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 privileged information about a growth firm optimally cash in on their "certification power" 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 have no certification power, firms optimally lever up only in later rounds. Our implications for relationship and venture capital financing highlight that the degree of investor dominance is a key determinant of growth firms' capital structure decisions. Methodologically, one of our paper's novel contributions is to characterize the key role played by, so-called, "countervailing incentives" in dynamic financial contracting.

Keywords: financial contracting, relationship financing, dominant investors, equity financing.

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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 his certification in follow-up financing rounds, giving rise to hold-up problems (Boot, 2000; Gompers and Learner, 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). This characterization does not seem a good description of VC investors' practice of shifting to equity in later financing rounds or pushing firms towards issuing equity in IPOs. It might not be capturing the full picture even for relationship lending. Indeed, banks benefit only if loans are repaid, and 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). Thus, the *first main question* we ask in this paper is why in instances, such as these, in which relationship investors cash in on their dominance, do growth firms move away from debt and issue equity. And if relationship investors profit from pushing growth firms towards issuing equity, why does it contradict the classical prediction that firms, marred by problems of asymmetric information, should use debt financing (Myers and Majluf, 1984)?

Our *second main question* focuses on how growth firms design their initial capital structure while still facing competition among investors, i.e., prior to being locked-in with a relationship investor. Applied to relationship lending, this question helps to shed light on the importance of relationship lending for growth firms and whether its role is likely to increase or decrease with the development of equity markets. Applied to VC financing, our analysis sheds light on why the convertible contracts of the type commonly used by U.S. VCs are practically irrelevant in countries in which investors' inexperience could hamper their ability to obtain a dominant position (Kaplan et al., 2007). By addressing these questions, our paper seeks to bridge 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 two stages. Financial markets are competitive, but investors are at an information disadvantage regarding the viability of the firm's investment opportunities. Specifically, the key problem is that by the time of the second investment round all investors are less informed about the profitability of scaling up, but this disadvantage is lower for an early (i.e., relationship) investor. This gives him a dominant position at that round, as it makes raising new financing without his certification prohibitive.

Our first main result is that the best way for an early investor to cash in on the dominant position he has gained by the second financing round is to push the firm towards issuing (levered) equity in that round. Suppose for now that the relationship investor himself takes equity in exchange for providing new financing (thereby shifting away from his initial contract). Equity gives the relationship investor a claim on the firm's upside, which allows him to absorb more of the profits from scaling up. This offers two advantages: (i) First, it leaves the value of the owner-manager's residual claim less sensitive to the success likelihood of scaling up and, hence, to her private information. Thus, the value of her residual claim can be reduced more closely to her outside option of not scaling up, so that she retains less information rent.[1] (ii) By increasing the investor's participation on the profits from scaling up, equity makes the investor more interested in offering financing that the owner-manager will prefer over her outside option of not scaling up. Thus, it 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 himself, but steers the firm towards issuing equity to new investors. In that case, the dominant investor's profit comes from having his 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 his 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, while it still has access to competitive financing. Our second main result is that this decision is crucially determined by the following *countervailing incentives* faced by the owner-manager. (i) On the one hand, the owner-manager would like to overstate the value of the existing business in order to convince the investor (who is dominant by then) that she would abstain from the additional investment if its financing dilutes her claim on the existing operations too much. (ii) On the other hand, a growth firm with a good existing business is also more likely to have better scaling up prospects. Thus, overstating would give the dominant investor reasons to believe that he

[1] This is the flip-side of the standard explanation that firms with good investment opportunities avoid issuing equity when they (instead of a dominant investor) can choose the type of financing (Myers and Majluf, 1984).

can dictate expensive financing, as the firm would be unwilling to walk away from the second investment opportunity. This creates the countervailing incentive not to exaggerate. The key insight here is that the firm's initial capital structure determines to what extent these opposing incentives balance each other out and, thus, reduce the negative effect of asymmetric information, leading to underinvestment. To our knowledge, this is the first paper to highlight the important role of countervailing incentives (Lewis and Sappington, 1989) in a financial contracting setting.

We show that high initial leverage mitigates the negative effect of asymmetric information in the scaling-up investment round. With initial debt financing, the owner-manager benefits only when the firm realizes high enough cash flows to repay its existing debt, which makes her particularly eager to scale up. This, in turn, makes her more willing to accept the dilutive (equity) financing dictated by the dominant investor in that round. As a result, debt financing reduces, and sometimes completely solves, 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 dominant investor setting has two main 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. This is because, by being able to steer firms towards issuing equity to repay existing debt or make it more secure, relationship lenders have a particularly profitable channel to cash in on their certification power.[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 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 investor's certification power is also crucial (Megginson and Weiss, 1991). By interpreting the sequence of financing contracts as a single renegotiation-proof convertible security, we obtain the shape of 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

[2] As noted, 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).

of being persistently less informed than the owner-manager in multiple investment rounds. Our results further stress the key role of investor dominance for the optimal type of VC contacts. In particular, if investors are unlikely to develop certification and hold-up power due to their lack of expertise or experience, the capital structure predictions are strikingly different. An immediate extension of our main model shows that initially raising equity will be preferred, with higher leverage becoming optimal only at later stages. This could help explain Kaplan et al.'s (2007) corresponding empirical evidence, which has raised questions about the universal optimality of U.S.-style VC financing.

Related Literature. As noted above, 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. Consequently, our empirical predictions closely follow this theme. 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. The underlying idea 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 her investment opportunity, making her appear ready to tolerate more expensive financing. This adds 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), and Strebulaev et al. (2016) who also discuss why equity could dominate debt in the context of asymmetric information.[3] Also related, Fulghieri et al. (2016) build on Nachman and Noe's (1994) analysis to derive a condition on the distribution functions for which non-debt securities might be optimal. Our key contribution to this literature is to show that capital structure decisions crucially depend on whether the firm or a dominant investor dictates financing choices.

Our paper also relates to the incomplete contracting literature, which has also analyzed the hold-up problem in relationship financing (Rajan, 1992) as well as the option-like conversion of financing contracts in venture capital (Schmidt, 2003) and it also touches upon the discussion of whether long-term financial contracts can help reduce investment inefficien-

[3]DeMarzo et al. (2005) and Axelson (2007) show that payments in equity help sellers extract more rent from better informed investors/buyers. Moreover, there are no inefficiencies in these models, whereas our insight that outstanding debt financing can help mitigate underinvestment runs counter to Myers' (1977) debt overhang prediction.

cies (Stulz, 1990; von Thadden, 1995), notably also when information asymmetry arises in stages (Axelson et al., 2009). Our key contribution to that literature is our focus on optimal financial contracting with a dominant investor.[4]

The revelation of information over time 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 (Hennesy 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). While our dynamics are captured with a stylized two-period model, this framework is sufficient to derive our main results. Our contribution is to show how firms can design their capital structure in a way that creates countervailing incentives to those triggering adverse selection in later financing rounds and to highlight the key role played by dominant investors.

2 The Model

We consider a firm that has an investment opportunity requiring a cash outlay $I_1 \geq 0$ at $t = 1$. At $t = 2$, the firm could scale up by making a follow-up investment, requiring $I_2 > 0$, which, however, is not always profitable. Cash flows are realized at the final date, $t = 3$. The firm is run by a penniless owner-manager who, just as outside investors, is risk neutral. We abstract from discounting.

The firm's verifiable cash flow at $t = 3$ can take on two values: $x_l \geq 0$ or $x_h > x_l$, where $\Delta x := x_h - x_l$. The assumption of only two cash flows is for more transparency only. In the working paper version we have shown that 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 $t = 2$ is made, $\phi = \{Y, N\}$ ("Yes" and "No") and on the firm's underlying profitability $\theta = \{G, B\}$.[5]

At the initial date $t = 1$, the owner-manager and investors are equally informed about θ. However, between $t = 1$ and $t = 2$, the owner-manager gains an information advantage about the true likelihood that $\theta = G$. Based on this private information at $t = 2$, the owner-manager's posterior beliefs are $\Pr(\theta = G) = q$ and $\Pr(\theta = B) = 1 - q$.[6] We refer to

[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] In Section 4, we introduce an additional defunct state D (in which $p_{dD} = 0$). We initially suppress this state, as it inconsequential for our analysis in Section 3.

[6] We could instead assume that the owner-manager observes a signal and forms her belief q using Bayes' rule.

the owner-manager's private information q as her "type" at $t = 2$. It is a priori distributed according to the CDF $F(q)$ over $q \in [0,1]$ with $\widehat{q} = \int_0^1 q dF(q)$.

Next to θ, the second factor that affects the probability $p_{\phi\theta}$ of achieving the high cash flow state is whether there is a new investment round at $t = 2$. We label state G the good state, as we assume that $p_{\phi G} \geq p_{\phi B}$ holds for all $\phi \in \{Y, N\}$. In this paper, we focus on growth firms. For such firms, scaling up (e.g., moving to or expanding production, sales, or marketing) typically features non-decreasing returns to scale (Jones, 1999). Thus, we assume that the follow-up investment increases the success likelihood in the good state by at least as much as in the bad state

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

This assumption is stronger than we need and we relax it in Section 3.2. However, it 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 $p_{YG} \geq p_{YB}$—i.e., 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 classical 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

$$(p_{YB} - p_{NB})\Delta x < I_2 < (p_{YG} - p_{NG})\Delta x. \tag{2}$$

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

$$x_l + (p_{YB} + q_{FB}(p_{YG} - p_{YB}))\Delta x - I_2 = x_l + (p_{NB} + q_{FB}(p_{NG} - p_{NB}))\Delta x \tag{3}$$

so that a new investment round at $t = 2$ increases the joint surplus only if the type (i.e., the probability of being in G) is above q_{FB}.

Financial Contracting and Paper Outline A security contract S^t, arranged in period t, and held by an outside investor until $t = 3$ is denoted by $S^t(x)$. The key problem in our paper is to derive the optimal financing contracts $S^1(x)$ and $S^2(x)$, by taking into account that the latter may arise from renegotiations at $t = 2$. Such problems are usually solved recursively. To derive our main results in a transparent way, we go a step further and break down the model in two as follows.

First, we consider in isolation financial contracting at $t = 2$. Focusing on a relationship finance setting similar to Rajan (1992), we stipulate that an initial (relationship) investor who already has claims $S^1(x)$ can dictate the terms for additional investment at $t = 2$, provided that the owner-manager goes along with it. Formally, we consider the case in which the investor is in a position to make a take-it-or-leave-it offer to the owner-manager at $t = 2$ that replaces an initial security $S^1(x)$ for a new security $S^2(x)$ in exchange for the investment of I_2. In Section 3.2, we show that our insights apply also when I_2 is provided by new investors, but the initial investor cashes in on his certification power. Then, we analyze how the efficiency of such refinancing at $t = 2$ depends on the initial security S^1, which highlights the key role played by countervailing incentives (Section 3.3).

In Section 4, we endogenize the investor's bargaining power at $t = 2$ by developing a dynamic financial contracting framework in which investors compete to offer finance at $t = 1$. In that section, we derive the optimal financing contract S^1 at $t = 1$ and discuss renegotiation-proof (convertible) contracts stipulating the terms of all financing already at $t = 1$. The key elements to endogenize the initial investor's "certification power" are that he develops an informational advantage vis-à-vis other investors at $t = 2$ and that he needs to retain the right to withhold finance at $t = 2$ to prevent fraudulent entrepreneurs from raising finance. In Section 5, we highlight the role of countervailing incentives and contrast our results to a setting in which the initial investor has no informational advantage at $t = 2$ and financing is offered competitively also at $t = 2$.

In line with the prior literature, the two main applications of our model are to relationship lending and venture capital financing.[7] 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.[8] To ease exposition, we use the following short-hand notation: $S^t_l := S^t(x_l)$ denotes the repayment for low cash flows and $\Delta S^t := S^t(x_h) - S^t(x_l)$

[7] Rajan (1992) and the literature that has followed this paper consider investor hold-up in the context of relationship lending, i.e., debt financing. However, certification by initial financiers is crucial also in the context of venture capital financing when obtaining follow-up financing and in IPOs (Megginson and Weiss, 1991).

[8] 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.

the investor's upside. Let

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

denote the expected probability of the high cash flow, conditional on the type q and the decision ϕ 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 $t = 2$

We follow the prior literature (Rajan, 1992) and model investor dominance by allowing the investor to make a take-it-or-leave-it offer at $t = 2$ that replaces the initial contract with S^2. We stipulate that only a single pooling contract S^2 is offered, instead of a menu. After deriving our main results, we show that offering a menu is, indeed, never optimal, and we endogenize the investor's dominant position.

Denote the set of all types q for whom it is profitable to accept the investor's offer with $\Phi \subseteq [0,1]$—i.e., $u_Y(S^2, q) \geq u_N(S^1, q)$ for $q \in \Phi$. Then, the investor's expected payoff at $t = 2$ is given by

$$\int_{\Phi} \left[v_Y(S^2, q) - I_2\right] dF(q) + \int_{[0,1]/\Phi} v_N\left(S^1, q\right) dF(q), \tag{8}$$

and his objective is to choose S^2 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 he can extract all of the 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 then the investor neither knows the true value-added from scaling up nor the true value of the owner-manager's outside option.

The owner-manager's information advantage could allow her to keep some of the profits from scaling up. However, the novel aspect of our setting is that the effects of this information advantage are reduced by the fact that the owner-manager is faced with two opposing incentives at the same time. On the one hand, she has incentives to exaggerate the expected profitability of her existing business in order to convince the investor that she would turn down his financing offer and not scale up if the proposed financing is too expensive. That is, she has incentives to overstate q so as to overstate the value of her outside option $u_N(S^1, q)$. On the other hand, if the investor believes that the existing business is very good, he would infer that also the new (scale-up) investment is very profitable. This would give the dominant investor a reason to set expensive financing terms, as the owner-manager would be very reluctant to forgo the profitable expansion. This creates an incentive not to exaggerate q, as this would overstate the value $u_Y(S^2, q)$ of accepting the investor's offer. These opposing incentives are known as "countervailing incentives" in the literature (Lewis and Sappington, 1989), and to our knowledge this is the first paper to analyze their role in financial contracting.

First-best Contract. The best the investor can do is to use these opposing incentives to his 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, $u_Y(S^2, q)$, and rejecting, $u_N(S^1, q)$, are the same for all type realizations

$$x_l - S^2 + p_Y(q)\left(\Delta x - \Delta S^2\right) = x_l - S^1 + p_N(q)\left(\Delta x - \Delta S^1\right) \;\; \forall q \in [0,1]. \tag{9}$$

Clearly, if the right-hand side, which captures the owner-manager's outside option $u_N(S^1, q)$, were not type-dependent, it would never be possible to satisfy (9), unless the owner-manager relinquishes all claims on the firm's upside, i.e. $\Delta S^2 = \Delta x$.

The key insight of our paper is that both financial claims, S^2 and S^1, determine whether or not the owner-manager benefits from scaling up the firm and, thus, whether the countervailing incentives are sufficiently strong, so that condition (9) can be satisfied. **Since scaling up means that the likelihood of achieving the high cash flow increases, i.e., $p_Y(q) > p_N(q)$, satisfying (9) requires reducing the sensitivity of the owner-manager's residual claim after scaling up to the high cash flow state and, thus, to her private information.** The owner-manager can be compensated for this by increasing her claim in the low cash flow state.

Formally, if there is a security $\widehat{S}$ that satisfies (9) for all types q, for this security it will hold $\frac{\partial}{\partial q} u_Y(S^2, q) = \frac{\partial}{\partial q} u_N(S^1, q)$. From this condition, we obtain

$$\Delta \widehat{S} = \Delta x - \left(\frac{p_{NG} - p_{NB}}{p_{YG} - p_{YB}} \right) \left(\Delta x - \Delta S^1 \right). \tag{10}$$

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

$$\begin{aligned} \widehat{S}_l &= S_l^1 - p_{NB} \left(\Delta x - \Delta S^1 \right) + p_{YB} \left(\Delta x - \Delta \widehat{S} \right) & (11) \\ &= S_l^1 - \left(\frac{p_{YG} p_{NB} - p_{YB} p_{NG}}{p_{YG} - p_{YB}} \right) \left(\Delta x - \Delta S^1 \right), & (12) \end{aligned}$$

where the second equality follows after plugging in from (10). As anticipated, the new security $\widehat{S}$ needs to give the owner-manager a smaller claim on the upside (i.e., the investor takes $\Delta \widehat{S} > \Delta S^1$) and a higher claim on the downside (i.e., the investor takes $\widehat{S}_l < S_l^1$) compared to her existing financial claim to make her expected payoff equal to her outside option of not making the new investment round.[9,10] **Overall, by extracting all of the upside from scaling up, the investor does not allow the owner-manager to benefit from her private information.**

Second-best Contract. Offering a security $\widehat{S}$ might not be possible, however, if the countervailing incentives are not sufficiently strong. 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 $S_l^2 < 0$). 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 of our setting 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 $u_Y\left(S^2, q\right)$ and $u_N\left(S^1, q\right)$ be denoted by q^*:[11]

$$u_Y\left(S^2, q^*\right) = u_N\left(S^1, q^*\right). \tag{13}$$

The set of owner-manager types who accept a refinancing offer with S^2 at $t = 2$ becomes, thus, $\Phi = [q^*, 1]$: The owner-manager prefers to accept S^2 if and only if $q \geq q^*$ and strictly

[9] Though the existence of a first-best security $\widehat{S}$ is due to a large extent to the linearity of u_Y and u_N in q, the first-best case presents the general idea of how countervailing incentives affect capital structure in the simplest possible way.

[10] The first claim follows from $p_{YG} - p_{NG} > p_{YB} - p_{NB}$, which is implied by condition (1).

[11] By optimality for the investor, such point will always exist.

so if $q > q^*$. All types $q > q^*$ who accept S^2 now receive an *information rent* of size

$$u_Y(S^2, q) - u_N\left(S^1, q\right), \tag{14}$$

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 her private information. This is achieved by reducing her claim on the upside from scaling up ($\Delta x - \Delta S^2$) in exchange for increasing her claim in the low cash flow state ($x - S_l^2$). Naturally, when the constraint $S_l^2 \geq 0$ becomes binding, it is optimal to set S_l^2 to its minimal value of zero, and give the investor only a participation on the upside. Such a "levered" equity contract (with $S_l^2 = 0$ and $\Delta S^2 > \Delta S^1$) becomes then the uniquely optimal security at the refinancing stage.

Intuitively, by exposing the investor more to the firm's upside, equity financing allows him to absorb more of the firm's success. This, in turn, gives the owner-manager less opportunity to benefit from favorable private information, reducing her information rent, and increasing the investor's profit. These are the diametrically opposite features to those of debt financing. Though debt "protects" investors by making their claim least dependent on the firm's success likelihood, the flip-side is that it allows the owner-manager to keep the maximum information rent (Myers and Majluf, 1984). Thus, debt is the least suitable type of financing for a dominant investor to extract rent.[12] The following proposition summarizes our results for the financing contract offered at $t = 2$ 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 $t = 2$, he offers security S^2 that increases his upside participation and decreases his downside protection compared to his initial security S^1: $S_l^2 \leq S_l^1$ and $\Delta S^2 \geq \Delta S^1$.*[13] *Furthermore:*
(i) The first-best security $S^2 = \widehat{S}$, 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 $S_l^2 = 0$, and there is underinvestment: $q_{FB} < q^* < 1$.

Proof. See Appendix.

[12] Restricting attention only to debt and equity, this implies that simple equity would also dominate debt. Thus, we refer to S^2 simply as equity in what follows. As noted in footnote 16, we have extended our results also to continuous cash flows.

[13] The inequalities are strict if initially $S_l^1 > 0$ or $\Delta S^1 < \Delta x$.

The second important benefit of using equity financing is that it mitigates underinvestment. The reason for underinvestment is that, since $\widehat{S}$ is not feasible, the investor maximizes his profit by trading off efficiency with minimizing the owner-manager's information rent. In this case, some owner-manager types for which the new investment is efficient, but does not lead to large improvements, might see the dominant investor's new financing terms as prohibitive and will abstain from investing. Equity financing mitigates this problem by increasing the investor's participation on the profits from scaling up compared to debt financing. Thus, equity makes the investor more interested in offering financing that the owner-manager will prefer over her outside option of not scaling up.

To formally pin down $q^* > q_{FB}$, we substitute $\Phi = [q^*, 1]$ into the investor's objective function (8) and use that $S_l^2 = 0$ from Proposition 1. We also use that from the owner-manager's indifference condition (13), we can obtain ΔS^2 as an increasing function of the induced cutoff q^*.[14] 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^*:

$$\frac{d\Delta S^2}{dq^*}\int_{q^*}^{1}\frac{dv_Y(S^2,q)}{d\Delta S^2}dF\left(q\right)-\left[w_Y(q^*)-w_N(q^*)\right]f\left(q^*\right)=0. \tag{15}$$

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 $\widehat{S}$ is not feasible (and as a result $\frac{d\Delta S^2}{dq^*} > 0$), we must have $w_Y(q^*) > w_N(q^*)$ and, hence, $q^* > q$.

Figure 1 graphically illustrates the intuition behind Proposition 1. The bold solid line represents the owner-manager's outside option $u_N(S^1, q)$ from not scaling up under an outstanding claim S^1. The dashed line represents her expected payoff from scaling up for some second-period security S_{NE}^2, 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 non-equity 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 clock-wise rotation of $u_Y(S_{NE}^2, q)$. Second, extracting more rent and, thus, internalizing more of the social surplus, the investor will offer an equity contract S_E^2, which not only leads to such clock-wise rotation, but also to a lower, more efficient cutoff $q_E^* < q_{NE}^*$.

[14] Formally, we have $\frac{dS^2}{dq^*} = \frac{\frac{\partial}{\partial q^*}\left(u_Y\left(S^2,q^*\right)-u_N\left(S^1,q^*\right)\right)}{-\frac{\partial}{\partial \Delta S^2}\left(u_Y\left(S^2,q^*\right)-u_N\left(S^1,q^*\right)\right)}$. Note that the numerator can be zero only if $\widehat{S}$ is feasible. For exposition purposes, we have relegated all derivations to the Appendix.

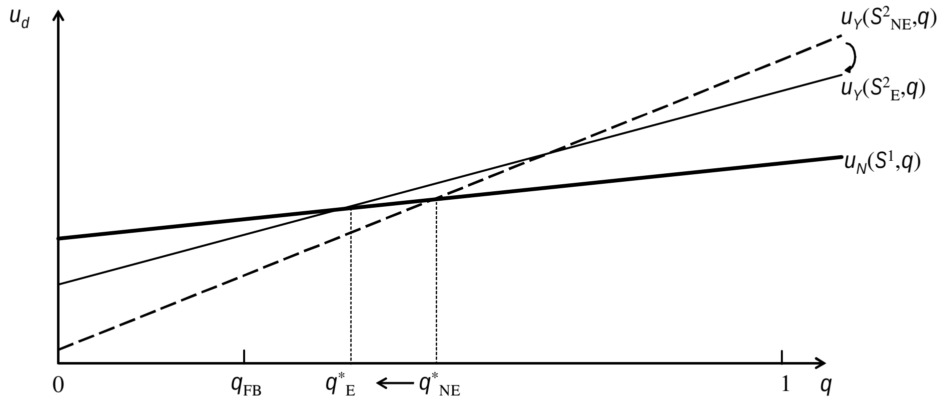

Figure 1: Financing under asymmetric information when a dominant or relationship investor seeks to monetize on his certification power.

3.2 Discussion: New Investors, Menus, and Robustness

Raising Financing from New Investors. The underinvestment problem arising from private information is conceptually quite different from an underinvestment problem that would arise when holders of outstanding (debt) claims would free-ride on the value creation by new investors. As we show next, our results extend also to raising new financing from new investors. For this we stick to our present assumption that the dominant initial investor steers the firm towards the type and amount of new financing to be raised. In case the firm raises more than I_2 to repay its existing investor, we denote the cash paid to the initial investor with C. Note that such 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 $t = 2$ by S^2_{New} and S^2_{Old}, and the combined outstanding risky claim by $S^2 = S^2_{Old} + S^2_{New}$. Again, financing is obtained for all types $q \geq q^*$ where the cutoff q^* is defined again by $u_Y(S^2, q^*) = u_N(S^1, q^*)$. To be acceptable for the new investor, these securities must satisfy

$$\int_{q^*}^{1} \left[v_Y\left(S^2_{New}, q\right) - I_2 - C\right] \frac{dF(q)}{1 - F(q^*)} \geq 0. \tag{16}$$

If certification can guarantee access to a competitive market for fresh financing, this participation constraint holds with equality.[15] If either the owner-manager or the new investor

[15] To focus on the security design aspect, we do not explicitly model monitoring or how certification works (see however below). 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.

rejects the respective offer, no refinancing takes place.

We can see now that our characterization results fully survive also when I_2 is raised from new investors. Using condition (16) to plug into the initial (dominant) investor's objective function, we obtain

$$\begin{aligned} & \int_0^{q^*} v_N\left(S^1, q\right) dF(q) + \int_{q^*}^1 \left[v_Y\left(S^2_{old}, q\right) + C\right] dF(q) \\ = & \int_0^{q^*} v_N\left(S^1, q\right) dF(q) + \int_{q^*}^1 \left[v_Y\left(S^2, q\right) - I_2\right] dF(q) \end{aligned}$$

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^2_{old} (or any combination of these alternatives), the qualitative results from Proposition 1 remain unchanged.

Proposition 2 *Consider the case in which the owner-manager raises I_2 from a new investor at $t = 2$. Regardless of whether the old dominant investor cashes out or stays invested, the (total) outstanding risky claims S^2 is the same as in Proposition 1.*

Menu of Contracts. Though the investor could alternatively offer a menu of contracts to discriminate among different types q, he would not find it optimal to do so, as his expected payoff is higher when offering a simple pooling (levered) equity contract S^2 to the owner-manager. The reason is that any non-degenerate menu of contracts would have to include also a non-equity 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 $t = 2$, it is not optimal for the investor to offer a (non-degenerate) menu, instead of only a single contract S^2.*

Distributional Assumptions. We have shown that the classical prediction that firms should issue debt financing under asymmetric information critically hinges upon the assumption that the owner-manager can make the contract offer. The result is straightforward to generalize to continuous cash flows.[16] Furthermore, we have already noted above that condition (1) captures as a special case the classical Nachman and Noe (1994) setting in which

[16] To generalize our results to continuous cash flows, let x be continuous, let $H_\phi(x|\theta)$ be the distribution function over cash flows for all combinations $\phi = \{Y, N\}$ and $\theta = \{G, B\}$, and let $p_{\phi\theta}(x) := 1 - H_\phi(x|\theta)$. Following Nachman and Noe (1994), assume that the distribution for G dominates that for B in terms of conditional stochastic dominance (CSD): $p_{\phi G}(x'|z) \geq p_{\phi B}(x'|z)$ for $x', z \in X$, where $p_{\phi\theta}(x|z)$ is the conditional probability $1 - \Pr(x' \leq x \leq x' + z)$. This assumption implies that high cash flows are increasingly

the owner-manager's outside option is *not* type-dependent. Slightly relaxing condition (1) does not change Proposition 1, as then the first-best security continues to be feasible. Only if p_{YG}/p_{YB} becomes significantly smaller than p_{NG}/p_{NB} (formally, if $\frac{p_{YB}p_{NG}-p_{YG}p_{NB}}{p_{YG}-p_{YB}}\Delta x > x_l$), do our predictions change. In this case, it can be shown that any feasible offer the financier 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 corresponds to decreasing returns to scale, which is probably a better description of mature firms. It can be shown that this case is characterized by either a market break-down for the new investment or the optimality of debt for a dominant investor (albeit we would then need to presume that the considered mature firm still depends on relationship finance).[17]

3.3 Role of Initial ($t = 1$) Financial Structure in Affecting Subsequent ($t = 2$) Investment Efficiency

We have analyzed so far how a dominant investor shapes the firm's capital structure choice at $t = 2$. An important insight from the preceding analysis is that private information about the firm's existing business gives rise to countervailing incentives to those arising from the problem that the firm has private information about its new investment opportunity. Since the firm's outstanding financing contract defines the owner-manager's cash flow claim on the existing business, it is natural to ask how S^1 could help mitigate the underinvestment problem described in Proposition 1.

The question of how to reduce underinvestment by lower, but still efficient, types can be restated as how to make the countervailing incentives generated by the initial financing structure from $t = 1$ stronger. Intuitively, we ask how to design initial financing such that a lower owner-manager type is more eager to raise new financing. This can be done by exposing her more to the downside of the existing business. This is precisely the effect of using debt financing at $t = 1$. Such financing maximally exposes the owner-manager to the firm's success and failure, as it forces her to repay the firm's creditor before being able to claim the residual cash flows. In Figure 1, debt financing corresponds to making $u_N(S^1, q)$

more likely in state G compared to state B: $\frac{\partial}{\partial x}\left(\frac{p_{\phi G}(x)}{p_{\phi B}(x)}\right) \geq 0$. More efficient scaling up in sate G means again shifting more probability mass to the high cash flow realizations, i.e., $\frac{p_{YG}(x)}{p_{NG}(x)} \geq \frac{p_{YB}(x)}{p_{NB}(x)}$. We have shown in a working-paper version that these assumptions ensure that our results extend to continuous cash flows.

[17] A formal derivation of these results is available upon request. Hansen (1987) analyzes a setting in wich 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 reminds of the described optimality of debt-financing for a dominant investor when condition (1) is violated.

steeper in q, which then makes it easier to design a second period security that minimizes the owner-manager's interim information rent and maximizes interim inefficiency.

Somewhat loosely speaking, the consequence of issuing debt at $t = 1$ is that it improves the firm's ability to issue equity at $t = 2$. The owner-manager has two benefits from making it possible for the investor to capture more information rent at $t = 2$. First, it reduces underinvestment. Second, by making it more likely that a relationship investor will profit from the relationship, the owner-manager can reduce the firm's initial cost of debt at $t = 1$.

We now formalize these insights. For this we extend the game as follows: We suppose that at $t = 1$ the initial security $S^1(x)$ is chosen such that the investor just breaks even. Note, however, that we are not considering the full game yet. We do so only in the subsequent section, where we endogenize the presently assumed staging of the contracting and investment decisions.[18]

Proposition 4 *Suppose that financing must be raised from the dominant investor at $t = 2$. Then:*
(i) Using debt financing ($S_l^1 = x_l$) at $t = 1$ reduces the scope for underinvestment at $t = 2$.
(ii) Underinvestment at $t = 2$ occurs even under debt financing at $t = 1$ if $x_l < \widehat{x}_l$, where the threshold $\widehat{x}_l$ 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 $t = 1$. From condition (12), we have that an efficient outcome at $t = 2$ is feasible only if S_l^1 is sufficiently high. The condition that $x_l < \widehat{x}_l$ simply means that it is easier to make S_l^1 higher if its upper bound x_l is higher, that is if the project's cash flow is relatively safer.

4 The Emergence of Relationship Finance

So far we have broken up the financing problem into two stages and endowed the initial investor with all bargaining power at $t = 2$. In this section, we endogenize this set-up.

To set the stage, we first discuss the benchmark case in which first-best investment can be achieved. Specifically, consider the following convertible contract specified at $t = 1$ according to which the owner-manager raises I_1 and obtains the option to invest I_2 at $t = 2$, after q has been realized. If the owner-manager does not draw on additional financing, the

[18] When comparing different securities S^1, we hold the investor's ex-ante payoff fixed. Otherwise, the efficient outcome is trivially obtained by setting $S^1(x) = x$: In this case the owner-manager receives nothing and does not benefit from distorting the efficient investment decision.

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 $t = 1$, $S_Y(x)$ and $S_N(x)$ can be chosen so that additional investment at $t = 2$ is always first-best and an investor's ex-ante break-even constraint is satisfied. First-best is achieved by designing S_Y and S_N such that the owner-manager is indifferent between raising and not raising I_2 at $q = q_{FB}$, i.e., $u_Y(S_Y, q_{FB}) = u_N(S_N, q_{FB})$, and strictly prefers raising I_2 if and only if $q > q_{FB}$. It is straightforward to show the existence of such contract.

Endogenizing Investor Discretion. The crux with this contractual solution is that it leaves the owner-manager at a very long leash, as it grants the owner-manager discretion over whether to draw down the additional funds I_2. This may give rise to agency problems of its own, as it may let entrepreneurs without a viable investment opportunity hold-up the investor and extract a "bribe" for forgoing their right to sink I_2. Alternatively, they could play "hit-and-run" and abscond with some of the funds (Rajan, 1992).[19]

To capture this formally, we stipulate that there is a large pool of "fraudulent" or "fly-by-night" entrepreneurs of type $\psi = D$ with an essentially defunct project, yielding zero cash flows regardless of how much capital is invested. While the initial outlay I_1 is sunk irreversibly, such an entrepreneur can divert any additional capital into some fungible assets that she can sell, absconding with the price τI_2, with $\tau > 0$. The a priori likelihood that the owner-manager's project is not defunct, i.e., $\psi = ND$, is $0 < \gamma < 1$. Following Rajan, 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 initial investor learns whether $\psi = D$ at $t = 2$ only after she has provided I_1 at $t = 1$. The key specification is that 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 that a project is non-defunct. Our final assumption is that for this case the owner-manager's human capital is essential to identify whether and how to grow the firm. That is, investing at $t = 2$ without being informed about whether the firm is investing into the "right" growth strategy is sufficiently bad to be unattractive to both parties. This assumption, which follows Burkart et al. (1997), allows us to subsequently extend our model and contrast the results to a setting in which the initial investor has no information advantage over new investors at $t = 2$ (Section 5). Subsequently, we discuss when either setting may be more applicable and, based on this distinction, derive

[19] We could appeal also to various other arguments in the literature why granting firms long leash and precommitting funds could result in inefficiencies. For instance, such long-term commitment of capital could be too expensive for investors (e.g., if there is a risk that they become cash-constrained themselves in $t = 2$; cf. Boot et al., 1993; Parlour and Plantin, 2008).

some of our key empirical implications in Section 6.

Financial Contracting. We now formally set up the financing problem at $t = 1$. In line with the literature, we stipulate that the firm faces a competitive market for capital in which investors compete to offer financing to the owner-manager. Consistent with our preceding notation, these offers stipulate that one of two contracts, S^1 or S^2, applies, depending on whether I_2 is invested at $t = 2$. What is key is that, to deter owner-managers of defunct projects from accepting the offer and then absconding with τI_2, the offers must allow the initial investor to withhold financing at $t = 2$. Given an infinitely small opportunity cost $\varepsilon > 0$ of applying for financing, this deterrence is effective. Summing up, an investor's offer at $t = 1$ is described by $\mathbf{S} = \{S^1, S^2\}$, together with the right to withhold finance for I_2.[20]

The investor's right to withhold new finance creates scope for holding up the owner-manager of a non-defunct project. Specifically, since only the initial investor observes whether or not the firm is defunct, the owner-manager will not be able to raise financing from new investors at $t = 2$ (without the initial investor's "certification"). This is because *any* prospect of raising I_2 from an uninformed new investor at $t = 2$, also in the context of renegotiations, will attract defunct firms at $t = 1$. Thus, in the only equilibrium in which the firm raises financing at $t = 1$, new investors must believe that the firm is defunct whenever they are approached for new financing at $t = 2$. This observation provides the foundation for the emergence of relationship financing.

To formally model renegotiations, we incorporate a stage at $t = 2$ at which the initial investor can privately make a new offer to the owner-manager. This offer can specify a new contract $\widetilde{S}^2$ that, if accepted, is implemented in case the investment is made.[21] Similar to Rajan (1992), the threat is that the owner-manager does not receive follow-up financing if she rejects the offers.

Since the owner-manager has no access to financing from new investors at the renegotiation stage and given the initial investor's threat, it is immediate that for a given contract $\mathbf{S}$, the unique renegotiation offer $\widetilde{S}^2$ is as characterized in Proposition 1. That is, $\widetilde{S}^2$ maximizes the investor's profits subject to the fact that q is the owner-manager's private information at

[20] For completeness, observe that enriching the contract space at $t = 1$ by allowing the owner-manager to send a message m after she 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). Furthermore, note that since the owner-manager is essential for growing the firm, she cannot be forced to invest and the decision whether or not to invest at $t = 2$ will remain with her (however, even if she were not essential, a contract that would force investment would be renegotiated so as to harness her better information about q).

[21] 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 $u_N(\widetilde{S}^1, q) > u_N(S^1, q)$ implies $v_N(\widetilde{S}^1, q) < v_N(S^1, q)$.

that stage and that the owner-manager's outside option of no new investment is $u_N(S^1, q)$. Since the renegotiations are expected by both sides and since investors compete at $t = 1$, a winning offer must maximize the ex-ante payoff of the owner-manager of a non-defunct project

$$\max_{\mathbf{S}} \int_0^{q^*(\mathbf{S})} u_N\left(S^1, q\right) dF(q) + \int_{q^*(\mathbf{S})}^1 u_Y(\widetilde{S}^2(\mathbf{S}), q) dF(q), \tag{17}$$

subject to the break even condition

$$\int_0^{q^*(\mathbf{S})} v_N\left(S^1, q\right) dF(q) + \int_{q^*(\mathbf{S})}^1 \left(v_Y(\widetilde{S}^2(\mathbf{S}), q) - I_2\right) dF(q) \geq I_1. \tag{18}$$

In equilibrium, (18) will be satisfied with equality. Substituting (18) into (17), the optimal offer must maximize ex-ante surplus (efficiency). Hence, based on Proposition 4, we obtain the following result.

Proposition 5 *Consider the full game in which investors compete at $t = 1$ and offers must deter defunct projects $\psi = D$. Suppose that only the initial investor observes whether or not a project is defunct. In a renegotiation-proof equilibrium, security S^2, which describes how cash flows are shared if the new investment I_2 is made, is uniquely determined as in Proposition 1, while security S^1, which describes how cash flows are shared without a new investment, is debt. Jointly, S^1 and S^2 are chosen to just satisfy the investor's break-even constraint (18).*

Proof. See Appendix.

As noted, we can interpret the contracts derived in Propositions 1–5 also as a single renegotiation-proof security. Under this interpretation, the owner-manager issues initially a debt-like contract, which gives her the right to raise new financing at $t = 2$, 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^1 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 Possess Certification Power

Our paper's focus is on a setting in which the firm's initial investor becomes better informed about the firm's viability compared to 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 hold-up. What is more, the contrasting results in this section are subsequently used to sharpen our empirical predictions from the main analysis.

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^1 that has no provisions for second period investment, and we analyze its effect on financial contracting at $t = 2$. The key difference to the previous section is that all investors are equally informed at $t = 2$, and the owner-manager does not need her initial investor's certification. Hence, the initial investor competes with outside investors whose offers stipulate not only offering I_2 in return for a security S^2_{new}, but also buying out the initial investor's security S^1 for cash or a new security S^2_{old}.

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The analysis at $t = 2$ is now standard. Competition implies that all outside investors just break even. The initial investor can also not do better than accepting an offer S^2_{old} that gives him the same as his outside option. That outside option is to reject offers by new investors (put to him by the owner-manager), effectively obstructing the second period investment and staying with S^1.[22] Thus, the best he can do when offering himself I_2 is to offer to replace S^1 for a new security S^2 that also gives him the same as his outside option under no new investment.

Following standard arguments, the unique financing offer (for the *joint* claim held by new and old investors) made at $t = 2$ is debt and it leads to overinvestment ($q^* \leq q_{FB}$). The intuition is the same as in Nachman and Noe (1994): Debt minimizes underpricing for the owner-manager with the highest type, and is, thus, the most attractive security competing investors can offer.[23] Countervailing incentives at $t = 2$ are now best exploited by issuing

[22] We consider ony the two extreme cases, in which the initial investor either has all or no bargaining power. The reason is that, unlike with Nash bargaining, there is no universally accepted solution concept for capturing differing levels of bargaining power under asymmetric information. In the Working Paper we also considered the case in which bargaining power residing with the owner-manager is captured by a signaling game, in which the informed owner-manager makes the offer. **Using a standard refinement, the signaling game's results are identical to that of the considered screening game in which uninformed financiers compete to make the offers.**

[23] In analogy to our baseline model, there is no investment inefficiency at $t = 2$ if there is a debt offer S^2 for which $v_N\left(S^1, q\right) = v_Y\left(S^2, q\right) - I_2$ for all q. Furthermore, also here a menu of securities cannot do better, as it must involve also non-debt 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.

levered equity at $t = 1$.

Proposition 6 *If the owner-manager does not face a dominant investor at $t = 2$, she issues debt and there is overinvestment at $t = 2$. Issuing levered equity at $t = 1$ 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 $t = 1$ now maximally counteracts the owner-manager's incentive to pretend being a higher type at $t = 2$. The reason is that such exaggeration would imply that the initial investor's *existing* claim is worth more, making it more expensive to buy him out. This countervailing incentive reduces overinvestment at $t = 2$ and, thus, increases the ex-ante value of the firm. The stark contrast between the optimal securities at both $t = 1$ and $t = 2$ depending on whether or not the initial investor gains certification power will subsequently guide our empirical predictions.

Discussion of Persistence of Competition. As in our baseline case, the specification that the second investment needs the initial investor's approval arises from the need to fend off fraudulent entrepreneurs with defunct projects. The key difference to the baseline case is that the initial investor lacks certification power, as the presence of fraudulent entrepreneurs is no longer his private information. As a consequence, the owner-manager's essential role for making the new investment work endows her now with all bargaining power at $t = 2$. Specifically, she can threaten not to undertake the new investment, unless the initial investor accepts the terms offered by new investors.(**MAYBE ADD:** [24]?) In this sense, the sequence of contracts S^1 and S^2, given by Proposition 6, represents the unique renegotiation-proof outcome.

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 certification power he gains over the course of his relationship with a growth firm.

The standard view is that relationship investors benefit from their dominant position by increasing the cost of debt in later stages (Rajan, 1992). However, this does not seem

[24] Related, the owner-manager would have bargaining power if she could threaten to walk away with her inalienable human capital (Hart and Moore, 1994).

in line with the practice of VCs to move towards equity in later rounds or to push growth firms towards issuing equity in IPOs (Megginson and Weiss, 1992). Even in the context of relationship lending, focusing on the cost of debt does not seem to 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 certification power 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).**[25] **Hence, at least in the context of the growth firms covered by this evidence, VCs and relationship lenders might be cashing in on their certification power in a comparable way.**[26] Our first question in this paper is to ask whether there is a theoretical foundation for such behavior. Our theory predicts:

Implication 1 *Dependence on relationship investors' certification is a key determinant of growth firms' capital structure decisions. When relationship investors seek to cash in on their certification power, they will push growth firms that raise financing under asymmetric information to issue equity.*

Implication 1 contrasts with Myers and Majluf's (1984) celebrated prediction that firms should issue debt when facing problems of asymmetric information. However, also recent evidence 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.[27]

An important prediction stemming from Implication 1 is 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 on their certification power

[25] There are a number of ways in which banks can benefit from directing the firm towards issuing equity and repaying their debts outside our model, but which 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 expects to do business in the future. See Deyoung et al. (2015) for a recent discussion of the trade-offs in relationship lending.

[26] 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.

[27] 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.

and realize a higher benefit off the relationship by pushing the firm to issue equity to repay or make its debt more secure. Since the existence of this channel makes it optimal to offer cheaper initial financing, engaging in relationship financing would become more attractive for financially constrained firms (Propositions 1 and 2).

A further prediction of our analysis is that high leverage not only does not exacerbate, but even mitigates underinvestment in follow-up financing rounds in the presence of a relationship investor. Thus, firms will optimally seek debt financing when entering such relationships (Proposition 5). This could add to our understanding 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 dominant investors to monetize on their certification power. (ii) Debt investors have a competitive advantage in relationship financing, as firms optimally seek to enter relationship financing through debt-like contracts.*

Our results extend to venture capital financing, where relationships and certification in new investment rounds is also of first-order importance (Megginson and Weiss, 1991; Cumming, 2008). We show that information asymmetry, arriving in stages, generates the widely used contract structure for such financing. Specifically, the contract that is the norm in the U.S. is convertible preferred equity. This contract initially gives venture capitalists a liquidation preference (mimicking our debt contract) and it converts 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). This is consistent with our results when we interpret the contracts derived in Propositions 1 and 5 as a single renegotiation-proof convertible security. Our novel insight here is that venture capital contracts established in the U.S. 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 that investors, even when they enter early, are persistently less informed about the firm's prospects than insiders.

Implication 3 *A key determinant of financial contracting with venture capital investors is whether or not firms expect to depend on their certification in new financing rounds. If firms depend on such certification, providing a venture capitalist with a liquidation preference 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 could further shed light on why 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 towards raising new external financing, they would not be able to dictate terms as in Proposition 1. In such cases, firms would switch from equity to debt (Proposition 6). Indeed, in countries where 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 develop 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 the firm cannot raise competitive financing without the certification of such investor, it will issue equity when raising financing under asymmetric information, and it will be exposed to a problem of underinvestment. 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. Intuitively, the firm is more eager to raise new financing if, absent such financing, the owner-manager is more exposed to the downside of the existing business. This effect can be exploited by financing the firm with debt early on, as this maximally leaves the owner-manager exposed to the firm's success.

Our theory best applies to informationally opaque growth firms, as such firms are most likely to be financially constrained and to enter relationships with banks or venture capitalists. Our insights could, thus, help explain why relationship lenders seem to cash in on their certification power by steering firms towards issuing equity; and why equity dominates debt in times of asymmetric information, contrary to what is known from prior theory. Furthermore, we argue that the presence of an active equity market can help spur, rather than diminish, the role of relationship lending. Intuitively, being able to steer firms towards issuing equity allows relationship lenders to cash in on existing debt contracts and make them more secure. This makes it easier to offer cheap credit in the first place. Furthermore, we apply our results to venture capital, arguing why U.S.-style VC contracts might be suitable only if the investor is sufficiently sophisticated to develop an informational advantage vis-á-vis outside investors.

Overall, our paper brings together the optimal capital structure and relationship financing literature and offers novel predictions, which are in line with the sometimes contrasting empirical evidence. 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.

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Appendix

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

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

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

$$\widehat{S}_l = S_l^1 - \left(\frac{p_{YG}p_{NB} - p_{YB}p_{NG}}{p_{YG} - p_{YB}}\right)\left(\Delta x - \Delta S^1\right). \tag{19}$$

This implies from (1) that $\widehat{S}_l < S_l^1$ and thus also $\widehat{S}_l < x_l$, given that S^1 was feasible. The remaining condition is, thus, that $\widehat{S}_l \geq 0$, which from (19) is just that (12) is positive. From this it also follows that this condition is necessary for $\widehat{S}$ to be feasible. **Q.E.D.**

The next claim establishes that by optimality of S^2, 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^2 so that the owner-manager would prefer acceptance for low but *not* for high q, then the first-best contract $\widehat{S}$ would be feasible, instead. Then, as argued in the main text, it is clearly optimal to offer $\widehat{S}$.

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

Proof. Note first that from the assumed inequalities $u_Y(S^2,0) > u_N(S^1,0)$ (owner-manager prefers refinancing for $q = 0$) and $u_N(S^1,1) > u_Y(\widehat{S}^2,1)$ (owner-manager prefers no-refinancing for $q = 1$), $\Delta\widehat{S} < \Delta S^2$ must hold to ensure that the slope of $u_Y(S^2,q)$ is strictly smaller than that of $u_Y(\widehat{S},q)$. But then $u_Y(S^2,0) > u_Y(\widehat{S},0)$ implies that $S_l^2 < \widehat{S}_l$. By the assumed feasibility of S^2, we have from this that $\widehat{S}_l > 0$, so that (12) is strictly positive. **Q.E.D.**

From Claims 1-2 refinancing takes place whenever $q \geq q^*$ (with $q^* = q_{FB}$ if $\widehat{S}$ 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 $u_Y(S^2,q^*) = u_N(S^1,q^*)$ (cf. also (13)).

Claim 3. *Levered-equity with $S_l^2 = 0$ is the uniquely optimal security for the investor if the first-best security $\widehat{S}$ is not feasible.*

Proof. We argue to a contradiction. Suppose that, so as to induce some $q^* \in [0,1]$, another security S^2 with $S_l^2 > 0$ were optimal. Choose now $\widetilde{S}^2 = (0, \Delta\widetilde{S}^2)$ so that $u_Y(\widetilde{S}^2, q^*) = u_N(S^1, q^*)$, 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: $v_Y(\widetilde{S}^2, q^*) = v_Y(S^2, q^*)$. However, as $u_Y(\widetilde{S}^2, q^*) = u_Y(S^2, q^*)$ together with $\widetilde{S}_l^2 = 0 < S_l^2$ must imply that $\Delta\widetilde{S}^2 > \Delta S^2$, we have that $v_Y(\widetilde{S}^2, q) - v_Y(S^2, q) > 0$ holds for all $q > q^*$. Thus, provided it is feasible, the investor is indeed strictly better off under the newly constructed contract $\widetilde{S}^2$.

It remains to show that $\widetilde{S}^2$ is feasible. By the assumed feasibility of S^2 and construction of $\widetilde{S}^2$, this is the case if $\Delta\widetilde{S}^2 \leq \Delta x$. (The other feasibility restrictions on $\widetilde{S}^2$ are satisfied by feasibility of S^2.) From $u_Y(\widetilde{S}^2, q^*) = u_Y(S^2, q^*)$ and $\widetilde{S}_l^2 = 0$, we can obtain

$$\Delta\widetilde{S}^2 = \frac{S_l^2}{p_{YB} + q^*(p_{YG} - p_{YB})} + \Delta S^2,$$

so that $\Delta\widetilde{S}^2 \leq \Delta x$ holds whenever

$$0 \leq -S_l^2 + (p_{YB} + q^*(p_{YG} - p_{YB}))\left(\Delta x - \Delta S^2\right). \tag{20}$$

However, (20) is implied by the assumption that the first-best security is not feasible, i.e., that (12) is cannot be positive. To see this, note first that from the definition of q^*, i.e. $u_Y(S^2, q^*) = u_N(S^1, q^*)$, condition (20) is equivalent to

$$0 \leq -S_l^1 + (p_{NB} + q^*(p_{NG} - p_{NB}))\left(\Delta x - \Delta S^1\right). \tag{21}$$

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

$$\begin{aligned} 0 &< -S_l^1 + \left(\frac{p_{YG}p_{NB} - p_{YB}p_{NG}}{p_{YG} - p_{YB}}\right)\left(\Delta x - \Delta S^1\right) \\ &< -S_l^1 + (p_{NB} + q^*(p_{NG} - p_{NB}))\left(\Delta x - \Delta S^1\right), \end{aligned}$$

where the last inequality holds for *any* q^*. But this is just what we needed to show (condition (21)). **Q.E.D.**

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

$$\Delta S^2 = \Delta x - \frac{S_l^2 - S_l^1 + [p_{NB} + q^*(p_{NG} - p_{NB})](\Delta x - \Delta S^1)}{p_{YB} + q^*(p_{YG} - p_{YB})}, \tag{22}$$

from which we obtain explicitly

$$\frac{d\Delta S^2}{dq^*} = \frac{(S_l^2 - S_l^1)(p_{YG} - p_{YB}) + (p_{NB}p_{YG} - p_{YB}p_{NG})(\Delta x - \Delta S^1)}{[p_{YB} + q^*(p_{YG} - p_{YB})]^2} > 0, \tag{23}$$

where the inequality follows as $S_l^2 = 0$ 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))

$$-[w_Y(q^*) - w_N(q^*)] f(q^*) + \frac{d\Delta S^2}{dq^*}\int_{q^*}^1 \frac{dv_Y(S^2, q)}{d\Delta S^2} dF(q) = 0, \tag{24}$$

where the first term follows from $w_\phi(q) = u_\phi(S^t, q) + v_\phi(S^t, q)$ and (13). As $\frac{d\Delta S^2}{dq^*} > 0$,

$$\frac{dv_Y(S^2, q)}{d\Delta S^2} = p_{YB} + q(p_{YG} - p_{YB}),$$

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 him to offer S^2 that leads to a more efficient q^*. To see this, suppose that $S_l^2 = \varepsilon > 0$. The cross-partial of the investor's expected payoff with respect to q^* and ε shows that it is supermodular in these variables

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

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

Proof of Proposition 3. Consider any non-degenerate menu of contracts $\{S_i^2\}$, which stipulates that the owner-manager receives I_2 for any contract S_i^2 from the menu.[28] By the arguments in Proposition 1 we can restrict consideration to the case in which the owner-

[28] It is not optimal for the investor to offer contracts $\{S_i^1\}$ that the owner-manager could choose over the original contract S^1 in case of no new investment, since $u_N(S_i^1, q) > u_N(S^1, q)$ implies that $v_N(S_i^1, q) < v_N(S^1, q)$.

manager prefers a contract in i over her outside option of not investing if and only if $q \geq q^*$. Let S_*^2 be the contract chosen by type q^*. If the first-best contract $\widehat{S}$ is not feasible, we know that all types $q > q^*$ would prefer S_*^2 to S_1. But then it is straightforward that by dropping all other contract except S_*^2 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^2 in the menu such that $u_Y(S_i^2, q) > u_Y(S_*^2, q)$, then this would necessarily imply that $v_Y(S_i^2, q) < v_Y(S_*^2, q)$. **Q.E.D.**

Proof of Proposition 4. (i) The proof is by contradiction. Suppose that S^1 with $S_l^1 < x_l$ maximized the value of a firm that turns out to be non-defunct and that there is inefficiency at $t = 2$. By Proposition 1, the investor chooses a security $S^2 = (0, \Delta S^2)$ 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 his optimal correspondence and, thus, plays a pure strategy. We proceed in three steps.

Step 1. We start by constructing $\widetilde{S}^1 = (x_l, \Delta\widetilde{S}^1)$ together with $\widetilde{S}^2 = (0, \Delta\widetilde{S}^2)$ so that two conditions are satisfied: The owner-manager is still indifferent at his 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

$$0 = \int_0^{q_{old}^*} \left[v_N(\widetilde{S}^1, q) - v_N(S^1, q) \right] dF(q) + \int_{q_{old}^*}^1 \left[v_Y(\widetilde{S}^2, q) - v_Y(S^2, q) \right] dF(q), \tag{25}$$

together with $u_Y(S^2, q_{old}^*) = u_N(S^1, q_{old}^*)$ and $u_Y(\widetilde{S}^2, q_{old}^*) = u_N(\widetilde{S}^1, q_{old}^*)$. To ease exposition, let

$$\begin{aligned} \widehat{p}_N &:= p_{NB} + (p_{NG} - p_{NB}) \int_0^{q_{old}^*} q \frac{dF(q)}{F(q_{old}^*)}, \\ \widehat{p}_Y &:= p_{YB} + (p_{YG} - p_{YB}) \int_{q_{old}^*}^1 q \frac{dF(q)}{1 - F(q_{old}^*)}. \end{aligned}$$

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^1, ΔS^2 is given in (22). Plugging into (25) we have

$$\begin{aligned} 0 = & \left(x_l - S_l^1 + \widehat{p}_N \left(\Delta\widetilde{S}^1 - \Delta S^1 \right) \right) F(q_{old}^*) \\ & + \frac{\widehat{p}_Y}{p_Y(q_{old}^*)} \left(x_l - S_l^1 + p_N(q_{old}^*) \left(\Delta\widetilde{S}^1 - \Delta S^1 \right) \right) (1 - F(q_{old}^*)), \end{aligned}$$

from which we can express $\Delta\widetilde{S}^1$ as

$$\Delta\widetilde{S}^1 = \Delta S^1 - \left(\frac{x_l - S_l^1}{\widehat{p}_N}\right)\left(\frac{p_Y(q_{old}^*)F\left(q_{old}^*\right) + \widehat{p}_Y\left(1 - F\left(q_{old}^*\right)\right)}{p_Y(q_{old}^*)F\left(q_{old}^*\right) + \frac{p_N(q_{old}^*)}{\widehat{p}_N}\widehat{p}_Y\left(1 - F\left(q_{old}^*\right)\right)}\right). \tag{26}$$

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

As the second security is levered equity with $S_l^2 = \widetilde{S}_l^2 = 0$, the indifference condition of the owner-manager at a cutoff q^* gives the respective value ΔS^2 as a unique function of S^1 and q^* only (cf. (22)). We use $\Delta S^2\left(q^*, S^1\right)$ and $\Delta S^2(q^*, \widetilde{S}^1)$, making thereby explicit that $\Delta S^2(\cdot)$ presently denotes a function. Next, we define the investor's expected payoff at $t = 2$ for some q^* and an initial contract S^1 by

$$V\left(q^*, S^1\right) := \int_0^{q^*} v_N\left(S^1, q\right) dF\left(q\right) + \int_{q^*}^1 \left(v_Y\left(S^2, q\right) - I_2\right) dF\left(q\right). \tag{27}$$

Defining $V(q^*, \widetilde{S}^1)$ accordingly, we now show that the difference $V(q^*, \widetilde{S}^1) - V\left(q^*, S^1\right)$ 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

$$\begin{aligned} & \frac{d}{dq^*}\left[V(q^*, \widetilde{S}^1) - V\left(q^*, S^1\right)\right] \\ = & \int_{q^*}^1 p_Y\left(q\right)\left(\frac{d\Delta S^2(q^*, \widetilde{S}^1)}{dq^*} - \frac{d\Delta S^2\left(q^*, S^1\right)}{dq^*}\right) dF\left(q\right). \end{aligned} \tag{28}$$

Next, using (23) and (26), we obtain an explicit expression for the second term under the integral in (28). Importantly, observe that $\widetilde{S}^1$ is defined as a function of q_{old}^* and *not* q^*. We have

$$\begin{aligned}
& \frac{d\Delta S^2(q^*,\widetilde{S}^1)}{dq^*}-\frac{d\Delta S^2\left(q^*,S^1\right)}{dq^*} \\
= & -\frac{\left(x_l-S_l^1\right)\left(p_{YG}-p_{YB}\right)+\left(p_{NB}p_{YG}-p_{YB}p_{NG}\right)\left(\Delta\widetilde{S}^1-\Delta S^1\right)}{p_Y(q^*)^2} \\
= & \frac{-\left(x_l-S_l^1\right)\left(p_{YG}-p_{YB}\right)}{p_Y(q^*)^2} \\
& \times\left(1-\frac{\left(p_{NB}p_{YG}-p_{YB}p_{NG}\right)}{\left(p_{YG}-p_{YB}\right)\widehat{p}_N}\frac{p_Y(q_{old}^*)F\left(q_{old}^*\right)+\widehat{p}_Y\left(1-F\left(q_{old}^*\right)\right)}{p_Y(q_{old}^*)F\left(q_{old}^*\right)+\frac{p_N(q_{old}^*)}{\widehat{p}_N}\widehat{p}_Y\left(1-F\left(q_{old}^*\right)\right)}\right) \\
< & \frac{-\left(x_l-S_l^1\right)\left(p_{YG}-p_{YB}\right)}{p_Y(q^*)^2}\left(1-\frac{\left(p_{NB}p_{YG}-p_{YB}p_{NG}\right)}{\left(p_{YG}-p_{YB}\right)\widehat{p}_N}\right)<0,
\end{aligned}$$

where for the first inequality we use that $p_N\left(q_{old}^*\right)/\widehat{p}_N>1$, and for the second inequality we use that $\widehat{p}_N>p_{NB}$. From (28), it follows, therefore, that

$$\frac{dV(q^*,\widetilde{S}^1)}{dq^*}<\frac{dV\left(q^*,S^1\right)}{dq^*}.$$

Thus, the difference $V(q^*,\widetilde{S}^1)-V\left(q^*,S^1\right)$ decreases in q^*. By standard monotone selection arguments, strictly decreasing differences imply the following: Any optimal cutoff q_{new}^* that the investor chooses given $\widetilde{S}^1$ is lower than any optimal cutoff q_{old}^* that he selects given S^1, 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^1,S^2) and $(\widetilde{S}^1,\widetilde{S}^2)$, when holding $q^*=q_{old}^*$ constant. But as $q_{new}^*<q_{old}^*$, it follows from (23) ($d\Delta S^2/dq^*>0$) that for the new optimal second-period contract, which implements some q_{new}^*, we have that $\Delta S^2(q_{new}^*,\widetilde{S}^1)<\Delta S^2(q_{old}^*,\widetilde{S}^1)$. Denote this contract by $\overline{S}^2$. Hence, $u_Y(\overline{S}^2,q)>u_Y(\widetilde{S}^2,q)$ holds for all q, and the ex ante expected payoff of the owner-manager with $(\widetilde{S}^1,\overline{S}^2)$ is strictly higher than with either $(\widetilde{S}^1,\widetilde{S}^2)$ or (S^1,S^2), respectively. To finish this step, note that by optimality of $\overline{S}^2$ the investor is also at least weakly better off with $(\widetilde{S}^1,\overline{S}^2)$ than with $(\widetilde{S}^1,\widetilde{S}^2)$, so that $(\widetilde{S}^1,\overline{S}^2)$ satisfies the investor's break-even condition. Taken together, this contradicts the claim that S^1 maximizes the value of a firm that turns out to be non-defunct.

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 his optimal contractual choice at $t=2$ is not uniquely determined. Given a debt security at $t = 1$, one can use the indifference condition (13) to express the second-stage levered equity security S^2 as a function of ΔS^1 and q^*. We can, thus, write $V(q^*, \Delta S^1)$ instead of $V(q^*, S^1)$ (cf. expression (27)). Further, we use $Q^* = \arg\max V(q^*, \Delta S^1)$ to denote the optimal choice correspondence subject to (18). Observe now that given S^1, $V(q^*, \Delta S^1)$ is strictly submodular in q^* and ΔS^1 :

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

Therefore, again by monotonic selection arguments, relaxing the investor's ex ante participation constraint by increasing ΔS^1 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 ΔS^1 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 $t = 1$. Recall from Proposition 1 that if the investor induces q_{FB}, then $u_N(S^1, q) = u_Y(\widehat{S}, q)$ 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 $t = 1$, one can express ΔS^1 as

$$\Delta S^1 = \Delta x - \frac{W_{FB} - I_1 - (x_l - S_l^1)}{p_N(\widehat{q})}. \tag{29}$$

A first-period security that satisfies (29) is feasible if

$$\begin{aligned} x_l &\geq S_l^1 \geq 0, \\ \Delta x &\geq \Delta S^1 = \Delta x - \frac{W_{FB} - I_1 - (x_l - S_l^1)}{p_N(\widehat{q})} \geq 0, \\ S_l^1 &\geq \left(\frac{p_{NB}p_{YG} - p_{YB}p_{NG}}{p_{YG} - p_{YB}} \right) \frac{W_{FB} - I_1 - (x_l - S_l^1)}{p_N(\widehat{q})}, \end{aligned}$$

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

$$\begin{aligned} & \min\left(x_l, x_l + p_N(\widehat{q})\Delta x - W_{FB} - I_1\right) \\ \geq\ & S_l^1 \geq \max\left(x_l - W_{FB} - I_1, \frac{p_{NB}p_{YG} - p_{YB}p_{NG}}{(p_{NG} - p_{NB})p_Y(\widehat{q})} (W_{FB} - I_1 - x_l) \right). \end{aligned}$$

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

$$
\begin{aligned}
x_l \quad \geq \quad & \max\left(x_l - W_{FB} - I_1, \frac{p_{NB}p_{YG} - p_{YB}p_{NG}}{(p_{NG} - p_{NB})p_Y(\widehat{q})}\left(W_{FB} - I_1 - x_l\right)\right) \\
& + \max\left(0, W_{FB} - I_1 - p_N(\widehat{q})\Delta x\right).
\end{aligned}
$$

Simple transformations imply that first-best is achieved if:

$$
\begin{aligned}
x_l \quad \geq \quad \widehat{x}_l := & \frac{p_{NB}p_{YG} - p_{YB}p_{NG}}{(p_{YG} - p_{YB})p_N(\widehat{q})}(W_{FB} - I_1) \\
& + \frac{(p_{NG} - p_{NB})p_Y(\widehat{q})}{(p_{YG} - p_{YB})p_N(\widehat{q})}\max\left(0, W_{FB} - I_1 - p_N(\widehat{q})\Delta x\right),
\end{aligned} \tag{30}
$$

where $W_{FB} := \int_0^{q_{FB}} w_N\left(q\right) dF\left(q\right) + \int_{q_{FB}}^1 \left[w_Y\left(q\right) - I_2\right] dF\left(q\right)$ denotes the maximum feasible joint surplus, *gross* of the initial outlay I_1. If (30) holds, by optimality for the owner-manager we then have that $q^* = q_{FB}$: The security S^1 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 $t = 2$ only if (30) is satisfied. Q.E.D.

Proof of Proposition 6. We show that financing with levered equity at $t = 1$ reduces overinvestment (i.e., $q^* < q_{FB}$) at $t = 2$. Since the investor just breaks even ex-ante, we have

$$
\begin{aligned}
\Delta S^1 \quad &= \quad \frac{I_1 - S_l^1}{p_N(\widehat{q})}, \\
\Delta S^2 \quad &= \quad \Delta x - \frac{S_l^2 - S_l^1 + p_N(q^*)\left(\Delta x - \Delta S^1\right)}{p_Y(q^*)}.
\end{aligned} \tag{31}
$$

(Recall that $\widehat{q}$ is the unconditional expectation of q.) Note that $S_l^2 = x_l$, so that we can represent the equilibrium security S^2 as a function of S^1 and q^* only. By plugging (31) into the investor's binding ex ante participation constraint, one can express this constraint entirely as a function of S_l^1 and q^*

$$
\begin{aligned}
I_1 \quad = \quad & \int_0^{q^*}\left(S_l^1 + p_N(q)\frac{I_1 - S_l^1}{p_N(\widehat{q})}\right) dF\left(q\right) \\
& + \int_{q^*}^1\left(S_l^2 + p_Y(q)\left(\Delta x - \frac{x_l - S_l^1 + p_N(q^*)\left(\Delta x - \frac{I_1 - S_l^1}{p_N(\widehat{q})}\right)}{p_Y(q^*)}\right) - I_2\right) dF\left(q\right).
\end{aligned} \tag{32}
$$

Taking the total derivative of (32) allows us, therefore, to examine how a change in S_l^1 affects the equilibrium cutoff q^* at the interim stage, given that S^1 and S^2 adjust so that the investor has the same ex ante expected payoff under the old and the new equilibrium. From total differentiation we obtain

$$\begin{aligned} 0 &= \left[\begin{array}{c} \left(S_l^1 + p_N(q^*)\Delta S^1 - x_l - p_Y(q^*)\Delta S^2\right) f\left(q^*\right) \\ + \int_{q^*}^1 p_Y(q) \frac{d\Delta S^2}{dq^*} dF\left(q\right) \end{array} \right] dq^* \\ &\quad + \left[\int_0^{q^*} \left(1 - \frac{p_N(q)}{p_N(\widehat{q})}\right) dF\left(q\right) + \int_{q^*}^1 \frac{p_Y(q)}{p_Y(q^*)} \left(1 - \frac{p_N(q^*)}{p_N(\widehat{q})}\right) dF\left(q\right) \right] dS_l^1, \end{aligned} \tag{33}$$

where for ease of exposition only we have plugged back in for ΔS^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 $d\Delta S^2/dq^* > 0$.[29] 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

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

Further, these terms are zero at $q^* = 1$, while $q^* \leq q_{FB} < 1$. Taken together, from the preceding observations on (33) 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^1 is optimally chosen as small as possible: $S_l^1 = 0$. **Q.E.D.**

[29] See (31) and (23) and recall that $S_l^2 = x_l$.