DEPARTAMENTO DE ECONOMIA
PUC-RIO

TEXTO PARA DISCUSSÃO
Nº. 402

MANAGERIAL TURNOVER AND LEVERAGE UNDER A TAKEOVER THREAT

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JULHO 1999

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First Draft: July 30, 1999

This Draft: October 10, 1999

Abstract

How do shareholders perceive managers who lever up under a takeover threat? Increasing leverage conveys good news if it reflects management's ability to enhance value. It conveys bad news, though, if inefficient managers are more pressured to lever up. This paper demonstrates that while high leverage conveys good news under a weak takeover threat, negative updating prevails when the takeover threat is strong. Managers who lever up to defeat a takeover attack, thus, increase the chances of being replaced by their own shareholders. The model predicts that intra-industry leverage is less disperse when the takeover market is very active.

*I would like to thank Rubens Cysne, Ilan Goldfajn, Armando Gomes, Humberto Moreira, Jeff Pontiff, Ed Rice, and Luigi Zingales for helpful comments.

Since Modigliani and Miller (1958), most of the capital structure literature has assumed that debt is chosen to maximize shareholders' value. Recent papers, however, have explored the implications of giving control over the capital structure decision to self interested managers. Zwiebel (1996), for instance, argues that, in the absence of a takeover threat, managers underlever to avoid being ousted in default. In turn, managers of target firms lever up to commit to an increase in firm value that makes a disciplinary takeover unnecessary. In support of the managerial approach to the capital structure problem, Berger, Ofek, and Yermack (1997) and Garvey and Hanka (1999) document that firms respond to a stronger (weaker) takeover threat by increasing (decreasing) leverage, while Safieddine and Titman (1999) report an increase in operating performance for firms that lever up the most in response to an unsuccessful takeover attempt.

Despite finding an increase in performance, Safieddine and Titman document that 32% of the 573 firms in their sample replaced their managers within one year of the failed takeover attempt. This turnover rate is much higher than, for example, the 17% turnover rate reported by Denis and Denis (1995) in a sample of 1,689 firms in the Value Line Survey. In addition, Safieddine and Titman report an average turnover rate of 36.8% for the firms in their sample that increased leverage the most and a 30% turnover rate for those that increased leverage the least.[1] These findings suggest that shareholders of firms under a takeover attack do not view an increase in leverage as a signal of superior managerial quality. Should they view it as a bad signal of the managers' skills? Shedding some light on this question is the main goal of this paper.

The interaction of two opposing effects determines what type of signal an increase in leverage under a takeover threat sends. As in the signaling models of Ross (1977) and Leland and Pyle (1977), increasing leverage conveys good news if it reflects management's ability to generate cash-flows. It conveys bad news, though, if inefficient managers, who are likely to fear takeovers the most, are more pressured to lever up. This paper demonstrates that increasing leverage under a weak takeover threat conveys good news. Under a strong takeover threat,

[1] More precisely, Safieddine and Titman split the firms that have remained independent for at least one year after the failed takeover bid in two sub-samples: the ones that increased leverage above the median leverage increase in the sample and those that increased leverage below the median. Although the average turnover is higher in the sub-sample of firms that levered up the most, the difference is not statistically significant.

however, negative updating prevails. In this case, increasing leverage enhances the chances that the incumbent management team is replaced by their own shareholders. As a result, inefficient managers may rather pool with the efficient ones at lower debt in an attempt to mislead not only the raider but also the shareholders. The model thus predicts that intra-industry leverage is less disperse in periods of intense activity in the takeover market.

In our model, a raider forms expectations on the quality of an incumbent manager - assumed for simplicity to be either "high" or "low" - to decide whether to replace him/her in a takeover. We assume that the incumbent manager is partially entrenched, that is, in order for a takeover to be successful, the implied increase in the value of the target firm must be higher than a cut-off $C > 0$, which we interpret as the takeover cost. In addition, the manager can further reduce the chances of a takeover by increasing the firm's leverage. Leverage reduces the likelihood of a takeover for a variety of reasons. In this paper, we focus on the disciplinary role of financial distress.

In case a firm is unable to pay its debt, an event which we call financial distress, either the manager sells some of the firm's assets or she renegotiates the debt with the creditors. In any event, the manager has to deal with her shareholders in a weaker bargaining position. We model this loss of bargaining power by assuming that, in financial distress, shareholders replace the incumbent manager whenever they believe that managerial turnover enhances value (i.e. $C = 0$). The greater willingness to change managers is particularly threatening to the incumbent because, as Harris and Raviv (1990) point out, a distress event negatively updates the shareholders' beliefs on the manager's quality. High leverage, thus, imposes a financial distress threat on the incumbent manager that, as we argue below, may block a takeover.

In Ross (1977) and Leland and Pyle (1977), high leverage signals management's confidence in a strong cash-flow stream. Likewise, high leverage may signal that the incumbent is a high type manager, who would not have levered up had not she felt confident in her ability to avoid financial distress. Debt may block a takeover, thus, by signaling to the raider that managerial turnover will not enhance value.

Signaling superior managerial skills is not the only reason for why leverage may block a takeover. By levering up, the incumbent manager enhances the chances of managerial turnover in financial distress, which substitutes for the disciplinary role of a takeover. Debt can thus

reduce the value added of a takeover enough to prevent it from happening. Presumably, managers who fear takeovers the most should be more willing to substitute financial distress for the takeover threat. Hence, high leverage may block a takeover and yet convey bad news on the incumbent if inefficient managers are under a stronger takeover threat than the efficient ones.

An increase in leverage, thus, reflects not only the incumbent manager's ability to generate cash-flow but also her desire to fight the takeover threat. Can we tell which effect determines the type of signal that an increase in leverage sends? A main contribution of this paper is to demonstrate that negative (positive) updating prevails if the takeover threat is sufficiently strong (weak). The intuition is as follows. Under a weak takeover threat, a relatively low debt level can deter the raider. Accordingly, a low type manager's use of debt as an entrenchment device does not prevent the high type one from choosing an even higher debt level to signal her superior skills. Under a strong takeover threat, however, the debt that blocks the takeover likely imposes a large risk of financial distress on the high type manager. As a result, the latter will not want to further increase the risk that the firm becomes financially distressed to signal her superior skills.[2]

Finding an equilibrium where high leverage conveys good news is not difficult. For large enough takeover costs (i.e. a weak takeover threat), there exists a separating equilibrium where the high type manager chooses the largest debt. Separating equilibria where the low type manager chooses the largest debt do not exist, though. Hence, in order to obtain an equilibrium where high leverage conveys bad news, we look at semi-separating equilibria. More precisely, we exhibit a semi-separating equilibrium where the low type manager randomizes between a debt level that curbs the takeover threat and a lower debt level (which is chosen by the high type manager with probability 1) that reduces the probability of managerial turnover in financial distress but keeps the takeover threat alive. In this semi-separating equilibrium, thus, managers who lever up to defeat a takeover attack reveal themselves as low type ones and enhance the chances of being replaced in financial distress by their own shareholders.

[2]One might wonder whether it is optimal for a low type manager to substitute a strong distress threat for the takeover threat when the high type one is not willing to do so. After all, for a given debt level, the more efficient high type managers face a smaller chance of financial distress than the low type ones. As it will become clearer in section 3, though, other things equal, low type managers face a stronger takeover threat than the high type ones. Hence, low type managers are more eager to substitute financial distress for the takeover threat.

The comparative statics on the debt choices of the semi-separating equilibrium resembles some of the predictions of theories of debt that focus on minimizing managerial agency costs (e.g. Grossman and Hart, 1982, Hart and Moore, 1995, Jensen, 1986, and Stulz, 1990). For example, both the high and low debt levels increase with the inefficiency of the low type manager. Somewhat surprisingly, though, the incentives for a low type manager to use debt as an entrenchment device decrease with the takeover threat.

The intuition is straightforward. Debt can only block a strong takeover threat if it imposes on the low type manager a high probability of turnover in financial distress. Substituting turnover in a very likely distress event for a takeover is not a substantial improvement for low type managers, though. As a result, the latter may prefer to pool with the high quality managers at lower debt in an attempt to mislead the raider while reducing the probability of losing their jobs in financial distress. The model thus predicts low dispersion of intra-industry leverage in periods of intense activity in the market for corporate control.

The remainder of the paper is organized as follows. Section 1 lays down the framework and formalizes the entrenchment role of debt. Section 2 shows that high leverage conveys good news on the manager's quality only if the takeover threat is not too strong. Section 3 characterizes a semi-separating equilibrium where high leverage conveys bad news on the quality of the incumbent manager. Section 4 discusses some extensions of the model and relates its implications to the existing evidence on capital structure choice. Conclusions follow. Proofs of the propositions that are not presented in the text can be found in the appendix.

1 General Framework

1.1 The model

We start with an all equity firm run by a self interested manager. The conflict of interest that we focus on in this paper concerns the manager's ability to run the firm. We assume that the incumbent wants to retain her control position, even if she is not the best person for the job.[3] Shareholders, thus, cannot rely on the manager to voluntarily step down to enhance firm

[3]For simplicity, we abstract from other common sources of conflicts such as the investment policy and willingness to exert effort. The tension between a CEO who wants to keep her job and shareholders who want the best person to run the business is the same as in Grossman and Hart (1988), Harris and Raviv (1988) and

value. Moreover, in order to stay closer to the signaling literature on the capital structure choice, we rule out incentive contracts that induce the manager to quit. Hence, as in Hart and Moore (1995) and Zwiebel (1996), we assume that the utility of the manager is $B > 0$ in case she stays in control until the final cash-flows are paid and zero otherwise.[4]

We restrict the analysis to two production periods. The cash-flow generation of the first period, $\theta + s$, consists of two components. The first one, θ, is uniformly distributed over the interval $[0, 1]$ and captures the firm's uncertainty that is outside the manager's control. The second component, s, reflects the incumbent manager's skill (type). At the time that the manager is hired, she is one of two equally likely types: a high quality manager, s_H, or a low type one, s_L. We assume that, regardless of θ, a high type manager is more efficient than a low type one: $s_H > s_L$. We do not allow the difference in productivity to be too large, however. Formally,[5]

Assumption 1 *The minimum first period cash-flow under a high type manager cannot be as large as the maximum first period cash-flow under a low type manager. Hence,* $s_H - s_L < 1$.

We interpret the second cash-flow generation, ks, as the firm's continuation value, where $k > 1$. Assuming a risk-neutral economy with a zero risk-free rate, the firm value under the incumbent manager is equal to

$$V = E[\theta + s] + kE[s].$$

If the incumbent manager is replaced, the first cash-flow generation is not affected by the quality of the new manager.[6] Managerial replacement is only profitable, thus, if it increases the firm's continuation value. To avoid a bias in the firing decision, we assume that the quality

(1989), Israel (1992), and Stulz (1988).

[4] In his seminal paper, Ross (1977) allows for an exogenous compensation scheme on the manager. Nonetheless, he did not jointly solve for the signaling equilibrium and the optimal incentive contract. More generally, incentive contracts may be used to avoid costly signaling devices. The signaling literature ignores this possibility, though. Also, Persons (1994) shows that allowing for renegotiation weakens the effectiveness of optimal contracts in signaling models. Hence, one can interpret our analysis as the study of the polar case where renegotiation hinders the ability of compensation contracts to align incentives.

[5] Assumption 1 prevents separating equilibria where the high type manager chooses a debt level that, although safe for her, leads the low type manager to financial distress with probability 1.

[6] This assumption can be justified by the existence of a time lag for a new manager to implement changes in the firm.

of a new manager is always unknown, with average type $\bar{s} \equiv \frac{1}{2}s_L + \frac{1}{2}s_H$. Hence, if there has been no updating on the quality of the initial manager since her hiring, then there is no reason to replace her.

A negative updating on the manager's quality does not necessarily imply her dismissal, though. As in Zwiebel (1996), we assume that the incumbent manager is partially entrenched. More precisely, managerial turnover can only happen in a takeover event or in financial distress. Moreover, a takeover that aims to replace the incumbent manager succeeds only if it leads to an increase in firm value that is larger than a cut-off $C > 0$, which we interpret as the takeover cost.[7] Financial distress disentrenches the manager, though. In financial distress, the firm's cash-flow is not enough to pay the debt obligations. Thus, either the debt is renegotiated or shareholders agree to sell some of the firm's assets. In any event, the manager faces her shareholders under a weaker bargaining power, being replaced whenever the latter feel that a new manager would enhance firm value. In other terms, $C = 0$ in financial distress.

Figure 1: Sequence of events

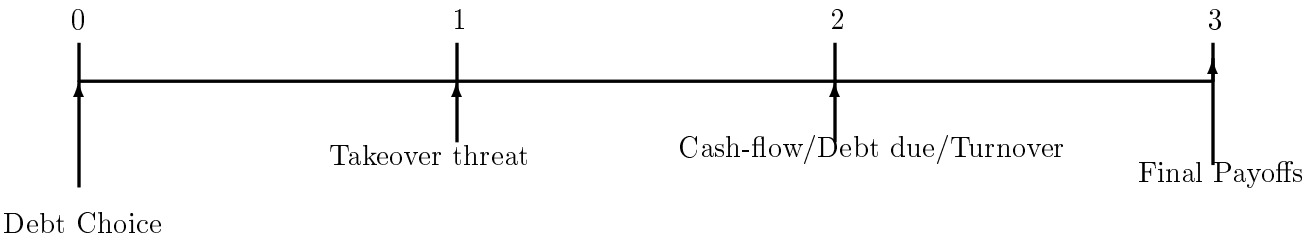

Figure 1 summarizes the sequence of events. At time t=0, the debt level D is chosen by the incumbent manager in order to maximize her chances of staying in control, which are threatened by the possibility of a takeover at time $t = 1$. As of $t = 0$, only the incumbent manager knows his/her type. The raider and the shareholders have equally likely beliefs on the two possible types (s_H and s_L). Such beliefs may be updated, though, once the capital

[7] Entrenchment may happen for several reasons. For one, free riding problems might make it more difficult for a raider to profit from a takeover that aims the replacement of a sub-optimal manager (see Grossman and Hart, 1980). Free riding problems can be partly solved if shareholders perceive themselves as pivotal to the outcome of the takeover (Holmstrom and Nalebuff, 1992) or if they allow the raider to dilute some of the firm value. In any of these two cases, the takeover succeeds if the efficiency gains are sufficiently large.

structure is chosen.

At time $t = 1$, the raider receives a private signal $r \in \{r_0, r_1\}$ of the quality of the incumbent manager. If there was some uncertainty left on the manager's type prior to the signal, then $r = r_0$ increases the incentives for a takeover. More precisely, r_0 updates equally likely priors to $prob(s = s_L|r_0) = p_0 > \frac{1}{2}$. In contrast, $r = r_1$ decreases the incentives for a takeover. In case the raider had equally likely beliefs on the two types prior to the signal, the updating with r_1 leads to a probability $p_1 < \frac{1}{2}$ that the incumbent manager is a low type one. For simplicity, we assume that the two signals, r_0 and r_1, are equally likely when the manager chooses the capital structure (time $t = 0$). Therefore, consistency with the priors ($\text{prob}(s = s_H) = \text{prob}(s = s_L) = \frac{1}{2}$) requires that $p_0 + p_1 = 1$.

A takeover happens if, after the private signal r is received, the raider believes that managerial turnover will increase firm value by more than the takeover cost C. We thus say that a takeover threat exists if, in case the firm remains with a riskless capital structure, a takeover happens with positive probability. From now on we restrict attention to firms under a takeover threat.

Assumption 2 *(Existence of a Takeover Threat) If the firm's capital structure is safe for both types of managers, that is $D \leq s_L$, then a takeover happens if the probability that the incumbent manager is a low type one is at least $p_0 > \frac{1}{2}$.*

In case a takeover does not happen at $t = 1$, the incumbent manager remains in power at least until $t = 2$, when the industry-wide shock, θ, realizes, determining the first cash-flow, $\theta + s$. Also at $t = 2$, any debt is due.

In the tradition of the costly verification models (e.g. Gale and Hellwig, 1985), we assume that shareholders cannot verify the first cash-flow generation without a cost.[8] More precisely, verifying the cash-flow requires making the incumbent manager lose some control over business decisions, an event which we model as managerial turnover. Thus, in case the manager announces that the firm is financially distressed (i.e. the cash-flow is not enough to pay the debt level D), the shareholders update their beliefs on the quality of the incumbent to $prob(s = s_L|s + \theta < D)$ and replace her if the expected gains of managerial turnover are

[8] A possible justification for this assumption is that the first cash-flow includes assets whose values are not readily known by outsiders.

positive under the updated beliefs.[9] Finally, at time $t = 3$ the second cash-flow realizes and the firm is liquidated.

1.2 The entrenchment role of debt

As we argued in the introduction, debt may block a takeover for two reasons. First, it may convey a good signal of the incumbent manager's skills, letting the raider know that managerial replacement is not profitable. Second, financial distress is a substitute for a disciplinary takeover, reducing the value added of a takeover that aims to replace the incumbent management team. In this sub-section, we illustrate the disciplinary role of a debt level that is risky for the low type manager but safe for the high type one.

Let p be the probability that the incumbent manager is a low type one and consider a debt level D^α that is risky for the low type manager only, that is, $D^\alpha = s_L + \alpha \leq s_H$, with $\alpha > 0$. From the perspective of the raider, the value of the target in case the takeover does not happen is

$$V^{NT}(D^\alpha, p) = p\{\int_0^\alpha (\theta + s_L + k\bar{s})d\theta + \int_\alpha^1 (\theta + s_L + ks_L)d\theta\} + (1-p)\{\int_0^1 (\theta + s_H + ks_H)d\theta\}. \quad (1)$$

The first term in brackets is the firm value under a low type manager, who will be in control with probability p. Conditioned on the incumbent being a low type manager, financial distress happens when $D^\alpha > s_L + \theta \Rightarrow \theta < \alpha$. Since D^α is safe for the high type manager, financial distress reveals the incumbent as a low type one and managerial turnover follows. By assumption, the first cash-flow is sunk while the expectation of the second period cash-flow increases from ks_L to $k\bar{s} \equiv k(\frac{1}{2}s_L + \frac{1}{2}ks_H)$. For $\theta \geq \alpha$, distress does not happen. In the absence of a takeover, the low type manager stays in control and the firm value is $\int_\alpha^1 (\theta + s_L + ks_L)d\theta$.

The second term in brackets is the firm value under a high type manager, who will be in control with probability $1 - p$. Since D^α is riskless for a high quality incumbent, there is no risk of financial distress. Hence, the firm value is equal to the value of an all equity firm under a high type manager.

Assume now that the raider takes over the company to replace the incumbent manager.

[9] See Fluck (1998) for a paper that focuses on the shareholders' decision to replace the incumbent management team.

Since a new manager does not affect the first cash-flow generation, a takeover event does not change the firm value in the distress states, where managerial turnover would have happened regardless of the raider. In the non-distress states, a takeover enhances value if it replaces a low type manager. Value is destroyed, though, if the raider mistakenly replaces a high quality manager. Firm value after a takeover is then equal to

$$V^T(D^\alpha, p) = p\{\int_0^\alpha (\theta + s_L + k\bar{s})d\theta + \int_\alpha^1 (\theta + s_L + k\bar{s})d\theta\} + (1-p)\{\int_0^1 (\theta + s_H + k\bar{s})d\theta\}. \quad (2)$$

By subtracting equation (1) from equation (2), we obtain the increase in value that is due to a takeover:

$$V^T(D^\alpha, p) - V^{NT}(D^\alpha, p) = k(s_H - s_L)(p - \frac{1}{2}) - p\int_0^\alpha k(\bar{s} - s_L)d\theta. \quad (3)$$

The first term in equation (3) is the expected increase in the continuation value of an all equity firm whose incumbent manager - who is a low type one with probability p - is replaced by a new manager - who is a low type one with probability $\frac{1}{2}$. The second term in the equation captures the effects of leverage on the value added of a takeover. For a debt level that is safe for the high type manager, financial distress reveals low quality, implying managerial replacement. The value added of a takeover is then reduced because managerial turnover would have happened in the distress states regardless of the raider.

By looking at equation (3), one might think that the value added of a takeover always decreases with leverage (the negative term increases in absolute terms with the probability α of distress). Nonetheless, equation (3) is no longer valid if D^α is also risky for the high type manager. In this case, financial distress does not necessarily imply that the incumbent manager is a low type one. Thus, it may not trigger the managerial turnover decision that is necessary for leverage to block the takeover. For instance, as Hirshleifer and Thakor (1994) point out, a takeover bid negatively updates shareholders' beliefs on the quality of the incumbent management. Likewise, the absence of a takeover may signal that the incumbent is a high quality manager. As a result, even if financial distress signals that the incumbent is a low type manager, it may not be enough to offset the positive updating from the absence of a takeover.

In solving the model, thus, we have to control for the shareholders' beliefs in financial distress.

2 Leverage Conveys Good News

The interaction of two opposing effects determines shareholders' updating upon an increase in leverage under a takeover threat. On one hand, increasing leverage conveys good news on the manager's quality if it reflects her ability to generate cash-flow. On the other hand, it conveys bad news if inefficient managers are more pressured to lever up. In this section, we show that positive updating prevails only if the takeover threat is not too strong.

2.1 The standard separating equilibrium

Probably, a separating equilibrium where the high type manager chooses the largest debt level - call it the *standard separating equilibrium* - is the most natural candidate to obtain good news from high leverage. In this sub-section, we show that a standard separating equilibrium exists if and only if the takeover threat is not too strong.

A low type manager can never be sure to remain in control in a standard separating equilibrium. If her debt choice, call it D^L, is risky, then the low type manager will be replaced in financial distress because D^L reveals her type to the shareholders. If D^L is safe, Assumption 2 (existence of a takeover threat) implies that a takeover will happen with probability 1. In contrast, the high type manager is sure to remain in control because, according to the equilibrium beliefs, the raider and the shareholders perceive a manager who chooses the largest debt, call it D^H, as a high type one. As a result, managerial turnover is seen as unprofitable and neither takeover nor financial distress represent a threat for a high type manager who chooses D^H.[10] A low type manager can thus eliminate the takeover threat by deviating to D^H. In order for the equilibrium debt D^L to remain optimal, the distress threat that D^H imposes on the low type manager must offset the end of the takeover threat. As we show below, this will not happen if, in order to block the takeover, D^L must be risky for the high type manager.

Suppose first that D^H is risky for the high type manager. In this case, financial distress

[10] According to the equilibrium beliefs, managerial turnover would, at best, replace a high type manager for another one. Moreover, the new manager would be a low type one with probability $\frac{1}{2}$, implying a loss to firm value.

under D^H does not trigger managerial turnover because the equilibrium beliefs would make shareholders think that the realization of θ was low enough to prevent the high type manager from paying the debt in full. Thus, in a separating equilibrium where high leverage conveys good news, D^H must be safe for the high type manager, or else the low type manager can be sure to remain in control by deviating from D^L to D^H.

Assume then that D^H is safe for the high type manager, implying managerial turnover in financial distress (a distress event now reveals the incumbent as a low type manager). Also, define D^{NT} as the smallest debt that blocks the takeover when the raider knows that the incumbent is a low type manager. We show that the standard separating equilibrium breaks down if, from the perspective of a high type manager, D^H is safe while D^{NT} is risky.

Assumption 1 implies that a debt level that is safe for the high type manager cannot impose financial distress on the low type manager with probability 1. The latter can thus keep her job with positive probability by deviating to D^H, which makes the raider think that the incumbent is a high type manager. In contrast, the proposed equilibrium debt D^L implies a takeover with probability 1 if, as assumed, D^{NT} is risky for the high type manager. To see this note that if D^H is safe for the high type manager while D^{NT} is risky, then, in the proposed equilibrium, $D^L < D^H \leq s_H < D^{NT}$. The definition of D^{NT} as the smallest debt that blocks the takeover then implies that a takeover will happen with probability 1 if D^L is chosen. The low type manager is thus strictly better off deviating to D^H, breaking down the standard separating equilibrium.

Proposition 1 *Let D^{NT} be the smallest debt that blocks the takeover when the raider knows that the incumbent manager is a low type one. If D^{NT} is risky for the high type manager, then there is no separating equilibrium where the high type manager chooses the largest debt.*

One would expect that a strong takeover threat would not be curbed by a debt level that is safe for a high type manager. In turn, a relatively low debt level might block a weak takeover threat. Accordingly, Proposition 1 suggests that the standard separating equilibrium exists if and only if the takeover threat is not too strong. Proposition 2 below confirms this intuition by using the level of the takeover cost as a proxy for the strength of the takeover market.

Proposition 2 *A separating equilibrium where the high type manager chooses the largest debt*

exists if and only if the takeover cost C is sufficiently large, that is, $C \geq \frac{ki_L(1-i_L)}{2}$, where $i_L \equiv s_H - s_L$ is the inefficiency of the low type manager.

2.2 Semi-separating equilibria

So far, we have restricted attention to the standard separating equilibrium in our attempt to obtain good news from an increase in leverage. Yet, high leverage conveys good news in a semi-separating equilibrium where the high type manager randomizes between a high debt level that reveals her superior skills and a lower debt level that is chosen by the low type manager with probability 1.[11] One might then be interested to know if a strong takeover threat breaks down not only the standard separating equilibrium but this semi-separating equilibrium as well. Proposition 3 below shows that this is indeed the case.

Proposition 3 *If we rule out equilibria where the low type manager chooses a debt level that implies financial distress with probability* 1*, then, in a semi-separating equilibrium where high leverage conveys good news, the high type manager randomizes between a debt level that is chosen by the low type manager with probability* 1 *and a higher debt level that reveals her superior skills. In this semi-separating equilibrium, the lowest debt blocks the takeover despite being safe for the high type manager. As a result, semi-separating equilibria where high leverage conveys good news exist only if the standard separating equilibrium exists as well.*

The intuition for Proposition 3 is as follows. In the semi-separating equilibrium, the lowest debt conveys bad news on the manager's quality. As a result, it must block the takeover or else the low type manager would resist choosing it. In turn, the largest debt assures that the high type manager stays in the job with probability 1. Therefore, the high type manager will be willing to randomize only if the lowest debt blocks the takeover. Blocking the takeover requires managerial turnover in financial distress, though. Hence, the lowest debt must be safe for the high type manager or else she would be strictly better off under the highest debt. We thus conclude that the lowest debt must block the takeover while being safe for the high type

[11] In principle, high leverage would also convey good news in a semi-separating equilibrium where the high type manager chooses the largest debt with probability 1, while the low type one randomizes between the high type manager's debt choice and a lower debt level. The proof of Proposition 3 shows that this equilibrium cannot obtain, though.

manager. Since this is a sufficient condition for a standard separating equilibrium to exist (see the proof of Proposition 2), we conclude that a semi-separating equilibrium where high leverage conveys good news exists only if the standard separating equilibrium exists as well.

Propositions 2 and 3 combined imply that high leverage conveys a good signal of the quality of the incumbent manager only if the takeover threat is not too strong. Under a strong takeover threat, the low type manager's desire to remain entrenched prevents the high type manager from signaling her superior skills through a leverage increase.

3 Leverage Conveys Bad News

The analysis in section 2 suggests that high leverage conveys bad news on the manager's type when the takeover threat is strong. In this section, we exhibit a semi-separating equilibrium where the high type manager chooses a debt level, call it D^H, that keeps the takeover threat alive, while the low type manager randomizes between D^H and a higher debt level that blocks the takeover. In this semi-separating equilibrium, high leverage conveys bad news on the manager's type.[12]

3.1 An example

To illustrate the semi-separating equilibrium, consider a firm whose incumbent manager has type $s \in \{s_L, s_H\} = \{1, 1.4\}$. We assume that the takeover cost is $C = .07$, $k = 1.09$, and that the signals r_0 and r_1 update equally likely priors to $p_0 = prob(s = s_L | r = r_0) = 0.7$ and $p_1 = prob(s = s_L | r = r_1) = 0.3$, respectively. For these parameters, the takeover gain in case the firm stays with riskless debt and the signal r_0 realizes is (see equation 3) $V^T(D \leq s_L, p_0) - V^{NT}(D \leq s_L, p_0) = k(s_H - s_L)(p_0 - \frac{1}{2}) = .0872$, which is greater than the takeover cost. Hence, in order to prevent a takeover under r_0, the manager must lever up.

We exhibit a semi-separating equilibrium where the high type manager chooses a safe debt level with probability 1, $D^H = s_L = 1$, while the low type manager randomizes between D^H

[12] A separating equilibrium where the low type manager chooses the highest debt level would be a natural candidate for high debt to convey bad news. Nevertheless, in this proposed equilibrium, the low type manager would be strictly better off deviating to the lower debt level, which would block the takeover with a lower risk of distress. Hence, there cannot be a separating equilibrium where the low type manager chooses the highest debt with probability 1.

and a debt level $D^L = s_L + \alpha$, where $\alpha \in (0, 1]$ is the probability that the low type manager cannot pay the debt fully. Assuming that $D^L = s_L + \alpha$ blocks the takeover, the expected utility of a low type manager in the proposed equilibrium is

$$U(D^L|s_L) = (1 - \alpha)B,$$

where $1 - \alpha$ is the probability that the low type manager will not be in financial distress and B is the benefit of remaining in control. Note that, in computing $U(D^L|s_L)$, we took into account that shareholders optimally fire the incumbent in a distress event (the choice of D^L reveals the incumbent as a low type manager).

Consider now the lower debt level D^H, which is safe for both types of manager. By choosing D^H over D^L, the low type manager eliminates the distress threat. The problem is that, in the semi-separating equilibrium, D^H does not block the takeover. Thus, the low type manager knows that the takeover happens if the signal r_0 realizes. A straightforward application of Bayes' rule shows that the probability that $r = r_0$ conditioned on $s = s_L$ is $p_0 > \frac{1}{2}$.[13] Hence, a low type manager knows that a takeover is likely to come. Accordingly, the expected utility of the low type manager under D^H is

$$U(D^H|s_L) = (1 - p_0)B.$$

In order for the low type manager to be willing to randomize, she must be indifferent between D^L and D^H. This is true only if $U(D^L|s_L) = U(D^H|s_L)$, which implies $\alpha = p_0 = 0.7$. We must then have $D^L = s_L + p_0 = 1.7$.

Having computed D^L, we check whether the high type manager has incentives to deviate from $D^H = s_L$ to D^L. In the proposed equilibrium, D^H does not block the takeover if the raider receives the signal r_0. Hence, from the perspective of the high type manager, the probability of a takeover is equal to the probability that $r = r_0$ conditioned on the incumbent being a high type one. By Bayes' rule, this conditional probability is $p_1 = 0.3 < \frac{1}{2}$.[14] Differently from

[13] By Bayes' rule, $prob(r = r_0|s = s_L) = \frac{prob(s=s_L|r_0)prob(r_0)}{prob(s=s_L|r_0)prob(r_0)+prob(s=s_L|r_1)prob(r_1)} = \frac{p_0\frac{1}{2}}{p_0\frac{1}{2}+p_1\frac{1}{2}} = \frac{p_0}{p_0+p_1} = p_0$.

[14] By Bayes' rule, $prob(r = r_0|s = s_H) = \frac{prob(s=s_H|r_0)prob(r_0)}{prob(s=s_H|r_0)prob(r_0)+prob(s=s_H|r_1)prob(r_1)} = \frac{(1-p_0)\frac{1}{2}}{(1-p_0)\frac{1}{2}+(1-p_1)\frac{1}{2}} = \frac{1-p_0}{(1-p_0)+(1-p_1)} = p_1$.

a low type manager, a high type one does not think that a takeover is likely. Accordingly, takeovers do not pressure high type managers to lever up as much as the low type ones.

The expected utility of the high type manager under her equilibrium debt strategy is

$$U(D^H|s_H) = (1 - p_1)B.$$

By deviating to $D^L = s_L + p_0$, the high type manager avoids the takeover threat. For the parameters of the example, though, the probability p_0 that the incumbent is a low type manager is larger than the inefficiency $s_H - s_L$. Hence, $D^L = s_L + p_0 > s_H$, implying that D^L is risky for the high type manager as well. Since the beliefs are updated according to the equilibrium strategies, shareholders perceive any incumbent that goes into distress under D^L as a low type manager. It then follows that, by choosing D^L, a high type manager would be replaced in a distress event. To compute the probability of financial distress under D^L, we write $D^L = s_H + p_0 - (s_H - s_L)$, from which one can see that $prob(\text{distress}|s = s_H, D^L) = p_0 - (s_H - s_L) = 0.3$. The expected utility of the high type manager under D^L is thus

$$U(D^L|s_H) = (1 - p_0 + (s_H - s_L))B.$$

The high type manager prefers D^H over D^L if and only if $U(D^H|s_H) \geq U(D^L|s_H) \Rightarrow s_H - s_L \leq p_0 - p_1 = 0.4$, which is satisfied with equality.

It remains to show that, contrary to D^L, D^H does not block the takeover when the signal r_0 realizes. In the semi-separating equilibrium, the low type manager randomizes between D^L and D^H. Let $\gamma = prob(D = D^H|s_L) = 0.9$.[15] By Bayes' rule, $l(p, \gamma) \equiv \frac{\gamma p}{\gamma p + (1-p)}$ is the probability that the incumbent manager is a low type one given that D^H was chosen and that the low type manager randomizes between D^H and D^L with probabilities γ and $1 - \gamma$, respectively. For $\gamma = 0.9$ and $p = p_0 = 0.7$, we have that $l(p_0, \gamma) = 0.677$. Plugging $p = l(p_0, \gamma)$ and $D^H = s_L$ into equation (3) yields

$$V^T(D^H, l(.)) - V^{NT}(D^H, l(.)) = k(s_H - s_L)(l(\gamma, p_0) - \frac{1}{2}) = .077 > .07 = C. \qquad (4)$$

[15] There is no restriction on γ other than belonging to the open interval $(0, 1)$. Nonetheless, a large γ increases the incentives for a takeover under D^H as required by the semi-separating equilibrium.

Thus, under D^H and r_0, the value added of a takeover is greater than the takeover cost C. As required by the semi-separating equilibrium, D^H keeps alive the takeover threat.

Finally, we show that $D^L = s_L + p_0$ blocks the takeover, that is, the takeover gains are smaller than the takeover cost. According to the equilibrium beliefs, D^L reveals the incumbent as a low type manager. Hence, the value added of a takeover consists of the expected increase in the firm's continuation value (ks) due to the replacement of a low type manager by a new one in the non-distress states (probability $1 - p_0$). The takeover gains are then equal to $V^T(D^L, p = 1) - V^{NT}(D^L, p = 1) = k\frac{s_H - s_L}{2}(1 - p_0) = .0654 < .07 = C$.

We have thus shown that: i) D^L, but not D^H, blocks the takeover, ii) the high type manager prefers the lower debt D^H over D^L, and iii) the low type manager is willing to randomize between the two debt levels. A Perfect Bayesian Equilibrium where high leverage conveys bad news on the quality of the incumbent manager then follows if the out of equilibrium beliefs are such that $prob(s = s_L | D \neq D^H) = 1$.

3.2 Characterizing the semi-separating equilibrium

The example in the previous subsection proves that, in equilibrium, high leverage may convey bad news on the manager's quality. The example does not illustrate, though, how the equilibrium changes with perturbations in the main sources of conflicts in the capital structure choice, namely: the inefficiency of the low type manager and the takeover cost. In addition, one might want to know whether the equilibrium is robust to the usual refinements.

Proposition 4 below characterizes the set of semi-separating equilibria where high leverage conveys bad news on the manager's quality. The proposition also shows that the semi-separating equilibria satisfy the intuitive criterion of Cho and Kreps (1987).

Proposition 4 *Let $i_L \equiv s_H - s_L$ be the inefficiency of the low type manager and $\underline{i}_L(C)$ be the minimum level of inefficiency that allows for a takeover when the capital structure is riskless, the takeover cost is C, and the probability that the incumbent is a low type manager is $p_0 > \frac{1}{2}$. Then, there is a level of inefficiency $\hat{i}_L(C) < \frac{p_0}{2}$ such that any $i_L \in [\underline{i}_L(C), \hat{i}_L(C))$ allows for a semi-separating equilibrium that satisfies the intuitive criterion. In the semi-separating equilibrium, the lowest debt level is at least equal to $D^H(i_L) = s_L + \frac{i_L - (p_0 - p_1)}{1 - p_0}$ and the strategies and beliefs are:*

- *Debt Levels*

$$D^H = s_L + \beta < s_H \quad \textit{where } \beta \in [\tfrac{i_L-(p_0-p_1)}{1-p_0}, i_L) \textit{ and } D^H \textit{ cannot block the takeover,}$$

$$D^L = s_L + p_0 + \beta(1-p_0) \quad \textit{where } D^L \textit{ blocks the takeover.}$$

- *Strategies: High type manager chooses* D^H *with probability* 1*, low type manager randomizes between* D^H *and* D^L *with probabilities* γ *and* $1-\gamma$*, respectively.*

- *Beliefs:* $prob(s = s_L | D \neq D^H) = 1$*,* $prob(s = s_L | D = D^H) = \frac{\gamma p}{\gamma p + (1-\gamma)}$*, where* p *is the unconditional probability that the incumbent is a low type manager.*

Moreover, the semi-separating equilibrium breaks down if the inefficiency of the low type manager is bigger than or equal to $\frac{p_0-p_1}{p_0}$.

Proposition 4 generalizes the example given in the previous section. In a semi-separating where high leverage conveys bad news, the high type manager chooses a debt level D^H that keeps the takeover threat alive, while the low type manager randomizes between D^H and a larger debt level D^L that blocks the takeover. The characterization of the semi-separating equilibrium shows that D^H is safe for the high type manager, with a lower bound ($s_L + \frac{i_L-(p_0-p_1)}{1-p_0}$) that, for a fixed s_L, increases with the inefficiency, i_L, of the low type manager. In turn, the debt D^L that blocks the takeover increases with D^H, implying that D^L increases with the manager's inefficiency if D^H does. If we restrict attention to semi-separating equilibria where the debt levels are as low as possible, then D^H *and* D^L strictly increase with the manager's inefficiency.[16]

The intuition for this comparative statics result is straightforward. If the debt levels are as low as possible, then D^L is just large enough to block the takeover. Since an increase in the inefficiency of the low type manager enhances the replacement gains, D^L must be increased or else a takeover will happen. In order for the low type manager to remain indifferent between the larger D^L and D^H, the latter will have to increase as well.

[16] If we allow for financial distress costs, we can see this restriction on the set of semi-separating equilibria as an efficiency based refinement (it minimizes the expected costs of distress).

Note that the inefficiency of the low type manager is not essential for the argument above. The debt D^L must increase whenever the takeover threat becomes stronger. In particular, this is true when the takeover cost C decreases. Accordingly, our model predicts that both debt levels increase in periods of intense activity in the takeover market, which are captured in our model as periods where the takeover cost is low. Somewhat surprisingly, though, a strong takeover market reduces the likelihood that a low type manager will lever up to block the takeover threat.

In the semi-separating equilibrium, the lower debt cannot block the takeover or else the low type manager would strictly prefer to pool with the high type one at D^H, which would block the takeover with a smaller probability of financial distress. Still, a large D^H can be part of a semi-separating equilibrium if the low type manager chooses it with a large probability. In this case, the lower probability that the raider will mistakenly replace an efficient manager may offset the reduction in the value added of a takeover that comes with a large D^H. Accordingly, in order for D^H not to block the takeover, the probability that the low type manager pools with the high type one must be at least equal to a cut-off $\hat{\gamma}$ that increases with D^H. Now, since D^H decreases with C, we conclude that, as the takeover cost decreases, the cut-off $\hat{\gamma}$ increases, making it is less likely that the larger debt D^L that blocks the takeover will be chosen. Proposition 5 below formalizes the discussion on the takeover cost C and the leverage decision.

Proposition 5 *Consider a semi-separating equilibrium where the larger debt D^L is just enough to block the takeover. Thus, the equilibrium debt levels D^H and D^L decrease with the takeover cost. Moreover, the probability γ that the low type manager pools with the high type one at the lower debt D^H must be at least equal to a cut-off $\hat{\gamma}(C)$ that decreases with the takeover cost C.*

Proposition 5 suggests that, for a sufficiently low takeover cost, the semi-separating equilibrium breaks down because the low type manager will end up pooling with the high type one at the lower debt level with probability 1. Indeed, as the takeover cost decreases, the minimum debt level that blocks the takeover increases, implying a larger probability that the incumbent will be ousted in financial distress. One would then expect that low type managers strictly prefer to pool with the high type ones at a lower debt level, in an attempt to mislead the raider while reducing the probability of being ousted in financial distress.

A low takeover cost is not the only hurdle for a semi-separating equilibrium where high leverage conveys bad news. Large takeover costs (i.e. a weak takeover threat) may also prevent a low type manager from levering up to block a takeover. The intuition is simple. A takeover threat is the only reason in our model for the low type manager not to pool with the high type one at the lower leverage. For a sufficiently large takeover cost, though, even the lower bound of D^H would block the takeover. Accordingly, the low type manager would not need to lever up beyond the high type manager's debt choice to block the takeover. Of course, the semi-separating equilibrium where the low type manager chooses the highest leverage with positive probability breaks down. We thus have

Proposition 6 *Semi-separating equilibria where high leverage conveys bad news on the quality of the incumbent manager do not exist if the takeover cost is either sufficiently small or sufficiently large.*

Propositions 6 raises the question of which type of equilibrium is likely to obtain when the semi-separating equilibrium breaks down. For small takeover costs, the answer is unambiguous. As section 2 demonstrated, separating and semi-separating equilibria where high leverage conveys good news also break down when the takeover costs are small. Hence, a pooling equilibrium arises as a natural outcome of the capital structure problem.

Consider large takeover costs now. The proof of Proposition 6 shows that large takeover costs break down the semi-separating equilibrium because any debt D^H that is bigger than or equal to the lower bound given in Proposition 4 blocks the takeover. Thus, there exist debt levels that block the takeover while being safe for the high type manager (e.g. the lower bound $D^H(i_L)$). From the proof of Proposition 2, this is a sufficient condition for the existence of a standard separating equilibrium where high leverage conveys good news, which then arises as a natural candidate for the solution of the capital structure problem.

Pooling equilibria may also obtain when the takeover costs are high, though. Thus, whether the standard separating equilibrium (or a semi-separating equilibrium where high leverage conveys good) actually obtains, it depends on the high type manager's incentives to signal her superior type. One case where such incentives should be present is in a pooling equilibrium where the pooling debt does not block the takeover. As Proposition 7 below shows, the intuitive criterion prunes this equilibrium if the inefficiency of the low type manager is sufficiently large.

Proposition 7 *If takeover costs are large enough to prevent semi-separating equilibria where high leverage conveys bad news and the inefficiency of the low type manager is sufficiently large, then pooling equilibria that do not insulate the incumbent manager from the takeover market do not satisfy the intuitive criterion.*

The intuition underlying Proposition 7 is as follows. In a pooling equilibrium that does not block the takeover, the low type manager tries to mislead the raider by choosing low leverage. This strategy hurts the high type manager because the raider may mistakenly replace her. Whenever possible, thus, the latter will try to break down the pooling equilibrium. Since the standard separating equilibrium exists, the smallest debt that blocks the takeover, call it D^{NT}, is safe for the high type manager (see Proposition 1). Hence, the pooling debt that does not block the takeover, which must be lower than D^{NT}, is also safe for the high type manager. As a result, the latter can deviate to a larger debt level, say the maximum one that is safe for her, and credibly argue that the low type manager would be strictly better off playing the equilibrium strategy rather than facing the distress threat in the deviation. By convincingly arguing her case, the high type manager would not be taken over, increasing her utility vis-à-vis the pooling equilibrium, which would then fail the intuitive criterion.

A high type manager may not have incentives to break down a pooling equilibrium that blocks the takeover, however. Pooling equilibria may then arise for a sufficiently weak takeover threat.[17] Still, the main message of this section is clear: high leverage conveys bad (good) news if the takeover threat is strong (weak).

4 Discussion and Extensions

4.1 Stock price reaction to debt-for-equity exchanges

In the signaling literature on the capital structure choice (e.g. Ross, 1977 and Leland and Pyle, 1977), managers lever up to signal a strong cash-flow stream. In support of these

[17] A small perturbation in the payoffs of our model would break this indifference, though. For instance, the high type manager would gain from breaking down a pooling equilibrium if, by signaling her superior type, she can obtain a raise in compensation. Building upon Proposition 7, the pooling equilibrium would survive only if the inefficiency of the low type manager is small. Otherwise, separating or semi-separating equilibria where high leverage conveys good news should prevail.

models, empirical research has documented a positive stock price reaction to debt for equity exchanges.[18]

If there is a chance of a hostile takeover, though, an increase in leverage reflects not only the incumbent manager's estimate of the cash-flow stream but also her ability to remain entrenched. To be sure, saving the job of the incumbent manager does not necessarily hurt the shareholders. Conceivably, the increase in leverage just lets the raider know that managerial turnover will not enhance value. It might also be possible, though, that the incumbent is not the best person for the job and that the leverage increase prevents a value enhancing managerial turnover. The market's updating weighs these two possibilities.

As demonstrated in sections 2 and 3 of this paper, the strength of the takeover threat - summarized by the level of the takeover cost - determines what type of signal an increase in leverage sends. Under a weak takeover threat, the increase in leverage conveys a good signal of the quality of the incumbent management team. In contrast, negative updating prevails under a strong takeover threat. As a result, our model predicts a stronger positive stock price reaction to debt-for-equity exchanges in periods of weak activity in the takeover market.

4.2 Leverage and managerial turnover under a strong takeover threat

In our model, shareholders act on their beliefs only if the firm becomes financially distressed. In reality, financial distress is not the only corporate event that makes managers more vulnerable to shareholders' assessment of their skills. The arrival of a large shareholder, for instance, may trigger the same type of control fight that we implicitly assumed to happen in financial distress. By causing a negative updating of the incumbent manager's abilities, an increase in leverage enhances the chances of a future control fight in *and* outside financial distress.[19]

[18] For instance, Masulis (1980) and (1983), and Cornett and Travlos (1989).

[19] Although the possibility of a proxy fight reduces the takeover gains, it does not eliminate them entirely if the raider has private information on the incumbent manager's skill. Thus, the possibility of a proxy fight does not destroy the incumbent manager' incentives to use debt as a takeover defense. In this setting, the same semi-separating equilibrium of section 3 obtains: a high type manager chooses a debt level that does not block the takeover while a low type one randomizes between the high type manager's debt choice and a larger debt that blocks the takeover. Differently from section 3, though, the low type manager is now indifferent between the probability of a takeover under the lower debt level and the probability of being ousted later on in financial distress or in a control contest in case she chooses the larger debt. High leverage thus conveys a bad signal of the manager's quality, enhancing the probability that the incumbent is fired not only in financial distress but also in a proxy fight.

In deciding whether to use debt as an entrenchment device, managers then face a trade-off between an ongoing takeover threat and the risk of being ousted later on by their own shareholders. This trade-off is the essence of the semi-separating equilibrium of section 3, which yields the following implications on the leverage and managerial turnover decisions: i) Managers who lever up are more likely to be replaced by their own shareholders, ii) As the takeover threat increases, debt is less often used as an entrenchment device, iii) Intra-industry leverage is less disperse in periods of intense activity in the takeover market.

The first implication, which follows naturally from high leverage conveying bad news under a strong takeover threat, is consistent with the findings in Safieddine and Titman (1999), who report that, for a sample of firms that defeated a takeover bid, the average turnover rate is higher in the firms that levered up the most (36.8%) than in the firms that levered up the least (30%).

Turning to the two other implications, Proposition 5 shows that smaller takeover costs (i.e. a stronger takeover threat) inhibit managers' use of debt as an entrenchment device. Instead of levering up and facing a greater risk of being fired by their own shareholders, inefficient managers under a strong takeover threat may rather pool with the efficient ones at lower debt in an attempt to mislead not only the raider but also the shareholders. Accordingly, intra-industry leverage should be less disperse in periods of intense activity in the takeover market.

The increase in corporate leverage in the 1980s - a period of intense activity in the takeover market - seems to contradict the implication on the use of debt as an entrenchment device, though. Nonetheless, Proposition 5 implies that a stronger takeover threat increases the debt that blocks the takeover *and* the lower pooling debt. Hence, the strengthening of the takeover market in the 1980s may have forced managers to lever up even if they did not set their leverage high enough to end the takeover threat. In order to test our second implication, thus, one has to control for the industry leverage. For instance, Berger, Ofek and Yermack (1997) show that firms under a takeover attack, on average, lever up above their industry average. If we assume that the pooling leverage equals the industry average, then the model predicts that, during the 1980s, fewer firms under a takeover attack levered up beyond the industry average than in periods when the takeover market was not so active.

Finally, we are not aware of any empirical study that looked at the dispersion of intra-industry leverage in periods of strong takeover activity. The implication can be tested, though, by constructing proxies for the strength of the takeover threat, as in, for instance, Berger, Ofek, and Yermack (1997).

4.3 Overleverage

Harris and Raviv (1988), Stulz (1988), and Novaes and Zingales (1995) argue that, in response to a stronger takeover threat, managers may lever up above the value maximizing level. In order to assess this possibility, we assume that leverage is determined by the semi-separating equilibrium of section 3, where the low type manager randomizes between a high debt level that blocks the takeover and a lower level of debt that keeps the takeover threat alive.[20]

Determining whether a manager overlevers in response to a takeover threat requires computing the value maximizing debt, that is, the debt level that shareholders would like to impose at $t = 0$ when they do not know the type of the incumbent manager and the signal that the raider will receive at $t = 1$.

To accomplish this task while retaining most of our framework intact, we assume that a fraction $\lambda \in (0,1)$ of the first cash-flow, $\theta + s$, is lost in financial distress, and we call this loss the *cost of financial distress*. Since managerial turnover does not affect the first cash-flow generation, the cost of financial distress does not change the replacement gains. Therefore, the characterization of the semi-separating equilibrium given in Proposition 4 remains valid. In particular, the lower debt D^H must amount to at least $s_L + \frac{i_L - (p_0 - p_1)}{1 - p_0}$.

The value maximizing debt level involves a trade-off between two types of error. On the one hand, high leverage may eliminate a less expensive disciplinary device: takeovers. On the other hand, low leverage prevents shareholders from taking advantage of financial distress as a signal of the manager's quality. As we argue below, this trade-off implies that, in our framework, the value maximizing debt is safe for the high type manager.

To see why, note first that shareholders may not want to lever up too much if takeovers are desirable (remember that leverage may block the takeover). Thus, the optimal debt level

[20] In principle, overleverage might also happen in a pooling equilibrium. We do not consider this possibility, though, because the analysis would depend too much on which refinement is used to constrain the set of equilibria.

in the absence of takeovers is at least as large as the value maximizing debt level (which takes into account that it may be optimal to reduce debt to keep alive the takeover threat). As a result, we only have to show that, when takeovers are not allowed, firm value decreases if debt goes above the maximum level that is safe for the high type manager. Accordingly, we rule out takeovers and write the firm value for a given debt level D as

$$V(D) = \frac{1}{2}\{\int_0^{\theta_D(s_L)} [(1-\lambda)(s_L+\theta) + k\bar{s}]d\theta + \int_{\theta_D(s_L)}^1 [s_L + \theta + ks_L]d\theta\} + \tag{5}$$

$$\frac{1}{2}\{\int_0^{\theta_D(s_H)} [(1-\lambda)(s_H+\theta) + k\bar{s}]d\theta + \int_{\theta_D(s_H)}^1 [s_H + \theta + ks_H]d\theta\}.$$

The first term in brackets in equation (5) is the firm value under a low type manager. As before, the firm becomes financially distressed if and only if the first cash-flow generation cannot meet all the debt's obligations, that is, $s_L + \theta < D$. This condition induces a cut-off, $\theta_D(s_L)$, such that financial distress happens if and only if $\theta < \theta_D(s_L)$. The cut-off varies with the debt level as follows

$$\theta_D(s_L) = \begin{cases} 0 & \text{if } D \leq s_L \\ D - s_L & \text{if } D \in (s_L, 1+s_L) \\ 1 & \text{if } D \geq 1 + s_L. \end{cases}$$

Returning to equation (5), the integrals in the first bracket capture the firm value with and without distress, respectively. Note also that the integral over the distress states takes into account managerial turnover and the cost of distress $\lambda(s_L+\theta)$.[21] Analogously, the second term in brackets is the firm value conditioned on the incumbent being a high type manager.[22]

Let D be any debt level that is risky for the high type manager, thus: $\theta_D(s_L) > \theta_D(s_H) > 0$. Differentiating the firm value at D yields $\frac{\partial V(D)}{\partial D} = -2\lambda\bar{s} - \lambda(\theta_D(s_H) + \theta_D(s_L)) < 0$. Therefore, a decrease in leverage enhances firm value, implying that the optimal debt level cannot be risky for the high type manager.

[21] If takeovers are not allowed, a simple application of Bayes' rule implies that $prob(s = s_L | \text{distress}, D) > \frac{1}{2}$ for any $D \in (s_L, 1+s_H)$.

[22] In the value maximizing approach, shareholders are assumed to have control on the firm's leverage. Thus, the debt choice does not convey information on the type of the incumbent manager and $V(D)$ is computed under the prior $prob(s = s_L) = \frac{1}{2}$.

Now, the debt D^L that blocks the takeover must be risky for the high type manager in any semi-separating equilibrium, otherwise the latter would deviate to D^L to eliminate the takeover threat.[23] Since the value maximizing debt is safe for the high type manager, the low type one overlevers when she chooses a debt that blocks the takeover. We thus have

Proposition 8 *In any semi-separating equilibrium where leverage conveys bad news, the debt D^L that blocks the takeover is above the value maximizing debt level.*

As in Harris and Raviv (1988), Stulz (1988) and Novaes and Zingales (1995), our model allows for overleverage.[24] The analysis in section 3 suggests that asymmetry of information on the manager's quality limits the expected cost of overleverage, though. Indeed, Proposition 5 implies that a low type manager is unlikely to use debt as an entrenchment device if blocking a takeover requires a very large leverage. Instead, she may try to disguise herself by pooling with the high type manager at a debt level that does not block the takeover. Hence, as the following example illustrates, a costly overleverage is an unlikely outcome of a takeover threat.

Suppose that the manager's type is either $s_L = 1$ or $s_H = 1.55$ with beliefs $prob(s = s_L|r_0) = 0.75$ and $prob(s = s_L|r_1) = 0.25$. The takeover cost is $C = .06$, $k = 1.09$, and financial distress destroys 4% of the first cash-flow ($\lambda = .04$). The minimum debt that blocks the takeover is $D^L = 1.80$, which imposes a probability of financial distress of 80% in a firm run by a low type manager. From $D^L = s_L + p_0 + \beta(1 - p_0) = 1.8$ (see Proposition 4), we obtain the lower debt as $D^H = s_L + \beta = 1.2$. In order for D^H not to block a takeover, the probability γ that the low type manager chooses D^H must be at least 67%.[25] Hence, although D^L overlevers the firm, a low type manager will not likely choose it in a semi-separating equilibrium. Instead, the inefficient manager will likely pool with the high type manager at

[23] Proposition 4 implies that $D^L \geq s_L + p_0 + \frac{i_L - (p_0 - p_1)}{1 - p_0}(1 - p_0) = s_L + i_L + p_1 = s_H + p_1 > s_H$. Hence, the probability of financial distress for the high type manager under D^L is equal to p_1.

[24] One might think that Proposition 8 is not consistent with the existing evidence on the positive stock price reaction to debt-for-equity exchanges. As we have already argued, however, the model predicts a positive stock price reaction under a weak takeover threat. Moreover, if, consistent with Berger, Ofek, and Yermack (1997), the firm was underlevered prior to the increase in the takeover threat, then overleverage leads to a decrease in firm value only if the cost of overleverage outweighs the benefits of ending the underleverage.

[25] The minimum debt that blocks the takeover can be found by solving $V^T(D^L, 1) - V^{NT}(D^L, 1) = C$, while the minimum probability γ that the low type manager chooses D^H follows from $V^T(D^H, l(\gamma, p_0)) - V^{NT}(D^H, l(\gamma, p_0)) = C$, where $l(\gamma, p_0) \equiv \frac{\gamma p_0}{\gamma p_0 + (1 - p_0)}$ is the probability that the incumbent is a low type manager conditioned on the signal r_0, D^H, and γ.

the lower debt $D^H = 1.2$. In case the firm's capital structure was riskless prior to the takeover threat, value under the pooling debt increases by 4.3%.[26]

5 Conclusions

Recent empirical research provides evidence that, under a takeover threat, managers lever up to commit to an increase in value that makes a disciplinary takeover unnecessary. In particular, Safieddine and Titman (1999) document an increase in operating performance for the firms in their sample that have increased leverage the most in response to a takeover bid. Despite the increase in performance, Safieddine and Titman report that the managerial turnover rate in these firms is at least as high as in the firms that have levered up the least. Apparently, shareholders do not view an increase in leverage under a takeover attack as a signal of superior managerial quality.

This paper shows that the strength of the takeover threat determines what type of signal an increase in leverage under a takeover threat sends. Under a weak takeover threat, high leverage conveys good news as in the standard signaling models of capital structure choice. Under a strong takeover threat, however, negative updating prevails, enhancing the chances that the incumbent management team will be replaced by their own shareholders. As a result, inefficient managers may prefer to pool with the efficient ones at lower debt, in an attempt to mislead not only the raider but their shareholders as well. Somewhat surprisingly, thus, managers refrain from using debt as an entrenchment device when the threat that it is aimed to defeat becomes very strong.

[26] To obtain the 4.3% increase in firm value, assume equally likely priors and that the low type manager chooses D^H with the minimum probability .667 that keeps the takeover threat alive. The choice of D^H updates the raider's beliefs at the takeover decision to $l(\gamma, p) = \frac{\gamma p}{\gamma p + (1-\gamma)}$, where $p \in \{p_0, p_1\}$. From the shareholders' perspective, the probability that the raider will receive the signal r_1 that prevents the takeover is $prob(r_1|D^H) = \frac{prob(D^H|r_1)prob(r_1)}{prob(D^H)} = .55$. To evaluate this probability, we made use of $prob(D^H|r_1) = prob(D^H|r_1, s_H)prob(s_H|r_1) + prob(D^H|r_1, s_L)prob(s_L|r_1)$ and $prob(D^H) = prob(D^H|s_L)prob(s_L) + prob(D^H|s_H)prob(s_H)$. Firm value conditioned on D^H follows from $V(D^H) = prob(r_1|D^H)[l(p_1,\gamma)V^{NT}(s_L, D^H) + (1 - l(p_1,\gamma))V^{NT}(s_H, D^H)] + (1 - prob(r_1|D^H))[l(p_0,\gamma)V^T(s_L, D^H) + (1 - l(p_0,\gamma))V^T(s_H, D^H)] = 3.30$, where $V^T(.)$ and $V^{NT}(.)$ are, respectively, the firm value with and without the takeover. In turn, firm value prior to the takeover threat was $\frac{1}{2}(E[\theta] + (1+k)s_L) + \frac{1}{2}(E[\theta] + (1+k)s_H) = 3.16$.

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Appendix

Proof of Proposition 2

Call D^{NT} the minimum debt that blocks the takeover when the raider knows that the incumbent manager is a low type one. If D^{NT} is safe for the high type manager, then we claim that the following strategies and beliefs form a separating equilibrium: $D^L = D^{NT}$, $D^H \in (D^{NT}, s_H]$, $prob(s = s_L | D \neq D^H) = 1$, and $prob(s = s_L | D = D^H) = 0$. To prove the claim, note first that the high type manager does not have incentives to deviate because the equilibrium strategies and beliefs assure that she will stay in the job with probability 1. In contrast, the probability of the low type manager being ousted in distress is positive (but lower than one) under D^L because $D^L = D^{NT} \leq s_H$ and D^{NT} can only block the takeover if it imposes on the low type manager a positive probability of being ousted in financial distress. We show that the low type manager cannot improve by deviating from her equilibrium strategy. Given the beliefs and the choice of D^{NT} as the minimum debt level that blocks a takeover, any deviation to $D < D^{NT}$ triggers a takeover. By deviating to $D > D^{NT}$, the probability of distress would be larger than in D^L and distress would trigger managerial replacement either because D^H is safe for the high type manager or $D \neq D^H$ reveals the incumbent as a low type manager. Hence, the low type manager is strictly better off following the equilibrium strategy.

Now we prove that a debt level that is safe for the high type manager may block the takeover if the takeover cost is sufficiently large. Let the inefficiency of the low type manager be $i_L \equiv s_H - s_L$. Plugging $D^L = s_H \equiv s_L + i_L$ and $p = prob(s = s_L | D^L) = 1$ in equation (3) yields the following takeover gain:

$$V^T(D = s_H, 1) - V^{NT}(D = s_H, 1) - C = k(s_H - s_L)\frac{1}{2} - \int_0^{i_L} k(\bar{s} - s_L)d\theta - C = k\frac{i_L}{2}(1 - i_L) - C.$$

The takeover is blocked if $V^T(D = s_H, 1) - V^{NT}(D = s_H, 1) - C \leq 0$, which is satisfied for $C \geq k\frac{i_L}{2}(1 - i_L)$.

□

Proof of Proposition 3

We first show that, if we rule out equilibria where the low type manager may choose a debt

level that leads her to financial distress with probability 1, then there is no semi-separating equilibrium where the low type manager randomizes and high leverage conveys good news.

Suppose by contradiction that there is a semi-separating equilibrium where the low type manager randomizes between a debt level D^L and a higher debt level, call it D^H, that is chosen by the high type manager with probability 1. If D^L does not block the takeover, $U(D^L|s_L) = 0$. Consider first that $D^L < D^H \leq s_L$. The strategies of the semi-separating equilibrium and Bayesian updating imply that, under D^H, the probability that the incumbent is a low type manager is lower than $\frac{1}{2}$ when the raider receives the signal $r = r_1$. Thus, the takeover does not happen under r_1 and the expected utility of the low type manager under D^H is at least $(1 - prob(r = r_0|s_L))B = (1 - p_0)B > 0$, implying that the low type manager strictly prefers D^H over D^L. Assume now that the takeover is blocked under $D^H > s_L$ but not under $D^L < D^H$. Hence, the low type manager is indifferent between D^L and D^H only if her probability of distress under D^H is 1; deviation to D^H is then ruled out by an assumption of the proposition. If $D^H > s_L$ and neither D^H nor D^L block the takeover, then the expected utility of the low type manager under D^H in the worst case scenario where distress leads to managerial turnover is $(1 - prob(r = r_0|s_L))(1 - prob(distress|D^H, s_L)B$, which is equal to zero only if $prob(distress|D^H, s_L) = 1$. We thus conclude that D^L must block the takeover.

In order to block the takeover, D^L must be risky for the low type manager (Assumption 2), triggering managerial turnover in a distress event. Now, since D^L blocks the takeover, the larger D^H must block it as well. But then the low type manager cannot be indifferent between D^L and D^H. Indeed, the low type manager strictly prefers D^H over D^L if D^H does not trigger managerial turnover in financial distress. If, instead, financial distress under D^H implies managerial turnover, then the low type manager strictly prefers the smaller D^L, which imposes a lower probability of financial distress. Hence, the proposed semi-separating equilibrium breaks down, proving that, in order for high leverage to convey good news in a semi-separating equilibrium, the high type manager must randomize between a debt level that reveals her superior skills and a lower debt level that is chosen by the low type manager with probability 1. Below, we prove that this lower debt must be safe for the high type manager and yet it must block the takeover.

Call D^H the debt that reveals the incumbent as a high type manager and D^L the smaller

debt that is chosen by the low type manager with probability 1. By choosing D^H, the high type manager stays in the job with probability 1. In particular, there is no managerial turnover even if distress happens. Thus, the high type manager can only be indifferent between the two debt levels if D^L blocks the takeover. D^L can only block the takeover, though, if it triggers managerial turnover in distress (otherwise D^L is like safe debt from the perspective of the raider). But then D^L must be safe for the high type manager, or else she would be strictly better off choosing D^H with probability 1 to avoid the risk of being replaced in a distress event under D^L. From the proof of Proposition 2, the standard separating equilibrium must also exist.

□

Proof of Proposition 4

In the semi-separating equilibrium, the low type manager is indifferent between $D^H = s_L + \beta$ and $D^L = s_L + \alpha > D^H$. The larger debt D^L leads a low type manager into financial distress with probability α, triggering managerial turnover because D^L reveals that the incumbent is a low type manager. Assuming that D^L blocks the takeover, the expected utility of a low type manager is $U(D^L|s_L) = (1-\alpha)B$, where B is the manager's benefit of staying in control.

To obtain $U(D^H|s_L)$, recall that, in the proposed equilibrium, D^H does not block the takeover if the signal $r = r_0$ realizes. A straightforward application of Bayes' rule shows that $prob(r = r_0|s = s_L) = p_0 > \frac{1}{2}$. Hence, the probability that the low type manager is not replaced by the raider under D^H is $1 - p_0$. Now, even if the low type manager survives the takeover threat, she can lose her job in a distress event. To evaluate this probability, suppose first that D^H is safe for the high type manager. Thus, financial distress reveals the incumbent as a low type one and replacement follows. If D^H is risky for the high type manager, then Bayesian updating implies that the probability that $s = s_L$ given that distress happened under D^H and that the takeover did not happen ($r = r_1$) is equal to

$$\frac{prob(\text{distress}|s_L, D^H)prob(D^H|s_L)prob(r = r_1|s_L)}{prob(\text{distress}|s_L, D^H)prob(D^H|s_L)prob(r = r_1|s_L) + prob(\text{distress}|s_H, D^H)prob(D^H|s_H)prob(r = r_1|s_H)}$$

$$= \frac{1}{1 + \frac{p_0}{1-p_0}\frac{prob(\text{distress}|s_H, D^H)}{prob(\text{distress}|s_L, D^H)\gamma}},$$

which is larger than $\frac{1}{2}$ if and only if $\gamma > \frac{prob(\text{distress}|s_H, D^H)}{prob(\text{distress}|s_L, D^H)}\frac{p_0}{1-p_0}$. Assume for a while that this

condition holds. Thus, financial distress triggers managerial turnover and, by choosing D^H, the low type manager enjoys the benefits of control only if she survives the takeover threat, an event with probability $1-p_0$, *and* the threat of distress, which happens with probability $1-\beta$. The expected utility of the low type manager in case she chooses the lower debt D^H is then $U(D^H|s_L) = (1-p_0)(1-\beta)B$.

Indifference between D^L and D^H for the low type manager requires $U(D^L|s_L) = U(D^H|s_L)$, which implies $\alpha = p_0+\beta(1-p_0)$. For the low type manager to be willing to randomize between D^H and D^L we must have $D^L = s_L + p_0 + \beta(1-p_0)$.

To obtain restrictions on D^H, we look at the incentive compatibility condition of the high type manager. In the proposed equilibrium, D^H does not block the takeover if the raider receives the signal r_0. By Bayes' rule, $prob(r = r_0|s = s_H) = p_1 < \frac{1}{2}$. Hence, the high type manager is not replaced by a takeover under D^H with probability $1-p_1 > \frac{1}{2}$. If D^H is risky for the high type manager, that is $s_L + \beta > s_H$, then D^H leads the firm to financial distress with probability $s_L + \beta - s_H = \beta - (s_H - s_L) \equiv \beta - i_L$, where i_L is the inefficiency of the low type manager. Still assuming that $\gamma > \frac{prob(\text{distress}|s_H, D^H)}{prob(\text{distress}|s_L, D^H)} \frac{p_0}{1-p_0}$, managerial turnover would follow, implying that the expected utility of the high type manager is $U(D^H|s_H) = (1-p_1)(1-max[\beta - i_L, 0])B$.

By deviating to $D^L = s_L + p_0 + \beta(1-p_0)$, the high type manager avoids the takeover threat. However, the higher debt level imposes a larger probability of distress, which implies managerial turnover under the equilibrium beliefs. The expected utility of the high type manager under D^L is thus $U(D^L|s_H) = (1-[p_0+\beta(1-p_0)-i_L])B$, where we made use of $p_0+\beta(1-p_0)-i_L > 0$ (otherwise, $U(D^L|s_H) = B$ would imply that the high type manager is strictly better off under D^L). It then follows that the high type manager prefers D^H over D^L if and only if

$$U(D^H|s_H) \geq U(D^L|s_H) \Rightarrow i_L \leq \begin{cases} \frac{p_0-p_1}{p_1}(1-\beta) & \text{if } \beta \geq i_L \\ (p_0-p_1)+\beta(1-p_0) & \text{otherwise.} \end{cases} \tag{6}$$

The incentive compatibility constraint of the high type manager imposes an upper bound on the inefficiency i_L of the low type manager. Note that a higher debt D^H allows for more inefficient low type managers until it becomes risky for the high type manager. By plugging

$D^H = s_H$ ($\beta = i_L$) in either equation in the right-hand side of inequality (6) gives us an upper bound of the level of inefficiency ($\frac{p_0 - p_1}{p_0}$).

We now consider the constraints that the market for corporate control imposes on the lower debt D^H. Let $l(\gamma, p_0)$ be the updating of the probability that the incumbent is a low type manager conditioned on D^H, a prior p_0, and the probability γ that the low type manager chooses D^H. By Bayes' rule, $l(\gamma, p_0) \equiv \frac{\gamma p_0}{\gamma p_0 + (1 - p_0)}$. Still assuming that financial distress triggers managerial turnover, the increase in firm value upon a takeover can be shown to be equal to

$$V^T(D^H, l(.)) - V^{NT}(D^H, l(.)) = l(.)(1 - \beta)k\frac{i_L}{2} - (1 - l(.))(1 - max[\beta - i_L, 0])k\frac{i_L}{2}. \quad (7)$$

The first term in equation (7) is the expected gain of a takeover conditioned on the incumbent being a low type one, which is an event with probability $l(\gamma, p_0)$. Clearly, the raider's decision to replace the incumbent increases firm value only if it would not have happened in the absence of the takeover. For debt $D^H = s_L + \beta$, managerial turnover in distress happens with probability β. Therefore, given D^H, the expected gain of a takeover conditioned on the incumbent being a low type manager is $l(.)(1 - \beta)k\frac{i_L}{2}$, where $k\frac{i_L}{2}$ is the expected gain of replacing a low type incumbent. The second term shows that managerial turnover may be a mistake. With probability $1 - l(\gamma, p_0)$, the incumbent is a high type one and managerial turnover leads to an expected loss of $k\frac{i_L}{2}$. This loss cannot be fully attributed to the takeover, though, if D^H also leads to managerial turnover in distress. Accordingly, the expected loss due to the takeover is $(1 - l(\gamma, p_0))(1 - max[\beta - i_L, 0])k\frac{i_L}{2}$, where $1 - max[\beta - i_L, 0]$ is the probability that a high type manager will not be in distress under D^H.

From equation (7), one can check that there exist incentives to takeover under D^H only if $l(.) > \frac{1}{2}$. Thus, the incentives to takeover decrease with debt and the best case scenario for D^H not to block the takeover is if the low type manager chooses it with a probability $\gamma \to 1$ and D^H is as small as possible.

For $\gamma \to 1$, one can easily check that $l(\gamma, p_0) \to p_0$. Solving for β in equation (6) when $\beta \leq i_L$ yields $\beta = \frac{i_L - (p_0 - p_1)}{1 - p_0}$, implying that the minimum debt D^H that is consistent with optimality for the debt strategies is $D^H(i_L) = s_L + \frac{i_L - (p_0 - p_1)}{1 - p_0}$. Plugging $D^H(i_L)$ and $l(\gamma, p_0) = p_0$ into equation (7) gives us $V^T(D^H(i_L), p_0) - V^{NT}(D^H(i_L), p_0) = k\frac{i_L}{2}[p_0(\frac{1 - i_L}{1 - p_0}) - 1]$, which

is a strictly concave function of i_L with a maximum at $\bar{i}_L = \frac{p_0 - p_1}{2p_0}$.

One can easily check that $V^T(D^H(i_L = \frac{p_0-p_1}{p_0}), p_0) - V^{NT}(D^H(i_L = \frac{p_0-p_1}{p_0}), p_0) = 0$, implying that the takeover is blocked in the upper bound for the level of inefficiency, $i_L = \frac{p_0-p_1}{p_0}$, that we have previously established from the incentive compatibility conditions. Since $D^H(i_L) = s_H$ when $i_L = \frac{p_0-p_1}{p_0}$ and the incentives to takeover decrease with the debt while increase with the inefficiency, we conclude that $i_L < \frac{p_0-p_1}{p_0}$ and $D^H < s_H$ in a semi-separating equilibrium where high leverage conveys bad news. Moreover, because financial distress under $D^H < s_H$ reveals that the incumbent is a low type manager, a distress event triggers managerial turnover regardless of the probability γ that the low type managers chooses D^H. Thus, we do not need to assume that $\gamma > \frac{prob(\text{distress}|s_H, D^H)}{prob(\text{distress}|s_L, D^H)} \frac{p_0}{1-p_0}$.

From Assumption 2, the takeover is not blocked under $D^H = s_L \Rightarrow \beta = 0$ and $i_L \leq p_0 - p_1$. Strict concavity of $V^T(D^H(i_L), p_0) - V^{NT}(D^H(i_L), p_0)$ thus implies that there exists a cut-off $\bar{i}_{D^H}(C) \in (\frac{p_0-p_1}{2p_0}, \frac{p_0-p_1}{p_0})$ such that the takeover is not blocked under $D^H(i_L)$ for $i_L \in (\underline{i}_L(C), \bar{i}_{D^H}(C))$, where $\underline{i}_L(C)$ is the minimum inefficiency that allows a takeover when $prob(s = s_L) = p_0$ and $D \leq s_L$.

We now turn to the constraints that the takeover market imposes on D^L. Given $D^H(i_L)$, the debt level that makes the low type manager willing to randomize is $D^L(i_L) = s_L + i_L + p_1$. Plugging $\beta = i_L + p_1$ and $l(.) = 1$ (the equilibrium beliefs imply that $prob(s = s_L|D^L(i_L)) = 1$) into equation (7) gives us that the post-takeover increase in value is $V^T(D^L(i_L), p = 1) - V^{NT}(D^L(i_L), p = 1) = \frac{ki_L}{2}(p_0 - i_L)$, which is a strictly concave function of i_L that takes value zero at $i_L = 0$ (any debt level blocks the takeover if there is no inefficiency to fix), and reaches a maximum at $i_L = \frac{p_0}{2}$ with a value of $\frac{kp_0^2}{8}$. If $\frac{kp_0^2}{8} < C$, then $D^L(i_L)$ blocks the takeover for any $i_L \leq \frac{p_0-p_1}{p_0}$. Otherwise, concavity of $V^T(D^L(i_L), p = 1) - V^{NT}(D^L(i_L), p = 1)$ and the absence of takeover gains under $i_L = 0$ imply that there exist $\bar{i}_{D^L}(C) > \frac{p_0}{2}$ and $\underline{i}_{D^L}(C) < \frac{p_0}{2}$ such that $D^L(i_L)$ blocks the takeover for $i_L \leq \underline{i}_{D^L}(C)$ or $i_L \geq \bar{i}_{D^L}(C)$.

Now, define $\hat{i}_L(C) = \min\{\underline{i}_{D^L}(C), \bar{i}_{D^H}(C)\}$. Thus, for $i_L \in [\underline{i}_L(C), \hat{i}_L(C)]$, the takeover is profitable under $D^H(i_L)$ and unprofitable under $D^L(i_L)$. Since $D^L(i_L)$ and $D^H(i_L)$ were constructed to satisfy the optimality conditions of the two types of manager, we conclude that there exists a semi-separating equilibrium for $i_L \in [\underline{i}_L(C), \hat{i}_L(C)]$. Moreover, because $\underline{i}_{D^L}(C) < \frac{p_0}{2}$, it must be true that $\hat{i}_L(C) < \frac{p_0}{2}$. If $\bar{i}_{D^L}(C) < \bar{i}_{D^H}(C)$, then semi-separating

equilibria may exist for $i_L > \hat{i}_L(C)$. In this case, the upper bound would be determined by $\bar{i}_{D^H}(C) < \frac{p_0 - p_1}{p_0}$.

Finally, we show that the semi-separating equilibria satisfy the intuitive criterion. For the debt that blocks the takeover, $D^L = s_L + p_0 + \beta(1-p_0) \geq s_L + p_0 + \frac{i_L - (p_0 - p_1)}{1-p_0}(1-p_0) = s_L + i_L + p_1$, implying that $0 < U(D^L|s_L) \leq (1 - i_L - p_1)B$, where the strict inequality follows from the low type manager being indifferent between D^L and D^H, D^H not allowing the takeover with strictly positive probability, and $D^H < s_H$ with s_H not leading the low type manager to distress with probability 1 (Assumption 1). For any deviation $D^v \leq s_H$, financial distress reveals the incumbent as a low type manager, triggering managerial turnover. However, testing whether the equilibrium satisfies the intuitive criterion requires assuming that there is no takeover under D^v. Since D^v is smaller than D^L ($D^L > s_H \geq D^v$), the deviation blocks the takeover with a lower probability of distress. Thus, the low type manager is strictly better off under D^v implying that the deviation does not prune the semi-separating equilibrium.

For $D^v > s_H$, the high type manager will be in financial distress with positive probability. Hence, the intuitive criterion requires that there will be no takeover and that financial distress does not trigger managerial turnover.[27] The low type manager reaches the first best with D^v, implying that the deviation does not prune the equilibrium. We thus conclude that the semi-separating equilibria satisfy the intuitive criterion.

□

Proof of Proposition 5

Given the level of inefficiency i_L and a takeover cost C, the minimum debt $D^L = s_L + p_0 + \beta(1-p_0)$ that blocks the takeover despite revealing that the incumbent is a low a type manager solves $[1 - p_0 - \beta(1-p_0)]\frac{ki_L}{2} = C \Rightarrow \beta(C) = 1 - \frac{C}{(1-p_0)\frac{ki_L}{2}}$, which decreases with C. For $D^H = s_L + \beta(C)$ and $D^L = s_L + p_0 + \beta(C)(1-p_0)$, both debt levels increase with $\beta(C)$, which implies that the debt levels decrease with the takeover cost.

Plugging $D^H = s_L + \beta(C) < s_H$ in equation (7) in the proof of Proposition 4 and equating it to the takeover cost C yields the minimum probability γ, call it $\hat{\gamma}$, that allows for a takeover

[27] Differently from the case that D^v is safe for the high type manager, the set of types that may have led the firm to distress is now $T = \{s_L, s_H\}$. The intuitive criterion requires the low type manager to be strictly better off in the equilibrium strategy than in D^v for any best response of the shareholders given beliefs in T.

to happen. The cut-off $\hat{\gamma}$ is implicitly defined by the equation $l(\hat{\gamma}, p_0) = 1 - \frac{Cp_0}{C+\frac{(1-p_0)ki_L}{2}}$. The proof follows by showing that $l(\hat{\gamma}, p_0)$ increases with $\hat{\gamma}$, while the right-hand side of the equation decreases with C.

□

Proof of Proposition 6

Fix the level of inefficiency i_L of the low type manager. In any semi-separating equilibrium where high leverage conveys bad news, the debt that blocks the takeover is equal to $D^L = s_L + p_0 + \beta(1-p_0) \geq D^L(i_L)$, where β is given by $D^H = s_L + \beta$. For D^L to block the takeover, it must be true that $V^T(D^L, p=1) - V^{NT}(D^L, p=1) = (1 - p_0 - \beta(1-p_0))k\frac{i_L}{2} \leq C$. From the proof of Proposition 4, $D^H < s_H = s_L + i_L$. Thus, $s_L + p_0 + i_L(1-p_0)$ is an upper bound for D^L. Therefore, the semi-separating equilibrium breaks down if the maximum viable D^L cannot block a takeover. This happens if $C \leq (1 - p_0 - i_L(1-p_0))k\frac{i_L}{2}$.

To see that large takeover costs can also break down the semi-separating equilibrium, recall that the lower debt D^H cannot block the takeover. The best case scenario for not blocking the takeover is if the low type manager chooses D^H with a probability close to 1 (which implies that $l(p_0, \gamma) = p_0$) and D^H is as small as possible, that is, $D^H(i_L) = s_L + \frac{i_L - (p_0 - p_1)}{1-p_0}$. Plugging $l(p_0, \gamma) = p_0$ and $D^H(i_L)$ into equation (7) (in the proof of Proposition 4) yields $V^T(D^H(i_L), p_0) - V^{NT}(D^H(i_L), p_0) = \frac{ki_L}{2}[\frac{p_0}{1-p_0}(p_0 - i_L) - (1-p_0)]$. Therefore, the semi-separating equilibrium breaks down if $C \geq \frac{ki_L}{2}[\frac{p_0}{1-p_0}(p_0 - i_L) - (1-p_0)]$.

□

Proof of Proposition 7

From Proposition 2, it suffices to prove that if the standard separating equilibrium exists and the level of inefficiency of the low type manager is sufficiently large, then pooling equilibria that do not block the takeover do not survive the intuitive criterion.

Consider pooling equilibria at $D^p \in [s_L, D_0^{NT})$, where $D_0^{NT} = s_L + \alpha^{NT}$ is the smallest debt that blocks the takeover when $prob(s = s_L | r_0) = p_0$. Note that if D^{NT} is the smallest debt that blocks the takeover when the raider knows that the incumbent is a low type one, then the existence of a standard separating equilibrium implies that $D^{NT} \leq s_H$. If the raider is not sure that the incumbent is a low type manager, then $D_0^{NT} < D^{NT} \leq s_H$. The expected utility of the

low type manager with a pooling debt level $D^p < D_0^{NT}$ has $(1-p_0)(1-\alpha^{NT})B$ as a lower bound. For a deviation $D^v = s_H \equiv s_L + i_L$, her expected utility is $U(D^v|s_L) = (1-i_L)B$, where we took into account that D^v blocks the takeover and that financial distress reveals the incumbent as a low type manager. Since $U(D^p|s_L) > (1-p_0)(1-\alpha^{NT})B$, $U(D^p|s_L) > U(D^v|s_L) = (1-i_L)B$ is satisfied if $(1-p_0)(1-\alpha^{NT}) \geq 1-i_L \Rightarrow i_L \geq 1-(1-p_0)(1-\alpha^{NT})$. In the spirit of the intuitive criterion, the high type manager could then choose D^v and argue to the raider that she should not be perceived as a low type manager because the latter would be strictly better in the equilibrium strategy. The pooling equilibrium would then fail the intuitive criterion.

□