Financing Choices When Investors Can Become Dominant

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Abstract

We analyze capital structure choices in firms engaging in relationship financing. We show that if investors develop certification power and become dominant over time, they benefit by steering firms towards issuing equity in follow-up financing rounds. Firms underinvest if owners refuse to accept dilution, but this problem is mitigated (rather than exacerbated) in highly-leveraged firms. We further show that debt is the cheapest funding option when initially accepting relationship finance. Securing credit lines or excess cash to avoid hold-up is a preferable alternative only for small and less opaque investments. Our novel implications for relationship and venture capital financing highlight that investor dominance is a key determinant of capital structure decisions.

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

JEL Classification: G32

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1 Introduction

A common assumption in modern corporate finance is that firms are in the lead when choosing how to raise financing. However, in many circumstances they might find themselves in a dependent position with investors dictating not only financing terms, but also the type of new financing. This could emerge when there is insufficient competition among investors (Rice and Strahan, 2009; Amore et al., 2013; Cornaggia et al., 2014) or if an initial investor acquires privileged information that leads to hold-up problems and gives him a dominant position. Such investor dominance is common in "relationship financing" and is of first-order importance even in competitive capital markets, with relationship lending and venture capital financing being the best-known examples (Boot, 2000; Gompers and Learner, 2004).

This paper analyzes capital structure decisions in firms that might become dependent on a dominant investor. In doing so, we relate two strands of the literature that have considerably shaped our views of corporate finance, but have hitherto mostly coexisted in isolation: the literature on optimal capital structure and, respectively, relationship finance. This opens several questions. For example, it is often assumed that relationship investors use debt, and that they profit by increasing the cost of debt in later stages (Rajan, 1992). However, we show that after an investor has gained a dominant position, he can make even higher profits by pushing the firm towards equity issues. This holds true especially in times of asymmetric information, implying that dominant investors will not follow the classical prediction of relying on debt in such times (Myers and Majluf, 1984). A natural question then is how firms should design their initial capital structure when entering a relationship with an investor who could become dominant. At a more basic level, this is related to why providers of debt financing, such as banks, have settled as major players in relationship finance. Extending our results to venture capital, we are interested in whether investors' ability to obtain a dominant position could help explain the use of different types of VC financing contracts (Kaplan et al., 2007). We further ask when credit lines and raising excess cash could substitute relationship finance.

To investigate these issues, we develop a model in which a firm invests repeatedly and faces outside investors that are less informed about both its initial viability and its potential future prospects. Early investors observe the firm's initial state at some interim stage, but by then the owner-manager of a viable firm has gained an information advantage about the profitability of scaling up, which requires a new investment. Yet the fact that an early investor knows more than outsiders regarding the firm's viability gives him a dominant position, as absent his certification the firm might be unable to raise external financing in a second investment/financing round.

Our first main result is that an early investor who has gained a dominant position by the time of the second financing round benefits most by pushing the firm towards issuing (levered) equity in that round. By giving the investor a larger exposure to the firm's upside, equity allows him to absorb more of the new investment's success, which offers two related advantages: (i) It leaves the owner-manager less opportunity to benefit from favorable private information, resulting in higher profits for the investor.[1] (ii) By making it possible to have high profits even when demanding a lower stake, it induces the investor to make a financing offer that the owner-manager is more likely to prefer over her outside option of not scaling up. Thus, equity financing reduces the scope for *underinvestment*. We show that the preference for equity holds even if the dominant investor does not provide the follow-up financing himself, but steers the firm towards issuing equity to new investors. In that case, the firm will use part of the proceeds to repay the dominant investor's initial (debt) claim or make it more secure. Overall, this analysis highlights that a dominant investor, such as a relationship lender, benefits not only from dictating the terms (as commonly assumed), but also the type of new financing.

Our second main result is that the firm could reduce its initial funding cost by designing its initial capital structure in a way that provides countervailing incentives to those triggering the underinvestment problem described above. These incentives arise as follows. On the one hand, the owner-manager would like to overstate the value of the existing business in order to convince the investor that she would abstain from the additional investment if its financing dilutes her claim on the existing operations too much. On the other hand, a 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 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 outstanding financing contracts and, thus, the firm's initial capital structure determine to what extent these opposing incentives balance each other out and thereby reduce the underinvestment problem. Specifically, it is optimal for the firm to finance itself with debt when it expects that the investor can become dominant. With debt financing, the owner-manager benefits only when the firm realizes high enough cash flows to repay the existing debt, which makes her particularly eager to undertake the follow-up investment round. 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 firm, as it lowers its initial cost of debt.

Our third main result concerns when firms may want to secure credit lines or raise excess cash to preempt the detrimental conditions that a dominant investor may attach to follow-up financing. That is, the firm could try raising enough financing ex ante to be able to make both current and future investments. However, the cost of this strategy is that the manager of a firm that turns out to be defunct has incentives to overinvest and burn the excess cash. We show that securing credit lines or raising excess cash will be preferred to relationship financing only if the subsequently needed financing amount is small and if the initial probability that the investor faces a non-viable firm is low.

Fourth, we show that without investor dominance, firms follow the standard predictions of

[1] This is closely related to the explanation why firms with good investment opportunities avoid equity when they (instead of a dominant investor) can choose the type of financing (Myers and Majluf, 1984).

issuing debt to finance the second investment. The resulting overinvestment is mitigated by issuing equity in the initial funding stage. The contrast to the preceding results highlights that investor dominance plays a key role for capital structure decisions.

Our theory gives rise to several novel empirical implications. First, it highlights that competitive equity markets not only might not diminish, but might even increase the role of dominant investors, such as relationship lenders. This is because, by being able to steer firms towards issuing equity to repay existing debt or make it more secure, dominant investors 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, the analysis of how dominant investors affect firms' capital structure decisions offers another piece to the puzzle that many firms issue equity in times marred by asymmetric information (Frank and Goyal, 2003; Leary and Roberts, 2010). We further predict that small and informationally opaque firms resort to credit lines rather than relationship financing only for small and more certain investments, which is also in line with recent findings (Robb and Robinson, 2014).

Investor's certification power is crucial also in venture capital (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 in this context is that such securities help investors in dealing with information asymmetry in multiple investment rounds rather than with pure moral hazard problems (Schmidt, 2003). This distinction matters, because it highlights the role of investor dominance. In particular, if investors are unlikely to become dominant, e.g., because their lack of experience deters them from developing certification and hold-up power, initially raising equity will be preferred. This could help explain Kaplan et al.'s (2007) corresponding findings.

This 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 (e.g., 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

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

and Thakor (1993), Fulghieri and Lukin (2001), Fulghieri et al. (2016), and Strebulaev et al. (2016) who also discuss why equity could dominate debt in the context of asymmetric information.[3] One of our contributions to this literature is to show that capital structure decisions crucially depend on whether the firm or a dominant investor could dictate 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 (e.g., Schmidt, 2003). By focusing, instead, on the effects of asymmetric information arising over time, we obtain a more flexible contracting framework that can motivate fundamental differences in financing contracts and their subsequent alterations, depending on the dominance of early investors.

Our work also touches upon the discussion of whether long-term financial contracts can help reduce investment inefficiencies (Stulz, 1990; von Thadden, 1995). We add to this literature by analyzing a setting in which information asymmetry arises and is revealed in stages. This allows us to compare when staged relationship financing will be preferred to raising excess cash or securing long-term credit lines. These aspects together with the focus on the role of dominant investors also differentiate our contribution from Axelson et al. (2009), in which information asymmetry also arises in stages.[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 three-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 $I_1 \geq 0$ in $t = 1$. 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 in the final period, $t = 3$. 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

[3] DeMarzo et al. (2005) and Axelson (2007) show that payments in equity help sellers extract more rent from better informed investors/buyers. By contrast, in our model, it does *not* matter who has better information, but who can dictate financing terms. 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.

[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.

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 (e.g., Nachman and Noe, 1994; see also footnote 7). The likelihood $p_{\phi\theta}$ of realizing the high cash flow depends on two factors: whether the additional capital investment in $t = 2$ is made, $\phi = \{Y, N\}$ ("Yes" and "No") and on the firm's underlying profitability θ.

The firm's profitability can be characterized by one of three states. We refer to these as a good, bad, and defunct state, $\theta = \{G, B, D\}$. The difference among these states is simple: If the firm is in the good (G) or the bad (B) state, it has a chance of producing more than x_l (i.e., $p_{\phi G}, p_{\phi B} > 0$). However, making the new investment of I_2 in $t = 2$ is socially optimal only in the good state. Instead, if the firm lands in the defunct state D, its technology turns out to be faulty and the firm generates x_l in $t = 3$ regardless of how much extra capital is sunk (i.e., $p_{\phi D} = 0$). Moreover, it is intransparent and might allow the owner-manager to privately divert a fraction $\tau \geq 0$ of any additionally sunk cash for her personal gain. Our key assumptions in what follows concern how private information about these states θ arises and is revealed over time:

- Our first main assumption is that both the owner-manager and an investor engaged with the firm learn whether the firm is defunct with certainty in $t = 2$. However, in the initial period $t = 1$, the owner-manager is better informed about the likelihood $1 - \gamma$ of being defunct ($\theta = D$), whereas the investor only knows the distribution of γ.

- Conditional on not being defunct, which happens with probability γ, the firm's probability that it is in state $\theta = G$ is given by $0 < \widehat{q} < 1$. Our second main assumption is that this likelihood is common knowledge for the owner-manager and potential investors in the initial period $t = 1$. However, the owner-manager privately learns the true likelihood of $\theta = G$ between $t = 1$ and $t = 2$. Hence, when the decision about the new financing round in $t = 2$ must be made, she has again an information advantage over the investor. Based on this private information in $t = 2$, the owner-manager's posterior belief regarding $\Pr(\theta = G)$ is q. We refer to 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 $q \in [0, 1]$.[5]

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 in $t = 2$. We call state G the good state, as we assume that $p_{\phi G} \geq p_{\phi B}$ holds for all $\phi \in \{Y, N\}$. In what follows, we are interested in a setting in which new investment in the good state is not less efficient than in the bad state. That is, assuming that the new investment increases the success probability by a factor of β_θ, we have

$$\beta_G \geq \beta_B, \tag{1}$$

[5] Clearly, we have $\widehat{q} = \int q dF(q)$. Alternatively, we may, instead, stipulate that the owner-manager privately observes some signal ϑ, which is generated by the CDFs $\Psi_\theta(\vartheta)$. We can then generate q as well as $F(q)$ by using Bayes' rule.

where β_θ can be stated equivalently as $\beta_\theta := p_{Y\theta}/p_{N\theta}$. This assumption states that scaling up (e.g., moving to or expanding production, sales, marketing) is not less efficient for good firms.[6] This assumption makes investment in $t = 2$ comparable to its standard one-shot counterpart in papers, such as Nachman and Noe (1994). In this counterpart, the outside option of not making the investment is constant ($p_{NG} = p_{NB}$), and assumption (1) boils down to the standard assumption that $p_{YG} \geq p_{YB}$—i.e., investing is more efficient in the good state. Thus, condition (1) allows us to extend our insights to this standard one-shot setting.

Our assumption that the new investment round is efficient only in $\theta = G$, and is a negative NPV investment in both states B and D, helps to limit trivial case distinctions. This assumption can be stated as

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

which implies that there exists a cutoff $0 < q_{FB} < 1$ defined by

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

so that a new investment round in $t = 2$ increases the joint surplus only if the firm is not defunct and the owner-manager's type (the probability of being in G) is above q_{FB}.[7] In a nutshell, our analysis will be about how asymmetric information arising over time affects the decision ϕ to raise new financing in $t = 2$.

Contracting and Paper Outline Our main focus in this paper is to characterize the financing contracts between the firm and outside financiers in $t = 1$ and $t = 2$. To be consistent with the literature, we stipulate that a security contract S^t, arranged in period t, and held by an outside investor until $t = 3$ must satisfy: $S^t(x) \in [0, x + c^t]$, where c^t denotes any excess cash hoarded until $t = 3$. 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 and hoarded within the firm.[8] What about payouts before $t = 3$? Payouts between $t = 2$ and $t = 3$

[6] Assuming instead that $\beta_G < \beta_B$ could (if β_B was sufficiently larger) cause the incentives we discuss below to invert—i.e., instead of being better off in the good state, the owner-manager would be better off in the bad state—leading respectively to inverse results. However, a setting in which investors go along with new financing only if the firm can convince that it is sufficiently bad seems a less relevant assumption for healthy (and growing) firms.

[7] Generalizing our results to a setting with continuous cash flows requires slightly more structure similar to that in the related security design literature (e.g., Nachman and Noe, 1994), without leading to material new insights. Precisely, denoting with $H_\phi(x|\theta)$ the distribution function over cash flows for all combinations $\phi = \{Y, N\}$ and $\theta = \{G, B\}$, we can first generalize $p_{\phi\theta}(x) := 1 - H_\phi(x|\theta)$. 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 implies that high cash flows are increasingly 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 refinancing means again shifting more probability mass to the high cash flow states–i.e., $\beta_G(x) \geq \beta_B(x)$, where as before $\beta_\theta(x) := \frac{p_{Y\theta}(x)}{p_{Y\theta}(x)}$. We have shown in a working-paper version how these assumptions jointly ensure that our subsequent results and predictions hold.

[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.

could be equivalently represented as part of S^t (due in $t = 3$), while payouts to the investor between $t = 1$ and $t = 2$ are equivalent to raising less (by the amount of such payouts) in $t = 1$. Hence, we only need to consider payouts to the owner-manager between $t = 1$ and $t = 2$ out of the initially raised capital. Since these payouts are pinned down by the difference between the amount P raised in $t = 1$ and what is hoarded and spent on the first period investment, i.e., $P - c^1 - I_1$, we do not introduce separate notation for them.

The main characteristic of our model is that private information arises and is revealed over time. This has two implications. On the one hand, the owner-manager could try to mitigate the information asymmetry problem that arises in $t = 2$ by appropriately designing the financing contract in $t = 1$. On the other hand, the initially designed contract might not be robust to renegotiations in $t = 2$. We need to consider two cases depending on how much capital the owner-manager raises in $t = 1$.

In the first case, the firm chooses to raise $P \geq I_1 + I_2$ in the initial period and the owner-manager has the unconditional right to decide whether to invest or continue hoarding the excess cash. In this case, the owner-manager does not have to worry about raising financing under asymmetric information in $t = 2$, but will face the problem that raising so much capital might be too expensive.

In the second case, which is the central one for our analysis, the firm chooses to raise $P < I_1 + I_2$ in $t = 1$ (or, respectively, the investor has the right to withhold the additional financing needed to make the second period investment). This case gives rise to the well-known problem in relationship financing that the initial investor could hold up the firm when it seeks additional financing in $t = 2$ by threatening to portray it as defunct to outsiders and refuse financing. Following Rajan (1992), we assume that this certification power allows the initial investor to force renegotiations of the existing contract in return for offering a new financing round.

To characterize financial contracting in this case in an intuitive way and with the minimum use of notation, we break it up in two by presenting it as raising financing in stages. Specifically, in return for raising P in $t = 1$, the owner-manager offers the investor a contract that pays him $S^1(x)$ in $t = 3$. In case $P > I_1$, the owner-manager can hoard c^1 out of the excess cash until $t = 3$. Such hoarding, or respectively, payouts $(P - c^1 - I_1)$ prior to $t = 3$ can be made part of the initial contract. In case of a new financing round, the initial financing contract is replaced by a new contract $S^2(x)$, and we denote the cash hoarded until $t = 3$ with c^2.[9] After deriving the respective optimal contracts for each stage, we also give an alternative interpretation in terms of a single renegotiation-proof contract $\{S^1, S^2\}$ offered in $t = 1$. The timing of our contracting game is presented in Figure 1.

Our paper continues as follows: We focus on the optimal design of the financial contracts S^2 and S^1 in Sections 3 and 4.1 when the manager initially raises less than $I_1 + I_2$. As it is standard, we proceed backwards and solve, first, the investment problem at $t = 2$ and then plug in the equilibrium into the initial problem in $t = 1$. Initially, we assume away raising excess cash, cash

[9] We allow for S^1 and S^2 to be menus seeking to discriminate among different γ-types in $t = 1$ and, repsectively, among different q-types in $t = 2$. We stick to the simple notation $S^t(x)$, as we show that such menus will not arise in equilibrium.

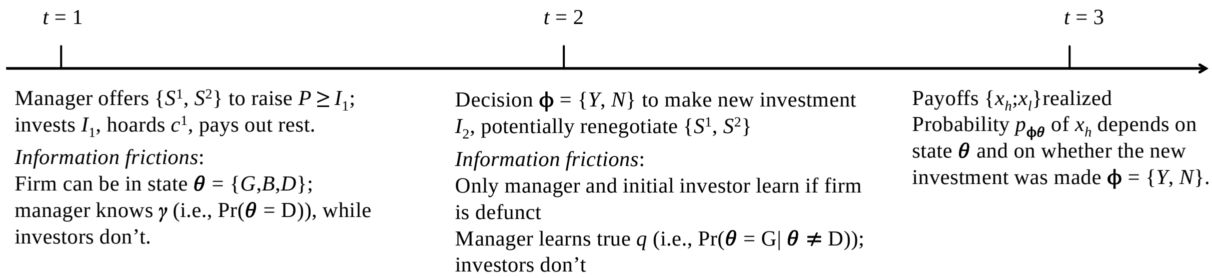

Figure 1: Timeline and Information Frictions.

hoarding, and payouts before $t = 3$, and we discuss the full problem in Section 4.2. We then analyze when the firm will raise $I_1 + I_2$ or more already in $t = 1$ (while, respectively, obtaining the right to decide how the excess cash is spent) in Section 4.3. In this section we discuss alternatives to relationship financing. We present the main empirical implications of our model in Section 5. Section 6 concludes. All proofs are in the Appendix.

3 Financing from a Dominant Investor

The central case in our paper is when the owner-manager has less than I_2 at her disposal at $t = 2$ and must approach the investor for a new financing round. As motivated above, in this case the initial investor can hold up the locked-in owner-manager if the firm seeks new financing. We follow the prior literature (Rajan, 1992) and model this 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 extend our analysis to financing from new investors in Section 3.2.

To ease exposition, we use the following short-hand notation: $S_l^t := S^t(x_l)$ denotes the repayment for low cash flows and $\Delta S^t := S^t(x_h) - S^t(x_l)$ the investor's upside. Let

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

denote the expected probability of the high cash flow, conditional on the type q as well as the decision whether or not to undertake the investment. The gross expected profits for $\phi = \{Y, N\}$ including the hoarded cash c^t are

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

Under some security $S^t \in [0, x + c^t]$, these cash flows are shared so that the investor realizes

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

while the owner-manager obtains

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

To ease notation, we suppress c^t in the function arguments when it does not cause confusion.

3.1 Financing under Asymmetric Information in $t = 2$

As noted, initially we focus on the role of security design when the owner-manager of a non-defunct firm has no excess cash and considers raising I_2 to make the second investment in $t = 2$ (i.e., $c^{1,2} = 0$). 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.

First-best Contract. The investor's profits are highest when the investment decision is made efficiently and he can extract all of the thereby generated surplus. 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 and leave her with an expected payoff that equals her outside option of not raising financing.

In our setting, however, the owner-manager has an information advantage relative to the initial investor also at $t = 2$, which could allow her to keep more information rent. However, she is faced with two opposing incentives at the same time, which are known as "countervailing incentives" in the literature (e.g., Lewis and Sappington, 1989). On the one hand, the owner-manager has incentives to exaggerate how good her existing business is in order to convince the investor that she would turn down his financing offer and stay with her outside option if the proposed financing is too expensive. On the other hand, if the investor believes that the existing investment is very good, he would infer that also the new (scale-up) investment would be 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.

The best the investor can do is to use these opposing incentives to his advantage by making an offer for which they offset each other. Formally, this would require making an offer for which the payoffs from accepting, $u_Y(S^2, q)$, and rejecting, $u_N(S^1, q)$, are the same for all owner-manager types

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

The left-hand-side of (9) is increasing in the owner-manager's type q as long as she participates in the firm's upside. However, the same holds for the right-hand-side, since a firm that does not undertake a new investment round still generates positive payouts. In particular, the higher the owner-manager's type q, the better also her outside option from not making the new investment round.

One of the key insights of our paper is that both financial claims, S^1 and S^2, determine to what extent the owner-manager benefits from the firm's potential success absent new investment and, thus, to what extent the countervailing incentives balance each other out. In particular, the lower the owner-manager's cushion in case the firm's cash flows turn out to be low, the more willing she would be to go for a new investment round. If this effect is sufficiently strong, the investor can offer a security $S^2 = \widehat{S}$ that satisfies (9). In this case, the countervailing incentives generated by the owner-manager's stake in the firm fully neutralize the effect of asymmetric information and allow to achieve first-best investment.

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

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

where the second equality follows after plugging in from (10).

The new security $\widehat{S}$ gives the investor a higher participation on the upside, $\Delta\widehat{S} > \Delta S^1$, and less protection on the downside, $\widehat{S}_l < S_l^1$.[10] The reason is that by making the owner-manager's new residual claim *less* sensitive to being in the good state (and, thus, to favorable private information of being a high type q), the investor can make the owner-manager's payoff resemble more closely her outside option of not making the new investment round. This insight is especially clear in the extreme in which the owner-manager's outside option is not type dependent (as in the canonical one-shot counterpart of our interim stage): In this setup, the investor would offer the owner-manager simply a cash payment equal to her outside option, as it would make all types indifferent to accepting. The intuition becomes even more transparent once we characterize the second-best contract.[11]

Second-best Contract. Offering a security $\widehat{S}$ might not be possible, however. When the countervailing incentives provided by initial financing are not sufficiently strong, a new security that

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

[11] 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.

extracts all surplus and satisfies (12) might require setting $S_l^2 < 0$. This would violate the condition that securities cannot offer a negative repayment to the investor in the low state and, respectively, pay the owner-manger more than is produced or hoarded within the firm. In this case, suppose for the moment that the investor offers a single feasible security S^2. 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^*:[12]

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

The set of owner-manager types who accept a refinancing offer with S^2 in $t = 2$ becomes, thus, $\Phi = [q^*, 1]$: The owner-manager prefers to accept S^2 if and only if $q \geq q^*$ and strictly so if $q > q^*$. All types $q > q^*$ who accept S^2 now receive an *information rent* of size

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

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 narrowing the difference between her payoff in the low and high cash flow states as much as possible, subject to the constraint that $S_l^2 \geq 0$. Naturally, when the latter constraint is 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.[13] This, in turn, allows the owner-manager to benefit less 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, implying that what makes debt financing optimal when investors compete (Myers and Majluf, 1984), makes it suboptimal when an investor is dominant and dictates the financing terms.

Proposition 1 ***(Dominant Investor)*** *If the investor can make a take-it-or-leave-it offer in the new financing round in $t = 2$, 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 $\Delta S^2 \geq \Delta S^1$.*[14] *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] By optimality for the investor, such point will always exist.
[13] We sometimes refer to levered equity simply as equity, where it is now the owner-manager who holds a priority claim in the low cash flow state. As noted in footnote 7, we have extended our results also to continuous cash flows.
[14] The inequalities are strict if initially $S_l^1 > 0$ or $\Delta S^1 < \Delta x$.

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 lower 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.

Another important benefit of using equity financing is that it mitigates underinvestment. This problem arises, as the owner-managers' countervailing incentives are not strong enough to help the investor extract the full surplus created by the new investment. 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 giving the dominant investor a larger claim on the firm's upside. In this manner, he forgoes less profit from higher types when offering terms for which also lower types invest.

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^*.[15] Intuitively, this reflects that more expensive 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

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

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 2 graphically illustrates the intuition behind Proposition 1. The bold solid line represents the owner-manager's expected payoff $u_N(S^1, q)$ under some outstanding claims S^1. The dashed line represents her payoff 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 there will be new financing and investment for types $q \geq q_{NE}^*$. 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 seek an equity contract S_E^2, which not only leads to such clock-wise rotation, but also to a lower, more efficient cutoff $q_E^* < q_{NE}^*$.

[15] 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.

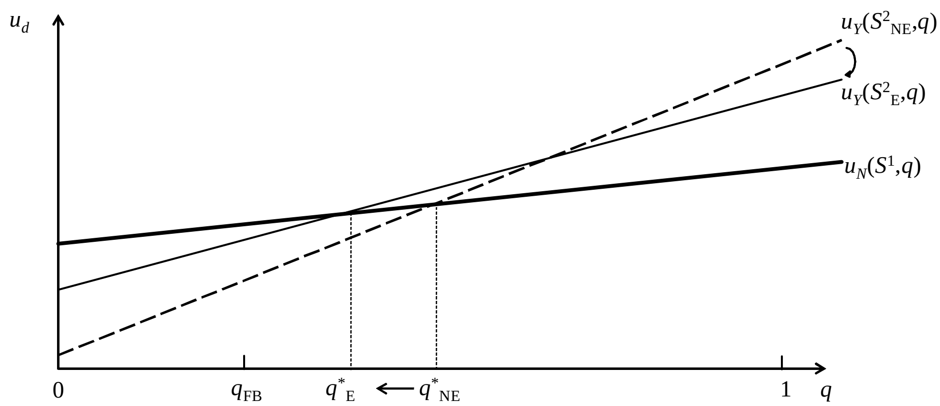

Figure 2: Financing under asymmetric information when a dominant or relationship investor seeks to monetize on his certification power.

Finally, we extend our analysis to consider the role of excess cash in $t = 2$. A straightforward extension of Proposition 1 implies that even if cash was hoarded in $t = 1$, it will not be co-invested in $t = 2$. Since a co-investment of c^1 by the owner-manager could equivalently be represented as posing c^1 as a collateral to be paid to the investor in $t = 3$, such co-investment is equivalent to setting $S_l^2 = c^1$, contradicting Proposition 1. Intuitively, such "collateral pledges" make it more difficult to extract information rent from the owner-manager, as they make the owner-manager's expected payoff $u_Y\left(S^2, q\right)$ more exposed to the firm's success (i.e., information sensitive). This makes it more difficult to bring down every owner-manager type q to her outside option $u_N\left(S^1, q\right)$.[16] Thus, a dominant investor's offer will seek to provide the full financing I_2 in return for a larger claim ΔR^2 and will allow the owner-manager to pay out previously hoarded excess cash to herself (where it does not matter whether this is done in $t = 2$ and so $c^2 = 0$ or in $t = 3$ and so $c^2 = c^1$).

Proposition 2 *If the initial investor has a dominant position in the new financing round, he will offer to finance all of I_2 and will allow the owner-manager to pay out previously hoarded excess cash to herself.*

We conclude this section with a brief discussion of the results so far. Observe, first, that the shape of the optimal security would be levered equity even if it was the initial investor who had privileged information at this stage. The intuition is that it would be now the owner-manager who is afraid to be cheated by the better-informed investor. It can be shown that this concern is best alleviated by offering the owner-manager the least information-sensitive claim. Hence, the investor would hold again a levered equity claim. Thus, the key driving force for security design in $t = 2$ is not who has better information, but who has the upper hand in financing negotiations.

Second, the underinvestment problem arising from private information is conceptually quite different from an underinvestment problem that would arise when holders of outstanding (debt)

[16] Observe that raising cash ζ in excess of I_2 is formally equivalent to making $S_l^2 = -\zeta < 0$. It is straightforward to verify that, even allowing for this, it continues to hold that the firm's leverage decreases following new financing in $t = 2$, as the investor receives a greater upside participation and lower (here even negative) downside protection.

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. Moreover, in contrast to debt-overhang settings, the inefficiency will be *mitigated* when the outstanding initial security S^1 is debt (Section 4).[17]

3.2 Raising Financing from New Investors

It is straightforward to extend our results to raising financing from a new investor at $t = 2$. 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. In line with our underlying assumption that the initial investor has all the bargaining power, we assume that it is him who steers the firm towards the type and amount of new financing to be raised. Allowing for the general case that new financing includes replacing the initial investor's claim for a new one or cash (or, equivalently, safe debt), 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 $S^2 = S^2_{Old} + S^2_{New}$.[18] Again, financing is obtained for all types $q \geq q^*$ where q^* is given again by $u_Y(S^2, q^*) = u_N(S^1, q^*)$. To be acceptable for the new investor, the new investor's securities must pay

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

If certification can guarantee access to a competitive market for fresh financing, this participation constraint holds with equality.[19] If either the owner-manager or the new 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.

[17] Our key innovation is to analyze how shifting bargaining power and countervailing incentives from the initial capital structure affect optimal security design. These two aspects differentiate our second-period underinvestment problem from that discussed in papers, such as Myers and Majluf (1984), where information asymmetry affects only the value of existing assets, which are unrelated to the value of new opportunities, there are no outstanding securities, and the owner-manager has all bargaining power.

[18] Observe that the old investor retaining S^1 is the special case in which S^2_{old} is the same as S^1.

[19] To focus on the security design aspect, we do not explicitly model monitoring or how certification works. However, our analysis 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.

Proposition 3 *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 previous characterization of (total) outstanding risky claims S^2 still fully applies.*

4 Engaging in Relationship Financing

We now solve the owner-manager's problem at $t = 1$, which aims at minimizing the initial funding cost. Recall that information asymmetry arises in stages in our model. While at $t = 1$ the owner-manager is not yet better informed than investors about q, she is better informed about the likelihood γ that the firm turns out to be viable rather than defunct. In line with the previous literature, we assume that, before developing a relationship and becoming locked-in with an investor, the firm faces a competitive market for capital (Rajan, 1992). We model this by giving the firm the right to make an offer to investors, who are identical and, thus, only require breaking even for their on or off equilibrium beliefs, respectively. Only once an investor engages with the firm and obtains privileged information, does he gain the strong bargaining position, characterizing period 2. The forces at play if we would allow the bargaining power to shift towards the investor also in $t = 1$ are related to those discussed in Proposition 1 (see also Section 4.4).

As now the privately informed owner-manager makes the offer, we face a game of signaling. In our general specification, which involves also raising and hoarding excess cash, a candidate for an equilibrium of the signaling game where each type γ plays a pure strategy is a quadruple of functions $\left(S^1(\gamma), c^1(\gamma), \widehat{\gamma}, P\right)$: $S^1(\gamma)$ is the security issued by type γ; $c^1(\gamma)$ is the excess cash that the firm hoards after $t = 1$; $\widehat{\gamma}$ is the investor's posterior belief, which maps the proposed security contract into the set of probability distributions over the type set $\gamma \in [0, 1]$; and P represents the investor's decision how much financing to offer in return for $\left\{S^1, c^1\right\}$. Our equilibrium concept is that of a Perfect Bayesian Equilibrium. We rule out the use of safe debt by assuming that $I_1 > x_l$.

The owner-manager's problem at $t = 1$ is to design security S^1 and cash hoarding strategy c^1 to maximize

$$\gamma U\left(S^1, c^1\right) + (1 - \gamma) U_D\left(S^1, c^1\right) + P - c^1 - I_1, \tag{17}$$

where $U\left(S^1, c^1\right)$ and $U_D\left(S^1, c^1\right)$ are the owner-manager's expected payoffs if the firm is not defunct and defunct, respectively. Naturally, the owner-manager anticipates how $\left\{S^1, c^1\right\}$ will affect renegotiations and, respectively, financial contracting in $t = 2$ (as already noted, we can also interpret $\left\{S^1, S^2\right\}$ as a single renegotiation-proof contract, which converts from S^1 to S^2 upon raising new financing in $t = 2$). This payoff is maximized subject to the investor's break even constraint in $t = 1$

$$\widehat{\gamma} V\left(S^1, c^1\right) + (1 - \widehat{\gamma}) V_D\left(S^1, c^1\right) \geq P, \tag{18}$$

which in a competitive capital market will be satisfied with equality. In this constraint, $V\left(S^1, c^1\right)$ and $V_D\left(S^1, c^1\right)$ are the investor's expected payoffs if the firm is not defunct and defunct, respectively.[20] Finally, if instead of offering a single contract $\{S^1, c^1\}$ the owner-manager offers a menu that should separate low from high γ-types, it needs to be incentive compatible. We show, however, that such menus will not arise in equilibrium.

We give the solution to this problem in several steps. First, we discuss the role of security design in $t = 1$ in affecting investment efficiency in the second period. The key novel insight from our analysis of this stage is that debt financing in $t = 1$ maximally exploits the countervailing incentives arising in $t = 2$. This allows the firm to maximize efficiency, when it expects to issue equity in $t = 2$ (Section 4.1). Second, we show that debt would, indeed, arise as equilibrium financing in $t = 1$ (Section 4.2). For our equilibrium characterization, we solve the joint problem of optimal security design and raising excess cash in $t = 1$. We characterize equilibria in which the owner-manager raises all necessary financing in $t = 1$ in Section 4.3.

4.1 Role of Financial Structure in $t = 1$ in Affecting Investment in $t = 2$

Our first step is to derive the period-one security that, for some given financing level P and hoarding decision c^1, maximizes the owner-manager's expected payoff $U\left(S^1, c^1\right)$ if the firm turns out to be non-defunct. The source of inefficiency in $t = 2$ is that information asymmetry about q forces the investor to trade off rent extraction from the owner-manager with efficiency.

In the previous section, we showed that equity financing in $t = 2$ leads to a more efficient refinancing decision. Efficiency is even higher if the countervailing incentives generated by the initial financing structure from $t = 1$ are stronger. This is the case if the owner-manager's residual claim, and thus the profitability of her outside option, is more sensitive to her type. Intuitively, the firm is more eager to raise new financing if she is more exposed to the downside of the existing business. This is precisely the effect of using debt financing in $t = 1$. Such financing maximally exposes the owner-manager to the firm's success, as it forces her to repay the firm's creditor before being able to claim the residual cash flows. In Figure 2, debt financing corresponds to making $u_N\left(S^1, q\right)$ 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 in $t = 1$ is that it improves the firm's ability to issue equity in $t = 2$. The owner-manager's advantage from making it possible for the investor to capture more information rent in $t = 2$ is that she is compensated for this with cheaper financing in $t = 1$. That is, reducing underinvestment makes it more likely that the investor makes additional profits in future financing rounds, which can be then reflected in a lower cost of debt in $t = 1$.

Proposition 4 *(i) Debt financing with $S_l^1 = x_l + c^1$ maximizes the owner-manager's expected payoff in case the firm turns out to be non-defunct. Debt uniquely maximizes this payoff if the firm anticipates underinvestment ($q^* > q_{FB}$). (ii) Underinvestment occurs if the following condition is*

[20] Note that, to simplify the exposition, we have presently assumed that, for given S^1, the investor chooses a pure strategy in $t = 2$, so that S^2 and q^* are pinned down uniquely. We show in the proof of Proposition 5 that this must indeed hold in equilibrium, even though the investor's program at $t = 2$ may not be strictly quasiconcave.

violated:

$$
\begin{aligned}
& x_l + c^1 && (19)\\
\geq \; & \frac{p_{NB}p_{YG} - p_{YB}p_{NG}}{(p_{YG} - p_{YB})p_N(\widehat{q})}(W_{FB} - I_1) + \frac{(p_{NG} - p_{NB})p_Y(\widehat{q})}{(p_{YG} - p_{YB})p_N(\widehat{q})} \max(0, W_{FB} - I_1 - p_N(\widehat{q})\Delta x),
\end{aligned}
$$

where $W_{FB} := \int_0^{q_{FB}} w_N(q)\, dF(q) + \int_{q_{FB}}^1 [w_Y(q) - I_2]\, dF(q)$ *denotes the maximum feasible joint surplus, gross of the initial outlay* I_1*. If condition (19) is met, the first-best investment outcome* ($q^* = q_{FB}$) *in* $t = 2$ *is obtained.*

Proof. See Appendix.

Proposition 4 derives the condition when first-best efficiency can be achieved, using that from condition (12) an efficient outcome in $t = 2$ is feasible only if S_l^1 is sufficiently high. The intuition for condition (19) is simple. If x_l is large enough, the owner-manager can ensure that the investor just breaks even with a security that leaves most of the upside from the non-refinanced firm to the owner-manager, making the countervailing incentives in $t = 2$ sufficiently strong (cf. (9)).

4.2 Equilibrium Financing and Excess Cash in $t = 1$

The key new insight from the preceding section is that, if $P < I_1 + I_2$, debt would be the firm's preferred way of building up financial flexibility even absent asymmetric information in $t = 1$. In the second step towards solving the overall problem, we show that the main restriction placed by asymmetric information in $t = 1$ is on whether or not the firm should engage in relationship financing and, respectively, on how much excess cash to raise. However, it does not affect the preference for debt financing if the firm raises less than $I_1 + I_2$. Indeed, considering such asymmetry will only strengthen the argument for debt financing. To deal with the multiplicity of equilibria if the investor's out-of-equilibrium beliefs are allowed to be arbitrary, we impose the standard refinement D1. It requires that the investor restricts his out-of-equilibrium beliefs only to the type(s) that have most to gain from the deviation (see Lemma 1 in the Appendix).[21]

Applying the D1 refinement leaves debt financing in $t = 1$ as the only equilibrium financing candidate. This is for two reasons. First, debt financing maximizes the owner-manager's payoff of a non-defunct firm because of the countervailing incentives it provides in $t = 2$ (Proposition 4). Second, it minimizes her payoff $U_D\left(S^1, c^1\right)$ if the firm turns out to be defunct by stipulating that all proceeds in the low cash flow state go to the investor. This helps to relax the investor's ex ante break even condition (18), as it makes $V_D\left(S^1, c^1\right)$ maximal. Thus, high γ-types benefit most from a debt issuance, implying that financing with debt will be the only equilibrium candidate from which these types will not be able to successfully deviate. Also here, a menu of securities will be

[21] D1 was introduced by Cho and Kreps (1987) and extended to a continuum of types by Ramey (1996). In a security design context, the refinement has been used by Nachman and Noe (1994), DeMarzo and Duffie (1999), and DeMarzo et al. (2005).

dominated, as such menus will include non-debt contracts and, thus, ultimately make financing more expensive for the owner-manager.

Proposition 5 *Suppose that the firm enters relationship financing ($P < I_1 + I_2$). Issuing debt in $t = 1$ is the only type of financing that satisfies D1.*

Proof. See Appendix.

We have interpreted so far raising capital in stages as approaching investors and negotiating financing terms separately in $t = 1$ and $t = 2$. An alternative way to interpret the contracts derived in Propositions 1–5 is in the context of 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 in $t = 2$ upon which the initial contract converts to equity. We elaborate on this interpretation in more detail in Section 5.

Raising and Hoarding Excess Cash in $t = 1$ Deriving the equilibrium in $t = 1$ goes hand-in-hand with the question whether the owner-manager should raise more than I_1 in $t = 1$. Raising more than I_1 while there is still symmetric information about q (making the pricing of S^1 with regard to q "fair") matters only if there is a new financing round. However, having excess cash in this case could benefit the owner-manager by mitigating the underinvestment problem in $t = 2$. Intuitively, when there is more cash in the firm due to higher borrowing in $t = 1$, it is possible to replace the owner-manager's initial claim on the firm's cash flows with one that is less sensitive to the firm's success without violating the constraint that $S_l^2 \geq 0$.

What makes raising cash in $t = 1$ costly, however, is that the firm could turn out to be defunct. This leads to two insights. First, if the owner-manager raises cash in excess of I_1, she will not make any payouts to herself between $t = 1$ and $t = 2$. The intuition is that such payouts are more beneficial for low-γ types, as they are more likely to be in charge of a defunct firm. Thus, high γ-types are those most likely to deviate to reducing payouts, convincing the investor (by D1) that such deviations must have come from high γ-types, and making payouts unsustainable in equilibrium.

Second, if the owner-manager of a defunct firm can threaten to divert some of the excess cash ($\tau > 0$), she would have an incentive to do so, as debt financing would otherwise leave her with a zero payoff in $t = 3$. Clearly, such inefficient outcome would be renegotiated away, as the initial investor would prefer paying a defunct firm a bribe of τc^1 rather than losing its claim on all of c^1.[22] As a result, firms more likely to turn out defunct benefit more from raising excess cash. This triggers a rat race to reducing cash hoarding to zero. The reason is that if there were an equilibrium with positive hoarding, high γ-types could decide to deviate by offering to hoard slightly less cash. This would only marginally change efficiency in $t = 2$, while leading the investor to believe that he is facing a high γ-type: This is because high γ-types benefit least from from the lost chance

[22]We assume that receiving τc^1 would be sufficient for the entrepreneur not to sink c^1. However, our analysis naturally extends also to larger "bribes."

of threatening to divert cash if they turned out to be defunct. Clearly, if cash hoarding did not entail a cost for investors (i.e., $\tau = 0$), these arguments would not apply, and there would be a multiplicity of debt financing equilibria involving cash hoarding.[23]

Proposition 6 *Suppose that the firm enters relationship financing ($P < I_1 + I_2$).*
(i) There is no equilibrium in which the owner-manager uses excess cash ($P > I_1$) to pay herself a dividend before $t = 2$.
(ii) The manager does not raise and hoard excess cash in $t = 1$ if a defunct firm can divert cash from a sunk investment, i.e., $\tau > 0$. By contrast, if $\tau = 0$, there are multiple debt financing equilibria involving raising excess cash.

Proof. See Appendix.

Summarizing Propositions 1–6, we expect the following effects of relationship financing:

Corollary 1 ***(Relationship Financing)****: (i) Firms will raise debt if they expect that a relationship investor might become dominant. In financing rounds in which they are dependent on a dominant investor, they will issue equity. If such equity issues are made to new investors, some of the proceeds might be used to repay or make existing debt more secure. (ii) Alternatively, firms can resort to convertible debt that converts to equity in an investment round in which the firm needs certification.*

Furthermore, raising excess cash before getting locked in to a relationship investor does not help much the owner-manager. As long as she ends up in a dependent position, this excess cash does not help to reduce the dependence on potentially costly external finance, and the owner-manager's payoff is highest if it is avoided (Proposition 2 and 6).

Corollary 2 ***(Raising Excess Cash):*** *Firms that expect to rely on a dominant investor for a future investment will avoid raising excess cash for the purpose of later co-financing this investment or paying out dividends beforehand.*

4.3 Alternatives to Relationship Financing

An alternative to engaging in relationship financing and risking being held up by a dominant investor is that the owner-manager raises at least $I_1 + I_2$ already in the initial period or that she obtains the unconditional right to raise I_2 or more in $t = 2$. The advantage of such a contract is that it could deal away with the underinvestment problem we described above. Specifically, the owner-manager could design a contract $\{S^1, S^2\}$ for which converting from S^1 to S^2 in $t = 2$ is optimal for all $q \geq q_{FB}$, where the ability to raise I_2 unconditionally removes the threat of being

[23] Though D1 is silent on how the owner-manager should choose among these equilibria, the owner-manager's expected payoff is highest for the equilibrium that leads to the highest interim efficiency.

held up by the investor in $t = 2$. However, the disadvantage is again that if the firm turns out to be defunct, the owner-manager could threaten to sink the excess cash. In what follows, we focus straight on offering a renegotiation-proof contract $\{S^1, S^2\}$ in which defunct firms do not have an incentive to make such threats.

Two observations follow immediately. First, it must be that the owner-manager's expected payoff in the low cash flow state is as low as possible. This makes sure that the investor can recover as much as possible if the firm turns out to be defunct, implying again the optimality of debt-like financing. Second, since defunct firms can always obtain at least τc^1 by threatening to sink c^1, renegotiation-proof contracts should give the owner-manager at least τc^1 more in the low cash flows state in the case of no new investment compared to the low cash flows state in the case of undertaking the new investment.

Observe, next, that if such an equilibrium exists, there will be no payouts before $t = 3$ and the owner-manager will secure financing for at most $P = I_1 + I_2$. The intuition is similar to before. Payouts before $t = 3$ benefit types who are more likely to be in charge of a defunct firm. Thus, high γ-types would successfully deviate from such equilibrium candidates. Similarly, raising more than $I_1 + I_2$ cannot be an equilibrium, as it unnecessary dilutes high γ-types that suffer from underpricing when pooled with the lowest γ-type. This is because defunct firms obtain a positive payoff when $P \geq I_1 + I_2$, making a successful deviation possible.

It remains to characterize when an equilibrium with $P = I_1 + I_2$ will exist. The reason such existence is possible is that raising all of $I_1 + I_2$ could completely circumvent the underinvestment problem characterizing the previous sections. Thus, the question boils down to asking whether the potential underinvestment problem due to raising less than $I_1 + I_2$ is less costly compared to the "bribe" needed to stop the manager of a defunct firm from investing in $t = 2$. Clearly, the latter is less of a problem if I_2 is small and the likelihood of facing a non-defunct firm ($\widehat{\gamma}$) is high.

Proposition 7 ***(Alternatives to Relationship Finance)*** *Suppose that the firm seeks to avoid relationship financing ($P \geq I_1 + I_2$):*
(i) For such an equilibrium to arise, relationship finance must lead to underinvestment. Furthermore, such equilibrium is more likely to arise if the second-period investment need I_2 is low; and/or the ability to divert cash τ is small; and/or the ex ante likelihood of a non-defunct firm $\widehat{\gamma}$ is high.
(ii) In this equilibrium, the (renegotiation-proof) financing contract features $S_l^1 = x_l + (1 - \tau) I_2$ if there is no new investment, and $S_l^2 = x_l$ if I_2 is invested.

Proof. See Appendix.

4.4 Discussion: Financing when Early Investor has No Certification or Bargaining Power

The focus of our paper is on explaining how firms raise financing under asymmetric information when they (expect to) find themselves in a situation in which the investor will be dictating the terms of financing. One of our main results is to show when firms will issue equity in this context and how they could ameliorate the investment inefficiencies connected with such issues. In this section, we briefly deviate from this focus to relate to a well-known intuitive argument that issuing equity preserves the ability to issue debt in the future. In what follows, we bring more structure to this argument by highlighting the role of countervailing incentives also in this more standard setting.

Suppose that a non-defunct firm does not have all necessary cash to invest I_2, but contrary to our baseline assumption, can still make a take-it-or-leave it offer to investors in $t = 2$. This could be, for example due to initial investors not being able to develop an information advantage relative to outside investors (because of their lack of expertise or experience) and the manager being able to threaten to walk away with her inalienable human capital. Following Nachman and Noe (1994), we can show that the unique equilibrium contract in $t = 2$ is debt and that there will be overinvestment. The way countervailing incentives in $t = 2$ arise in this setting is as follows: On the one hand, the owner-manager would like to overstate her type to receive cheaper financing. On the other hand, raising new financing needs to make sure that the initial investor is not worse off. Since the initial investor's outstanding claim also depends on the owner-manager's type, this gives the owner-manager incentives to understate her type. Incidentally, these effects become even clearer within the context of raising financing from new investors, as then the owner-manager would like to present a different image of the firm to new and old investors.

We argue now that by exploiting these countervailing incentives, the owner-manager can reduce the overinvestment problem in $t = 2$, associated with this setting, by issuing equity in $t = 1$. Here overinvestment results from the cross subsidization of lower by higher types, where debt financing in $t = 2$ helps to reduce this cross subsidy. We keep the analysis brief just to make the main point, assuming away information asymmetry in $t = 1$ and the possibility of raising excess cash, and we refer the reader interested in details to the online appendix. For ease of exposition, we assume that the new investment round is raised from the initial investor.

Proposition 8 ***(No Investor Dominance)*** *If the owner-manager does not face a dominant investor in $t = 2$, she issues debt and there is overinvestment in $t = 2$. Issuing levered equity in $t = 1$ helps to reduce this investment inefficiency and, hence, the owner-manager's ex ante cost of finance.*

Proof. See Appendix.

Levered equity maximizes the sensitivity of the investor's claim to the owner-manager's type under the initial contract S^1. This boosts the countervailing incentives, as the owner-manager's benefit from being (or pretending to be) a higher type when seeking new financing is more strongly counteracted by the implied increase in value of the investor's initial claim S^1. Furthermore, equity financing in $t = 1$ makes the manager less sensitive to whether the existing business is good or bad and, thus, less desperate to raise new financing if it is not so good. Thus, fewer owner-manager types decide to raise new financing, resulting in less overinvestment and less cross-subsidization.

The equity financing result in $t = 1$ is in stark contrast to the debt financing result from Proposition 5. We do not further pursue this discussion here in more detail, not to stray too much from our baseline model. However, we conclude by summarizing that financing choices in relationship financing crucially depend whether or not the early investor can gain a dominant position, and that countervailing incentives arising from the initial capital structure can play an important role in designing the optimal financing contracts.

Corollary 3 *Debt investors are well positioned to benefit from relationship financing only if early investors can expect to develop substantial certification and bargaining power. Otherwise, equity investors might have an advantage.*

5 Empirical Implications

Modern MBA textbooks devote significant space to the costs and benefits of various forms of corporate financing decisions. However, recent empirical evidence shows that one of the underlying assumptions of the theories building the backbone of such discussions—that investors compete to offer financing—is sometimes not satisfied even in the U.S. for small and financially constrained firms (Rice and Strahan, 2009; Amore et al., 2013; Cornaggia et al., 2014). The idea that investors can dictate financing terms has long been recognized in the literature on relationship financing in which firms become locked-in over time with a relationship investor (Rajan, 1992; Boot, 2000). In this paper, we bring these two strands of the literature together. By dispensing from the somewhat unnatural assumption that a relationship investor dictates only the terms, but not the type of new financing, our first prediction is that firms that rely on relationship financing would often appear to violate the classical prediction that firms seek debt financing when plagued by asymmetric information (Myers and Majluf, 1984). Indeed, this prediction often fails in practice (Frank and Goyal, 2003; Leary and Roberts, 2010; Gomes and Phillips, 2012), which has spurred a sizeable body of research rationalizing its failure in various settings (see Introduction). Our novel insight is:

Implication 1. *Dependence on dominant investors' certification is a key determinant of capital structure decisions. Firms facing this problem will choose equity when raising financing under asymmetric information.*

Another implication 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 and realize a higher benefit off the relationship by steering the firm towards issuing equity to repay or make existing 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 3).

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.*

While we are not aware of other papers making the arguments in the core of Implication 2, there is plenty of empirical evidence pointing to the importance of the effects we are discussing. First, repaying debt holders is one of the primary reasons for and consequences of equity issues (Leone et al., 2007; Pagano et al., 1998). Second, certification stemming from a relationship investor is crucial for obtaining better pricing when firms issue equity (Schenone, 2004; Duarte-Silva, 2010), and banks use this power to impose more expensive loan terms on their borrowers prior to their IPOs (Schenone, 2010; Santos and Winton, 2008).[24] Thus, relationship lenders do, indeed, have important certification power, and they seem to monetize on this power when firms repay their expensive loans when issuing equity.[25] Naturally, equity issuance could also take place in the form of private placements, which could help explain Gomes and Phillips' (2012) finding that smaller firms issue equity in private placements when information asymmetry is a factor.

How do alternatives to relationship financing shape firms' capital structure decisions? Our predictions that firms issue equity in new rounds of financing with a relationship investor depend on several conditions. First, relationship investors should possess privileged information, crucial for assessing the viability of the firms and unavailable to outside investors. Otherwise, firms will turn to debt financing (Propositions 5 and 7). Second, even in such times, staged financing leading to equity financing will be used in the case of larger investments. Instead, smaller and less opaque investments (in the sense of higher $\widehat{\gamma}$) are likely to be financed with credit-line type of arrangements (Proposition 7). Given that investments of freshly created firms tend to be highly opaque and require large funding (relative to the firm's size), these insights could help explain why credit lines, though important, do not account for a large fraction of external financing in such firms (Robb and Robinson, 2014).

Implication 3. *A firm would prefer credit lines and raising excess cash to raising financing*

[24] There are a number of ways in which banks can benefit from steering 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, when banks steer underpriced equity issues towards preferred investors with which the bank expects to do business in the future. See Deyoung et al. (2015) for a recent discussion of the trade-offs in relationship lending.

[25] Though IPOs help reduce firms' dependence on relationship lending (Pagano et al., 1998), our novel insight is the equity issuance at the same time presents an attractive channel for lenders to cash in on their certification power.

in stages from a relationship investor in the case of small and less opaque investments, and when early investors are less likely to develop a crucial certification role.

Our results also readily 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). Our main result in this context is to show that information asymmetry, arriving in stages, generates the widely used contract structure used 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 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 first-order problem that investors, even when they enter early, are persistently less informed about the firm's prospects that insiders.

Implication 4. *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 capitalists 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.*

The insight that U.S.-type of contracts could be driven by adverse selection rather than moral hazard problems is important, as it could help explain why such contracts are not so common in countries where 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 8).[26] Indeed, in countries where venture capitalists are still a relatively new investor class, VC's are more likely to take common equity in first financing rounds (Kaplan et al., 2007; Lerner and Schoar, 2005). More successful and experienced firms then issue more senior securities in later rounds (Kaplan et al., 2007).

Implication 5. *U.S.-style VC contracts and relationship lending are less likely to emerge in*

[26] Asymmetric information at $t = 2$ constrains us to look at the two opposite scenarios where we grant either the investor or the owner-manager full contracting power, since a more flexible solution concept, such as Nash bargaining, is not generally available when there is asymmetric information.

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.

6 Conclusion

We develop a theory in which a 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. As such financing is expensive, firms would sometimes avoid it and prefer to stick to their existing business. The key effect that we explore, when analyzing how the firm could deal with the resulting investment inefficiencies, is that a firm's existing capital structure and cash hoarding strategy can create countervailing incentives to those causing the firm to see new financing as too expensive and eschew 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 model also analyzes when, instead of engaging in relationship financing, the firm is better off raising excess cash or relying on long-term credit line-types of arrangements. The cost of such strategies is that they create incentives for overinvestment. Thus, they are optimal only when future funding needs are small and investments are relatively certain.

Our theory best applies to small and informationally opaque 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 small and informationally opaque firms are especially likely to violate the standard predictions that firms should prefer debt financing in times marred by asymmetric information. 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.

Another implication of our model is that the optimal way to engage in relationship financing is through debt-like contracts, which could explain why debt, and not equity investors, have been historically well positioned in this type of business. Furthermore, we offer novel insights pertaining to venture capital financing. We argue that the common U.S. venture capital contract stipulating debt-like initial financing, which converts to equity as venture capitalists certify for the firms and take them to the public equity markets, can help when financing is raised in stages and investors worry about the quality of the firm's investment opportunities. However, such financing is not optimal if VCs are inexperienced and are unlikely to develop a strong certification role in future investment rounds. Some of our further empirical implications concern why credit lines and raising excess cash play a relatively small role in small and risky growth firms. 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 to 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

$$\widehat{S}_l = S_l^1 - \left(\frac{p_{YG}p_{NB} - p_{YB}p_{NG}}{p_{YG} - p_{YB}}\right)\left(\Delta x - \Delta S^1\right). \tag{20}$$

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 (20) is just condition the condition 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.*

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 $u_Y(\widetilde{S}^2, q^*) = u_N\left(S^1, q^*\right)$, 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: $v_Y(\widetilde{S}^2, q^*) = v_Y\left(S^2, q^*\right)$. However, as $u_Y(\widetilde{S}^2, q^*) = u_Y\left(S^2, q^*\right)$ 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 $u_Y(\widetilde{S}^2, q^*) = u_Y\left(S^2, q^*\right)$ and $\widetilde{S}_l^2 = 0$, we can obtain

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

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

$$0 \leq -S_l^2 + \left(p_{YB} + q^*\left(p_{YG} - p_{YB}\right)\right)\left(\Delta x - \Delta S^2\right). \tag{21}$$

However, (21) 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. $u_Y\left(S^2, q^*\right) = u_N\left(S^1, q^*\right)$, condition (21) is equivalent to

$$0 \leq -S_l^1 + \left(p_{NB} + q^*\left(p_{NG} - p_{NB}\right)\right)\left(\Delta x - \Delta S^1\right). \tag{22}$$

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

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

where the last inequality holds for *any* q^*. But this is just what we needed to show (condition (22)). **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

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

from which we obtain explicitly

$$\frac{d\Delta S^2}{dq^*} = \frac{\left(S_l^2 - S_l^1\right)\left(p_{YG} - p_{YB}\right) + \left(p_{NB}p_{YG} - p_{YB}p_{NG}\right)\left(\Delta x - \Delta S^1\right)}{\left[p_{YB} + q^*\left(p_{YG} - p_{YB}\right)\right]^2} > 0, \tag{24}$$

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))

$$-\left[w_Y(q^*) - w_N(q^*)\right] f\left(q^*\right) + \frac{d\Delta S^2}{dq^*}\int_{q^*}^{1}\frac{dv_Y(S^2,q)}{d\Delta S^2}dF\left(q\right) = 0, \tag{25}$$

where the first term follows from $w_d(q) = u_d\left(S^t, q\right) + v_d\left(S^t, q\right)$ 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 not only maximizes the investor's ability to extract rent from the owner-manager, but it also induces 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

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

Therefore, by monotonic selection arguments, q^* increases in ε. Thus, reducing ε leads to a lower 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 $S^2 = \left(0, \Delta S^2\right)$ 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

$$0 = \int_0^{q^*_{old}}\left[v_N(\widetilde{S}^1, q) - v_N(S^1, q)\right]dF\left(q\right) + \int_{q^*_{old}}^{1}\left[v_Y(\widetilde{S}^2, q) - v_Y(S^2, q)\right]dF\left(q\right), \tag{26}$$

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

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

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 (23). Plugging into (26) we have

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

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

$$\Delta\widetilde{S}^1 = \Delta S^1 - \left(\frac{x_l - S_l^1}{\widehat{p}_N}\right)\left(\frac{p_Y(q^*_{old})F\left(q^*_{old}\right) + \widehat{p}_Y\left(1 - F\left(q^*_{old}\right)\right)}{p_Y(q^*_{old})F\left(q^*_{old}\right) + \frac{p_N(q^*_{old})}{\widehat{p}_N}\widehat{p}_Y\left(1 - F\left(q^*_{old}\right)\right)}\right). \tag{27}$$

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. (23)). 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

$$V\left(q^*, S^1\right) := \int_0^{q^*} v_N\left(S^1, q\right)dF(q) + \int_{q^*}^1 \left(v_Y\left(S^2, q\right) - I_2\right)dF(q). \tag{28}$$

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

$$\begin{aligned} &\frac{d}{dq^*}\left[V(q^*, \widetilde{S}^1) - V\left(q^*, S^1\right)\right] \\ &= \int_{q^*}^1 p_Y(q)\left(\frac{d\Delta S^2(q^*, \widetilde{S}^1)}{dq^*} - \frac{d\Delta S^2\left(q^*, S^1\right)}{dq^*}\right)dF(q). \end{aligned} \tag{29}$$

Next, using (24) and (27), we obtain an explicit expression for the second term under the integral in (29). Importantly, observe that $\widetilde{S}^1$ is defined as a function of q^*_{old} and *not* q^*. We have

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

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 (29), 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 $\left(S^1,S^2\right)$ and $(\widetilde{S}^1,\widetilde{S}^2)$, when holding $q^* = q^*_{old}$ constant. But as $q^*_{new} < q^*_{old}$, it follows from (24) ($d\Delta S^2/dq^* > 0$) 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 $V\left(q^*,\Delta S^1\right)$ instead of $V\left(q^*,S^1\right)$ (cf. expression (28)). Further, we use $Q^* = \arg\max V\left(q^*,\Delta S^1\right)$ to denote the optimal choice correspondence subject to (18). Observe now that given S^1, $V\left(q^*,\Delta S^1\right)$ is strictly submodular in q^* and ΔS^1 :

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

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 $u_N\left(S^1, q\right) = u_Y(\widehat{S}, q)$ holds for all $q \in [0, 1]$. Using this and the identity $w_d\left(q\right) = v_d\left(S^t, q\right) + u_d\left(S^t, q\right)$ to plug into (18), if the investor just breaks even at $t = 1$, one can express ΔS^1 as

$$\Delta S^1 = \Delta x - \frac{W_{FB} - I_1 - \left(x_l - S_l^1\right)}{p_N(\widehat{q})}. \tag{30}$$

A first-period security that satisfies (30) is feasible if

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

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

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

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

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

Simple transformations yield condition (19). If (19) 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 in $t = 2$ only if (19) is satisfied. **Q.E.D.**

Lemma 1 *Consider an equilibrium candidate in which more than one $\gamma-$type, including the lowest, offers S^1. This equilibrium candidate does not survive D1 if there is a deviation for which conditions (31)-(34) below are satisfied.*

Proof of Lemma 1. In what follows, to ease notation, we suppress S^2 and c^2 in the function arguments when it does not lead to confusion. In our setting, D1 can be stated as follows. Consider a deviation from some equilibrium candidate to security $\widetilde{S}^1$ and cash hoarding $\widetilde{c}^1$. For every type γ, determine the lowest price $\widetilde{P}(\gamma)$ for which this type is weakly better off offering the deviating contract $\{\widetilde{S}^1, \widetilde{c}^1\}$ than offering the equilibrium contract, say $\{S^1, c^1\}$, associated with her type

$$\begin{aligned} & \gamma\left(U(\widetilde{S}^1, \widetilde{c}^1) - U_D(\widetilde{S}^1, \widetilde{c})\right) + U_D(\widetilde{S}^1, \widetilde{c}^1) + \widetilde{P}(\gamma) - \widetilde{c}^1 - I_1 \\ = \;& \gamma\left(U\left(S^1, c^1\right) - U_D\left(S^1, c^1\right)\right) + U_D\left(S^1, c^1\right) + P - c^1 - I_1. \end{aligned} \tag{31}$$

Then D1 requires that the investor restricts his beliefs to the type(s) that find(s) deviating to $\{\widetilde{S}^1, \widetilde{c}^1\}$ attractive for the minimum of these $\widetilde{P}(\gamma)$-prices: $\Gamma = \arg\min_\gamma \widetilde{P}(\gamma)$ (i.e., the set of responses for which these types would deviate is largest). The equilibrium does not survive D1 if the minimum deviation payoff for a type from Γ is larger than her equilibrium payoff given the investor's best response for the refined beliefs. This is guaranteed to be the case if the investor makes a profit for $\widetilde{P} = \min_\gamma \widetilde{P}(\gamma)$ given his refined beliefs. To see this, note that in a competitive market, the best response of an investor is to offer a price for which he breaks even—i.e., if he makes a profit for $\widetilde{P}$ he would offer a higher price than that and, thus, a type from Γ will strictly benefit from the deviation.

To see the claim in the lemma, observe, first, that any equilibrium candidate must involve partial pooling in which positive NPV γ-types cross-subsidize the lowest γ-type(s). This is because the investor will never finance the lowest type if she knew her type and because the lowest type is always better off raising financing (potentially mimicking) compared to her zero profits from no financing. We can easily compare the $\widetilde{P}(\gamma)$'s for the types in this pool by simply totally differentiating (31)

$$\frac{d\widetilde{P}(\gamma)}{d\gamma} = -\frac{U(\widetilde{S}^1, \widetilde{c}^1) - U_D(\widetilde{S}^1, \widetilde{c}^1) - U\left(S^1, c^1\right) + U_D\left(S^1, c^1\right)}{\frac{\partial}{\partial \widetilde{P}(\gamma)}\left(\gamma U(\widetilde{S}^1, \widetilde{c}^1) + (1-\gamma)\, U_D(\widetilde{S}^1, \widetilde{c}^1) + \widetilde{P}(\gamma) - \widetilde{c}^1\right)}.$$

If $\frac{d\widetilde{P}(\gamma)}{d\gamma} < 0$, D1 dictates that, if a type from this pool has deviated, it must have been the highest type. Call this type $\overline{\gamma}$. Thus, for the investor's out-of-equilibrium belief it should hold that $\widetilde{\gamma} = E\left[\gamma | \gamma \in \Gamma\right] \geq \overline{\gamma}$.

Since the denominator in $\frac{d\widetilde{P}(\gamma)}{d\gamma}$ must be positive, $\frac{d\widetilde{P}(\gamma)}{d\gamma} < 0$ if and only if

$$U(\widetilde{S}^1, \widetilde{c}^1) - U_D(\widetilde{S}^1, \widetilde{c}^1) > U(S^1, c^1) - U_D\left(S^1, c^1\right). \tag{32}$$

Plugging in from (31), this is equivalent to verifying that

$$U_D(\widetilde{S}^1, \widetilde{c}^1) + \widetilde{P}(\gamma) - \widetilde{c}^1 < U_D\left(S^1, c^1\right) + P - c^1. \tag{33}$$

The investor makes a profit accepting for out-of equilibrium beliefs $\widetilde{\gamma}$ when offering $\widetilde{P}$ if

$$\widetilde{\gamma} V(\widetilde{S}^1, \widetilde{c}^1) + (1-\widetilde{\gamma})\left(\underbrace{x_l + \widetilde{c}_1 - U_D(\widetilde{S}^1, \widetilde{c}^1)}_{V_D(\widetilde{S}^1, \widetilde{c}^1)}\right) > \widetilde{P}.$$

As stated above, if this condition is satisfied, the equilibrium candidate does not satisfy D1. For our algebraic derivations in the following proofs (which involve comparing on and off equilibrium payoffs as in (31)-(33)), it is convenient to reformulate the preceding inequality as follows: Subtract P on both sides and use that from (18) $P = \gamma V(S^1, c^1) + (1-\gamma) V_D(S^1, c^1)$ to obtain

$$\begin{aligned} 0 \quad < \quad & P - (1-\widehat{\gamma})\left(x_l + c^1\right) - \left(\widetilde{P} - (1-\widetilde{\gamma})\left(x_l + \widetilde{c}^1\right)\right) - \left(U_D(\widetilde{S}^1, \widetilde{c}^1) - U_D\left(S^1, c^1\right)\right) \\ & + \widetilde{\gamma}\left(V(\widetilde{S}^1, \widetilde{c}^1) + U_D(\widetilde{S}^1, \widetilde{c}^1)\right) - \widehat{\gamma}\left(V\left(S^1, c^1\right) + U_D(S^1, c^1)\right), \end{aligned} \tag{34}$$

We have two types of equilibrium candidates: One in which the owner-manager raises $P < I_1 + I_2$ (Propositions 5 and 6) and one in which the opposite is true (Proposition 7). **Q.E.D.**

Proof of Propositions 5 and 6. Consider an equilibrium candidate in which the manager raises $P < I_1 + I_2$. Any such equilibrium candidate must take into account that any initial contract (or menu of contracts) will be renegotiated as described in Proposition 1, unless it stipulates that new financing leads to conversion of the initial contract into the contract derived in that proposition. We show the proof in five steps. We show, first, that in any equilibrium candidate containing the lowest type, the firm issues debt and there are no payouts (Steps 1 and 2); We show then existence of pooling debt equilibria (Step 3). Finally, we show that there are no equilibria with cash hoarding if $\tau > 0$ (Step 4) and that there are no separating equilibria for any $\tau \geq 0$ (Step 5).

Step 1. *In any candidate equilibrium, the security S^1 issued by the pool containing the lowest type must be debt with $S_l^1 = x_l + c^1$.* Suppose to a contradiction that this were not the case and consider a deviation to $\widetilde{S}_l^1 = S_l^1 + \delta$, where $\delta > 0$ and where the manager hoards the same amount of cash $\widetilde{c}^1 = c^1$. We now apply Lemma 1. Since a defunct firm can threaten to sink c^1, unless she is paid τc^1, for such a firm, we have

$$U_D\left(S^1, c^1\right) = \max\left(x_l + c^1 - S_l^1, \tau c^1\right)$$

and this construction implies that

$$U_D\left(S^1, c^1\right) - U_D(\widetilde{S}^1, \widetilde{c}^1) = \max\left(x + c^1 - S_l^1, \tau c^1\right) - \max\left(x_l + \widetilde{c}^1 - \widetilde{S}_l^1, \tau \widetilde{c}^1\right) = \varepsilon \geq 0. \tag{35}$$

where it is straightforward that $\varepsilon \in [0, \delta]$. Thus, condition (32) can be stated as

$$U(\widetilde{S}^1, \widetilde{c}^1) - U(S^1, c^1) > -\varepsilon.$$

which is always satisfied if $U(\widetilde{S}^1, \widetilde{c}^1) \geq U\left(S^1, c^1\right)$. Furthermore, (31) can be stated as

$$P - \widetilde{P}(\gamma) = \gamma\left(U(\widetilde{S}^1, \widetilde{c}^1) - U\left(S^1, c^1\right)\right) - (1-\gamma)\,\varepsilon. \tag{36}$$

Observe now that since $\widetilde{c}^1 = c^1$ and $\widetilde{S}_l^1 > S_l^1$, Proposition 4 implies that it is possible to construct $\Delta\widetilde{S}^1$ such that

$$V(\widetilde{S}, \widetilde{c}^1) \geq V\left(S, c^1\right) \text{ and } U(\widetilde{S}, \widetilde{c}^1) > U\left(S, c^1\right) \tag{37}$$

implying that (32) is satisfied and, by D1, it must be that $\widetilde{\gamma} \geq \overline{\gamma} > \widehat{\gamma}$ (where $\overline{\gamma}$ is the highest type in the pool containing the lowest type, and $\widetilde{\gamma}$ and $\widehat{\gamma}$ are the on and off-equilibrium beliefs—cf. Lemma 1). Turning to (34), we have that the equilibrium candidate does not survive D1 if the investor makes a profit when offering $\widetilde{P}$. Since (taking into account all types) $\widetilde{P} \leq \widetilde{P}(\overline{\gamma})$ (where $\widetilde{P}(\overline{\gamma})$ satisfies (36) for type $\overline{\gamma}$), it is sufficient to show that

$$\begin{aligned}
& P - (1-\widehat{\gamma})\left(x_l + c^1\right) - \left(\widetilde{P}(\overline{\gamma}) - (1-\widetilde{\gamma})\left(x_l + \widetilde{c}^1\right)\right) - \left(U_D(\widetilde{S}^1, \widetilde{c}^1) - U_D\left(S^1, c^1\right)\right) \\
& +\widetilde{\gamma}\left(V(\widetilde{S}^1, \widetilde{c}^1) + U_D(\widetilde{S}^1, \widetilde{c}^1)\right) - \widehat{\gamma}\left(V\left(S^1, c\right) + U_D(S^1, c^1)\right) \\
\geq\; & P - (1-\widehat{\gamma})\left(x_l + c^1\right) - \left(\widetilde{P}(\overline{\gamma}) - (1-\overline{\gamma})\left(x_l + \widetilde{c}^1\right)\right) - \left(U_D(\widetilde{S}^1, \widetilde{c}^1) - U_D\left(S^1, c^1\right)\right) \\
& +\overline{\gamma}\left(V(\widetilde{S}^1, \widetilde{c}^1) + U_D(\widetilde{S}^1, \widetilde{c}^1)\right) - \widehat{\gamma}\left(V\left(S^1, c^1\right) + U_D(S^1, c^1)\right) \\
\geq\; & P - \widetilde{P}(\overline{\gamma}) + (1-\overline{\gamma})\,\varepsilon + (\overline{\gamma} - \widehat{\gamma})\left(V\left(S^1, c^1\right) + U_D(S^1, c^1) - x_l - c^1\right) \\
=\; & \overline{\gamma}\left(U(\widetilde{S}^1, \widetilde{c}^1) - U\left(S^1, c^1\right)\right) + (\overline{\gamma} - \widehat{\gamma})\left(V\left(S^1, c^1\right) + U_D(S^1, c^1) - x_l - c^1\right) > 0
\end{aligned}$$

where for the first inequality we use that the investor's expected payoff is (weakly) higher for $\widetilde{\gamma}$ than for $\overline{\gamma}$; the second inequality follows from the first part of (37) and after plugging in from (35); the equality follows from (36), while the last inequality follows from the second part of (37) and from the fact that the second term is equal to $(\overline{\gamma} - \widehat{\gamma})\,\frac{P - x_l - c^1 + U_D\left(S^1, c^1\right)}{\widehat{\gamma}} > 0$ from the investor's break even condition (18). Thus, (34) is satisfied as well, leading to the desired contradiction.

Step 2. *There is no equilibrium with payouts before $t = 3$, i.e., $c^1 = P - I_1$.* Suppose to a contradiction that $c^1 < P - I_1$ and consider a deviation to another debt contract $\widetilde{S}^1$ for which the owner-manager hoards δ more in $t = 1$: $\widetilde{c}^1 = c^1 + \delta$, implying again that $\widetilde{S}_l^1 - S_l^1 = \delta$. Just as in (35) we have that $U_D\left(S^1, c^1\right) - U_D(\widetilde{S}^1, \widetilde{c}^1) = \varepsilon$ with $\varepsilon \in [0, \delta]$, implying that we can express (31) again as (36) and that (37) holds again. Thus, we can follow the same steps as in Step 1 to show that there will be a successful deviation.

Step 3. *Existence:* Consider a candidate debt equilibrium in which all types offer $S_l^1 = x_l + c^1$

and zero payouts—i.e., $P - c^1 = I_1$ (this is the minimum, as after raising P and setting aside c^1, the owner-manager still needs I_1 to make the investment). We show that this equilibrium can be supported by arguing that there will be no profitable deviation that satisfies (33) and is, thus, consistent with D1 (loosely speaking, Lemma 1 does no apply).

If $\tau = 0$, the right-hand-side of (33) is minimal and equal to I_1. Thus, there is no deviation that can satisfy the strict inequality in (33), implying that a deviation will be attributed either to the lowest γ-type or (if $\frac{\partial P(\gamma)}{\partial \gamma} = 0$) D1 will have no bite in which case we can assume that the investor places probability one on the lowest type. In either case, for these beliefs the best response of the investor is not to offer financing, making the deviation unprofitable. Thus, when $\tau = 0$ there is a multiplicity of debt financing equilibria with positive cash hoarding.

If $\tau > 0$, we can support a debt equilibrium with $c^1 = 0$. In this case, there is no deviation for which $\widetilde{P}(\gamma) > P$ satisfies condition (33), as $U_D\left(S^1, c^1\right)$ is already minimal and there are no payouts. Thus, the investor can set probability one on the deviation coming from the lowest type, and his best response for these beliefs is to offer $P = 0$, making the deviation unprofitable. Thus, when $\tau > 0$, a debt financing equilibrium involving $P = I_1$ (and no hoarding $c^1 = 0$) can always be sustained.

Step 4: *Non-existence of equilibria with cash hoarding, i.e.,* $c^1 = 0$*, if* $\tau > 0$. We apply again Lemma 1. Suppose to a contradiction that a debt equilibrium with $c^1 > 0$ existed and consider a deviation to a debt contract with $\widetilde{c}^1 < c^1$ for which $\widetilde{P}(\gamma) < P$. In what follows, we show again that we can apply Lemma 1. Specifically, condition (33) can be satisfied, as the difference between the LHS and the RHS is $\tau\left(c^1 - \widetilde{c}^1\right)$. Thus, if (32) is satisfied, the investor's out of equilibrium belief is again $\widetilde{\gamma} \geq \overline{\gamma} > \widehat{\gamma}$.

Observe now that if $\widetilde{P}(\gamma) < I_1 + I_2$, the owner-manager faces a problem of underinvestment as described in the previous section. Define ΔW as the difference in social surplus created by the investment when the firm is not defunct and is financed with S^1 and $\widetilde{S}^1$, respectively (note, we need to subtract the hoarded cash from the overall cash flows):

$$\Delta W = W(\widetilde{S}^1, \widetilde{c}^1) - \widetilde{c}^1 - W(S^1, c^1) + c^1.$$

Plugging in (31) into (34), we now obtain

$$\begin{aligned}
& P-(1-\widehat{\gamma})\left(x_l+c^1\right)-\left(\widetilde{P}(\gamma)-(1-\widetilde{\gamma})\left(x_l+\widetilde{c}^1\right)\right)-\left(U_D(\widetilde{S}^1,\widetilde{c}^1)-U_D\left(S^1,c^1\right)\right) \\
& +\widetilde{\gamma}\left(V(\widetilde{S}^1,\widetilde{c}^1)+U_D(\widetilde{S}^1,\widetilde{c}^1)\right)-\widehat{\gamma}\left(V\left(S^1,c^1\right)+U_D(S^1,c^1)\right) \\
= \; & \widehat{\gamma}\left(x_l+c^1\right)-\widetilde{\gamma}\left(U\left(S^1,c^1\right)-U_D\left(S^1,\, c^1\right)\right)+\widetilde{\gamma}\left(U(\widetilde{S}^1,\widetilde{c}^1)-U_D(\widetilde{S}^1,\widetilde{c})\right) \\
& -\widetilde{\gamma}\left(x_l+\widetilde{c}^1\right)+\widetilde{\gamma}\left(V(\widetilde{S}^1,\widetilde{c}^1)+U_D(\widetilde{S}^1,\widetilde{c}^1)\right)-\widehat{\gamma}\left(V\left(S^1,c^1\right)+U_D(S^1,c^1)\right) \\
= \; & \widetilde{\gamma}\left(W(\widetilde{S}^1,\widetilde{c}^1)-U\left(S^1,c^1\right)+U_D\left(S^1,\, c^1\right)-\widetilde{c}^1\right)-\widehat{\gamma}\left(V\left(S^1,c^1\right)+U_D(S^1,c^1)-x_l-c^1\right) \\
= \; & \widetilde{\gamma}\left(\Delta W+W(S^1,c^1)-U\left(S^1,c^1\right)+U_D\left(S^1,\, c^1\right)-c^1\right)-\widehat{\gamma}\left(V\left(S^1,c^1\right)+U_D(S^1,c^1)-x_l-c^1\right) \\
= \; & \widetilde{\gamma}\Delta W+(\widetilde{\gamma}-\widehat{\gamma})\left(V\left(S^1,c^1\right)+U_D(S^1,c^1)-x_l-c^1\right) \\
= \; & \widetilde{\gamma}\Delta W+(\widetilde{\gamma}-\widehat{\gamma})\,\frac{I_1-x_l+\tau c^1}{\widehat{\gamma}} \qquad (38)
\end{aligned}$$

where the last equality obtains by plugging in from the investor's ex ante break even condition (18), using that $P = I_1 + c^1$. Though a decrease in c^1 leads to a decrease in surplus (Proposition 4), this decrease is only marginal if the decrease from c^1 to $\widetilde{c}^1$ is marginal. Instead, the second term of expression (38) is strictly positive, making the overall expression positive. Thus, equilibria where $c^1 > 0$, but $P < I_1 + I_2$ do not survive D1 if $\tau > 0$.

Step 5: *There are no (semi-) separating equilibria.* Step 4 implies that the defunct manager's payoff U_D is zero, since either $\tau = 0$ or $c^1 = 0$ (if $\tau > 0$). We can now show that there is no semi-separating equilibrium in which type $\overline{\gamma}$ (who is in the pool with the lowest type) offers a contract $\{\overline{S}^1, \overline{c}^1\}$ that is different from the contract $\left\{S^1, c^1\right\}$ offered by higher types $\gamma > \overline{\gamma}$. To see the claim, observe that if there were such an equilibrium, by incentive compatibility it must hold

$$\begin{aligned}
\overline{\gamma}U(\overline{S}^1,\overline{c}^1) &\geq \overline{\gamma}\left(U\left(S^1,c^1\right)-U_D\left(S^1,c^1\right)\right)+U_D\left(S^1,c^1\right)+P-c^1-I_1 \\
\gamma U(\overline{S}^1,\overline{c}^1) &\leq \gamma\left(U\left(S^1,c^1\right)-U_D\left(S^1,c^1\right)\right)+U_D\left(S^1,c^1\right)+P-c^1-I_1,
\end{aligned}$$

where we have simplified the LHS's of the inequalities by using that with debt financing $\overline{S}^1$ and $\overline{c}^1 = 0$, we have $U_D(\overline{S}^1, \overline{c}^1) = 0$ and $\overline{P} = I_1$. The inequalities above can be now rewritten as

$$\begin{aligned}
& \overline{\gamma}\left(U(\overline{S}^1,\overline{c}^1)-U\left(S^1,c^1\right)+U_D\left(S^1,c^1\right)\right) \\
\geq \; & U_D\left(S^1,c^1\right)+P-c^1-I_1 \\
\geq \; & \gamma\left(U(\overline{S}^1,\overline{c}^1)-U\left(S^1,c^1\right)+U_D\left(S^1,c^1\right)\right)
\end{aligned}$$

The first inequality implies that $U(\overline{S}^1, \overline{c}^1) \geq U\left(S^1, c^1\right) - U_D\left(S^1, c^1\right)$. This gives a contradiction in the second inequality as $\overline{\gamma} < \gamma$. Hence, the owner-manager does not offer a menu of contracts also in $t = 1$. **Q.E.D.**

Proof of Proposition 7. Given that the owner-manager does not have to raise money twice, we focus without loss on the interpretation of raising a single renegotiation-proof contract, where the potential for renegotiations is that the owner-manager of a defunct firm might threaten to sink c^1. Consider an equilibrium candidate $\left\{S^1, S^2, c^1\right\}$. Analogous to the preceding section, we have

$$U_D\left(S^1, S^2, c^1\right) = \max\left[x_l + c^1 - S_l^1, x_l + c^1 - I_2 - S_l^2 + \tau c^1\right],$$

and in a renegotiation-proof contract, the first part of the max-term will be (weakly) higher than the second term. Furthermore, there would be again a cutoff q^* so that only types $q \geq q^*$ find it optimal to invest in period $t = 2$ exchanging their initial security S^1 for S^2—i.e., $u_Y\left(S^2, q\right) \geq u_N\left(S^1, q\right)$ for $q \geq q^*$. Clearly, the best the owner-manager can have in $t = 1$ is that $q^* = q_{FB}$. Note that, just as before, the lowest $\gamma-$type will be in a pool with some higher type.

Step 1. *In every equilibrium candidate the owner-manager receives at most τc^1 in the low cash flow state in case of no new investment and zero in the low cash flow state in case of investment.* Observe first that the difference between what the manager receives in the low cash flow state in case of no new and, respectively, of new investment must be at least τc^1, as she would otherwise press the investor for this amount in return for not sinking c^1 from which she can appropriate the fraction τ. Thus, the proof boils down to showing that the manager's payoff should be minimal in the low cash flow state (both with and absent a new investment), implying also that U_D should be minimal.

We show this by arguing to a contradiction. Suppose that $U_D\left(S^1, S^2, c^1\right) > \tau c^1$ and consider a deviation to a contract for which $U_D(\widetilde{S}^1, \widetilde{S}^2, \widetilde{c}^1) = \tau c^1 < U_D\left(S^1, S^2, c^1\right)$, where this is achieved by increasing $\widetilde{S}_l^1 = S_l^1 + \delta$ or respectively $\widetilde{S}_l^2 = S_l^2 + \varepsilon$ (depending on which security affects U_D). Apart from this, the deviation contract sets the same hoarding policy, $\widetilde{c}^1 = c^1$, and is constructed to achieve the same level of interim efficiency q^* and the same expected payoff for the owner-manager in case the firm is not defunct $U(\widetilde{S}^1, \widetilde{S}^2, \widetilde{c}^1) = U(S^1, S^2, c^1)$.[27] Note that this would also imply that $V(\widetilde{S}^1, \widetilde{S}^2, \widetilde{c}^1) = V(S^1, S^2, c^1)$. With this construction, (32) is satisfied and, by D1, this deviation will be attributed at least to type $\overline{\gamma}$ (the highest type in the pool containing the lowest type) and,

[27] Formally, this would require an appropriate change in $\left\{S^1, \Delta S^1\right\}$ and/or $\left\{S^2, \Delta S^2\right\}$, such that

$$\begin{aligned}
\int_0^{q^*} u_N(\widetilde{S}^1, q) dF(q) + \int_{q^*}^1 u_Y(\widetilde{S}^2, q) dF(q) &= \int_0^{q^*} u_N\left(S^1, q\right) dF(q) + \int_{q^*}^1 u_Y\left(R^2, q\right) dF(q) \\
u_N(\widetilde{S}^1, q^*) &= u_Y(\widetilde{S}^2, q^*)
\end{aligned}$$

Note that we have three remaining variables and two equations, implying that this construction can always be satisfied without hitting any feasibility restrictions.

thus, $\widetilde{\gamma} \geq \overline{\gamma} > \widehat{\gamma}$. For such beliefs, the investor makes a profit when offering $\widetilde{P}(\overline{\gamma})$:

$$\begin{aligned}
& P-(1-\widehat{\gamma})\left(x_l+c^1\right)-\left(\widetilde{P}(\overline{\gamma})-(1-\widetilde{\gamma})\left(x_l+\widetilde{c}^1\right)\right)-\left(U_D(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)-U_D\left(S^1,S^2,c^1\right)\right) \\
& +\widetilde{\gamma}\left(V(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)+U_D(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)\right)-\widehat{\gamma}\left(V\left(S^1,S^2,c^1\right)+U_D\left(S^1,S^2,c^1\right)\right) \\
\geq\ & P-(1-\widehat{\gamma})\left(x_l+c^1\right)-\left(\widetilde{P}(\overline{\gamma})-(1-\overline{\gamma})\left(x_l+\widetilde{c}^1\right)\right)-\left(U_D(\widetilde{S}^1,\widetilde{S}^2,\overline{\gamma}^1)-U_D\left(S^1,S^2,c^1\right)\right) \\
& +\overline{\gamma}\left(V(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)+U_D(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)\right)-\widehat{\gamma}\left(V\left(S^1,S^2,c^1\right)+U_D\left(S^1,S^2,c^1\right)\right) \\
=\ & (\overline{\gamma}-\widehat{\gamma})\left(V\left(S^1,S^2,c^1\right)+U_D(S^1,S^2,c^1)-x_l-c^1\right)>0
\end{aligned}$$

where the first inequality follows from the fact that the investor's payoff increases in the type he is facing ($\widetilde{\gamma} \geq \overline{\gamma}$); for the equality we use that by construction, $\widetilde{c}^1 = c^1$ and that (31) could be stated as

$$\widetilde{P}(\gamma)-P=(1-\gamma)\left(U_D\left(S^1,\ S^2,c^1\right)-U_D(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c})\right),$$

and for the final inequality we use that the last line is equal to $(\overline{\gamma}-\widehat{\gamma})\,\frac{P-x_l-c^1+U_D\left(S^1,c^1\right)}{\widehat{\gamma}}>0$ from (18). Hence (34) is also satisfied, leading to the desired contradiction.

Step 2. *There is no equilibrium candidate in which the owner-manager raises more than I_1+I_2.* We argue again to a contradiction. Suppose that the owner-manager raised more than $I_1 + I_2$. Consider a deviation to a security $\widetilde{S}^1$ by type $\overline{\gamma}$ (the highest type in the pool containing the lowest γ-type). $\widetilde{S}^1$ is such that it implements the same level of interim efficiency q^*, the hoarding policy is the same $c^1 = \widetilde{c}^1$, we have $U_D(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1) = U_D\left(S^1,S^2,c^1\right)$, but the owner manager is better off if the firm is not defunct, $U(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1) > U\left(S^1,S^2,c^1\right)$.[28] Note that (31) becomes

$$P-\widetilde{P}(\gamma)=\gamma\left(U(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)-U\left(S^1,S^2,c^1\right)\right).$$

Furthermore, (32) is satisfied, so that by D1 this deviation will be attributed at least to type $\overline{\gamma}$ (the highest type in the pool containing the lowest type) and, thus, $\widetilde{\gamma} \geq \overline{\gamma} > \widehat{\gamma}$. Following similar steps

[28] This could be achieved by decreasing ΔS^1 and ΔS^2, subject only to the condition that $u_N(\widetilde{S}^1,q^*) = u_Y(\widetilde{S}^2,q^*)$ remains satisfied. Note that such deviation is not possible for $P < I_1 + I_2$, as then q^* results from the investor's optimization problem in $t = 2$.

to Step 1, we can show again that the investor makes a profit when offering $\widetilde{P}(\overline{\gamma})$

$$
\begin{aligned}
& P-(1-\widehat{\gamma})\left(x_l+c^1\right)-\left(\widetilde{P}(\overline{\gamma})-(1-\widehat{\gamma})\left(x_l+\widetilde{c}^1\right)\right)-\left(U_D(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)-U_D\left(S^1,S^2,c^1\right)\right) \\
& +\widetilde{\gamma}\left(V(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)+U_D(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)\right)-\widehat{\gamma}\left(V\left(S^1,S^2,c^1\right)+U_D\left(S^1,S^2,c^1\right)\right) \\
> \; & P-(1-\widehat{\gamma})\left(x_l+c^1\right)-\left(\widetilde{P}(\overline{\gamma})-(1-\overline{\gamma})\left(x_l+\widetilde{c}^1\right)\right)-\left(U_D(\widetilde{S}^1,\widetilde{S}^2,\widetilde{\gamma}^1)-U_D\left(S^1,S^2,c^1\right)\right) \\
& +\overline{\gamma}\left(V(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)+U_D(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)\right)-\widehat{\gamma}\left(V\left(S^1,S^2,c^1\right)+U_D\left(S^1,S^2,c^1\right)\right) \\
= \; & \gamma\left(U(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)-U\left(S^1,S^2,c^1\right)\right)+(\overline{\gamma}-\widehat{\gamma})\left(V\left(S^1,S^2,c^1\right)+U_D\left(S^1,S^2,c^1\right)-x_l-c^1\right) \\
& +\overline{\gamma}V(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)-\overline{\gamma}V\left(S^1,S^2,c^1\right) \\
= \; & \overline{\gamma}\left(W(\widetilde{S}^1,\widetilde{S}^2,\widetilde{c}^1)-W\left(S^1,S^2,c^1\right)\right)+(\overline{\gamma}-\widehat{\gamma})\left(V\left(S^1,S^2,c^1\right)+U_D\left(S^1,S^2,c^1\right)-x_l-c^1\right)
\end{aligned}
$$

where $W(\cdot) := V(\cdot)+U(\cdot)$ is by construction unchanged and so the first term in the last line is zero. The second term is positive as in Step 1. Thus, (34) is also satisfied and the pool of types containing the lowest type never raise more than I_1+I_2.

In what remains, we argue that also higher types do not raise more than that amount. Specifically, consider now a semi-separating equilibrium candidate in which type $\overline{\gamma}$ (who is in the pool with the lowest type) offers a different contract than higher types. From incentive compatibility, we have

$$
\begin{aligned}
& \overline{\gamma}\left(U(\overline{S}^1,\overline{S}^2,\overline{c}^1)-U_D(\overline{S}^1,\overline{S}^2,\overline{c}^1)\right)-\overline{\gamma}\left(U\left(S^1,S^2,c^1\right)-U_D\left(S^1,S^2,c^1\right)\right) \\
\geq \; & P-c^1-I_1+U_D(S^1,S^2,c^1)-\left(\overline{P}-\overline{c}^1-I_1+U_D(\overline{S}^1,\overline{S}^2,\overline{c}^1)\right) \\
\geq \; & \gamma\left(U(\overline{S}^1,\overline{S}^2,\overline{c}^1)-U_D(\overline{S}^1,\overline{S}^2,\overline{c}^1)\right)-\gamma\left(U\left(S^1,S^2,c^1\right)-U_D\left(S^1,S^2,c^1\right)\right).
\end{aligned} \tag{39}
$$

However, if higher types than $\overline{\gamma}$ raise more than I_1+I_2, then by the arguments above, the second line in (39) is positive, as $\overline{P}-\overline{c}^1-I_1=0$ and $U_D(\overline{S}^1,\overline{S}^2,\overline{c}^1)$ is minimal. But then the first and the third line give a contradiction to $\overline{\gamma}<\gamma$.

Step 3. *Existence of pooling equilibrium with* $P=I_1+I_2$ *and* $c^1=I_2$. The deviation contracts can be grouped depending on whether $\widetilde{P}(\gamma)$ is lower or higher than I_1+I_2. Consider, first, deviations for which $\widetilde{P}(\gamma)>I_1+I_2$. For such deviations condition (33) cannot be satisfied, as $U_D\left(S^1,S^2,c^1\right)$ is already minimal and there are no payouts. Thus, the investor sets probability one on the deviation coming from the lowest type and responds with $P=0$, for which the manager is worse off deviating. Consider next, deviations for which $\widetilde{P}(\gamma)<I_1+I_2$. Proceeding as in Step 4 of Proposition 6 up until expression (38), that expression becomes here

$$
\widetilde{\gamma}\Delta W+(\widetilde{\gamma}-\widehat{\gamma})\frac{I_1-x_l+\tau I_2}{\widehat{\gamma}} \tag{40}
$$

where we use that $c^1=I_2$. Expression (40) is negative and gives a contradiction (i.e., there is no profitable deviation for which the investor breaks even when offering $\widetilde{P}(\gamma) < I_1 + I_2$ even for beliefs placing probability one on the highest type) if ΔW is sufficiently negative—i.e., there is large underinvestment for $\widetilde{P}(\gamma) < I_1 + I_2$ relative to the first-best achieved for $P = I_1 + I_2$—and/or $\widehat{\gamma}$ is high, and/or I_2 and τ are small. **Q.E.D.**

Proof of Proposition 8. We show that financing with levered equity in $t = 1$ reduces overinvestment (i.e., $q^* < q_{FB}$) in $t = 2$. Since the investor just breaks even ex-ante, we have

$$\begin{aligned} \Delta S^1 &= \frac{I_1 - S_l^1}{p_N(\widehat{q})}, \\ \Delta S^2 &= \Delta x - \frac{S_l^2 - S_l^1 + p_N(q^*)\left(\Delta x - \Delta S^1\right)}{p_Y(q^*)}. \end{aligned} \tag{41}$$

(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 (41) into the investor's binding ex ante participation constraint, one can express this constraint entirely as a function of S_l^1 and q^*

$$\begin{aligned} I_1 &= \int_0^{q^*} \left(S_l^1 + p_N(q) \frac{I_1 - S_l^1}{p_N(\widehat{q})} \right) dF(q) \\ &\quad + \int_{q^*}^1 \left(S_l^2 + p_Y(q) \left(\Delta x - \frac{x_l - S_l^1 + p_N(q^*)\left(\Delta x - \frac{I_1 - S_l^1}{p_N(\widehat{q})}\right)}{p_Y(q^*)} \right) - I_2 \right) dF(q). \end{aligned} \tag{42}$$

Taking the total derivative of (42) 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

$$\begin{aligned} 0 &= \left[\begin{array}{c} \left(S_l^1 + p_N(q^*)\Delta S^1 - x_l - p_Y(q^*)\Delta S^2\right) f(q^*) \\ + \int_{q^*}^1 p_Y(q) \frac{d\Delta S^2}{dq^*} dF(q) \end{array} \right] dq^* \\ &\quad + \left[\int_0^{q^*} \left(1 - \frac{p_N(q)}{p_N(\widehat{q})}\right) dF(q) + \int_{q^*}^1 \frac{p_Y(q)}{p_Y(q^*)} \left(1 - \frac{p_N(q^*)}{p_N(\widehat{q})}\right) dF(q) \right] dS_l^1, \end{aligned} \tag{43}$$

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

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

[29] See (41) and (24) and recall that $S_l^2 = x_l$.

Further, these terms are zero at $q^* = 1$, while $q^* \leq q_{FB} < 1$. Taken together, from the preceding observations on (43) 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.**