

$$\Delta\tilde{S}^1 = \frac{S_l^1}{p_{YB} + q^*(p_{YG} - p_{YB})} + \Delta S^1$$

so that $\Delta\tilde{S}^1 \leq \Delta x$ holds whenever

$$0 \leq -S_l^1 + (p_{YB} + q^*(p_{YG} - p_{YB}))(\Delta x - \Delta S^1). \tag{A.2}$$

However, (A.2) is implied by the assumption that the first-best security is not feasible, that is, that (12) cannot be positive. To see this, note first that from the definition of $q^*$, that is, $u_Y(S^1, q^*) = u_N(S^0, q^*)$, condition (A.2) is equivalent to

$$0 \leq -S_l^0 + (p_{NB} + q^*(p_{NG} - p_{NB}))(\Delta x - \Delta S^0). \tag{A.3}$$

As, by assumption, $\hat{S}$ is not feasible, it holds from transforming the "first-best condition" (12) that

$$\begin{aligned} 0 &< -S_l^0 + \left(\frac{p_{YG}p_{NB} - p_{YB}p_{NG}}{p_{YG} - p_{YB}}\right)(\Delta x - \Delta S^0) \\ &< -S_l^0 + (p_{NB} + q^*(p_{NG} - p_{NB}))(\Delta x - \Delta S^0), \end{aligned}$$

where the last inequality holds for *any* $q^*$. But this is just what we needed to show (condition (A.3)). Q.E.D.

To conclude the proof of Proposition 1, we solve the investor's program when $\hat{S}$ is not feasible. For this, observe that from the indifference condition of the owner–manager at $q^*$, (13), we have that

$$\Delta S^1 = \Delta x - \frac{S_l^1 - S_l^0 + [p_{NB} + q^*(p_{NG} - p_{NB})](\Delta x - \Delta S^0)}{p_{YB} + q^*(p_{YG} - p_{YB})}, \tag{A.4}$$

from which we obtain explicitly

$$\begin{aligned} \frac{d\Delta S^1}{dq^*} &= \frac{(S_l^1 - S_l^0)(p_{YG} - p_{YB}) + (p_{NB}p_{YG} - p_{YB}p_{NG})(\Delta x - \Delta S^0)}{[p_{YB} + q^*(p_{YG} - p_{YB})]^2} \\ &> 0, \end{aligned} \tag{A.5}$$

where the inequality follows as $S_l^1 = 0$ when (12) cannot be positive.

We can next substitute for the acceptance set $\Phi = [q^*, 1]$ into the investor's objective function (8), where $q^*$ is given by the indifference condition for the owner–manager (cf. condition (13)). Differentiating with respect to $q^*$, we have the first-order condition (cf. also (15))

$$-[w_Y(q^*) - w_N(q^*)]f(q^*) + \frac{d\Delta S^1}{dq^*}\int_{q^*}^1 \frac{dv_Y(S^1, q)}{d\Delta S^1}\,dF(q) = 0, \tag{A.6}$$

where the first term follows from $w_\phi(q) = u_\phi(S^t, q) + v_\phi(S^t, q)$ and (13). As $d\Delta S^1/dq^* > 0$,

$$\frac{dv_Y(S^1, q)}{d\Delta S^1} = p_{YB} + q(p_{YG} - p_{YB})$$

while $w_Y(q^*) - w_N(q^*)$ is strictly increasing and equal to zero when $q^* = q_{FB}$, we have that $q^* > q_{FB}$.

Finally, we show that levered equity also leads the investor to offer $S^1$ that leads to a more efficient $q^*$. To see this, suppose that $S_l^1 = \varepsilon > 0$. The cross-partial of the investor's expected payoff with respect to $q^*$ and $\varepsilon$ shows that it is supermodular in these variables

$$\frac{(p_{YG} - p_{YB})}{[p_{YB} + q^*(p_{YG} - p_{YB})]^2}\int_{q^*}^1 \frac{dv_Y(S^1, q)}{d\Delta S^1}\,dF(q) > 0.$$

Therefore, by monotonic selection arguments, $q^*$ increases in $\varepsilon$. Thus, reducing $\varepsilon$ leads to a lower $q^*$. Q.E.D.

**Proof of Proposition 3.** Consider any nondegenerate menu of contracts $\{S_i^1\}$, which stipulates that the owner–manager receives $I_1$ for any contract $S_i^1$ from the menu.[29] By the arguments in Proposition 1, we can restrict consideration to the case in which the owner–manager prefers a contract in $i$ over the owner—manager's outside option of not investing if and only if $q \geq q^*$. Let $S_*^1$ be the contract chosen by type $q^*$. If the first-best contract $\hat{S}$ is not feasible, we know that all types $q > q^*$ would prefer $S_*^1$ to $S_1^1$. But then it is straightforward that, by dropping all other contracts except $S_*^1$ from the menu, we have (i) the cutoff $q^*$ would remain unchanged and, (ii) by revealed preferences for the owner–manager, the investor is better off. The latter is true because, if for any other type $q > q^*$, there existed a contract $S_i^1$ in the menu such that $u_Y(S_i^1, q) > u_Y(S_*^1, q)$, then this would necessarily imply that $v_Y(S_i^1, q) < v_Y(S_*^1, q)$. Q.E.D.

**Proof of Proposition 4.** (i) The proof is by contradiction. Suppose that $S^0$ with $S_l^0 < x_l$ maximized the value of a firm that turns out to be nondefunct and that there is inefficiency at $t = 1$. By Proposition 1, the investor chooses a security $S^1 = (0, \Delta S^1)$ that induces a cutoff $q_{old}^* > q_{FB}$. Note that we relegate to the end of the proof the argument why, in the equilibrium of the whole game, the investor must always choose the most efficient cutoff from the investor's optimal correspondence and, thus, play a pure strategy. We proceed in three steps.

*Step* 1. We start by constructing $\tilde{S}^0 = (x_l, \Delta\tilde{S}^0)$ together with $\tilde{S}^1 = (0, \Delta\tilde{S}^1)$ so that two conditions are satisfied: the owner–manager is still indifferent at the old cutoff $q_{old}^*$ and, holding this cutoff fixed, the ex ante payoff for both parties stays the same. By construction, it then holds that

$$\begin{aligned} 0 = &\int_0^{q_{old}^*}[v_N(\tilde{S}^0, q) - v_N(S^0, q)]\,dF(q) \\ &+ \int_{q_{old}^*}^1 [v_Y(\tilde{S}^1, q) - v_Y(S^1, q)]\,dF(q), \end{aligned} \tag{A.7}$$

together with $u_Y(S^1, q^*_{old}) = u_N(S^0, q^*_{old})$ and $u_Y(\tilde{S}^1, q^*_{old}) = u_N(\tilde{S}^0, q^*_{old})$. To ease exposition, let

$$\hat{p}_N := p_{NB} + (p_{NG} - p_{NB}) \int_0^{q^*_{old}} q \frac{dF(q)}{F(q^*_{old})},$$
$$\hat{p}_Y := p_{YB} + (p_{YG} - p_{YB}) \int_{q^*_{old}}^1 q \frac{dF(q)}{1 - F(q^*_{old})}.$$

Further, let $p_\phi(q) := p_{\phi B} + q(p_{NG} - p_{NB})$ be defined as in (4) in the main text. Recall also that, for given $q^*$ and $S^0$, $\Delta S^0$ is given in (A.4). Plugging into (A.7), we have

$$0 = (x_l - S^0_l + \hat{p}_N(\Delta\tilde{S}^0 - \Delta S^0))F(q^*_{old}) + \frac{\hat{p}_Y}{p_Y(q^*_{old})}(x_l - S^0_l + p_N(q^*_{old})(\Delta\tilde{S}^0 - \Delta S^0))(1 - F(q^*_{old})),$$

from which we can express $\Delta\tilde{S}^0$ as

$$\Delta\tilde{S}^0 = \Delta S^0 - \left(\frac{x_l - S^0_l}{\hat{p}_N}\right) \cdot \left(\frac{p_Y(q^*_{old})F(q^*_{old}) + \hat{p}_Y(1 - F(q^*_{old}))}{p_Y(q^*_{old})F(q^*_{old}) + (p_N(q^*_{old})/\hat{p}_N)\hat{p}_Y(1 - F(q^*_{old}))}\right). \quad \text{(A.8)}$$

*Step* 2. We now show that, if offered $\tilde{S}^0$ in the initial period, the investor will actually offer a different security $\bar{S}^1 \neq \tilde{S}^1$ at $t = 1$ that implements a strictly lower cutoff. For this purpose, we look at the expected payoff of the investor at $t = 1$ when the investor is faced with $S^0$ or $\tilde{S}^0$, respectively, and then apply monotone comparative statics.

As the second security is levered equity with $S^1_l = \tilde{S}^1_l = 0$, the indifference condition of the owner–manager at a cutoff $q^*$ gives the respective value $\Delta S^1$ as a unique function of $S^0$ and $q^*$ only (cf. (A.4)). We use $\Delta S^1(q^*, S^0)$ and $\Delta S^1(q^*, \tilde{S}^0)$, making thereby explicit that $\Delta S^1(\cdot)$ presently denotes a function. Next, we define the investor's expected payoff at $t = 1$ for some $q^*$ and an initial contract $S^0$ by

$$V(q^*, S^0) := \int_0^{q^*} v_N(S^0, q)\, dF(q) + \int_{q^*}^1 (v_Y(S^1, q) - I_1)\, dF(q). \quad \text{(A.9)}$$

Defining $V(q^*, \tilde{S}^0)$ accordingly, we now show that the difference $V(q^*, \tilde{S}^0) - V(q^*, S^0)$ is decreasing in $q^*$. (Importantly, note that $q^*$ is *not* an optimal selection from the investor's optimization problem at this point.) After some transformations, we have

$$\frac{d}{dq^*}[V(q^*, \tilde{S}^0) - V(q^*, S^0)] = \int_{q^*}^1 p_Y(q)\left(\frac{d\Delta S^1(q^*, \tilde{S}^0)}{dq^*} - \frac{d\Delta S^1(q^*, S^0)}{dq^*}\right) dF(q). \quad \text{(A.10)}$$

Next, using (A.5) and (A.8), we obtain an explicit expression for the second term under the integral in (A.10). Importantly, observe that $\tilde{S}^0$ is defined as a function of $q^*_{old}$ and *not* $q^*$. We have

$$\frac{d\Delta S^1(q^*, \tilde{S}^0)}{dq^*} - \frac{d\Delta S^1(q^*, S^0)}{dq^*} = -\frac{(x_l - S^0_l)(p_{YG} - p_{YB}) + (p_{NB}p_{YG} - p_{YB}p_{NG})(\Delta\tilde{S}^0 - \Delta S^0)}{p_Y(q^*)^2}$$
$$= \frac{-(x_l - S^0_l)(p_{YG} - p_{YB})}{p_Y(q^*)^2} \times \left(1 - \frac{(p_{NB}p_{YG} - p_{YB}p_{NG})}{(p_{YG} - p_{YB})\hat{p}_N} \cdot \frac{p_Y(q^*_{old})F(q^*_{old}) + \hat{p}_Y(1 - F(q^*_{old}))}{p_Y(q^*_{old})F(q^*_{old}) + (p_N(q^*_{old})/\hat{p}_N)\hat{p}_Y(1 - F(q^*_{old}))}\right)$$
$$< \frac{-(x_l - S^0_l)(p_{YG} - p_{YB})}{p_Y(q^*)^2}\left(1 - \frac{(p_{NB}p_{YG} - p_{YB}p_{NG})}{(p_{YG} - p_{YB})\hat{p}_N}\right) < 0,$$

where for the first inequality we use that $p_N(q^*_{old})/\hat{p}_N > 1$, and for the second inequality we use that $\hat{p}_N > p_{NB}$. From (A.10), it follows, therefore, that

$$\frac{dV(q^*, \tilde{S}^0)}{dq^*} < \frac{dV(q^*, S^0)}{dq^*}.$$

Thus, the difference $V(q^*, \tilde{S}^0) - V(q^*, S^0)$ decreases in $q^*$. By standard monotone selection arguments, strictly decreasing differences imply the following: any optimal cutoff $q^*_{new}$ that the investor chooses given $\tilde{S}^0$ is lower than any optimal cutoff $q^*_{old}$ that the investor selects given $S^0$, so that $q^*_{new} < q^*_{old}$.

*Step* 3. In this step, we show that the owner–manager is indeed better off with the considered deviation. Observe first that by construction both the owner–manager and the investor are ex ante indifferent between $(S^0, S^1)$ and $(\tilde{S}^0, \tilde{S}^1)$, when holding $q^* = q^*_{old}$ constant. But as $q^*_{new} < q^*_{old}$, it follows from (A.5) $(d\Delta S^1/dq^* > 0)$ that for the new optimal second-period contract, which implements some $q^*_{new}$, we have that $\Delta S^1(q^*_{new}, \tilde{S}^0) < \Delta S^1(q^*_{old}, \tilde{S}^0)$. Denote this contract by $\bar{S}^1$. Hence, $u_Y(\bar{S}^1, q) > u_Y(\tilde{S}^1, q)$ holds for all $q$, and the ex ante expected payoff of the owner–manager with $(\tilde{S}^0, \bar{S}^1)$ is strictly higher than with either $(\tilde{S}^0, \tilde{S}^1)$ or $(S^0, S^1)$, respectively. To finish this step, note that by optimality of $\bar{S}^1$ the investor is also at least weakly better off with $(\tilde{S}^0, \bar{S}^1)$ than with $(\tilde{S}^0, \tilde{S}^1)$, so that $(\tilde{S}^0, \bar{S}^1)$ satisfies the investor's break-even condition. Taken together, this contradicts the claim that $S^0$ maximizes the value of a firm that turns out to be nondefunct.

To conclude the proof, we can make use of the preceding results to show that, as asserted in the main text, in equilibrium the *investor* chooses a pure strategy and, thereby, implements the most efficient (i.e., lowest) $q^*$ in case the investor's optimal contractual choice at $t = 1$ is not uniquely determined. Given a debt security at $t = 0$, one can use the indifference condition (13) to express the second-stage levered equity security $S^1$ as a function of $\Delta S^1$ and $q^*$. We can, thus, write $V(q^*, \Delta S^0)$ instead of $V(q^*, S^0)$ (cf. expression (A.9)). Further, we use $Q^* = \arg\max V(q^*, \Delta S^0)$ to denote the optimal choice correspondence subject to (18). Observe now that given $S^0$, $V(q^*, \Delta S^0)$ is strictly submodular in $q^*$ and $\Delta S^0$:

$$\frac{\partial^2 V(q^*, \Delta S^0)}{\partial q^* \partial \Delta S^0} = -\frac{(p_{NB}p_{YG} - p_{YB}p_{NG})}{p_Y(q^*)^2} \int_{q^*}^1 p_Y(q)\, dF(q) < 0.$$

Therefore, again by monotonic selection arguments, relaxing the investor's ex ante participation constraint by increasing $\Delta S^0$ results in a lower set $Q^*$. Since $Q^*$ is monotonic, it must be almost everywhere a singleton and continuous. Then, while the investor's payoff is continuous in $\Delta S^0$ everywhere, the owner–manager's expected payoff is continuous a.e. and, where $Q^*$ is not a singleton, the owner–manager strictly prefers the lowest (most efficient) value $q^* = \min Q^*$. Consequently, analogously to a tie-breaking condition, by optimality for the owner–manager the investor must choose $q^* = \min Q^*$ with probability one in equilibrium.

(ii) We now derive the condition for achieving first-best financing at $t = 0$. Recall from Proposition 1 that if the investor induces $q_{FB}$, then $u_N(S^0, q) = u_Y(\hat{S}, q)$ holds for all $q \in [0, 1]$. Using this and the identity $w_\phi(q) = v_\phi(S^t, q) + u_\phi(S^t, q)$ to plug into (18), if the investor just breaks even at $t = 0$, one can express $\Delta S^0$ as

$$\Delta S^0 = \Delta x - \frac{W_{FB} - I_0 - (x_l - S_l^0)}{p_N(\hat{q})}. \tag{A.11}$$

A first-period security that satisfies (A.11) is feasible if

$$\begin{aligned} x_l &\geq S_l^0 \geq 0, \\ \Delta x \geq \Delta S^0 &= \Delta x - \frac{W_{FB} - I_0 - (x_l - S_l^0)}{p_N(\hat{q})} \geq 0, \\ S_l^0 &\geq \left(\frac{p_{NB}p_{YG} - p_{YB}p_{NG}}{p_{YG} - p_{YB}}\right)\frac{W_{FB} - I_0 - (x_l - S_l^0)}{p_N(\hat{q})}, \end{aligned}$$

where the last inequality is just the condition that (12) is positive from Proposition 1. These three conditions can be rewritten as follows:

$$\begin{aligned} &\min(x_l, x_l + p_N(\hat{q})\Delta x - W_{FB} - I_0) \\ &\geq S_l^0 \geq \max\left(x_l - W_{FB} - I_0, \frac{p_{NB}p_{YG} - p_{YB}p_{NG}}{(p_{NG} - p_{NB})p_Y(\hat{q})}(W_{FB} - I_0 - x_l)\right). \end{aligned}$$

Since the left-hand side must be greater than the right-hand side, it must be that

$$\begin{aligned} x_l \geq &\max\left(x_l - W_{FB} - I_0, \frac{p_{NB}p_{YG} - p_{YB}p_{NG}}{(p_{NG} - p_{NB})p_Y(\hat{q})}(W_{FB} - I_0 - x_l)\right) \\ &+ \max(0, W_{FB} - I_0 - p_N(\hat{q})\Delta x). \end{aligned}$$

Simple transformations imply that first-best is achieved if

$$\begin{aligned} x_l \geq \hat{x}_l := &\frac{p_{NB}p_{YG} - p_{YB}p_{NG}}{(p_{YG} - p_{YB})p_N(\hat{q})}(W_{FB} - I_0) \\ &+ \frac{(p_{NG} - p_{NB})p_Y(\hat{q})}{(p_{YG} - p_{YB})p_N(\hat{q})}\max(0, W_{FB} - I_0 - p_N(\hat{q})\Delta x), \end{aligned} \tag{A.12}$$

where $W_{FB} := \int_0^{q_{FB}} w_N(q)\, dF(q) + \int_{q_{FB}}^1 [w_Y(q) - I_1]\, dF(q)$ denotes the maximum feasible joint surplus, *gross* of the initial outlay $I_0$. If (A.12) holds, by optimality for the owner—manager, we then have that $q^* = q_{FB}$: The security $S^0$ then maximizes joint surplus and, by making the investor just break even, achieves the maximum feasible payoff for the owner–manager. Thus, by Proposition 1, it follows that there is first-best-efficiency at $t = 1$ only if (A.12) is satisfied. Q.E.D.

**Proof of Proposition 5.** We show that financing with levered equity at $t = 0$ reduces overinvestment (i.e., $q^* < q_{FB}$) at $t = 1$. Since the investor just breaks even ex ante, we have

$$\begin{aligned} \Delta S^0 &= \frac{I_0 - S_l^0}{p_N(\hat{q})}, \\ \Delta S^1 &= \Delta x - \frac{S_l^1 - S_l^0 + p_N(q^*)(\Delta x - \Delta S^0)}{p_Y(q^*)}. \end{aligned} \tag{A.13}$$

(Recall that $\hat{q}$ is the unconditional expectation of $q$.) Note that $S_l^1 = x_l$, so that we can represent the equilibrium security $S^1$ as a function of $S^0$ and $q^*$ only. By plugging (A.13) into the investor's binding ex ante participation constraint, one can express this constraint entirely as a function of $S_l^0$ and $q^*$

$$\begin{aligned} I_0 = &\int_0^{q^*}\left(S_l^0 + p_N(q)\frac{I_0 - S_l^0}{p_N(\hat{q})}\right)dF(q) + \int_{q^*}^1\left(S_l^1 + p_Y(q)\right. \\ &\left.\cdot\left(\Delta x - \frac{x_l - S_l^0 + p_N(q^*)(\Delta x - (I_0 - S_l^0)/(p_N(\hat{q})))}{p_Y(q^*)}\right) - I_1\right)dF(q). \end{aligned} \tag{A.14}$$

Taking the total derivative of (A.14) allows us, therefore, to examine how a change in $S_l^0$ affects the equilibrium cutoff $q^*$ at the interim stage given that $S^0$ and $S^1$ adjust so that the investor has the same ex ante expected payoff under the old and the new equilibrium. From total differentiation, we obtain

$$\begin{aligned} 0 = &\left[\begin{array}{l} (S_l^0 + p_N(q^*)\Delta S^0 - x_l - p_Y(q^*)\Delta S^1)f(q^*) \\ \quad + \displaystyle\int_{q^*}^1 p_Y(q)\frac{d\Delta S^1}{dq^*}\, dF(q) \end{array}\right] dq^* \\ &+ \left[\int_0^{q^*}\left(1 - \frac{p_N(q)}{p_N(\hat{q})}\right)dF(q)\right. \\ &\quad \left. + \int_{q^*}^1 \frac{p_Y(q)}{p_Y(q^*)}\left(1 - \frac{p_N(q^*)}{p_N(\hat{q})}\right)dF(q)\right]dS_l^1, \end{aligned} \tag{A.15}$$

where for ease of exposition only we have plugged back in for $\Delta S^t$ in the first line. With overinvestment, $q^* < q_{FB}$, the first term in the first line is positive. Also the second term is positive, as $d\Delta S^1/dq^* > 0$.[30] Finally, the second line is also positive. To see this, note that differentiating the terms in front of $dS_l^1$ with respect to $q^*$ we have

$$\int_{q^*}^1\left[\frac{p_Y(q)}{p_N(\hat{q})}\left(\frac{(p_{YG}p_{NB} - p_{NG}p_{YB}) - (p_{YG} - p_{YB})p_N(\hat{q})}{p_Y(q^*)^2}\right)\right]dF(q) < 0.$$

Further, these terms are zero at $q^* = 1$ while $q^* \leq q_{FB} < 1$. Taken together, from the preceding observations on (A.15), we obtain $dq^*/dS_l^1 < 0$. As the owner–manager is the residual claimant and as $q^* < q_{FB}$, we thus have that $S_l^0$ is optimally chosen as small as possible: $S_l^0 = 0$. Q.E.D.

## Endnotes

[1] The owner–manager's information rent is the additional expected payoff the owner–manager can realize from investing compared with the owner–manager's outside option of not investing. This result is the flip side of the standard explanation that firms with good investment opportunities would avoid issuing equity if they can choose the financing type most attractive for them (and not for a dominant investor) in a competitive capital market (Myers and Majluf 1984).

[2] Financing debt repayments is one of the main reasons for firms to issue equity (Leone et al. 2007). It has been shown that certification by relationship banks is crucial for IPOs and SEOs (Schenone 2004, Duarte-Silva 2010) and that they use this power to impose expensive financing prior to equity offerings (Schenone 2010).

[3] DeMarzo et al. (2005) and Axelson (2007) show that payments in equity help sellers extract more rent from better informed investors/buyers. However, there are no inefficiencies and there is no discussion of the effect of existing financing in these models. The latter is also the main difference from Burkart and Lee (2016). In a

setting in which buyers are better informed than sellers, they show that buyers with incentives to understate should concede the upside while those with incentives to overstate should retain the upside.

4 Though DeMarzo and Duffie (1999) and Biais and Mariotti (2005) also consider a two-stage game, the security in their models is designed *before* private information is revealed, and ultimately, only a single security is issued.

5 For growth firms with an existing business, transitioning from the phase of idea generation and testing to expanding production, scaling up often requires a lumpy investment and typically features nondecreasing returns to scale (Jones 1999). This could be one intuitive interpretation of our intermediate investment stage and condition (1). We discuss relaxing the latter condition in Section 3.2.

6 The literature further stipulates that $S^t(x)$ and $x - S^t(x)$ are nondecreasing. Otherwise, either party could have an incentive to "destroy" cash flow by obstructing the operations of the firm. We also check for these restrictions, but we show that they are never binding in our setting.

7 This follows from $p_{YG} - p_{NG} > p_{YB} - p_{NB}$, which is implied by condition (1), $p_{YG}/p_{NG} > p_{YB}/p_{NB}$. Note that the latter further implies that $\hat{S}_l < S_l^0$ in (12).

8 By optimality for the investor, such a point will always exist.

9 We refer to $S^2$ simply as equity in what follows. Indeed, restricting attention only to debt and equity, our results imply that equity would also dominate debt. As noted, we have extended our results also to continuous cash flows.

10 Note that, in the special case in which the owner–manager's outside option is not type dependent, the owner–manager's outside option $u_N(S^0, q)$ would simply be parallel to the $q$-axis.

11 The inequalities are strict if initially $S_l^0 > 0$ or $\Delta S^0 < \Delta x$.

12 Formally, we have $dS^2/dq^* = (\partial/\partial q^*)(u_Y(S^2, q^*) - u_N(S^1, q^*))/ -(\partial/\partial \Delta S^2)(u_Y(S^2, q^*) - u_N(S^1, q^*))$. Note that the numerator can be zero only if $\hat{S}$ is feasible. For exposition purposes, we have relegated all derivations to the appendix.

13 To focus on the security design aspect, we do not explicitly model monitoring or how certification works. However, the analysis presented in this section allows for the possibility that the initial investor retains some "skin in the game" and stays at least partially invested in the firm. This might be necessary for certification to be credible.

14 To generalize our results to continuous cash flows, let $x$ be continuous, let $H_\phi(x \mid \theta)$ be the distribution function over cash flows for all combinations $\phi = \{Y, N\}$ and $\theta = \{G, B\}$, and let $p_{\phi\theta}(x) := 1 - H_\phi(x \mid \theta)$. Following Nachman and Noe (1994), assume that the distribution for $G$ dominates that for $B$ in terms of conditional stochastic dominance (CSD): $p_{\phi G}(x' \mid z) \geq p_{\phi B}(x' \mid z)$ for $x', z \in X$, where $p_{\phi\theta}(x \mid z)$ is the conditional probability $1 - \Pr(x' \leq x \leq x' + z)$. This assumption implies that high cash flows are increasingly more likely in state $G$ compared with state $B$: $(\partial/\partial x)(p_{\phi G}(x)/(p_{\phi B}(x))) \geq 0$. More efficient scaling up in state $G$ means again shifting more probability mass to the high cash flow realizations, that is, $p_{YG}(x)/(p_{NG}(x)) \geq p_{YB}(x)/(p_{NB}(x))$. We have shown in a working-paper version that these assumptions ensure that our results extend to continuous cash flows. Specifically, levered equity is then defined as $\max\{0, x - l\}$. This is the optimal security for the investor at $t = 1$, where $l$ is chosen to maximize the investor's payoff. (The other key security type we discuss in this paper is debt, which is defined as $\min\{x, D\}$ with $D$ being the face value of debt.)

15 A formal derivation of these results is available upon request. Hansen (1987) analyzes a setting in which an acquirer makes a take-it-or-leave-it offer to a privately informed target. Based on the assumption that acquirers with better assets in place benefit *less* from the acquisition, he shows that paying in equity dominates paying in cash (i.e., retaining equity). The latter corresponds to the described optimality of debt financing for a dominant investor when condition (1) is violated.

16 Specifically, consider a convertible contract specified at $t = 0$ according to which the owner–manager raises $I_0$ and obtains the option to invest $I_1$ at $t = 1$ after $q$ has been realized. If the owner–manager does not draw on additional financing, the contract stipulates the sharing rule $S_N(x)$ while drawing on additional financing converts the contract to $S_Y(x)$. Without further incentive problems at the contracting stage at $t = 0$, $S_Y(x)$ and $S_N(x)$ can be chosen so that the investors' ex ante break-even constraint is satisfied and investment at $t = 1$ is first-best efficient, that is, $u_Y(S_Y, q_{FB}) = u_N(S_N, q_{FB})$ and $u_Y(S_Y, q) > u_N(S_N, q)$ for $q > q_{FB}$. There are many contracts that can satisfy these conditions (e.g., $S_Y$ and $S_N$ can both be debt or equity or $S_Y$ can be equity and $S_N$ debt.).

17 That is, investing at $t = 1$ without the owner–manager's cooperation and, thus, effectively, without the owner–manager's agreement is sufficiently bad for the investor. This means that the decision whether to invest at $t = 2$ will remain with the owner–manager. However, note that even if the owner–manager were not essential, a contract that would force investment would be renegotiated so as to harness the owner–manager's better information about $q$.

18 For completeness, observe that enriching the contract space at $t = 1$ by allowing the owner–manager to send a message $m$ after the owner–manager obtains private information at $t = 2$ that would then map into a corresponding contract $S^2(m)$ cannot improve on the simple offers we have stipulated. This is because a menu of potentially separating contracts cannot improve efficiency (Proposition 3).

19 The case with owner–manager bargaining power is subsumed in the subsequent section. What restricts us to analyzing only the two extremes is that a solution concept that would allow us handling arbitrary allocations of bargaining power, such as Nash bargaining, is not available when analyzing negotiations under asymmetric information.

20 It is trivial that $S^1$ will not be renegotiated. Given that rejecting leaves the owner–manager with $u_N(S^1, q)$, the investor would be strictly worse off if a manager that does not invest accepts the renegotiation offer as $u_N(\tilde{S}^1, q) > u_N(S^1, q)$ implies $v_N(\tilde{S}^1, q) < v_N(S^1, q)$.

21 Outside investors offer to buy out the initial investor and require breaking even. Hence, new financing makes sense for them in the same cases that it would make sense for the initial investor. In analogy to Section 3.2, we obtain that the (joint) security $S^1_{old} + S^1_{new}$ offered by new investors is identical to the security offered by the initial investor.

22 In analogy to our baseline model, there is no investment inefficiency at $t = 2$ if there is a debt offer $S^2$ for which $v_N(S^1, q) = v_Y(S^2, q) - I_2$ for all $q$. Furthermore, also here a menu of securities cannot do better as it must involve also nondebt contracts, which would be less attractive for the highest type than a pooling debt offer. Hence, another investor would be able to profitably deviate by offering such a debt contract. We omit here the formal proof, but all details are available upon request.

23 Also in this case, we can argue that the sequence of contracts $S^0$ and $S^1$, given by Proposition 5, represents the unique renegotiation-proof outcome.

24 There are a number of ways in which banks can benefit from directing the firm toward issuing equity and repaying their debts outside our model but that could easily be integrated. First, there are direct ways in which banks can demand fees for early debt repayment or can simply increase interest rates prior to equity issues. Second, there are also indirect ways: for example, banks could allocate underpriced equity issues to preferred investors with whom they expect to do business in the future. See Deyoung et al. (2015) for a recent discussion of the trade-offs in relationship lending.

25 Though IPOs help reduce firms' dependence on relationship lending (Pagano et al. 1998), our novel insight is the equity issuance at

the same time presents an attractive channel for lenders to cash in on their certification power.

[26] Naturally, equity issuance could also take place in the form of private placements, which could help explain Gomes and Phillips' (2012) finding that smaller growth firms issue equity in private placements when information asymmetry is a factor.

[27] This debt-like feature of preferred equity is also referred to as "liquidation preference." This preference gives the VC all proceeds from liquidation, usually up to a multiple of the amount the VC has invested.

[28] We could extend our setting to model certification by initial investors in cases in which these investors do not provide financing themselves but agree to allow the firm to raise financing from outside investors and certify for it either by retaining a stake or using their reputation.

[29] It is not optimal for the investor to offer contracts $\{S_i^0\}$ that the owner–manager could choose over the original contract $S^0$ in case of no new investment since $u_N(S_i^0, q) > u_N(S^0, q)$ implies that $v_N(S_i^0, q) < v_N(S^0, q)$.

[30] See (A.13) and (A.5) and recall that $S_l^2 = x_l$.

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