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Contents

Introduction

This dissertation is composed of four self-contained chapters studying how financial markets affect the governance of public companies. The first chapter shows how large shareholders (blockholders) can engage in governance when there is an informational spillover to credit markets. In the second chapter, which is joint work with Marius Kulms, we investigate the role of strategic communication for the efficient allocation of control rights via takeovers. In Chapters 3 and 4, which are joint work with Andre Speit, we study how various financial markets affect corporate decision making by enabling investors to decouple their voting power from their economic exposure. Chapter 3 provides a classification of different decoupling techniques, whereas Chapter 4 develops a cost-benefit analysis of the most prominent decoupling technique called vote trading.

In Chapter 1, *Shareholder Governance and Debt Maturity Structure*, I develop a model to study how a company's debt maturity structure shapes shareholder governance. A large shareholder's exit signals adverse information via the public share price, resulting in an informational spillover to a firm's creditors. While long-term creditors' claims are fixed, short-term creditors can react quickly. By demanding higher credit spreads after an exit, short-term creditors amplify the effectiveness of exit to discipline management. However, short-term debt also reduces large shareholders' exit profits, potentially rendering the threat of exit empty and the share price uninformative. In the absence of short-term debt, the possibility to exit reduces large shareholders' incentives to engage in voice. By contrast, short-term debt can give rise to a complementarity of exit and voice. From a governance perspective, the optimal maturity structure features a mix of short-term and long-term debt. The model delivers novel empirical predictions on the relationship of a company's debt maturity structure to its governance, share price informativeness, and ownership structure.

In Chapter 2, *Strategic Information Transmission and Efficient Corporate Control*, which is joint work with Marius Kulms, we present a model of corporate takeovers in which both, a potential acquirer and incumbent management have private information about the firm value under their respective leadership. Despite the two-sided asymmetric information and endogenously misaligned interests of shareholders and incumbent management, first-best control allocation is feasible if incumbent management can strategically communicate with shareholders. However, shareholders prefer access to more information than revealed in equilibrium. This demand for information leads to inefficiently few takeovers. The model provides implications for the regulation of disclosure requirements and fairness opinions, as well as empirical predictions that link executive compensation to takeover outcomes.

In Chapter 3, *The Economics of Decoupling*, which is joint work with Andre Speit, we study the multitude of techniques activist investors can use to acquire voting rights in excess of their economic exposure. We provide structure to the manifold of decoupling techniques by classifying them into *Buy&Hedge*, *Hedge&Buy*, and *Vote Trading* techniques. The possibility to cast votes without bearing the effect on share value is of particular interest to an activist who wants to push her private agenda, instead of maximizing firm value. Thus, we analyze which classes of decoupling techniques can be exploited profitably by a hostile activist. We find that *Vote Trading* techniques are most profitable and have the largest potential to reduce over-all and shareholder welfare. *Buy&Hedge* techniques are constrained efficient because the activist suffers from a commitment problem. *Hedge&Buy* techniques fall in between, exhibiting inefficient and constrained-efficient equilibria. The results match the empirical evidence on vote prices from options and equity lending markets.

In Chapter 4, *Shareholder Votes on Sale*, which is joint work with Andre Speit, we examine the effect of vote trading on shareholder activism and corporate governance. We show that vote trading enables hostile activism because voting rights trade at inefficiently low prices even when the activist's motives are transparent. Our results explain previous empirical findings of low vote prices Christoffersen et al. (2007) and inefficient outcomes Hu and Black (2006). Though an activist with superior information can facilitate information transmission through vote trading, traditional activist intervention techniques provide the same information transmission without the downsides inherent in vote trading. Our analysis of potential policy measures suggests that adopting simple majority rules and excluding bought votes offer the most promising intervention avenues.

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Chapter 1

Shareholder Governance and Debt Maturity Structure

1.1 Introduction

Large shareholders (blockholders) are a cornerstone of sound corporate governance. In contrast to small shareholders, their concentrated stake incentivizes them to gather information about a firm's fundamentals and to monitor management.[1] When blockholders are dissatisfied, they can either sell their stake (exit) or intervene (voice). Voice can be valuable, for instance, by improving managerial incentives through the threat of a proxy fight. The exit of a blockholder incorporates her adverse, private information into the share price.[2] Because management's compensation is typically linked to the share price, the threat of exit can discipline management (Admati and Pfleiderer, 2009; Edmans, 2009).

In practice, not only shareholders but also stakeholders are interested in the firm's prospects. Since shareholder governance reveals new information about the firm, it can induce stakeholders to adjust decisions. Stakeholders' decisions, in turn, affect shareholder value, giving rise to a feedback loop.

This chapter analyzes how the endogenous response of stakeholders such as creditors[3] impacts shareholder governance. In particular, I show that the form of shareholder governance (voice or exit), its effectiveness, and a blockholder's incentives to exert governance fundamentally change with the debt maturity structure. The analysis builds on two key observations. First, because the share price is public, a blockholder's exit not only provides new information to other shareholders, but also to a firm's creditors. Second, the maturity of creditors' claims determines their ability to react to new information: short-term creditors can react quickly whereas

[1]There is ample evidence on the prevalence and importance of blockholders for corporate governance. See Edmans and Holderness (2017) for a recent survey.

[2]Among others, Parrino et al. (2003); Boehmer and Kelley (2009); Brockman and Yan (2009); Gallagher et al. (2013) and Gorton et al. (2017) present evidence that blockholders increase share price informativeness.

[3]For the sake of concreteness, I focus on the prominent case of creditors. However, the main mechanism can be applied to any stakeholder. See Section 1.6 for a more detailed discussion.

long-term creditors' claims are fixed.

I find that short-term creditors' response to the share price is a double-edged sword. On the one hand, it amplifies the effectiveness of exit to discipline management by making the share price more information sensitive. On the other hand, it reduces exit profits. This can undermine the blockholder's incentives to exit, potentially rendering the threat of exit empty. As a result, the share price informativeness and managerial incentives can be dampened. Short-term debt not only affects governance by exit but also governance by voice. In particular, I show that short-term debt can give rise to a complementarity of voice and exit. By contrast, in the absence of short-term debt, exit undermines voice as in the classical argument by Coffee (1991) and Bhide (1993).

Model A publicly traded company is run by a manager who faces a moral hazard problem. The manager can take a hidden action to increase firm value but has to bear a private cost. As in Admati and Pfleiderer (2009) and Edmans (2009), the manager's payoff rises in the share price. The majority of the company's shares are dispersed among small shareholders, whereas a minority stake is concentrated in the hands of a blockholder. The blockholder, as a large, professional investor, privately observes the state of the company. The informed blockholder can then exit her position and is able to partially camouflage her trade due to the presence of liquidity traders. The company has short-term and long-term debt contracts outstanding. Before rolling over, short-term creditors observe the public share price.

Feedback Effect of Short-term Debt In equilibrium, the blockholder only exits after adverse information. Because she cannot perfectly camouflage her trade, her exit signals adverse information to the stock market, inducing a decline in the share price. The increased default risk revealed by the falling share price leads short-term creditors to require higher credit spreads to roll over their claim. Higher credit spreads reduce the cash flows shareholders obtain as the residual claimants, amplifying the share price decline. Because the manager's payoff depends on the share price, the threat of a more severe share price drop induces the manager to exert effort to prevent an exit.

Since the blockholder can partially camouflage her trade, she makes a profit relative to the dispersed shareholders from her exit. However, because her exit raises short-term credit spreads, she also reduces overall cash flows that can be paid to shareholders. The reduction in shareholder value is anticipated by any rational buyer in the stock market. Thus, the equilibrium share price at which the blockholder can sell already reflects the higher credit spreads, decreasing the blockholder's exit profits.

How does the maturity structure affect exit? For low levels of short-term debt, the expected gains from informed trading exceed the costs accruing from increased credit spreads to the blockholder. Thus, the blockholder always exits after adverse information, leaving the share price fully informative. Because short-term debt only amplifies the share price movement after an exit (*share price sensitivity*), managerial incentives to exert effort are improved. For intermediate levels of short-term debt, the anticipated surge in credit spreads decreases the exit price too severely such that the the blockholder trades less frequently. Because this reduces share price informativeness, managerial incentives are dampened. Lastly, if debt claims are overwhelmingly short term, the credit spread adjustments are too severe such that exit is no longer profitable, and the blockholder is essentially locked-in: *the paralyzing effect of short-term debt*. This effectively renders the threat of exit empty and the share price uninformative.

From a governance perspective, the firm and shareholder value-optimal maturity structure is a mix of short-term and long-term debt. Levels of short-term debt below the optimum leave scope for a higher share price sensitivity without reducing the share price informativeness. Higher than optimal levels of short-term debt reduce the share price informativeness, dampening managerial incentives. Thus, the optimal mix yields the highest share price sensitivity that does not undermine share price informativeness.

Ownership Structure By altering trading incentives, the debt maturity structure has important implications for the optimal ownership structure and vice versa. The firm value-optimal ownership concentration maximizes the blockholder's exit incentives by allowing her to unwind her entire stake upon negative news. Larger stakes force the blockholder to retain part of her shares to camouflage her exit. When the blockholder retains shares, she has to bear the increased credit spreads on *all* of her shares but only profits from selling *part* of her shares at inflated prices. The blockholder's trading incentives are, hence, maximized if she can sell her entire stake. Notably, due to the feedback effect of short-term debt, exit profits decrease in the size of her stake, even for a fixed market liquidity.[4]

From a governance perspective, the jointly optimal ownership and debt maturity structure simply combines the independently derived optimal ownership and maturity structures. For any level of short-term debt, allowing the blockholder to unwind her entire stake maximizes her trading incentives. Further, the optimal level of short-term debt decreases strictly in the stake of the blockholder because a larger stake prevents exit for a smaller level of short-term debt. Hence, the optimal ownership structure yields the highest level of short-term debt (share price sensitivity),

[4] In blockholder models, the block size matters for trading incentives since it reduces amount of dispersedly held shares and, thereby, market liquidity (see Bolton and Thadden (1998); Kahn and Winton (1998); Maug (1998); Edmans (2009)). In contrast, in the presence of short-term debt, the size of the blockholder's stake changes trading incentives even if one abstracts from the potential effect on the market liquidity.

still consistent with a fully informative share price.

Voice In practice, besides exit, shareholders can also engage in voice. To examine the overall effect of short-term debt on shareholder governance, I extend the model: before the manager's effort choice, the blockholder can monitor management at a private cost. Similar to the model of Holmström and Tirole (1997), monitoring reduces managerial effort costs. If the manager shirks despite being monitored, the blockholder can still sell her stake to the liquid stock market.

Monitoring is valuable to the blockholder because it increases the probability that the manager exerts effort, which, in turn, makes a high firm value more likely. A more informative share price makes monitoring more lucrative to the blockholder because credit spreads adjust according to the information contained in the share price. That is, an informative share price increases (decreases) blockholder profits if the firm value is high (low) due to favorable (adverse) credit spread adjustments. Thus, I identify a new channel through which an informative share price improves voice incentives: short-term debt.

In line with the idea of Coffee (1991) and Bhide (1993), the possibility for the blockholder to sell her stake to a liquid stock market can undermine her voice incentives in my model. The reason is that the possibility of exit reduces the blockholder's exposure to a low firm value: the cost of not monitoring is larger if the blockholder cannot exit. Because short-term debt decreases exit profits monotonically, one may be tempted to think that voice incentives increase monotonically in the level of short-term debt. Surprisingly, this is not the case because short-term debt gives rise to a *complementarity of voice and exit*. As a result, voice incentives are maximal at an interior level of short-term debt that still induces the blockholder to exit.

The intuition is as follows: the blockholder's voice incentives are, roughly speaking, the difference between profits from exercising voice and from exiting. Since exit incorporates information into the share price, it induces more favorable short-term credit spreads after voice. In an equilibrium in which exit occurs after negative news, the absence of exit provides positive information to short-term creditors. Thus, they are willing to roll over their claim at lower credit spreads. Conversely, if short-term debt prevents exit after adverse information, short-term credit spreads are less favorable conditional on voice, hampering voice incentives. A countervailing effect is that exit profits decrease monotonically in the level of short-term debt. However, I show that, in equilibrium, the upside of favorable credit spreads after voice dominates the downside of higher credit spreads after exit. The reason is that credit spreads need to be paid more often after good news than after bad news. Hence, voice incentives are maximal at the same level of short-term debt that maximizes the effectiveness of exit. At any lower level, an increase in the short-term debt level would increase voice incentives because it decreases exit profits without undermining share price informativeness. Any higher level of short-term debt decreases share price informativeness and, therefore, dampens voice incentives.

Banks While the model can be applied to any company, banks rely heavily on short-term funding and are thus an obvious application. Many studies have raised the question of what is special about corporate governance in banks (Becht et al., 2011; Mehran and Mollineaux, 2012; Laeven, 2013). In general, my theory identifies a novel explanation of why shareholder governance in banks is systematically different from that of companies with less short-term debt.[5] Large shareholders of banks cannot govern by the threat of exit because banks' short-term funding renders an exit non-credible. Thereby, I identify a downside of short-term debt on managerial incentives, whereas, in the previous literature, short-term debt was thought to improve incentives unambiguously (Calomiris and Kahn, 1991; Diamond and Rajan, 2001). Because exit is non-credible, large shareholders of banks can only govern by voice, if at all. Important regulations in this context are the ownership limits imposed on large shareholders, as well as prohibitions to their access to board seats (Caprio and Levine, 2002).[6] With short-term debt preventing governance by exit, and regulation undermining voice, there appears to be a vacuum in the corporate governance of banks.

Empirical Predictions The model yields several testable empirical predictions. First, for a given level of short-term debt, credit spreads on short-term debt should increase after a blockholder exits. Due to the feedback effect, the share price drop after an exit is predicted to be more severe if a company has more short-term debt outstanding. However, the probability of an exit and, thus, share price informativeness decreases in the level of short-term debt according to the model. Creditors' response ought to be more pronounced if the company is near financial distress because in this case an exit will provide more information about the probability of default. Hence, if a company moves towards financial distress, blockholders will be more likely to retain their shares, leading to a *paralyzing effect of financial distress*. The model also predicts that exit is the prevalent governance channel for low levels of short-term debt because "cutting and running" undermines voice incentives. Conversely, since high levels of short-term debt prevent governance by exit, voice will be the predominant form of shareholder governance.

Relation to the Literature This chapter builds on three strands of the literature. First, the literature on shareholder governance has studied how the shareholders of publicly listed companies can increase firm value by exerting governance by voice or exit. I show how the debt maturity structure of the company shapes shareholder

[5] While deposits of banks may be (partially) backed by government guarantees, banks also hold a substantial amount of short-term debt from wholesale funding markets (Adrian and Shin, 2010).

[6] As noted by Laeven (2013), for instance, in the US, some of these regulations were relaxed to allow blockholders to acquire larger stakes in light of the financial crisis.

governance. Second, this chapter is related to the literature on (short-term) debt and corporate governance. It adds to this literature by examining a setting in which creditors learn from share prices. Third, this chapter is closely connected to the recent literature on feedback effects from financial markets. My findings contribute to this literature by showing how the debt maturity structure alters large shareholders' trading incentives and, thus, share price formation. In brief, to the best of my knowledge, this is the first study to examine how a company's debt maturity structure affects shareholder governance.

Overview The chapter is organized as follows: Section 1.2 reviews the literature. Section 1.3 introduces the baseline model (Section 1.3.1), analyzes the blockholder's exit incentives (Section 1.3.2) and characterizes the unique equilibrium and managerial incentives (Section 1.3.3). Further, Section 1.3.4 derives the optimal ownership concentration. Section 1.4 analyzes the model with both voice and exit. Empirical predictions are derived in Section 1.5, and Section 1.6 concludes. Afterward, in Section 1.7, several extensions are discussed.

1.2 Related Literature

Shareholder Governance Since Berle and Means (1932), agency problems arising from the separation of ownership and control in public corporations have been studied extensively. A crucial channel by which these agency problems can be alleviated is shareholder governance. Shareholder governance can take the form of exit or voice, according to the classical dichotomy of Hirschman (1970). By virtue of being the largest owners, large shareholders have the highest incentives to engage in governance (Shleifer and Vishny, 1986). The early literature on shareholder governance focused on the fact that liquid stock markets can undermine voice incentives by promoting "cutting and running." According to these theories, liquid stock markets allow large shareholders to sell their stake without a substantial price impact, reducing their incentives to engage in privately costly but welfare-enhancing interventions (Coffee, 1991; Bhide, 1993). Maug (1998) and Kahn and Winton (1998) qualified the early findings by showing that increased stock market liquidity also increases ex ante block-formation incentives. Holmström and Tirole (1993) study the role of the stock market in monitoring the management and derive the optimal executive contract. They find that greater stock market liquidity increases managerial incentives because more information is impounded into the share price.

Aghion et al. (2004) and Faure-Grimaud and Gromb (2004) study the relation of share price informativeness and voice incentives. In both theories, because a blockholder may need to exit, her ex ante incentives to conduct voice are reduced as her hidden voice effort will not be fully reflected in her exit price. A share price that is informative about whether or not the blockholder engaged in voice allows the blockholder to participate on her value improvement even if she exits, enhancing her voice incentives ex ante. In contrast, in my model, voice incentives increase in the share price informativeness since an informative share price induces more favorable credit spreads conditional on voice. Further, share price informativeness is itself driven by exit in my model, leading to a complementarity of voice and exit not present in Aghion et al. (2004) and Faure-Grimaud and Gromb (2004) where outside speculators determine the share price informativeness.

Admati and Pfleiderer (2009) and Edmans (2009) show that the threat of blockholder exit, rather than undermining governance, can itself help to improve managerial incentives by putting downward pressure on the stock price after bad managerial performance. My model builds on Admati and Pfleiderer (2009) and Edmans (2009) and shows how the debt maturity structure of a firm can shape exit and voice. Edmans and Manso (2010), Cvijanovic et al. (2019) and Edmans et al. (2018) investigate the effect of multiple blockholders, heterogeneous blockholders, and common ownership on exit, respectively. Dasgupta and Piacentino (2015) demonstrate that when blockholders are money managers who want to maximize investor flows, the threat of exit loses its credibility. The reason is that money managers fear being perceived as “bad stock pickers” when they exit, thereby losing investor flows. In contrast, in my theory, the feedback effect of short-term debt potentially renders exit unprofitable, even if the blockholder’s sole objective is direct profit maximization from her trade as in Admati and Pfleiderer (2009) and Edmans (2009). Broccardo et al. (2020) show in a model with investors with heterogeneous preferences that exit may prove ineffective. Since falling prices due to the exit of one type of investors will induce purchases by other types of investors, the equilibrium price impact of exit is limited. None of these papers consider the impact of short-term debt on exit or voice.

(Short-term) Debt In terms of incentives, short-term debt has been stressed as a disciplining device because creditors can quickly react to new information by refusing to roll over their claim (Calomiris and Kahn, 1991; Diamond and Rajan, 2001).[7] In these models, short-term debt unambiguously improves incentives. The downside of short-term debt is the risk of costly premature liquidation. By contrast, in my framework, costly premature liquidation is not needed to obtain an optimal interior level of short-term debt; instead, short-term debt can directly harm managerial incentives by impairing information revelation. Debt has been shown to directly im-

[7] Besides disciplining theories of short-term debt, Flannery (1986) and Diamond (1991) show how short-term debt can act as a signaling device for good borrower types, Myers (1977) argues that short-term debt can be a remedy to the debt overhang problem and Morris (1976) examines maturity matching of assets and liabilities. More recently, Berg and Heider (2020) show that short-term debt can arise endogenously for firms to commit themselves not to engage in risk shifting.

prove incentives for managers by making their payoff more sensitive to their actions (Jensen and Meckling, 1976; Innes, 1990). Furthermore, debt can also increase the share price informativeness by increasing information acquisition incentives (Boot and Thakor, 1993; Edmans, 2011). I show that if short-term creditors learn from the share price, the increased information sensitivity[8] of the share price can reduce trading incentives, share price informativeness, and thus lower managerial incentives. Berglöf and Thadden (1994) show how a mix of short-term and long-term debt arises endogenously if a company cannot commit to future payouts. (Senior) short-term debt is useful in their model because short-term creditors have a strong bargaining position in a renegotiation. In my model, a mix of short-term and long-term debt is optimal even in absence of renegotiation. Brunnermeier and Oehmke (2014) show that the anticipation of costly liquidation can lead to excessive short sales in a symmetric information environment. By contrast, costly liquidation is not needed for my results. Rather, my model focuses on the informational dimension of share prices and the resulting feedback effect. Dang et al. (2017) show that banks optimally hide information about their assets to produce safe debt claims. In Dang et al. (2017), financial institutions may prevent information production of creditors by reducing the provision of short-term debt. In contrast, my model shows how short-term debt can prevent information revelation in the stock market, without the need for "secret keeping." Piccolo and Shapiro (2017) study the interaction of credit rating agencies' incentives to inflate ratings and information acquisition incentives in the CDS market. Manso (2013), Goldstein and Huang (2020) and Walther and White (2020) study a situation in which creditors learn from credit ratings and policy interventions, respectively. Choi et al. (2020) consider the effect of open-end funds' bond holdings on credit risk through a strategic default channel.

Feedback Effects of Share Prices Bond et al. (2012) provide a survey of the feedback effects from financial market prices. They stress that prices affect real decisions through two channels: first, managers learn from the share price to guide (investment) decisions. Second, managers' compensation contracts and, thereby, their decisions are affected by the share price. This chapter clearly focuses on the second channel and expands on the role of the share price by examining a setting in which creditors learn from it. Goldstein and Guembel (2008) demonstrate how the feedback effect of the share price on real investment can incentivize uninformed short sellers to manipulate the stock price downward. Bond et al. (2010) show that financial market prices become less informative if agents want to take

[8] The notion of information sensitivity is different in the theories. In my theory, short-term creditors react to the share price, making the shareholder value more information sensitive. Conversely, in the previous theories information sensitivity emerges because creditors obtain the safe(r) part of the cash flow in form of a debt claim, making equity more sensitive to information.

corrective actions based on them. Goldstein et al. (2013) show that when equity providers learn from financial market prices, strategic complementarities arise, leading to (inefficient) coordination. Edmans et al. (2015) establish an asymmetric limit to arbitrage if managers base their investment decision on financial market prices.[9] Dow et al. (2017) consider information production incentives when firms learn about investment opportunities via the share price. Almazan et al. (2017) develop a theory of capital budgeting when investment decisions convey information to employees and, in turn, determine their effort provision. Opp (2019) uses a dynamic credit risk model to study the effect of capital injections by an informed blockholder on (strategic) default of a financially distressed firm. None of these papers study manager-shareholder conflicts or the debt maturity structure.

1.3 Debt Maturity Structure and Exit

1.3.1 Model

Overview There are three periods $t \in \{1, 2, 3\}$ and no discounting. A publicly traded company has a large minority shareholder (blockholder). The company invests in a single asset using short-term and long-term debt contracts to cover the funding costs. A manager runs the firm and can increase the return of its asset by a hidden action at a private cost. The blockholder, as the largest owner, obtains a private signal of the firm value and may exit afterward. While long-term debt contracts cover the entire investment horizon, short-term creditors' rollover decision is based on the information contained in the share price.

Ownership & Control Consider a company with a continuum of shares of measure 1 outstanding. A fraction α of the shares is owned by the blockholder B. The remaining $1 - \alpha$ shares are jointly owned by atomistic shareholders. The company is run by a manager M whose effort choice impacts the value of the company's asset.

Asset & Managerial Effort In $t = 1$, the company has access to a single long-term project that generates random return $R \in \{0, \overline{R}\}$ in the final period. In $t = 1$, after the company has invested the set-up costs normalized to 1, M spends hidden effort $a \in \{0, 1\}$. At $t = 2$, there are two potential states $S \in \{S_L, S_H\}$ of the project. Conditional on S_H (S_L), the project's success probability is p_H (p_L), where $p_H\overline{R} > 1 > p_L\overline{R}$. The distribution of the state S depends on managerial effort. Shirking ($a = 0$) yields S_H with probability $q \in (0, 1)$ whereas working ($a = 1$) increases the probability of the high state by Δ_q to $q + \Delta_q \leq 1$. M incurs privately

[9] A more detailed discussion of the relation to this chapter can be found in Section 1.7.2.

observable costs $c \sim G[0, \overline{c}]$ from working, where $G(c)$ admits a density $g(c)$ with full support, $\overline{c} > p_H \overline{R}$ and $g(c) \leq \frac{1}{\Delta_q^2}$.[10] The project has a positive net present value (NPV) ex ante, even under $a = 0$, i.e., $[qp_H + (1-q)p_L]\overline{R} > 1$. Therefore, the company always invests in the project.

Debt Financing In $t = 1$, to cover the set-up costs of the project, the company issues debt contracts to outside investors. For ease of exposition, debt claims are zero coupon bonds. There is a unit mass of risk-neutral, perfectly competitive investors, each endowed with a single unit of the numeraire to invest both at $t = 1$ and at $t = 2$. The company can issue short-term and long-term debt contracts. Let γ denote the fraction of short-term and $1 - \gamma$ the fraction of long-term debt. Both debt contracts yield the company 1 at issuance. A long-term debt contract covers the entire investment horizon of the long-term project and specifies a face value of D_{LT} promised to long-term creditors in $t = 3$. In contrast, a short-term debt contract has to be rolled over at the interim date $t = 2$. The initial short-term debt contract determines a face value D^1_{ST} promised to investors at $t = 2$. Since the company has no liquid funds at $t = 2$, the short-term debt contract has to be rolled over by promising short-term creditors face value D^2_{ST} at $t = 3$. Short-term creditors do not obtain private information and, thus, could be easily be substituted by outside investors at the rollover date: The firm can refinance by issuing debt to the competitive outside investors present at $t = 2$ and repay the initial short-term creditors. Hence, short-term creditors at $t = 2$ will be perfectly competitive as well.

If creditors do not invest in the company, they can simply store their wealth at the risk-free interest rate of zero. Due to the fixed risk-free rate of zero, the credit spread of a debt contract with face value D is simply given by $\frac{D-1}{D}$, coinciding with the (risky) interest rate. The terms are used interchangeably. If the company is in need of funds, the long-term project can be liquidated prematurely at $t = 2$ at the expected project return conditional on all publicly available information. I abstract from the typical early liquidation costs to highlight that short-term debt can be harmful even without exogenously assumed costs. If the project is sold at $t = 2$, and the company cannot honor all debt claims, it defaults, and proceeds are split equally among short-term and long-term creditors. I focus on fundamental runs throughout this chapter. As a consequence, if there is no additional information at $t = 2$, both short-term and long-term debt induce the same outcome. This allows me to distill the effect of short-term creditors' response to the share price.

[10] $\overline{c} > p_H \overline{R}$ ensures that there always are types of M shirking. $g(c) \leq \frac{1}{\Delta_q^2}$ guarantees uniqueness of the equilibrium. It is, for example, satisfied for the uniform distribution. Since $\overline{c} > p_H \overline{R}$, the density of the uniform distribution is $\frac{1}{\overline{c}} < \frac{1}{p_H \overline{R}} < 1$ whereas the upper bound on the density is $\frac{1}{\Delta_q^2} > 1$.

Trading In $t = 2$, the blockholder, as the largest owner and a professional investor, privately observes the state $S \in \{S_L, S_H\}$. Given her private information, B decides whether or not to exit her position. In particular, B chooses with which probability $\eta \in [0, 1]$ to sell her shares to a market maker.[11] In the tradition of Kyle (1985), some liquidity traders simultaneously sell an aggregate amount of ϕ or 0 shares with equal probability. The liquidity traders enable the blockholder to partially camouflage her trades, since the market maker only observes the total order flow $Q \in \mathcal{Q} = \{-2\phi, -\phi, 0\}$. The scope for camouflaging is limited, since, prior to trading, the liquidity traders' selling decision is not observed by B. For ease of exposition, I assume $\alpha = \phi$, i.e., the blockholder can unwind her entire stake. The assumption is dropped in Section 1.3.4. The market maker, being perfectly competitive, sets the share price P equal to the expected share value given the total order flow Q.

Informational Spillover At the heart of this chapter is an informational spillover from equity markets to short-term creditors. In particular, the rollover decision takes place *after* trading in the stock market,[12] such that short-term creditors take the share price P into account in their rollover decision. In practice, share prices are easily and freely observable such that even small creditors can use them to become informed.

Managerial Payoff As standard in the literature, I take a general contract structure to identify M's payoff (Admati and Pfleiderer, 2009; Edmans, 2009). This allows me to stress that the results do not depend on specifics of the contracting problem. $M's$ payoff is given by the weighted sum of the share price P at $t = 2$ and the terminal share value $V_{t=3}$ at $t = 3$ minus the private effort cost c, i.e.

$$\omega_p P + \omega_v V_{t=3} - \mathbf{1}_{a=1} c, \tag{1.1}$$

where $\omega_p \geq 0, \omega_v \geq 0$ and $\omega_p + \omega_v \in (0, 1)$. Contrary to typical exit models, all results hold even if there is no managerial short-termism, i.e., $\omega_p = 0$. The reason is

[11] Section 1.7.1 generalizes the results to a continuous trading technology and Section 1.7.2 discusses share purchase.

[12] This assumption is innocuous because the defining feature of short-term debt is that it has to be rolled over frequently. Hence, whenever a blockholder trades there will be a rollover decision briefly afterward if the company has short-term debt outstanding. More precisely, one can think about this issue in a discrete-time, infinite-horizon model in which short-term debt is rolled over every period, and the blockholder can trade every period. Whenever the blockholder exits in some period t, short-term creditors condition their rollover decision at $t + 1$ on the share price from t. In contrast, if there are long periods between rollover dates, there exists a possibility of strategically timing ones exit as shown in Section 1.7.4.

that short-term debt makes the terminal share value $V_{t=3}$ depend on the intermediate share price P through short-term debt face values. $\omega_p + \omega_v \in (0,1)$ ensures that M's payoff depends on shareholder value in some capacity and that the manager chooses $a = 0$ inefficiently often compared to the case where ownership and control are not separated. If ownership and control were not separated, there obviously was no role for exit or voice. The timing of the game is summarized in Figure 2.1.

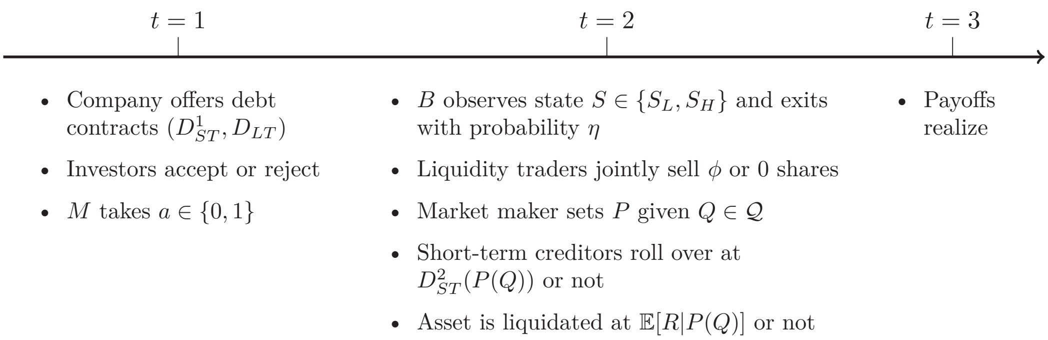

Figure 1.1 Timing Baseline Model

Strategies and Equilibrium Concept The equilibrium concept is the Perfect Bayesian equilibrium refined by the $D1$ criterion (Cho and Kreps, 1987), henceforth referred to as equilibrium. M's strategy $\sigma_M : [0, \bar{c}] \to \{0,1\}$ is a mapping from his type space into the binary action space. B's strategy $\eta : \{S_L, S_H\} \to [0,1]$ maps the observed state S into a probability of selling her shares. As B only sells after adverse information, I write $\eta := \eta(S_L)$ for brevity. The market maker observes Q and sets the share price $P : \mathcal{Q} \to \mathbb{R}_+$. In $t = 1$, investors decide, given the offered face value and the type of debt contract, whether to accept or reject, i.e., $\sigma^1_I : \mathbb{R}_+ \times \{short,\ long\} \to \{accept, reject\}$. In $t = 2$, investors who hold a short-term debt contract decide, given the proposed rollover face value and the share price, to roll over or not, i.e., $\sigma^2_I : \mathbb{R}_+ \times \mathbb{R}_+ \to \{roll, not\}$. I assume that indifference between *acceptance* and *rejection* as well as indifference between *roll* and *not* are broken in favor of *acceptance* and *roll*, respectively.

Definition 1 *An equilibrium is characterized by an effort strategy σ^*_M, a trading strategy η^*, a pricing rule P^*, creditors' acceptance and rollover decisions $\sigma^{1*}_I, \sigma^{2*}_I$ and debt face values $(D^{1*}_{ST}, D^{2*}_{ST}, D^*_{LT})$ such that*

1. *σ^*_M maximizes M's expected utility given $(\eta^*, P^*, \sigma^{1*}_I, \sigma^{2*}_I, D^{1*}_{ST}, D^{2*}_{ST}, D^*_{LT})$.*
2. *η^* maximizes B's expected utility given $(\sigma^*_M, P^*, \sigma^{1*}_I, \sigma^{2*}_I, D^{1*}_{ST}, D^{2*}_{ST}, D^*_{LT})$ and her posterior beliefs.*

3. *Market maker's pricing rule P^* allows him to break even given his posterior belief conditional on Q and $(\sigma_M^*, \eta^*, \sigma_I^{1*}, \sigma_I^{2*}, D_{ST}^{1*}, D_{ST}^{2*}, D_{LT}^*)$*
4. *All creditors break even in expectations given $(\sigma_M^*, \eta^*, P^*, D_{ST}^{1*}, D_{ST}^{2*}, D_{LT}^*)$ and their posterior beliefs.*
5. *All players update their beliefs according to Bayes's rule whenever possible.*
6. *Off-path beliefs are restricted by the $D1$ criterion (Cho and Kreps, 1987).*

1.3.2 Feedback Effect and Exit Incentives

Since the long-term project has a strictly positive NPV independent of managerial effort, the company always invests in it. Fix an equilibrium conjecture of managerial effort and the corresponding probability of the good state $\hat{q} \in [q, 1)$.[13] I start by analyzing the feedback effect of short-term debt and B's exit incentives as a function of the company's maturity structure γ. Afterward, M's effort choice and the resulting $\hat{q}$ are characterized.

Informational Spillover If the share price conveys information about the state S, short-term creditors condition their rollover decision on it. When the market maker sets the share price, he anticipates that the debt face values depend on the price he quotes. Since debt face values affect payments to shareholders, as the residual claimants, the market maker will incorporate creditors' expected response in his pricing rule. The share price is then given by the market maker's zero-profit condition which demands that the share price equals the expected shareholder value, i.e.,

$$P(Q) = \mathbb{E}[max\{R - \gamma D_{ST}^2(P(Q)) - (1-\gamma)D_{LT}; 0\}|Q]. \tag{1.2}$$

According to the market maker's break-even condition (1.2), the share price depends on the total order flow due to the information it conveys about the expected project return. Moreover, the share price decreases in the face values of short-term and long-term debt. The face value of long-term debt D_{LT} is fixed until the final date $t = 3$ and, thus, does not depend on interim share price. Conversely, the face value of short-term debt $D_{ST}^2(P(Q))$, determined in $t = 2$, is a function of $P(Q)$. Since the share price depends on the face value of short-term debt which, in turn, is a function of the share price, (1.2) gives rise to a fixed point problem.

The first question that arises is what short-term creditors can learn from the share price. Lemma 1.1 establishes that, in any equilibrium where the blockholder

[13] $\hat{q} < 1$ since $\bar{c} > p_H\overline{R}$ and full support of $G(c)$ imply that there always will be a positive mass of types of M who do not spend effort.

trades with positive probability, creditors can infer the total order flow from the share price. As a consequence, in equilibrium, creditors and the market maker share a common posterior belief. Let $\pi(Q)$ denote this common posterior of a high signal given Q and recall that η denotes the exit probability conditional on the low state.

Lemma 1.1 *Fix any equilibrium with $\eta^* > 0$. Then, the equilibrium price function $P^*(Q) : \mathcal{Q} \to \mathbb{R}_+$ is perfectly informative about the realization of the total order flow Q.*

The intuition for Lemma 1.1 is as follows. Even though short-term creditors would demand the same face value if the market maker posted the same share price for two different order flows, the expected shareholder value would still differ due to the information contained in Q. Thus, the market maker could not break even, and the share price completely reveals Q. In particular, in any equilibrium with $\eta^* > 0$, Q alters the market maker's posterior expectations about the project return.[14] There are three total order flows: $Q \in \{-2\phi, -\phi, 0\}$ where $\pi(-2\phi) = 0$, $\pi(-\phi) = \hat{q}$ and $\pi(0) = \frac{\hat{q}}{\hat{q}+(1-\hat{q})(1-\eta^*)}$. Hence, $Q = -2\phi$ reveals S_L, for $Q = -\phi$ the posterior equals the prior and $Q = 0$ is indicative of S_H if $\eta^* > 0$. Intuitively, M's decision is already sunk at the trading stage such that the share price only drives the distribution of profits across claim holders. Since Q still changes the market maker's posterior expectation of the project return, there cannot be equilibrium share prices that do not reveal Q. This is not in general true for models with feedback effects from the share price. For instance, in Edmans et al. (2015), the managerial decision determines the entire project return and is directly based on the share price, potentially leading to self-fulfilling equilibria and an uninformative share price. This is the first manifestation of the differences between models with feedback effects based on *prospective* information vis-à-vis this model, in which the feedback effect occurs solely due to *retrospective* information about managerial effort.

Rollover Short-term debt contracts owned by multiple creditors are prone to runs based on coordination failures (Diamond and Dybvig, 1983). I focus on fundamental runs. That is, creditors only refuse to roll over if rolling over is a strictly dominated strategy. Consequently, the company can ensure continuation by offering sufficiently high face values to short-term creditors. In $t = 2$, conditional on observing $P(Q)$ and all other short-term creditors rolling over, a short-term creditor's break-even condition is

$$D_{ST}^1 = [\pi(Q)p_H + (1 - \pi(Q))p_L]D_{ST}^2(Q). \tag{1.3}$$

Note that by Lemma 1.1, creditors' posterior belief can directly be conditioned

[14] If B never exits, Q is uninformative and, thus, the share price does not differ with Q.

on Q. The left side of equation (1.3) is the face value promised to a short-term creditor in the first period. It has to be equal to the expected repayment if the creditor rolls over at face value $D^2_{ST}(Q)$, assuming that the company is continued. Put differently, the right side is precisely the expected payment an outside investor would need to be promised by the company to be willing to invest D^1_{ST} in $t = 2$ conditional on the order flow Q. Equation (1.3) presumes that $D^2_{ST}(Q)$ can be fully repaid whenever the project succeeds, i.e., given the equal priority of creditors, it must be true that the total face value of debt outstanding does not exceed $\overline{R}$.[15] Formally, $\gamma D^2_{ST}(Q) + (1-\gamma)D_{LT} \leq \overline{R}$, which yields an upper bound on the face value of short-term debt of

$$D^2_{ST}(Q) \leq \frac{\overline{R} - (1-\gamma)D_{LT}}{\gamma}. \tag{1.4}$$

Hence, a short-term creditor cannot be induced to roll over if (1.3) and (1.4) cannot be jointly satisfied. In this case, the company defaults, is prematurely liquidated at $t = 2$, and proceeds are split equally among short-term and long-term creditors. Since early liquidation is not inefficient because the project can be sold at its full expected value $\mathbb{E}[R|Q]$, there are no aggregate gains due to a potential renegotiation.

The more short-term debt the company has outstanding, the more debt needs to be rolled over in the light of the adverse information revealed by B's exit. Thus, sufficiently high levels of short-term debt can induce premature liquidation if the blockholder reveals her private information via exit. In particular, if $\gamma = 1$ and $Q = -2\phi$, short-term creditors cannot be induced to roll over. This stems from the fact that a unit mass of creditors invested 1 in the company but, by $Q = -2\phi$, the project is revealed to only deliver an expected return of $\mathbb{E}[R|S_L] < 1$. Thus, short-term creditors cannot break even according to (1.3) and (1.4) and the company is prematurely liquidated at $t = 2$. For future reference, denote $\hat{\gamma} \in (0,1)$ the largest level of short-term debt for which short-term creditors can still be induced to roll over conditional on $Q = -2\phi$.[16] In the following, I focus on the equilibrium without premature liquidation whenever possible, i.e., for any $\gamma \leq \hat{\gamma}$.[17]

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[15] For ease of exposition, I abstract from the case where the company can induce rollover by pledging very high face values to short-term creditors, diluting long-term creditors' stake. Note that such dilution could never increase shareholder value since the company only has an incentive to dilute if $\gamma D^2_{ST}(Q) + (1-\gamma)D_{LT} > \overline{R}$, i.e., shareholder value is zero even without dilution. In any case, dilution would not change the qualitative results but complicate the analysis.

[16] For a derivation of $\hat{\gamma}$ see the Proof of Proposition 1.1 in the appendix.

[17] In general, there are self-fulfilling equilibria where the anticipation of a premature liquidation induces premature liquidation after $Q = -2\phi$ for some $\gamma < \hat{\gamma}$. The reason is that, under premature liquidation, long-term debt becomes partially state contingent and reduces the cash flows short-term creditors can be promised after $Q = -2\phi$, leading premature liquidation (a violation of (1.4)) under a larger set of parameters. In particular, given premature liquidation occurs conditional on $Q = -2\phi$, long-term creditors obtain an equal share of the proceeds of $p_L\overline{R}$ which is strictly larger than their expected payoff without premature liquidation of $p_L D_{LT}$. Since early liquidation has no

The Paralyzing Effect of Short-term Debt Let $V(S, Q)$ denote the expected return from holding a share until the final date conditional on the true state $S \in \{S_L, S_H\}$ and the total order flow $Q \in \{-2\phi, -\phi, 0\}$. Given the creditors' break-even conditions and the market maker's pricing rule,[18] I now turn to B's trading incentives. I abstract from the uninteresting case where B exits independent of the level of short-term debt. In particular, I assume that

Assumption 1.1 $p_L > \hat{q}\Delta_p$,

where $\Delta_p := p_H - p_L$. To see why the assumption is needed, consider the stylized example of $p_L = 0$. In this case, retaining her shares after observing S_L always yields B a payoff of zero since the project never succeeds. In contrast, if she exits, the liquidity traders do not sell with probability one half, B is able to camouflage her trade and obtains $P(-\phi) > 0$.[19] Hence, if p_L is too low, share retention can never constitute an equilibrium strategy. While p_L determines the return conditional on S_L, the market maker and creditors assign probability $\hat{q}$ to S_H conditional on $Q = -\phi$. In this case, the gain of exit relative to share retention is the difference in success probabilities Δ_p. Taking together, Assumption 1.1 requires that $p_L \geq \hat{q}\Delta_p$. Assumption 1.1 depends on an equilibrium object $\hat{q}$. When managerial incentives are analyzed, Assumption 1.1 will be replaced by an assumption on the model primitives. The following result characterizes B's exit incentives after observing the bad state as a function of the short-term debt level.

Proposition 1.1 *Suppose Assumption 1.1 holds. Then, given any $\hat{q} \in [q, 1)$, there is a unique equilibrium exit strategy η^* and*

1. *there is a $\underline{\gamma} > 0$ such that for all $\gamma \leq \underline{\gamma}$, $\eta^* = 1$.*
2. *There is a $\overline{\gamma} \in (\underline{\gamma}, 1)$ such that for all $\gamma \in (\underline{\gamma}, \overline{\gamma})$, $\eta^* \in (0, 1)$ and η^* strictly decreases in γ.*
3. *For all $\gamma \geq \overline{\gamma}$, $\eta^* = 0$.*
4. *There never is premature liquidation in equilibrium, i.e., $\overline{\gamma} < \hat{\gamma}$.*

Proposition 1.1 shows that B's exit probability is weakly decreasing in the level of short-term debt. Short-term debt introduces a downside of exit because the order flow after exit conveys adverse information, inducing short-term creditors to require

welfare implications in my model, and would only tend to strengthen the effect of short-term debt on exit incentives, I abstract form these self-fulfilling equilibria.

[18] See the proof of Proposition 1.1 for the explicit expressions.

[19] The precise argument for $P(-\phi) > 0$ is given in the proof of Lemma 1.1.

higher credit spreads for the increased default likelihood. As a consequence, short-term debt contracts move against the shareholders who, as residual claimants, have to bear the higher spreads. Since, in equilibrium, the stock market will incorporate the anticipated effect of higher credit spreads already when the blockholder trades (Equation (1.2)), short-term debt depresses the share price B receives when selling. Thus, the feedback effect diminishes trading incentives even if B can unwind her entire stake ($\alpha = \phi$). As I establish in Section 1.3.4, the effect is even stronger if $\alpha > \phi$.

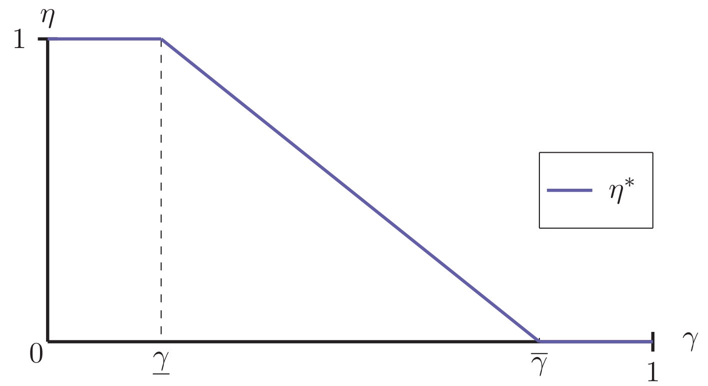

Figure 1.2 Equilibrium exit probability η^* as a function of the short-term debt level γ.

Figure 1.2 depicts the equilibrium exit probability η^* as a function of γ. For low levels of short-term debt, $\gamma \leq \underline{\gamma}$, the blockholder always exits upon the arrival of negative information ($\eta^* = 1$). If the company has issued only long-term debt ($\gamma = 0$) there is no downside of exit as all debt contracts are fixed. Hence, conditional on observing S_L, exit has only upside potential for B because with probability $\frac{1}{2}$ she camouflages her sale and obtains $P(-\phi) > V(S_L)$. Let $\Pi^E = \alpha[\frac{1}{2}P(-\phi) + \frac{1}{2}P(-2\phi)]$ denote B's expected profit from exit and $\Pi^{NE}(\eta^*) = \alpha[\frac{1}{2}V(S_L, -\phi) + \frac{1}{2}V(S_L, 0)]$ be B's expected payoff from share retention.[20] $\Pi^E - \Pi^{NE}(\eta^*)$ is maximal at $\gamma = 0$ and then decreases in γ as more short-term debt needs to be rolled over in light of adverse information revealed by B's exit.

For a company funded with intermediate levels of short-term debt, $\gamma \in (\underline{\gamma}, \overline{\gamma})$, $\eta^* \in (0, 1)$ and η^* strictly decreases in γ. First, no pure strategy equilibrium can exist because deviating to exit is profitable if no exit is expected and vice versa. If $\eta^* = 1$ in the conjectured equilibrium, creditors interpret $Q = 0$ as proof for S_H. This makes deviating to share retention attractive to B since share retention induces $Q = 0$ with probability one half and, thus, favorable short-term credit spreads. Conversely, if $\eta^* = 0$ in the conjectured equilibrium, $Q = 0$ does not convey any

[20] Only the posterior $\pi(0)$ depends on the equilibrium conjecture of η^*, whereas $\pi(-2\phi)$ and $\pi(-\phi)$ are independent of η^*. Thus, I write Π^E and $\Pi^{NE}(\eta^*)$.

information and, therefore, short-term credit spreads do not adjust favorably if B retains her stake. This makes a deviation to exit appealing for her. Since B needs to mix in equilibrium, her indifference condition at $t = 2$ requires that

$$\underbrace{\alpha\Big(\frac{1}{2}P(-\phi) + \frac{1}{2}P(-2\phi)\Big)}_{=\Pi^E} = \underbrace{\alpha\Big(\frac{1}{2}V(S_L, -\phi) + \frac{1}{2}V(S_L, 0)\Big)}_{=\Pi^{NE}(\eta^*)}. \tag{1.5}$$

For a fixed trading probability, more short-term debt reduces exit profits Π^E but increases retention profits $\Pi^{NE}(\eta^*)$. Thus, to keep B indifferent, η^* needs to decrease in γ such that $\Pi^{NE}(\eta^*)$ falls as well in γ and (1.5) can hold.

If the company has an excessive short-term maturity structure, i.e., $\gamma \geq \overline{\gamma}$, $\eta^* = 0$ is B's unique equilibrium exit strategy. Hence, share prices and credit spreads are completely uninformative. Nevertheless, the fear of triggering an adverse credit spread reversal and the resulting low exit price prevent B from selling her stake. If $\eta^* = 0$, $Q = -2\phi$ induces off-path beliefs regarding the state S. The $D1$ criterion rules out the odd case where off-path beliefs assign positive probability to the exit occurring despite the high state. The reason for $D1$'s selection is that a deviation to exit is always strictly more profitable for B after observing S_L than conditional on S_H.

Finally, there never is premature liquidation in equilibrium since $\overline{\gamma} < \hat{\gamma}$. Recall that if $\gamma \leq \hat{\gamma}$, the company can always roll over its short-term debt obligations. Equilibrium debt face values and share prices are given in the proof of Proposition 1.1 in the appendix.

Discussion It is noteworthy that exit has to be incentivized by B's trading profits since M's effort choice is already sunk at the trading stage. B's ability to earn trading profits relative to the other shareholders is not hampered by short-term debt because trading profits are determined by B's opportunity to camouflage, i.e., by the liquidity traders whose orders are exogenously fixed. However, by revealing adverse information due to her exit, B's sale leads to a redistribution of profits from shareholders to short-term creditors. As a result, the blockholder may be better off not trading.

In general, to incentivize effort provision by managers, it is crucial that retrospective information about managerial performance is incorporated into the share price. Since retrospective information inherently does not provide new information to the manager, there is no direct feedback effect of the share price to managerial decisions through learning. However, I show that retrospective information can still induce a feedback loop if outsiders, such as creditors, learn from the share price and adjust decisions.

1.3.3 Managerial Incentives

Given B's trading incentives and the resulting potential to discipline management by the threat of exit, I now analyze M's effort choice. Because short-term debt shapes the effectiveness and credibility of the threat of exit, the maturity structure is a crucial determinant of managerial incentives and firm value.

M's payoff (1.1) from taking the firm value-increasing action $a = 1$ strictly decreases in his true type c. Hence, in any equilibrium, there will be a cutoff $\hat{c} \in [0, \overline{c}]$ such that all manager types smaller than $\hat{c}$ work, whereas all managers with private costs above the cutoff shirk. The equilibrium cutoff $\hat{c}$ is M's type for which the payoff from working equals the payoff from shirking, given $\hat{c}$ is the conjectured cutoff.[21] Formally, $\hat{c}$ is the solution to

$$\begin{aligned}\hat{c} =& \omega_p \Delta_q \eta^* \frac{1}{2}\Big[P(0) - P(-2\phi)\Big] + \omega_v \Delta_q \frac{1}{2}\Big[\eta^* \Big(V(S_H, -\phi) + V(S_H, 0) - V(S_L, -2\phi) - V(S_L, -\phi)\Big) \\ &+ (1-\eta^*)\Big(V(S_H, -\phi) + V(S_H, 0) - V(S_L, -\phi) - V(S_L, 0)\Big)\Big]. \end{aligned} \tag{1.6}$$

The right side of (1.6) represents the expected difference in M's payoffs from working and shirking, gross of the effort cost. Since M's effort raises the probability of S_H by Δ_q, the right side of (1.6) is the weighted sum of the differences of interim share prices and terminal shareholder values conditional on S_H and S_L, multiplied by Δ_q.

Since $P(Q)$ and $V(S, Q)$ depend on the prior probability $\hat{q} = q + G(\hat{c})\Delta_q$ of the high state and, thus, on $\hat{c}$, Equation (1.6) gives rise to a fixed point problem. It cannot be explicitly solved for; under appropriate assumptions, however, it can still be guaranteed that there is a unique cutoff. To this end, I require that

Assumption 1.2 $p_L \geq max\{\frac{1}{2}, (1-q)\}p_H$.

The first part of Assumption 1.2, i.e. $p_L \geq \frac{1}{2}p_H$ or equivalently $p_L \geq \Delta_p$, is the special case of Assumption 1.1 evaluated at the upper bound of the prior success probability of 1. The second part of Assumption 1.2 is needed to guarantee that there is a unique cutoff $\hat{c}$ and thus a unique equilibrium.

Proposition 1.2 *Suppose Assumption 1.2 holds. Then, there exists a unique equilibrium with cutoff $\hat{c} \in (0, \overline{c})$ such that all types $c \leq \hat{c}$ work and all types $c > \hat{c}$ shirk. Further,*

1. *there is a $\underline{\gamma}^E > 0$ such that for all $\gamma < \underline{\gamma}^E$, $\eta^* = 1$ and $\hat{c}$ strictly increases in γ.*

[21] See the proof of Proposition 1.2 for the expressions of M's payoff from working and shirking, respectively.

2. *There is a* $\overline{\gamma}^E \in (\underline{\gamma}^E, 1)$ *such that for all* $\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)$, η^* *and* $\hat{c}$ *strictly decrease in* γ.
3. *For all* $\gamma \geq \overline{\gamma}^E$, $\eta^* = 0$ *and* $\hat{c}$ *is minimal, and constant in* γ.
4. *The optimal maturity structure is given by* $\gamma^{E*} = \underline{\gamma}^E$.

Proposition 1.2 establishes existence and uniqueness of a cutoff equilibrium. If the private costs c are below $\hat{c}$, M takes the shareholder value increasing action $a = 1$ whereas $c > \hat{c}$ induces M to shirk. Since $\omega_p + \omega_v < 1$, too few manager types c spend effort such that a higher $\hat{c}$ implies a higher aggregate welfare. Proposition 1.2 also characterizes the equilibrium relationship of the level of short-term debt γ and managerial incentives $\hat{c}$, illustrated in Figure 1.3. The cutoffs $\underline{\gamma}^E$ and $\overline{\gamma}^E$ follow from Proposition 1.1 evaluated at $\hat{q} = q + G(\hat{c})\Delta_q$.

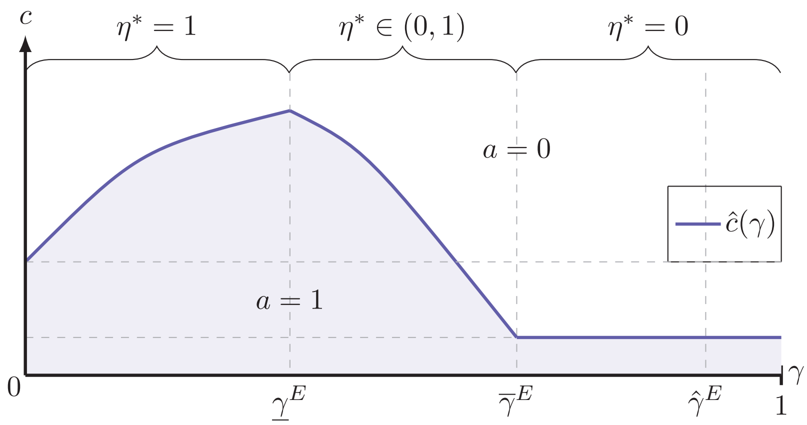

Figure 1.3 Managerial Incentives

If $\gamma < \underline{\gamma}^E$, $\hat{c}$ increases in the level of short-term debt. Short-term debt alleviates the moral hazard problem because it makes both the interim share price $P(Q)$ and the terminal shareholder value $V(S, Q)$ depend to a larger extent on B's exit and, thus, M's action. Therefore - and because the equilibrium exit probability is unaffected ($\eta^* = 1$) - short-term debt improves managerial incentives.

For all $\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)$, $\hat{c}$ strictly decreases in γ. Note that by B's indifference condition (1.5), increasing the level of short-term debt will decrease the equilibrium exit probability. This reduction of η^* has two effects on managerial effort. First, it reduces the probability with which S_L and, thus, shirking is detected. This decreases managerial incentives: for fixed share prices and expected shareholder values, the right side of (1.6) clearly decreases for a falling η^*. Second, η^* also affects share prices and shareholder values directly since a reduction in η^* dampens updating after $Q = 0$. A lower η^* implies that a total order flow of zero is less good news as it could also stem from B not trading despite observing S_L. In general, there are two opposing forces: increasing γ makes a larger fraction of the company's debt claims depend on the share price. However, increasing γ also decreases the equilibrium exit probability and, thus, the information contained in the share price. B's indifference condition 1.5 implies that the decrease in η^* outweighs the increase in γ, such that overall credit spreads after $Q = 0$ are less favorable. Hence, for a fixed $\hat{c}$, the right side of (1.6) decreases in γ since $P(0), V(S_H, 0)$, $V(S_L, 0)$, and $V(S_H, 0) - V(S_L, 0)$ decrease. $V(S_H, 0) - V(S_L, 0)$ falls in the level of short-term debt because favorable credit spreads are more valuable conditional on the high state, relative to the low one. The reason is that in the high state, the firm has to pay the credit spreads with a higher probability. As a result, managerial incentives decrease in the level of short-term debt for $\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)$.

For all $\gamma \geq \overline{\gamma}^E$, $\eta^* = 0$ constitutes the unique equilibrium, rendering the share price and credit spreads on short-term debt completely uninformative. Thus, $\hat{c}$ is constant in γ and attains its minimum. Since $\hat{c}$ first increases and then decreases in γ, the only other maturity structure that could minimize managerial incentives is $\gamma = 0$. While, by definition, long-term credit spreads are also uninformative, share prices are informative and improve managerial incentives at $\gamma = 0$, provided $\omega_p > 0$.[22] Hence, the moral hazard problem is most severe for all $\gamma \geq \overline{\gamma}^E$.

The firm value-optimal maturity structure γ^{E*} is $\underline{\gamma}^E$. γ^{E*} also minimizes managerial moral hazard, and maximizes aggregate welfare. The optimal maturity structure therefore features a combination of short-term and long-term debt to maximize share price sensitivity with respect to the arrival of new information, while not undermining B's incentives to share her private information via exit. Thus, it provides the steepest incentives for M to spend effort.

The model shows that short-term creditors change large shareholders incentives (trading profits) and effectiveness (share price sensitivity) to discipline management. While short-term debt monotonically increases share price sensitivity, it can diminish incentives for a blockholder to sell upon negative information. This renders the threat of exit empty, and reduces share price informativeness. Therefore, the optimal amount of short-term debt is interior even when I abstract from costs due to premature liquidation. In contrast, in the previous literature, short-term debt unambiguously improves managerial incentives (Calomiris and Kahn, 1991).

1.3.4 Ownership Concentration

The previous sections established that a company's debt maturity structure determines a large shareholder's scope and incentives to increase firm value. Thus, the maturity structure determines the value of concentrated ownership. In this section,

[22] If $\omega_p = 0$, $\hat{c}$ is minimized for $\gamma \geq \overline{\gamma}^E$ and $\gamma = 0$.

I derive the jointly optimal ownership and debt maturity structures, and shed light on the interaction of ownership concentration, market liquidity, and a company's debt maturity structure.

Consider an adaptation of the baseline model with an initial period $t = 0$ where the company is owned entirely by an initial owner I who wants to sell the company. I chooses the optimal ownership structure to maximize his proceeds from selling the company. As a result, I's choice of the optimal ownership structure will correspond to the social optimum. There is one potential blockholder B and a continuum of atomistic investors of measure 1, each endowed with one unit to invest. I makes a take-it-or-leave-it offer to B for a minority block $\alpha \in [0, \frac{1}{2})$ at price $\mathcal{P}_B \in \mathbb{R}_+$. In addition, I offers a single share to each of the $1 - \alpha$ atomistic investors for $\mathcal{P} \in \mathbb{R}_+$. I's offer is thus characterized by the triple $(\alpha, \mathcal{P}_B, \mathcal{P})$. Both types of investors face a cost. The blockholder incurs a fixed cost $k > 0$ from holding a non-diversified stake and the small shareholders may suffer a liquidity shock. With probability one half, a fraction $\zeta \in (0, 1)$ of the $1 - \alpha$ small shareholders needs to sell their share prematurely at $t = 2$. With probability $\frac{1}{2}$, all small shareholders hold on to their share until $t = 3$. The aggregate number of shares sold due to the liquidity shock is thus $\phi(\alpha) := \zeta(1 - \alpha)$ or 0 with equal probability. The liquidity shock is unobservable such that B may be able to camouflage her trade.[23] For now consider the case in which the business model of the company fixes the maturity structure at $\gamma \in [0, 1]$ already at $t = 0$. The optimal maturity structure is derived afterward. After the company is sold, it is run by manager M, and the game evolves as before. The timing is summarized in Figure **??** and I consider Perfect Bayesian equilibria under the $D1$ criterion.

First, I investigate the subgame game starting in $t = 1$. If $\alpha = \phi(\alpha)$, the unique equilibrium of the subgame game is given by Proposition 1.2. If $\alpha = 0$, then it is easy to see that the absence of a blockholder renders share prices and debt face values uninformative. Whenever $\alpha \in (0, \phi(\alpha))$, the blockholder can never strictly profit from trading since she cannot camouflage by the short-sale restriction.[24] Hence, the only interesting case is $\alpha \geq \phi(\alpha)$. As the next lemma establishes, B's exit incentives decrease in α for this case.

Lemma 1.2 *Suppose Assumption 1.2 holds and $\alpha \geq \phi(\alpha)$. Then, there exists a unique equilibrium with the structure of Proposition 1.2. In particular, there is a cost cutoff $\hat{c}(\alpha) \in (0, \bar{c})$ below which all types of M work and there are short-term debt cutoff levels $0 < \underline{\gamma}^E(\alpha) < \overline{\gamma}^E(\alpha) < 1$ that pin down η^*. Further,*

- *Both $\underline{\gamma}^E(\alpha)$ and $\overline{\gamma}^E(\alpha)$ strictly decrease in α.*

[23]Papers that also model market liquidity as a function of the free float $1 - \alpha$ include Holmström and Tirole (1993); Bolton and Thadden (1998); Maug (1998); Edmans (2009).

[24]In fact, for any $\gamma > 0$ exit would imply a strict loss to B.

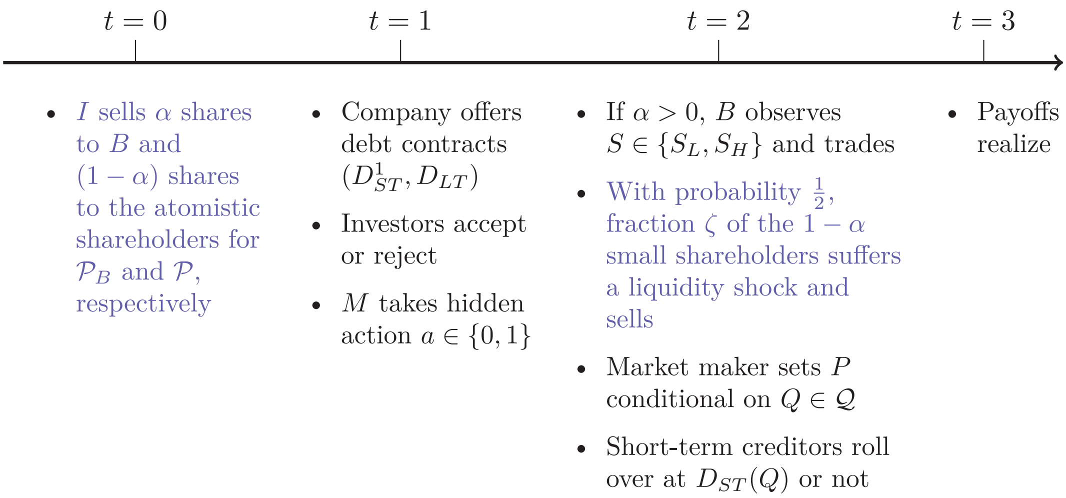

Figure 1.4 Timing with Endogenous Ownership Concentration

- *For any γ, $\hat{c}(\alpha)$ weakly decreases in α.*

Lemma 1.2 shows that there is a unique equilibrium with the same structure as in Section 1.3.3. Further, Lemma 1.2 establishes that an increase in the ownership concentration beyond $\phi(\alpha)$ reduces the thresholds $\underline{\gamma}^E(\alpha), \overline{\gamma}^E(\alpha)$. Therefore, for any maturity structure γ, the equilibrium exit probability weakly decreases in the ownership concentration α. The intuition is that the blockholder will always retain $\alpha - \phi(\alpha)$ shares because otherwise she would reveal her identity and could make at most zero profits on her trade. On the retained shares $\alpha - \phi(\alpha)$, B does not have the upside of selling at prices above the fair value. However, she still suffers the loss from the surge in credit spreads after an exit. Put differently, whenever B exits, she increases the credit spreads and reduces shareholder value. B, thereby, imposes a negative externality on the small shareholders. The more shares she has to retain, the more of this externality she internalizes. Thus, whenever $\alpha - \phi(\alpha)$ increases, the blockholder will trade with a weakly smaller likelihood in equilibrium. As a consequence, for any γ, share prices and credit spreads reward M's effort less and, thus, increasing α beyond $\phi(\alpha)$ will weakly decrease M's incentives to spend effort. It is noteworthy that the effect of ownership concentration on trading incentives is present even for a fixed market liquidity $\overline{\phi} \in (0, \alpha)$ that is independent of the free float $1 - \alpha$. Conversely, in absence of the feedback effect of short-term debt ($\gamma = 0$), for a fixed market liquidity, the size of $\alpha - \overline{\phi}$ is irrelevant for trading incentives because the value of the retained shares is not affected by the exit.

Equity Issuance In $t = 0$, I maximizes his proceeds from selling the company. Since I does not have private information about the firm value, I's problem is simply

$$\max_{\alpha\in[0,1],\mathcal{P}_B,\mathcal{P}\in\mathbb{R}_+} \quad \alpha\mathcal{P}_B + (1-\alpha)\mathcal{P} \tag{1.7}$$
$$s.t. \quad \alpha\mathcal{P}_B \leq \alpha\mathbb{E}[V^B(\hat{c}(\alpha))] - \mathbf{1}_{\alpha>0}k$$
$$\mathcal{P} \leq \mathbb{E}[V^S(\hat{c}(\alpha))]$$

I maximizes his proceeds from selling the company by choosing the optimal ownership structure α and the corresponding prices $\mathcal{P}_B$ and $\mathcal{P}$ subject to the blockholder and the small shareholders accepting I's offer. $\mathbb{E}[V^B(\hat{c}(\alpha))]$ is the expected (gross) per share value to B from holding a block α and $\mathbb{E}[V^S(\hat{c}(\alpha))]$ is the expected per share value to a small shareholder. Recall that k is the fixed cost accruing to B from holding a non-diversified stake.

In general, $\mathbb{E}[V^B(\hat{c}(\alpha))]$ will be weakly larger than $\mathbb{E}[V^S(\hat{c}(\alpha))]$ due to profits accruing from informed trading. B's profits can be decomposed as follows

$$\alpha\mathbb{E}[V^B(\hat{c}(\alpha))] = \alpha \underbrace{\mathbb{E}[V(\hat{c}(\alpha))]}_{\text{fundamental value}} + \phi(\alpha)\underbrace{[1-q-G(\hat{c})\Delta_q]\frac{1}{2}\eta^*(q+G(\hat{c}\Delta_q)\Delta_p(\overline{R}-\frac{1}{p_0})}_{\text{trading profits}}.$$

On her block, B earns the fundamental value $\mathbb{E}[V(\hat{c}(\alpha))]$ all shareholders receive if they hold their shares until the final date. In addition, B profits by exiting conditional on S_L as she is able to partially camouflage her trade. The low signal realizes with probability $(1-q-G(\hat{c})\Delta_q)$ and, with probability η^*, B sells $\phi(\alpha)$ shares. With probability one half, the liquidity traders do not suffer a shock and the total order flow amounts to $Q = \phi(\alpha)$. In this case, B earns a premium of $P(-\phi) - V(S_L, -\phi) = (q + G(\hat{c}\Delta_q)\Delta_p(\overline{R} - \frac{1}{p_0})$ relative to retaining her shares until the final period. In contrast, the small shareholders lose relative to the fundamental value because they suffer a liquidity shock with probability $\frac{1}{2}\zeta$. Aggregate small shareholder welfare is

$$\begin{aligned}(1-\alpha)\mathbb{E}[V^S(\hat{c}(\alpha))] &= (1-\alpha)\underbrace{\mathbb{E}[V(\hat{c}(\alpha))]}_{\text{fundamental value}} \\ &- \underbrace{(1-\alpha)\zeta}_{=\phi(\alpha)}\underbrace{\frac{1}{2}[q+G(\hat{c})\Delta_q](1-q-G(\hat{c})\Delta_q)\Delta_p(\overline{R}-\frac{1}{p_0})}_{\text{trading loss}} \\ &+ \underbrace{(1-\alpha)\zeta}_{=\phi(\alpha)}\underbrace{[1-q-G(\hat{c})\Delta_q]\frac{1}{2}(1-\eta^*)[q+G(\hat{c})\Delta_q]\Delta_p(\overline{R}-\frac{1}{p_0})}_{\text{trading gain}} \\ &= \mathbb{E}[V(\hat{c}(\alpha))](1-\alpha) \\ &- \phi(\alpha)\underbrace{\eta^*\frac{1}{2}[q+G(\hat{c})\Delta_q](1-q-G(\hat{c})\Delta_q)\Delta_p(\overline{R}-\frac{1}{p_0})}_{\text{net trading loss}}\end{aligned}$$

With probability $[q+G(\hat{c})\Delta_q]\frac{1}{2}\zeta$, the good state realizes, and a small shareholder suffers a liquidity shock such that she has to sell at $P(-\phi) < V(S_H, -\phi)$. If $\eta^* < 1$, the shareholder may, however, also gain due to the liquidity shock: with probability $[1-q-G(\hat{c})\Delta_q]\zeta\frac{1}{2}(1-\eta^*)$ the bad state realizes, and the shareholder needs to sell due to the liquidity shock, but B does not exit. Hence, small shareholders sell at $P(-\phi)$ above the fair value of the share $V(S_L, -\phi)$. Netting gain and loss due to trading always yields a strict net loss to the small shareholders in any equilibrium with $\eta^* > 0$ because B exploits her informational advantage. Since both constraints of (1.7) will bind in equilibrium, I's problem becomes

$$\begin{aligned}&\max_{\alpha\in[0,1]} \alpha\mathbb{E}[V^B(\hat{c}(\alpha))] - \mathbf{1}_{\alpha>0}k + (1-\alpha)\mathbb{E}[V^S(\hat{c}(\alpha))] \\ =&\max_{\alpha\in[0,1]} \mathbb{E}[V(\hat{c}(\alpha))] - \mathbf{1}_{\alpha>0}k \end{aligned} \tag{1.8}$$

The equality follows from the fact that trading profits and losses are merely a redistribution among the blockholder and small shareholders. Since the level of ownership concentration affects the overall firm value through the managerial incentives $\hat{c}$ and because creditors jointly receive an expected value of 1 due to their break-even constraints, I's problem boils down to maximizing $\hat{c}$ subject to the gain of concentrated ownership exceeding its cost k, i.e.,

$$k \leq \overline{k}(\gamma,\alpha) := \underbrace{\Delta_p\Delta_q\overline{R}[G(\hat{c}(\alpha) - G(\hat{c}(0))]}_{\text{benefit of concentrated ownership}}. \tag{1.9}$$

Inequality (1.9) demands that the costs from holding a non-diversified stake are smaller than the gain due to ownership concentration $\alpha > 0$ relative to a dispersedly held company ($\alpha = 0$). The next proposition describes the optimal choice of α^* as a function of γ, as well as the jointly optimal maturity and ownership structure (γ^*, α^*).

Proposition 1.3 *Suppose Assumption 1.2 holds. Then, there is a unique equilibrium. Further,*

1. $\alpha = \frac{\zeta}{1+\zeta}$ *maximizes the benefit of ownership concentration* $\overline{k}(\gamma, \alpha)$ *for all* $\gamma \in [0, 1]$.
2. $\alpha^* = \frac{\zeta}{1+\zeta}$ *if* $k \leq \overline{k}(\gamma, \frac{\zeta}{1+\zeta})$ *and* $\alpha^* = 0$ *otherwise.*
3. *The benefit of concentrated ownership* $\overline{k}(\gamma, \frac{\zeta}{1+\zeta})$ *strictly increases in* γ *for all* $\gamma \leq \underline{\gamma}^E(\frac{\zeta}{1+\zeta})$ *and strictly decreases in* γ *for all* $\gamma \in (\underline{\gamma}^E(\frac{\zeta}{1+\zeta}), \overline{\gamma}^E(\frac{\zeta}{1+\zeta}))$.
4. $\alpha^* = 0$ *for all* $\gamma \geq \overline{\gamma}^E(\frac{\zeta}{1+\zeta})$.
5. *The jointly optimal ownership and maturity structure is* $(\gamma^* = \underline{\gamma}^E(\frac{\zeta}{1+\zeta}), \alpha^* = \frac{\zeta}{1+\zeta})$ *if* $k \leq \overline{k}(\underline{\gamma}^E(\frac{\zeta}{1+\zeta}), \frac{\zeta}{1+\zeta})$ *and* $(\gamma^* = \gamma, \alpha^* = 0)$ *for any* $\gamma \in [0, 1]$ *otherwise.*

For a fixed γ, the benefit the blockholder generates through the threat of exit is maximized at $\eta^* = 1$. By Lemma 1.2, maximizing trading incentives requires that B can unwind her entire stake, i.e., $\alpha = \zeta(1 - \alpha)$, or equivalently, $\alpha = \frac{\zeta}{1+\zeta}$. Being able to sell her entire stake yields the largest exit incentives for B since she has the possibility to benefit from camouflaging on all her shares. However, if for a fixed γ, the maximal benefit of ownership concentration is exceeded by its cost k, a dispersed ownership is optimal. Hence, the equilibrium ownership concentration is $\alpha^* \in \{0, \frac{\zeta}{1+\zeta}\}$, depending on the level of short-term debt and the costs arising from concentrated ownership. The benefit of ownership concentration is hump shaped in the level of short-term debt as depicted in Figure 1.5.

For $\gamma \leq \underline{\gamma}^E(\frac{\zeta}{1+\zeta})$, the value of shareholder governance increases as short-term debt makes the shareholder value more responsive to the information revealed by exit and, therefore, improves managerial incentives. This, in turn, enhances firm value as M is induced to take $a = 1$ more often. If $\gamma \in (\underline{\gamma}^E(\frac{\zeta}{1+\zeta}), \overline{\gamma}^E(\frac{\zeta}{1+\zeta}))$, the benefit of concentrated ownership decreases in γ since the expected surge in credit spreads conditional on an exit reduces B's trading incentives. As a result, managerial incentives decrease as share prices and credit spreads become less informative. For $\gamma \geq \overline{\gamma}^E(\frac{\zeta}{1+\zeta})$, there is no benefit of concentrated ownership and, hence, $\alpha^* = 0$.

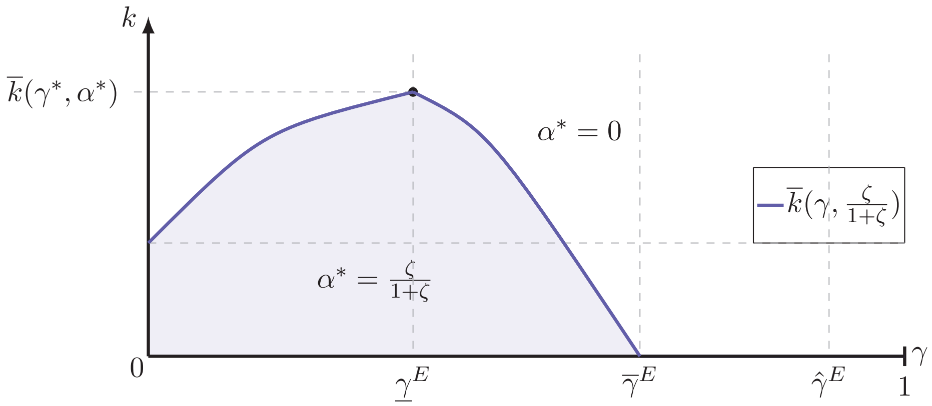

Figure 1.5 Value and Costs of Concentrated Ownership

Finally, the jointly optimal maturity and ownership structure is $(\underline{\gamma}^E(\frac{\zeta}{1+\zeta}), \frac{\zeta}{1+\zeta})$ whenever k is sufficiently small such that concentrated ownership can ever be profitable. By Lemma 1.2, for a given α, the optimal maturity structure is $\underline{\gamma}^E(\alpha)$. $\underline{\gamma}^E(\alpha)$, in turn, is maximal for $\alpha^* = \frac{\zeta}{1+\zeta}$. Therefore, the optimal ownership and maturity structure $(\underline{\gamma}^E(\frac{\zeta}{1+\zeta}), \frac{\zeta}{1+\zeta})$ allows a maximal sensitive and still fully informative share price. Of course, this is only relevant if costs of holding a non-diversified stake are not too high ($k \leq \overline{k}(\underline{\gamma}^E(\frac{\zeta}{1+\zeta}), \frac{\zeta}{1+\zeta})$). Otherwise, any maturity structure paired with a completely dispersed ownership is optimal.

1.4 Debt Maturity Structure and Voice

A blockholder can also influence the company's operations directly. To evaluate the overall impact of short-term debt on shareholder governance, I add the possibility that the blockholder engages in voice to the baseline model of Section 1.3.1.

In addition to trading, the blockholder can improve managerial incentives in $t = 1$ by spending hidden[25] monitoring effort $a_m \in \{0, 1\}$. Monitoring is valuable since it shifts M's cost distribution. Formally, under monitoring, M's effort costs are distributed according to $G^m[0, \overline{c}_m]$ with $g^m(c) \leq \frac{1}{\Delta_q^2}$, where G^m is a truncation of G at $\overline{c}_m \in (p_H R, \overline{c})$. Thus, $G^m(c) = \frac{G(c)}{G(\overline{c}_m)} > G(c)$ holds for any $c \in (0, \overline{c}_m]$. Intuitively, by monitoring, B is able to identify and discard the worst types from the pool of potential managers. Of course, there are many different ways to model monitoring or voice. The truncation of the cost distribution is appealing because it yields a very tractable model. It is reminiscent of the monitoring technology in Holmström and Tirole (1997). B may refrain from monitoring since $a_m = 1$ imposes a commonly known cost of $\kappa > 0$ on her. Afterward, the game evolves as in Section 1.3.1. In particular, the ownership concentration is fixed exogenously at $\alpha = \phi$. The

[25] Monitoring is unobservable to investors, dispersed shareholders, and the market maker.

timing is summarized in Figure 1.6.

$t = 1$

- Company offers debt contracts (D^1_{ST}, D_{LT})
- Investors accept or reject
- B spends hidden monitoring effort $a_m \in \{0, 1\}$
- M takes $a \in \{0, 1\}$

$t = 2$

- B observes state $S \in \{S_L, S_H\}$ and exits with probability η
- Liquidity traders jointly sell ϕ or 0 shares
- Market maker sets P given $Q \in \mathcal{Q}$
- Short-term creditors roll over at $D^2_{ST}(P(Q))$ or not
- The company is prematurely liquidated or not

$t = 3$

- Payoffs realize

Figure 1.6 Timing Voice Model

In $t = 1$, after observing c and a_m privately, M decides whether to take $a = 1$ or $a = 0$. At $t = 2$, after observing $S \in \{S_L, S_H\}$, the blockholder is able to exit, or "cut and run," with probability $\eta \in [0, 1]$. Note that exit is a double-edged sword here: exit makes the share price at the interim date and, thus, also short-term credit spreads depend on the managerial action. However, giving B the opportunity to exit may also provide her with fewer incentives to monitor ex ante because exit reduces her exposure to the firm value in the low state. Again, I consider Perfect Bayesian equilibria under the $D1$ criterion.

Fix an equilibrium in which B monitors as well as the associated equilibrium conjectures of $\hat{c}$ and η^*. Then, B's expected equilibrium payoff is

$$(q + G^m(\hat{c})\Delta_q)\ \mathcal{V}_H + (1 - q - G^m(\hat{c})\Delta_q)\ \mathcal{V}_L - \kappa, \tag{1.10}$$

where $\mathcal{V}_H := \frac{\alpha}{2}[V(S_H, -\phi) + V(S_H, 0)]$ is B's payoff conditional on S_H and $\mathcal{V}_L := max\{\Pi^E; \Pi^{NE}(\eta^*)\}$ represents the maximal profit B can obtain from exit or share retention conditional on S_L. B's expected profits from deviating to $a_m = 0$ are

$$(q + G(\hat{c})\Delta_q)\ \mathcal{V}_H + (1 - q - G^m(\hat{c})\Delta_q)\ \mathcal{V}_L. \tag{1.11}$$

Importantly, a deviation to not monitoring does not change the cutoff $\hat{c}$ because monitoring effort is hidden for outsiders. Consequently, credit spreads and the share price are not affected directly by B's deviation to $a_m = 0$. The deviation merely reduces the probability that M's type is below the fixed cutoff $\hat{c}$ from $G^m(\hat{c})$ to $G(\hat{c})$.

Proposition 1.4 *Suppose Assumption 1.2 holds true. Then, there is a unique equilibrium. B monitors if and only if* $\kappa \leq \overline{\kappa} := [G^m(\hat{c}) - G(\hat{c})]\ \Delta_q\ (\mathcal{V}_H - \mathcal{V}_L)$. *Further,*

1. *there is a* $\underline{\gamma}^V > 0$ *such that for all* $\gamma \leq \underline{\gamma}^V$, $\eta^* = 1$ *and* $\overline{\kappa}$ *increases in* γ.

2. *There is a* $\overline{\gamma}^V \in (\underline{\gamma}^V, 1)$ *such that for all* $\gamma \in (\underline{\gamma}^V, \overline{\gamma}^V)$, η^* *and* $\overline{\kappa}$ *strictly decrease in* γ.
3. *For all* $\gamma \geq \overline{\gamma}^V$, $\eta^* = 0$ *and* $\overline{\kappa}$ *is constant in* γ.
4. *The optimal maturity structure is given by* $\gamma^{V*} = \underline{\gamma}^V$.

Proposition 1.4 establishes existence and uniqueness of an equilibrium and characterizes B's optimal strategy of exit and voice as a function of the level of short-term debt, as well as the firm and shareholder value-maximizing maturity structure γ^{V*}. Monitoring forms an equilibrium if the difference of (1.10) and (1.11) is larger than zero, i.e., if

$$\kappa \leq \overline{\kappa} = \underbrace{[G^m(\hat{c}) - G(\hat{c})]\ \Delta_q \Big(\mathcal{V}_H(\hat{c})\ -\ \mathcal{V}_L(\hat{c})\Big)}_{\text{benefit of monitoring for } B}. \tag{1.12}$$

According to inequality (1.12), the benefit of monitoring to B is the product of the increase in the probability that M works due to monitoring, $[G^m(\hat{c}) - G(\hat{c})]$, the probability Δ_q that effort by M actually enhances firm value and B's payoff difference conditional on the high and low state.

For $\gamma \leq \underline{\gamma}^V$, short-term debt increases B's voice incentives. First, short-term debt increases the extent to which share price and shareholder value reflect managerial performance. This raises managerial incentives $\hat{c}$ which, in turn, boosts B's voice incentives $\overline{\kappa}$. The reason is that $G^m(\hat{c}) - G(\hat{c}) = G(\hat{c})[\frac{1}{G(\overline{c}_m)} - 1]$ increases in $\hat{c}$ as well as the blockholder's expected payoff difference from the high and low state. Second, higher levels of short-term funding increase $\mathcal{V}_H(\hat{c})$ due to more favorable credit spreads. Third, since B's exit conveys negative information, short-term debt contracts move against B after she sells her stake, reducing $\mathcal{V}_L(\hat{c})$. Hence, by all three channels, short-term debt increases voice incentives for all $\gamma \leq \underline{\gamma}^V$.

For intermediate levels of short-term debt, $\gamma \in (\underline{\gamma}^V, \overline{\gamma}^V)$, voice incentives $\overline{\kappa}$ strictly decrease in the level of short-term debt. As in Section 1.3.3, managerial incentives $\hat{c}$ decrease due to the reduction in η^* as share prices and credit spreads become less informative. A lower $\hat{c}$, in turn, decreases $\overline{\kappa}$. Since B mixes in equilibrium, it has to hold that $\mathcal{V}_L(\hat{c}) = \Pi^E = \Pi^{NE}(\eta^*)$, by her indifference constraint (1.5). As a result $\mathcal{V}_L(\hat{c}) = \frac{\alpha}{2}[V(S_L, -\phi) + V(S_L, 0)]$ falls in γ which implies that $\mathcal{V}_H(\hat{c}) = \frac{\alpha}{2}[V(S_H, -\phi) + V(S_H, 0)]$ also decreases in γ since in both cases credit spreads become less favorable. $\mathcal{V}_H(\hat{c}) - \mathcal{V}_L(\hat{c})$ decreases because $\mathcal{V}_H(\hat{c})$ falls at a faster rate. The reason is that since shareholders repay their debt obligations more often conditional on the high than conditional on the low state, less favorable credit spreads conditional on S_H are more costly than less favorable spreads conditional on S_L. Hence, the aggregate effect of short-term debt diminishes voice incentives.

For all $\gamma \geq \overline{\gamma}^V$, the blockholder is locked in conditional on S_L. "Cutting and running" is not a viable option for B as the surge in credit spreads after a deviation to exit would diminish the exit price too severely. This is beneficial for B's voice incentives because it minimizes $\mathcal{V}_L(\hat{c})$. However, the optimal level of short-term debt is given by $\gamma^{V*} = \underline{\gamma}^V$; that is, the optimal level of short-term debt induces $\eta^* = 1$. Even though "cut and run" incentives are not minimized at $\underline{\gamma}^V$, $\underline{\gamma}^V$ still allows maximal informative share prices benefiting the blockholder's intervention incentives through favorable credit spread adjustments after voice. The effect of favorable credit spreads after voice is larger than the effect of adverse spreads after exit because the company pays its debt back less often conditional on S_L. As a consequence, $\underline{\gamma}^V$ maximizes firm value by yielding the maximal effectiveness of exit and the highest voice incentives. $\underline{\gamma}^V$ gives M the highest-powered incentives as it maximizes share price sensitivity without undermining its informativeness. Further, $\underline{\gamma}^V$ minimizes exit profits without undermining informativeness and, thereby, yields the highest voice incentives for B.

Still, $\gamma \geq \overline{\gamma}^V$ increases the voice incentives relative to the case in which the company has only information insensitive debt ($\gamma = 0$). In contrast, in Section 1.3.2 it was shown that high levels of short-term debt minimize firm value if blockholder can only govern through exit. Hence, by its positive effect on voice incentives, if one adds voice to B's toolbox, large levels of short-term debt can dominate low levels in terms of firm value and overall welfare. An implication is that shareholder governance will tend to move away from exit, and more to voice as the level of short-term debt increases.

1.5 Empirical Predictions

Price Formation, Informativeness & Exit To validate the theory, a first step is to show that credit spreads react to the share price. Since exit conveys, at least on average, adverse information about a company's fundamentals, credit spreads of short-term debt rolled over after an exit should increase according to the model.

H1 Credit spreads increase after a blockholder exit.

As the discussion in Section 1.7.3 highlights, the model suggests that the effect on credit spreads should be more pronounced in firms with high leverage as well as in firms in bad financial shape. There is no direct evidence on the effect of an exit on credit spreads. Holthausen et al. (1990) and Sias et al. (2006) provide evidence that large shareholders' exit has a persistent negative effect on the share price and, thus, is likely to contain private information. Since creditors are interested in the prospects of the company, they are likely to react to such an informative exit of a blockholder by demanding higher credit spreads.

The model also predicts that conditional on blockholder exit, the share price drop should be more pronounced if the company has more short-term debt outstanding due to the (negative) amplification effect of higher credit spreads on the share price.

H2 Conditional on exit, the severity of the share price drop is increasing in the level of short-term debt.

However, the probability of an exit (Section 1.3.2), or the volume (Section 1.7.1), should decrease in the level of short-term debt according to the model.

H3 The (unconditional) exit volume and probability decrease in the level of short-term debt.

Again, this effect is likely to be more pronounced for firms in financial distress for which an exit conveys more information about the probability of default. Consequently, the unconditional effect on share price volatility is indeterminate from the perspective of my theory. Blockholders have been identified a key driver for share price informativeness (Parrino et al., 2003; Bushee and Goodman, 2007; Boehmer and Kelley, 2009; Brockman and Yan, 2009; Gallagher et al., 2013). Because, according to the model, blockholders trade less on adverse information, share prices are expected to conveys less (negative) information if a company's maturity is very short term.

H4 Share price informativeness regarding negative information decreases in the level of short-term debt.

Ownership Structure The model delivers two interesting predictions for ownership concentration and composition. First, as discussed in Sections 1.3.4 and 1.7.1, large blockholdings prevent exit if a company is funded by high levels of short-term debt. On the other hand, short-term debt can make blockholdings more effective and valuable for low levels of short-term debt. Together, this implies a hump-shaped relation of concentrated ownership and short-term debt.[26]

[26] To be precise, the hump shaped relationship follows if one takes a random sample of costs k of block formation such that most blocks form when they are most valuable (intermediate levels of short-term funding). For low levels of short-term debt, concentrated ownership will be formed less often as its benefit is smaller due to a lower share price sensitivity. For high levels of short-term debt, block formation will also be limited since exit, if it occurs at all, can only occur for small blocks.

H6 The ownership concentration is hump-shaped in the level of short-term debt.

Further, investors, such as hedge funds, which rely on the threat of exit to exert influence will acquire fewer or smaller blocks in companies with short maturity structures. In contrast, index funds, which do not use exit to discipline management or generate trading profits, will hold (relatively) more of the concentrated ownership in companies with larger levels of short-term debt.

H7 The concentrated ownership in companies with high levels of short-term debt encompasses more index funds and fewer hedge funds.

Exit vs. Voice The model predicts an asymmetric effect of short-term debt on exit and voice. While large levels of short-term debt prevent exit, they may also foster voice by making "cutting and running" less attractive for blockholders, committing them to engage in voice once a block is formed.

H8 For large levels of short-term debt, large shareholders govern through voice.

Empirically, block formation for voice and exit can be measured by 13D and 13F filings, respectively (Edmans et al., 2013).

Banks. By engaging in maturity transformation, banks hold large amounts of short-term debt. This holds true even if non neglects insured deposits (Adrian and Shin, 2010). Therefore, banks provide one example to which my model can be applied. My theory provides implications for the corporate governance and ownership concentration in banks. The following hypothesis wraps these up.

H9 Banks have low ownership concentration, and index funds hold a larger portion of their concentrated ownership. Shareholder governance in banks relies on voice.

1.6 Concluding Remarks

I develop a theory of how a company's debt maturity structure shapes blockholders' abilities and incentives to exert governance. Because short-term creditors adjust their credit spreads to the information contained in the share price, short-term debt can amplify the effectiveness of exit to discipline management. However, since the feedback effect of short-term debt on the share price reduces blockholders' exit profits, excessive short-term debt can render the threat of exit empty, and reduce share price informativeness. The jointly optimal debt maturity and ownership structure encompasses a mix of short-term and long-term debt contracts and limits the ownership concentration. It, thereby, maximizes the share price sensitivity without undermining exit incentives and share price informativeness.

Because blockholder exit improves share price informativeness, it increases voice incentives by making credit spreads depend more on the blockholder's intervention. This yields a complementarity of voice and exit. As a result, voice incentives are maximal at an intermediate level of short-term debt that enables exit. The model provides novel empirical predictions for how a company's maturity structure relates to its share price sensitivity and informativeness, and to blockholders' use of exit and voice. Moreover, the theory links the ownership and debt maturity structure of a company.

Even though the model focuses on creditors, the general logic applies to all stakeholders of the firm. Employees may jump ship after learning about poor firm performance through the share price because they fear worse career prospects. To retain these employees, the firm may need to make concessions, e.g., by paying higher salaries. Depending on their outside options and switching costs, the employees can either react to the share price or not. These information sensitive (insensitive) employees resemble short-term (long-term) creditors in my model. Similarly, other stakeholders, such as customers or suppliers, can use the information contained in the share price depending on their contractual relation with the firm.

Lastly, a key advantage of being a publicly held company is that public share prices can be used as an effective measure of executive performance:

"*A firm that is publicly traded can take advantage of the information contained in the continuous bidding for firm shares. Stock prices may be noisy, but they have a great deal more integrity than accounting-based measures of long-term value.*"
— Hölmstrom and Roberts (1998)

My theory shows that precisely because share prices are public, information-sensitive stakeholders can disincentivize valuable information sharing via the stock market. Therefore, the very feature that gives share prices "integrity" on the one hand, may also undermine their informational efficiency on the other hand. This has important implications for the boundaries of the firm. Companies with many information-sensitive contractual relationships cannot rely on the disciplining role of the share price. Therefore, these companies benefit less from going public, and, as a result, they may stay private.

1.7 Extensions

1.7.1 Continuous Liquidity Trader Demand

This section generalizes the results of Section 1.3.2 to a model with a continuous liquidity shock which allows me to derive the optimal trading volume as a function of the market liquidity and the firms maturity structure. For simplicity, abstract from management and suppose that S_H realizes with (exogenous) probability q. Further, I abstract from premature liquidation in this section by assuming $p_H R > p_L R > 1$, that is, the project has a positive NPV even after the low signal.

As in Edmans (2009), the liquidity traders' aggregate demand $h \in [0, \infty)$ for shares at $t = 2$ is distributed exponentially with parameter λ, that is

$$g(h) = \begin{cases} 0 & \text{if } h \leq 0 \\ \lambda e^{-\lambda h}, & \text{else.} \end{cases} \tag{1.13}$$

A higher value of λ implies a lower expected demand, i.e. a lower liquidity. As before, the market maker only observes the total order flow $Q \in [-\alpha, \infty)$ of blockholder and liquidity traders. Different from the previous sections, B can now choose which amount $\beta \in [0, \alpha]$ to sell given the privately observed state S_L. Denote $\hat{\beta}$ the, in equilibrium correct, conjectured sales volume by B conditional on S_L.

As before, the break-even face value of short-term debt at $t = 2$, $D^2_{ST}(P(Q))$, is a function of the share price P. The equilibrium price function $P^* : [0, \infty) \to \mathbb{R}_+$ will only reveal whether Q is negative or positive. This is, however, only a direct implication of the exponential liquidity demand as the market maker's posterior only differentiates between $Q < 0$ and $Q \geq 0$. Whenever the market maker observes a total order flow of $Q < 0$, he updates his belief to $\pi(Q < 0) = 0$. Since liquidity traders always demand a weakly positive amount of shares, a negative amount reveals B's exit. After $Q \geq 0$, the market maker's belief becomes

$$\pi(Q \geq 0) = \frac{q\lambda e^{-h\lambda}}{q\lambda e^{-h\lambda} + (1-q)\lambda e^{-(h+\hat{\beta})\lambda}} = \frac{q}{q + (1-q)e^{-\hat{\beta}\lambda}}. \tag{1.14}$$

The posterior (1.14) is increasing in the conjectured sales volume $\hat{\beta}$ because $Q \geq 0$ becomes less likely for larger exit volumes by B. The following lemma describes short-term creditors' inference from the share price.

Lemma 1.3 *Whenever $\beta^* > 0$, in any equilibrium, the share price reveals whether $Q < 0$ or $Q \geq 0$.*

The intuition is, similar to Lemma 1.1, that the posterior belief of the market maker changes differs for $Q < 0$ and $Q \geq 0$. As the NPV of the project is strictly positive after both signals in this extension, $0 < P(Q < 0) < P(Q \geq 0)$ and the result obtains.

Moreover, by assumption of a positive NPV even after S_L, there is never premature liquidation and creditors' break-even conditions are given by

$$\begin{cases} 1 = p_0 D_{LT} & \text{(long-term debt)}, \\ 1 = D^1_{ST} & \text{(short-term debt in } t = 1\text{)}, \\ 1 = p_L D^2_{ST}(Q < 0) & Q < 0, \\ 1 = \frac{q}{q+(1-q)e^{-\hat{\beta}\lambda}} p_H D^2_{ST}(Q \geq 0) + \frac{(1-q)e^{-\hat{\beta}\lambda}}{q+(1-q)e^{-\hat{\beta}\lambda}} p_L D^2_{ST}(Q \geq 0) & Q \geq 0. \end{cases} \tag{1.15}$$

Given these conditions, the market maker determines the prices according to pricing rule (1.2), yielding

$$\begin{aligned} P(Q \geq 0) = & \frac{q}{q + (1-q)e^{-\hat{\beta}\lambda}} p_H(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT}) \\ & + \frac{(1-q)e^{-\hat{\beta}\lambda}}{q + (1-q)e^{-\hat{\beta}\lambda}} p_L(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT}) \end{aligned} \tag{1.16}$$

and

$$P(Q < 0) = p_L(\overline{R} - \gamma D^2_{ST}(Q < 0) - (1-\gamma)D_{LT}). \tag{1.17}$$

Again, one can see that prices depend on the amount of short-term debt used to fund the company. I focus on the case where the liquidity is sufficiently high such that the blockholder will trade some shares. [27]

Assumption 1.3 $\lambda < \frac{p_0\overline{R}-1}{\alpha}$

The next proposition describes the optimal trading volume of a blockholder given the level of short-term debt γ and the block size α.

Proposition 1.5 *Suppose Assumption 1.3 holds true. Then, B's optimal trading volume is given by*

$$\beta^*(\alpha, \gamma) = min\{\frac{1}{\lambda} - \alpha\xi(\beta^*, \gamma); \alpha\},$$

where $\xi(\beta^*, \gamma) := \frac{V(S_L, Q \geq 0) - V(S_L, Q<0)}{P(Q \geq 0) - V(S_L, Q \geq 0)}$. *Further,* $\beta^*(\alpha, \gamma)$ *decreases in* γ.

Proposition 1.5 characterizes the optimal trading volume as a function of the market liquidity $\frac{1}{\lambda}$, the level of short-term debt γ and the blockholder's stake α. If

[27] Otherwise, she might prefer not to trade at all due to the presence of short-term debt. Note that this is consistent with the previous sections.

α is small, $\beta^*(\alpha,\gamma) = \alpha$. Conversely, if B holds sufficiently many shares, $\beta^*(\alpha,\gamma) = \frac{1}{\lambda} - \alpha\xi(\beta^*,\gamma)$. The optimal trading volume decreases in the level of short-term debt γ and in the ownership concentration α for this case. Short-term debt reduces the optimal trading volume since it increases credit spreads conditional on a sale by B, reducing the exit price. To avoid the surge in credit spreads, B sells fewer shares to increase the likelihood to be able to hide her trade in the total order flow Q. The optimal trading volume falls in α because on the shares B retains, she suffers the loss due to an expected increase in short-term credit spreads after her exit. Hence, the blockholder reduces her trading volume to increase the likelihood of being able to camouflage. Short-term debt again introduces an adverse effect of large blocks on the optimal trading volume and, thus, share price informativeness, as in Section 1.3.4. Note that if the company does not have any short-term debt, i.e. $\gamma = 0$, the blockholder's optimal trading volume collapses to the expression given in Edmans (2009), that is, $\beta^*(\alpha) = min\{\frac{1}{\lambda};\alpha\}$. If α is very small relative to the market liquidity $\frac{1}{\lambda}$, the blockholder sells all her endowment because the probability of being uncovered is sufficiently small. If the block size becomes very large, B optimally sells a constant amount of $\frac{1}{\lambda}$. Hence, contrary to the case where $\gamma > 0$, α does not negatively effect the trading volume. This highlights again how short-term debt shapes the relation of ownership concentration and trading volume.

1.7.2 Share Purchases

Up to now I restricted attention to blockholder exit and voice, the most prevalent governance channels in practice. In absence of risk aversion (Admati et al., 1994) and wealth constraints (Winton, 1993), the blockholder could also purchase additional shares upon the arrival of positive news. With large levels of short-term debt, the blockholder still does not trade after negative news but buys additional shares after positive news. Hence, short-term debt induces an asymmetric effect on a blockholder's trading incentives regarding positive and negative information. The overall informativeness of the share price will still fall in level of short-term funding as negative news is not incorporated into the share price.

Observation. *Large levels of short-term debt reduce share price informativeness also in a model that allows for share purchases.*

To see this formally, consider the model of Section 1.3.2 with the difference that liquidity traders may also buy ϕ shares. Hence, the order flow of the liquidity traders is $\{-\phi, 0, \phi\}$ with equal probability of $\frac{1}{3}$ each. For simplicity, abstract from management and assume that S_H realizes with (exogenously given) probability q. Further, suppose that the company has only short-term debt outstanding, i.e., $\gamma = 1$.

B can sell or buy ϕ shares, or remain passive, yielding potential total order flows of $Q \in \mathcal{Q} = \{-2\phi, -\phi, 0, +\phi, +2\phi\}$.

Consider the following pure strategy equilibrium: B buys ϕ shares conditional on S_H and remains passive conditional on S_L. Consequently, on the equilibrium path, the set of total order flows realized with positive probability is $\mathcal{Q}^* = \{-\phi, 0, +\phi, +2\phi\}$, and the associated posterior beliefs are given by $\pi(-\phi) = 0$, $\pi(0) = \frac{\frac{1}{3}q}{\frac{1}{3}q+\frac{1}{3}(1-q)} = q$, $\pi(+\phi) = \frac{\frac{1}{3}q}{\frac{1}{3}q+\frac{1}{3}(1-q)} = q$, $\pi(+2\phi) = \frac{\frac{1}{3}q}{\frac{1}{3}q} = 1$. As before, by the $D1$ criterion, off-path beliefs after $Q = -2\phi$ put probability one on S_L since the on-path profits from buying strictly exceed any possible proceeds from selling for a blockholder observing S_H. In fact, with share purchases, the intuitive criterion (Cho and Kreps, 1987) suffices to select $\pi(-2\phi) = 0$ as the unique off-path belief. In the conjectured equilibrium, B's expected profits conditional on observing S_L and retaining her stake are

$$\frac{1}{3}\alpha[V(S_L, -\phi) + V(S_L, 0) + V(S_L, +\phi)], \tag{1.18}$$

whereas deviating to exit yields

$$\frac{1}{3}\alpha[P(-2\phi) + P(-\phi) + P(0)]. \tag{1.19}$$

$D^2_{ST}(-2\phi) = D^2_{ST}(-\phi) = \frac{D^1_{ST}}{p_L} \geq \frac{1}{p_L} > \overline{R}$ and since $\gamma = 1$, $V(S_L, -\phi) = P(-2\phi) = P(-\phi) = 0$. Further, $D^2_{ST}(0) = D^2_{ST}(+\phi) = \frac{D^1_{ST}}{p_0}$ and $D^2_{ST}(+2\phi) = D^1_{ST}$. On the equilibrium path, there is premature liquidation with probability $\frac{1}{3}(1-q)$ which yields $D^1_{ST} = \frac{1-\frac{1}{3}(1-q)p_L\overline{R}}{(1-\frac{1}{3}(1-q))} > 1$. For simplicity, assume that $p_0\overline{R} > \frac{1-\frac{1}{3}(1-q)p_L\overline{R}}{(1-\frac{1}{3}(1-q))}$ such that the company is not prematurely liquidated after $Q \in \{0, +\phi\}$. Then, share retention conditional on S_L is a best response if (1.18) weakly exceeds (1.19), i.e., if

$$\frac{2}{3}\alpha p_L[\overline{R} - \frac{D^1_{ST}}{p_0}] \geq \frac{1}{3}\alpha p_0[\overline{R} - \frac{D^1_{ST}}{p_0}], \tag{1.20}$$

which rearranges to $p_L \geq q\Delta_p$ and holds true by Assumption 1.1. Thus, short-term debt also prevents exit if B can purchase additional shares after positive news. It is easy to see that share purchases are optimal for B conditional on S_H.

An asymmetric effect on trading incentives arises. The intuition is as follows. As before, short-term credit spreads increase if the share price signals S_L, making exit less attractive for B. In contrast, after positive news, which are conveyed by the share price after B acquires additional shares, credit spreads fall since creditors know the company to be in good shape. Hence, by acquiring additional shares, B can gain by purchasing shares at a price below the fair value (direct trading profits) but also if she is uncovered, B makes a profit as credit spreads decline (indirect effect on credit spreads).

Still, share prices are less informative due to high levels of short-term debt. The reason is that without short-term debt the blockholder trades both after positive and negative news. To see the difference in share price informativeness recall that posterior beliefs in the asymmetric equilibrium are $\pi(-\phi) = 0$, $\pi(0) = \frac{\frac{1}{3}q}{\frac{1}{3}q+\frac{1}{3}(1-q)} = q$, $\pi(+\phi) = \frac{\frac{1}{3}q}{\frac{1}{3}q+\frac{1}{3}(1-q)} = q$, $\pi(+2\phi) = \frac{\frac{1}{3}q}{\frac{1}{3}q} = 1$. Consequently, with probability $q\frac{1}{3}+(1-q)\frac{1}{3}+q\frac{1}{3}+(1-q)\frac{1}{3} = \frac{2}{3}$ a total order flow $Q \in \{0, +\phi\}$ realizes and the share price remains uninformative. In contrast, if B traded conditional on both kinds of news, as it is the unique equilibrium for $\gamma = 0$, posteriors are $\pi(-2\phi) = \pi(-\phi) = 0$, $\pi(0) = \frac{\frac{1}{3}q}{\frac{1}{3}q+\frac{1}{3}(1-q)} = q$, $\pi(+\phi) = \pi(+2\phi) = \frac{\frac{1}{3}q}{\frac{1}{3}q} = 1$. Hence, in the symmetric equilibrium with trade after both kinds of information, the market is uninformed only with probability $q\frac{1}{3} + (1-q)\frac{1}{3} = \frac{1}{3}$.

An asymmetric effect on trading incentives is also identified by Edmans et al. (2015) where a manager learns from the share price to guide his investment decision. Edmans et al. (2015) show that in such a situation, and if transactions costs of trading are large enough, there exists equilibria where a speculator never shorts the company's stock upon negative news but buys shares after positive news. As the manager improves firm value after learning from a speculator's short position, shorting becomes less profitable whereas a share purchase becomes even more profitable. My model adds to these findings by showing that short-term debt, or more generally, information sensitive stakeholders, can also induce an asymmetric effect on trading behavior, even without the need of substantial transaction costs. My model, building purely on retrospective information about managerial performance, stresses the corporate governance dimension whereas Edmans et al. (2015) consider prospective information about the optimal investment strategy. Moreover, the role of the trader's initial stake is inverse in the two models. The effect on trading incentives increases in the initial stake in my model (Section 1.3.4). The effect of short-term debt on trading incentives is, thus, most relevant for large blockholders, the crucial entities for shareholder governance. Conversely, Edmans et al. (2015) the effect decreases in the initial stake of the speculator in the sense that larger transactions costs are required to sustain the asymmetry.

1.7.3 Leverage and Safe Debt

While the focus of the model is the maturity structure of debt, a related question is what role the leverage plays when creditors learn from the share price. To shed light on the impact of leverage, it is useful to relax the simplifying assumption that $R \in \{0, \overline{R}\}$ which, as is well-known, cannot capture the relevant differences of debt and equity financing. For instance, a zero return conditional on project failure makes safe debt impossible. Hence, in the model, there always is an effect of exit on short-term creditors' required credit spreads, independent of the company's leverage. But this need not be the case. To see this, suppose $R \in \{\underline{R}, \overline{R}\}$, where $\overline{R} > \underline{R} > 0$. In such a setting, debt is safe as long as the company does not issue more debt than it is able to repay even after a project failure i.e., $\underline{R}$. If debt is safe, the fact that short-term creditors learn from share prices does not matter as they can be fully repaid in any state of the world. If the company needs to issue more debt such that safe debt is not feasible, even though the amount of short-term debt may be the same in both cases, the higher levered company will experience a feedback effect from short-term creditors while the company with only safe debt outstanding will not. This illustrates that leverage can strengthen the feedback effect of short-term debt.

1.7.4 Timing Ones Exit

A natural question to ask is how the occasional rollover of long-term debt affects governance by exit. Clearly, in such an instance, long-term creditors have as much, if not even more reason to learn from the share price. However, a rollover of long-term debt gives scope for strategic timing of the exit whereas short-term debt does not. As a consequence, the effect of long-term debt is at most transitory whereas the effect of short-term debt on roll over is persistent. Intuitively, a blockholder can simply postpone her exit until after the rollover date of long-term debt to circumvent creditors reacting to the exit. Conversely, since the defining feature of short-term debt is that it has to be rolled over frequently, the effect of short-term debt on exit is persistent. Whenever the blockholder may exit, briefly afterward short-term creditors face (another) rollover decision.

To illustrate this point, consider a model similar to that in Section 1.3.2. For ease of exposition, abstract from management and suppose that S_H realizes with (exogenously given) probability q. Further, suppose the company has only long-term debt with face value of 1 outstanding but long-term debt needs to be rolled over at $t = 1$. Because long-term debt only needs to be rolled over infrequently, the blockholder can also postpone her exit to a later stage, say $t = 2$.[28] In $t = 3$, payoffs realize and the timing is summarized in Figure **??**.

Suppose that B observes S_L and consider her incentives to exit at $t = 1$, before the rollover date. If exit is anticipated in equilibrium, B's exit profits at $t = 1$ are

[28] It is easy to see that a small cost of this delay does not prevent incentives to postpone the exit.

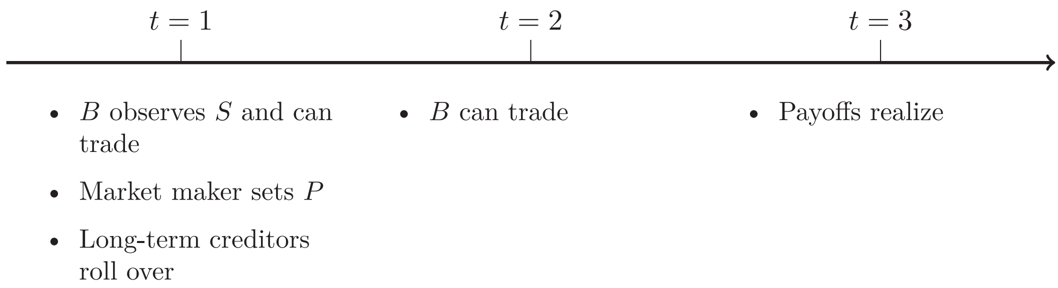

Figure 1.7 Timing Voice

given by

$$\frac{1}{2}\alpha[P^{t=1}(-\phi) + P^{t=1}(-2\phi)] = \frac{1}{2}\alpha[p_0(\overline{R} - \frac{1}{p_0}) + p_L \underbrace{max\{\overline{R} - \frac{1}{p_L}; 0\}}_{=0}]. \tag{1.21}$$

Deviating to exit as $t = 2$ yields expected an expected profit of

$$\frac{1}{2}\alpha[P^{t=2}(-\phi) + P^{t=2}(-2\phi)] = \frac{1}{2}\alpha[p_0(\overline{R} - \frac{1}{p_0}) + p_L(\overline{R} - \frac{1}{p_0})]. \tag{1.22}$$

Hence, the deviation to exit at $t = 2$ is strictly profitable. Given these considerations, it is straightforward to establish that exit after the roll over date constitutes the unique equilibrium.

Interestingly, ex ante, B would like to convince management that it will exit before the rolling over date, such that the price impact of exit is more severe. However, this is not credible as blockholders obtain lower exit prices if they sell before long-term creditors' roll over date.

1.8 Appendix

Proof of Lemma 1.1

Proof. Denote $\pi_M(Q)$ M's posterior that S_H realizes conditional on Q and suppose, on the way to a contradiction, $\eta^* \neq 0$ but $P^* := P(Q) = P(Q')$ for some $Q \neq Q'$. Then, $D^2_{ST}(P(Q)) = D^2_{ST}(P(Q'))$. However,

$$[\pi_M(Q)p_H + (1-\pi_M(Q))p_L]\ max\{R - \gamma D^2_{ST}(P^*) - (1-\gamma)D_{LT}, 0\}$$

$$\neq [\pi_M(Q')p_H + (1-\pi_M(Q'))p_L]\ max\{R - \gamma D^2_{ST}(P^*) - (1-\gamma)D_{LT}, 0\}$$

since $\pi_M(Q') \neq \pi_M(Q)$ for all Q and $max\{R - \gamma D^2_{ST}(P^*) - (1-\gamma)D_{LT}, 0\} > 0$ for all $Q \neq -2\phi$. The former inequality follows from the fact that in any equilibrium with $\eta^* > 0$ there are three potential order flows $Q \in \{-2\phi, -\phi, 0\}$ on the equilibrium path for which the induced posteriors $\pi_M(Q)$ are given by $\{0, \hat{q}, \frac{\hat{q}}{(1-\hat{q})(1-\eta^*)+\hat{q}}\}$, respectively. As $\hat{q} > 0$, $\pi_M(-\phi)$ and $\pi_M(-2\phi)$ are different from zero. Further, $\hat{q} \neq \frac{\hat{q}}{(1-\hat{q})(1-\eta^*)+\hat{q}}$ for $\eta^* > 0$. Moreover, it has to be shown that $max\{R-\gamma D^2_{ST}(P^*)-(1-\gamma)D_{LT}, 0\} \neq 0$ for $Q \in \{-\phi, 0\}$. It can never be true that $P(0) = 0$ since otherwise $P(-2\phi) = P(-\phi) = 0$ and, hence, creditors jointly obtain the entire expected project return of $E[R] > 1$ which contradicts their break-even constraint. Hence, one can follow that $P(0) > 0$ in any equilibrium. If it would hold that $P(-\phi) = 0$, exit leads to a zero shareholder value with certainty (since $P(-2\phi) = 0$ follows from $P(-\phi) = 0$). Deviating from $\eta^* > 0$ to $\eta = 0$ is then strictly profitable since $\eta^* > 0$ yields an expected payoff of

$$\begin{aligned}&\eta^*\phi(\frac{1}{2}P(-2\phi) + \frac{1}{2}P(-\phi)) + (1-\eta^*)\phi(\frac{1}{2}P(0) + \frac{1}{2}P(-\phi))\\ &= (1-\eta^*)\phi\frac{1}{2}P(0)\end{aligned}$$

Conversely, the deviation to $\eta = 0$ induces an expected return to the blockholder of $\phi(\frac{1}{2}P(0) + \frac{1}{2}P(-\phi)) = \phi\frac{1}{2}P(0) > (1-\eta^*)\phi\frac{1}{2}P(0)$ for all $\eta^* > 0$. Hence, $P(-\phi) > 0$ and premature liquidation can only occur after $Q = -2\phi$.

□

Proof of Proposition 1.1

Proof. Step 0: Characterization of $\hat{\gamma}$, $D^1_{ST}, D^2_{ST}(Q), D_{LT}$ and $P(Q)$.

Notation. Let p_0 denote the prior project success probability given $\hat{q}$, i.e., $p_0 = \hat{q}p_H + (1-\hat{q})p_L$. Further, denote the posterior expected success probability conditional on $Q = 0$ by $p'_H := \frac{\hat{q}}{\hat{q}+(1-\hat{q})(1-\eta^*)}p_H + \frac{(1-\hat{q})(1-\eta^*)}{\hat{q}+(1-\hat{q})(1-\eta^*)}p_L$.

Premature Liquidation. If $\gamma = 1$ and $Q = -2\phi$, (1.3) and (1.4) cannot be jointly satisfied since $D^2_{ST}(-2\phi) \geq \frac{1}{p_L} > \overline{R}$. Thus, short-term creditors cannot break-even, the company defaults and is prematurely liquidated at $t = 2$. Denote $\hat{\gamma}$ the largest level of short-term debt for which short-term creditors can still be induced to roll over. By continuity, there is a $\hat{\gamma} \in (0, 1)$ such that

$$\overline{R} = \hat{\gamma}\frac{1}{p_L} + (1-\hat{\gamma})D_{LT}. \tag{1.23}$$

For all $\gamma \leq \hat{\gamma}$, the company offers short-term creditors $D^1_{ST} = 1$. Accepting forms a best response since creditors can be induced to roll over even after $Q = -2\phi$ in this case and, thus, never incur a loss in the first period. Conversely, if $\gamma > \hat{\gamma}$, short-term creditors' break-even conditions (1.3) and (1.4) cannot be jointly satisfied if $Q = -2\phi$. Anticipating this, creditors require $D^1_{ST} > 1$.

Debt Face Values. Following the definition of $\hat{\gamma}$ and since I focus on the equilibria where premature liquidation only occurs if unavoidable, there are two cases for the creditors' break-even conditions. If $\gamma \leq \hat{\gamma}$, there never is premature liquidation and default at $t = 2$. Thus, creditors' break-even conditions are

$$\begin{cases} 1 = p_0 D_{LT} & \text{if long-term debt,} \\ 1 = D^1_{ST} & \text{if short-term debt in} t = 1, \\ 1 = [\pi(0)p_H + (1-\pi(0)p_L]D^2_{ST}(0) & \text{if } Q = 0, \\ 1 = p_0 D^2_{ST}(-\phi) & \text{if} Q = -\phi, \\ 1 = p_L D^2_{ST}(-2\phi) & \text{if} Q = -2\phi. \end{cases} \tag{1.24}$$

Conversely, if $\gamma > \hat{\gamma}$, premature liquidation after $Q = -2\phi$ is unavoidable and creditors' break-even conditions are

$$\begin{cases} 1 = \hat{q}p_H D_{LT} + (1-\hat{q})[(1-\eta^*) + \eta^*\frac{1}{2}]p_L D_{LT} + (1-\hat{q})\eta^*\frac{1}{2}p_L\overline{R} & \text{if long-term debt,} \\ 1 = \hat{q}D^1_{ST} + (1-\hat{q})[(1-\eta^*) + \eta^*\frac{1}{2}]D^1_{ST} + (1-\hat{q})\eta^*\frac{1}{2}p_L\overline{R} & \text{if short-term debt in } t = 1, \\ D^1_{ST} = [\pi(0)p_H + (1-\pi(0)p_L]D^2_{ST}(0) & \text{if } Q = 0, \\ D^1_{ST} = p_0 D^2_{ST}(-\phi) & \text{if } Q = -\phi, \\ D^1_{ST} = p_L D^2_{ST}(-2\phi) & \text{if } Q = -2\phi. \end{cases} \tag{1.25}$$

Share Prices. At $t = 2$, the share prices are given by

$$\begin{cases} P(0) = & p'_H\left(\overline{R} - \gamma\frac{1}{p'_H} - (1-\gamma)\frac{1}{p_0}\right), \\ P(-\phi) = & p_0\left(\overline{R} - \gamma\frac{1}{p_0} - (1-\gamma)\frac{1}{p_0}\right), \\ P(-2\phi) = & p_L\left(\overline{R} - \gamma\frac{1}{p_L} - (1-\gamma)\frac{1}{p_0}\right), \end{cases} \tag{1.26}$$

if $\gamma \leq \hat{\gamma}$ and by

$$\begin{cases} P(0) = & p'_H\Big(\overline{R} - \gamma\frac{1}{p'_H}\frac{1-(1-\hat{q})\eta^*\frac{1}{2}p_L\overline{R}}{\hat{q}+(1-\hat{q})[(1-\eta^*)+\eta^*\frac{1}{2}]} - (1-\gamma)\frac{1-(1-\hat{q})\eta^*\frac{1}{2}p_L\overline{R}}{\hat{q}p_H+(1-\hat{q})[(1-\eta^*)+\eta^*\frac{1}{2}]p_L}\Big), \\ P(-\phi) = & p_0\Big(\overline{R} - \gamma\frac{1}{p_0}\frac{1-(1-\hat{q})\eta^*\frac{1}{2}p_L\overline{R}}{\hat{q}+(1-\hat{q})[(1-\eta^*)+\eta^*\frac{1}{2}]} - (1-\gamma)\frac{1-(1-\hat{q})\eta^*\frac{1}{2}p_L\overline{R}}{\hat{q}p_H+(1-\hat{q})[(1-\eta^*)+\eta^*\frac{1}{2}]p_L}\Big), \\ P(-2\phi) = & max\{p_L(\overline{R} - \gamma\frac{1}{p_L}\frac{1-(1-\hat{q})\eta^*\frac{1}{2}p_L\overline{R}}{\hat{q}+(1-\hat{q})[(1-\eta^*)+\eta^*\frac{1}{2}]} - (1-\gamma)\frac{1-(1-\hat{q})\eta^*\frac{1}{2}p_L\overline{R}}{\hat{q}p_H+(1-\hat{q})[(1-\eta^*)+\eta^*\frac{1}{2}]p_L}); 0\} = 0, \end{cases} \tag{1.27}$$

otherwise.

Step 1: For any $\gamma > \hat{\gamma}$, $\eta^* = 0$ is the unique equilibrium exit probability.

Consider an equilibrium with $\eta^* = 0$. Thus, no premature liquidation ever occurs. Hence, creditors' break-even constraints are given by (1.25) and share prices by (1.26). Consider B's deviation to exit after both states S_L and S_H. Since $\eta^* = 0$, $Q = -2\phi$ induces off-path beliefs $\pi(-2\phi)$. The difference of deviation and on-path profits is given by

$$\begin{aligned}\Pi^{dev}(S_L) =& \frac{1}{2}\alpha[\pi(-2\phi)p_H + (1-\pi(-2\phi))p_L]max\{\overline{R} - \gamma\frac{1}{\pi(-2\phi)} - (1-\gamma)\frac{1}{p_0}; 0\} + \frac{1}{2}\alpha p_0(\overline{R} - \frac{1}{p_0}) \\ & -\alpha p_L(\overline{R} - \frac{1}{p_0}),\end{aligned}$$

and

$$\begin{aligned}\Pi^{dev}(S_H) =& \frac{1}{2}\alpha[\pi(-2\phi)p_H + (1-\pi(-2\phi))p_L]max\{\overline{R} - \gamma\frac{1}{\pi(-2\phi)} - (1-\gamma)\frac{1}{p_0}; 0\} + \frac{1}{2}\alpha p_0(\overline{R} - \frac{1}{p_0}) \\ & - \alpha p_H(\overline{R} - \frac{1}{p_0}),\end{aligned}$$

conditional on S_L and S_H, respectively. Thus,

$$\Pi^{dev}(S_L) - \Pi^{dev}(S_H) = \alpha\Delta_p(\overline{R} - \frac{1}{p_0}) > 0.$$

Hence, for any $\pi(-2\phi)$ for which the deviation is profitable for B conditional on S_H, it is also profitable conditional on S_L. Further, $\exists\pi(-2\phi)$ such that $\Pi^{dev}(S_L) > 0$ but $\Pi^{dev}(S_H) < 0$. Therefore, $D1$ restricts off-path beliefs to $\pi(-2\phi) = 0$.
For all $\gamma > \hat{\gamma}$, $\eta^* = 0$ constitutes an equilibrium trading strategy since

$$\Pi^{NE}(0) = \alpha p_L(\overline{R} - \frac{1}{p_0}) \geq \Pi^E = \alpha\frac{1}{2}p_0(\overline{R} - \frac{1}{p_0}) + \alpha\frac{1}{2}p_L\underbrace{max\{\overline{R} - \gamma\frac{1}{p_L} - (1-\gamma)\frac{1}{p_0}; 0\}}_{=0 \text{ by definition of } \hat{\gamma}}$$

which rearranges to $p_L \geq \hat{q}(p_H - p_L) = \hat{q}\Delta_p$ and holds true by Assumption 1.1.
Further, if $\eta^* > 0$ was expected, deviating to $\eta = 0$ would be strictly profitable for B conditional on S_L since

$$\begin{aligned}\Pi^{NE}(\eta^*) =&\alpha\frac{1}{2}p_L(\overline{R}-\gamma\frac{D^1_{ST}}{p_{H'}}-(1-\gamma)D_{LT})+\alpha\frac{1}{2}p_L(\overline{R}-\gamma\frac{D^1_{ST}}{p_0}-(1-\gamma)D_{LT})\\ >&\alpha p_L(\overline{R}-\gamma\frac{D^1_{ST}}{p_0}-(1-\gamma)D_{LT})\\ \geq&\underbrace{\alpha\frac{1}{2}p_0(\overline{R}-\gamma\frac{D^1_{ST}}{p_0}-(1-\gamma)D_{LT})+\alpha\frac{1}{2}p_L\underbrace{max\{\overline{R}-\gamma\frac{D^1_{ST}}{p_L}-(1-\gamma)D_{LT};0\}}_{=0\text{ by definition of }\hat{\gamma}}}_{=\Pi^E},\end{aligned}$$

where D^1_{ST} is given by (1.25) and the second inequality rearranges to $p_L \geq \hat{q}\Delta_p$ which holds true by Assumption 1.1.

Step 2: There exists a unique equilibrium candidate η^* for all $\gamma \leq \hat{\gamma}$.

Given a fixed $\hat{q}$ and the common posterior $\pi(Q)$, the share price P and the debt face values are pinned down by break-even conditions (1.2) and (1.24) since $\gamma \leq \hat{\gamma}$.
For different equilibrium conjectures of η^*, B' profits from no exit conditional on S_L are then given by

$$\Pi^{NE}(\eta^*) := \alpha\frac{1}{2}p_L(\overline{R}-\frac{1}{p_0})+\alpha\frac{1}{2}p_L(\overline{R}-\gamma\frac{1}{\frac{\hat{q}}{\hat{q}+(1-\hat{q})(1-\eta^*)}p_H+\frac{(1-\hat{q})(1-\eta^*)}{\hat{q}+(1-\hat{q})(1-\eta^*)}p_L}-(1-\gamma)\frac{1}{p_0})\ \forall\eta^*\in[0,1].$$

Analogously, the profits from exit Π^E conditional on S_L, which are independent of the equilibrium conjecture of η^*, are given by

$$\Pi^E = \alpha\frac{1}{2}p_0(\overline{R}-\frac{1}{p_0})+\alpha\frac{1}{2}p_L(\overline{R}-\gamma\frac{1}{p_L}-(1-\gamma)\frac{1}{p_0})\ \forall\eta^*[0,1],$$

for $\gamma \leq \hat{\gamma}$. Then, there are three cases to consider:

1. If $\Pi^{NE}(0) \geq \Pi^E$, $\eta^* = 0$ is the equilibrium candidate since $\Pi^{NE}(0) < \Pi^{NE}(\eta^*)$ for all $\eta^* \in (0,1]$.
2. If $\Pi^{NE}(1) \leq \Pi^E$, $\eta^* = 1$ is the equilibrium candidate since $\Pi^{NE}(1) > \Pi^{NE}(\eta^*)$ for all $\eta^* \in [0,1)$.
3. Thus, the only missing case is where both inequalities are violated, i.e., $\Pi^{NE}(0) < \Pi^E < \Pi^{NE}(1)$. In this case, neither $\eta^* = 0$ nor $\eta^* = 1$ can be equilibrium exit probabilities. Note that $\Pi^{NE}(\eta^*)$ is continuous and strictly increasing in $\eta^* \in [0,1]$ such that for all $m \in (\Pi^{NE}(0), \Pi^{NE}(1))$, there exists a unique $\eta^*_m \in (0,1)$ such that $\Pi^{NE}(\eta^*_m) = m$. Hence, there is an unique η^* such that $\Pi^{NE}(\eta^*) = \Pi^E$. This completes the existence and uniqueness part of the proof.

Step 3: $\exists\overline{\gamma} < \hat{\gamma}$ s.t. for all $\gamma \geq \overline{\gamma}$, $\eta^* = 0$.

Consider $\gamma < \hat{\gamma}$. Then, $\eta^* = 0$ constitutes the unique equilibrium candidate if

$$\alpha p_L(R - \frac{1}{p_0}) \geq \alpha \frac{1}{2} p_0(\overline{R} - \frac{1}{p_0}) + \alpha \frac{1}{2} p_L(R - \gamma \frac{1}{p_L} - (1-\gamma)\frac{1}{p_0}),$$

which rearranges to $\gamma \geq \overline{\gamma} := \overline{R}p_0 - 1$. Recall that $\overline{R} = \hat{\gamma}\frac{1}{p_L} + (1-\hat{\gamma})\frac{1}{p_0}$, which rearranges to

$$\hat{\gamma} = (\overline{R}p_0 - 1)\frac{p_L}{\hat{q}\Delta_p} = \overline{\gamma} \underbrace{\frac{p_L}{\hat{q}\Delta_p}}_{>1 \text{ by Assumption 1.1}} > \overline{\gamma}.$$

Thus, one can conclude that $\overline{\gamma} < \hat{\gamma} < 1$ and the claim follows.

Step 4: $\exists \underline{\gamma} \in (0, \overline{\gamma})$ such that for all $\gamma \leq \underline{\gamma}$, $\eta^* = 1$.

If $\gamma = 0$, $\eta^* = 1$ constitutes the unique equilibrium exit strategy if $p_0(\overline{R} - \frac{1}{p_0}) > p_L(\overline{R} - \frac{1}{p_0})$ which holds true since $p_0 = \hat{q}p_H + (1-\hat{q})p_L > p_L$ and $\hat{q} \geq q > 0$. Note that for any $\gamma > 0$, Π^E is strictly decreasing in γ whenever $\gamma < \hat{\gamma}$ since $\frac{1}{p_L} > \frac{1}{p_0}$. $\eta^* = 1$ constitutes the equilibrium exit strategy if $\Pi^E \geq \Pi^{NE}(1)$ where deviation profits $\Pi^{NE}(1)$ are strictly increasing in γ since $\frac{1}{p_H} < \frac{1}{p_0}$ and $\hat{q} < 1$.
At $\gamma = 0$, $\Pi^E > \Pi^{NE}(1)$, and for all $\gamma \geq \overline{\gamma}$, $\Pi^E \leq \Pi^{NE}(0) < \Pi^{NE}(1)$. Further, Π^E and $\Pi^{NE}(1)$ are continuous in γ, Π^E is strictly decreasing in γ for $\gamma < \hat{\gamma}$ and $\Pi^{NE}(1)$ is strictly increasing in γ. Thus, there exists an $\underline{\gamma} \in (0, \overline{\gamma})$ such that $\Pi^E = \Pi^{NE}(1)$, i.e.,

$$\alpha\frac{1}{2}p_0(\overline{R} - \frac{1}{p_0}) + \alpha\frac{1}{2}p_L(\overline{R} - \underline{\gamma}\frac{1}{p_L} - (1-\underline{\gamma})\frac{1}{p_0}) = \alpha\frac{1}{2}p_L(\overline{R} - \frac{1}{p_0}) + \alpha\frac{1}{2}p_L(\overline{R} - \underline{\gamma}\frac{1}{p_H} - (1-\underline{\gamma})\frac{1}{p_0})$$
$$\iff \hat{q}p_H(\overline{R} - \frac{1}{p_0}) = \underline{\gamma}.$$

Therefore, for all $\gamma \leq \underline{\gamma}$, $\eta^* = 1$ constitutes the unique equilibrium exit probability.

Step 5: For all $\gamma \in (\underline{\gamma}, \overline{\gamma}), \eta^* \in (0,1)$ and η^* is a strictly decreasing function of γ.

By definition, at $\underline{\gamma}$, it holds that $\Pi^E = \Pi^{NE}(1)$ and, thus, $\Pi^E > \Pi^{NE}(0)$. By continuity and monotonicity, $\underline{\gamma} < \overline{\gamma}$ and $\eta^* \in \{0,1\}$ cannot be an equilibrium strategy for any $\gamma \in (\underline{\gamma}, \overline{\gamma})$ since $\Pi^{NE}(0) < \Pi^E < \Pi^{NE}(1)$. To have indifference between exit and no exit, it has to holds true that $\Pi^{NE}(\eta^*) - \Pi^E = 0$ for $\gamma \in (\underline{\gamma}, \overline{\gamma})$, that is

$$\Pi^E - \Pi^{NE}(\eta^*) = \frac{\alpha}{2}\Big(\hat{q}\Delta_p(\overline{R} - \frac{1}{p_0}) - \gamma\frac{\hat{q}\Delta_p}{\hat{q}p_H + (1-\hat{q})(1-\eta^*)p_L}\Big) = 0$$

where rearranging yields

$$\eta^* = 1 - \frac{\frac{\gamma}{(R - \frac{1}{p_0})} - \hat{q}p_H}{(1-\hat{q})p_L}$$

and taking the derivative gives

$$\frac{\partial \eta^*}{\partial \gamma} = -\frac{1}{(\overline{R} - \frac{1}{p_0})(1-\hat{q})p_L} < 0.$$

□

Proof of Proposition 1.2

Proof. Step 1: There exists a unique equilibrium with cutoff $\hat{c}$ such that all types $c \leq \hat{c}$ take $a = 1$ and all $c > \hat{c}$ take $a = 0$.

For fixed equilibrium conjectures $(\hat{c}, \eta^*)$, M's payoff from working is given by

$$\begin{aligned}
&\omega_p\Big[(q+\Delta_q)\Big(\frac{1}{2}P(-\phi)+\frac{1}{2}P(0)\Big)+(1-q-\Delta_q)\Big(\frac{1}{2}\eta^*P(-2\phi)+\frac{1}{2}P(-\phi)+(1-\eta^*)\frac{1}{2}P(0)\Big)\Big]\\
&+\omega_v\Big[(q+\Delta_q)\Big(\frac{1}{2}V(-\phi,S_H)+\frac{1}{2}V(0,S_H)\Big)\\
&+(1-q-\Delta_q)\Big(\frac{1}{2}\eta^*V(-2\phi,S_L)+\frac{1}{2}V(-\phi,S_L)+\frac{1}{2}(1-\eta^*)V(0,S_L)\Big)\Big]-c. \qquad (1.28)
\end{aligned}$$

In contrast, shirking $(a = 0)$ gives M an expected payoff of

$$\begin{aligned}
&\omega_p\Big[q\Big(\frac{1}{2}P(-\phi)+\frac{1}{2}P(0)\Big)+(1-q)\Big(\frac{1}{2}\eta^*P(-2\phi)+\frac{1}{2}P(-\phi)+(1-\eta^*)\frac{1}{2}P(0)\Big)\Big]\\
&+\omega_v\Big[q\Big(\frac{1}{2}V(-\phi,S_H)+\frac{1}{2}V(0,S_H)\Big)\\
&+(1-q)\Big(\frac{1}{2}\eta^*V(-2\phi,S_L)+\frac{1}{2}V(-\phi,S_L)+\frac{1}{2}(1-\eta^*)V(0,S_L)\Big)\Big]. \qquad (1.29)
\end{aligned}$$

Let the difference of (1.28) and (1.29) be denoted by $h(c, \hat{c})$ where $\hat{c}$ is the equilibrium cutoff conjecture and c is M's type realization, that is

$$\begin{aligned}
h(c,\hat{c}) =&\frac{\omega_p}{2}\ \Delta_q\ \eta^*\ \Big(p'_H(\hat{c})(\overline{R}-\gamma\frac{1}{p'_H(\hat{c})}-(1-\gamma)\frac{1}{p_0(\hat{c})})-p_L(\overline{R}-\gamma\frac{1}{p_L}-(1-\gamma)\frac{1}{p_0(\hat{c})})\Big)\\
&+\frac{\omega_v}{2}\ \Delta_q\ \eta^*\ \Big(p_H(\overline{R}-\gamma\frac{1}{p'_H(\hat{c})}-(1-\gamma)\frac{1}{p_0(\hat{c})})-p_L(\overline{R}-\gamma\frac{1}{p_L}-(1-\gamma)\frac{1}{p_0(\hat{c})})\Big)\\
&+\frac{\omega_v}{2}\ \Delta_q\ (1-\eta^*)\ \Big(p_H(\overline{R}-\gamma\frac{1}{p'_H(\hat{c})}-(1-\gamma)\frac{1}{p_0(\hat{c})})-p_L(\overline{R}-\gamma\frac{1}{p'_H(\hat{c})}-(1-\gamma)\frac{1}{p_0(\hat{c})})\Big)\\
&+\frac{\omega_v}{2}\ \Delta_q\ \Big(p_H(\overline{R}-\gamma\frac{1}{p_0(\hat{c})}-(1-\gamma)\frac{1}{p_0(\hat{c})})-p_L(\overline{R}-\gamma\frac{1}{p_0(\hat{c})}-(1-\gamma)\frac{1}{p_0(\hat{c})})\Big)-c.
\end{aligned} \qquad (1.30)$$

I can drop any *max*-operators since the limited liability of shareholders is never binding as, by Proposition 1.1, all share prices and expected terminal values are strictly positive independent of the level of short-term debt. $\hat{c}$ is an equilibrium cutoff if and only if it is the solution to $h(\hat{c}, \hat{c}) = 0$. To highlight that p_0 and p'_H are functions of $\hat{c}$, I write $p_0(\hat{c})$ and $p'_H(\hat{c})$. There exists such a solution $\hat{c} > 0$ to (1.30) because even if $\hat{c} = 0$, $\mathbb{E}[R] > 1$. Hence, $D^1_{ST}, D^2_{ST}(0), D^2_{ST}(-\phi)$ and D_{LT} are all smaller than $\overline{R}$ as otherwise creditors' break-even constraints are violated. In particular, if $D^1_{ST}, D^2_{ST}(0)$ or D_{LT} were equal or larger than $\overline{R}$, short- and long-term creditors jointly obtain the entire ex ante expected return of $\mathbb{E}[R] > 1$ and, thus, cannot break even. Similar to the argument from Lemma 1.1, $D_{ST}(-\phi) < \overline{R}$ as otherwise exit would yield zero profits and the blockholder had a profitable deviation to $\eta = 0$. Again, if $\eta^* = 0$ in equilibrium, $D_{ST}(-\phi) < \overline{R}$ by the break-even conditions of creditors. Hence, $h(c,\hat{c})+c$ is strictly larger than zero at $\hat{c}=0$ and increases in $\hat{c}$ but is bounded above by $p_H\overline{R}$. c increases from 0 to $\overline{c}>p_H\overline{R}$. Since $h(\hat{c},\hat{c})$ is continuous in $\hat{c}$, there exits a cutoff $\hat{c}\in(0,\overline{c})$ such that $h(\hat{c},\hat{c})=0$. The cutoff $\hat{c}$ is unique since $\frac{\partial h(\hat{c},\hat{c})}{\partial \hat{c}}$ monotonically decreases in $\hat{c}$ as can be seen by

$$
\begin{aligned}
\frac{\partial h(\hat{c},\hat{c})}{\partial \hat{c}} &= \frac{\omega_p}{2}\Delta_q\ \eta^*\Big[\frac{\partial p'_H}{\partial \hat{c}}(\overline{R}-\gamma\frac{1}{p'_H}-(1-\gamma)\frac{1}{p_0})+p'_H\gamma(-\frac{\partial\frac{1}{p'_H}}{\partial \hat{c}})+(1-\gamma)(p'_H-p_L)(-\frac{\partial\frac{1}{p_0}}{\partial \hat{c}})\Big]\\
&+\frac{\omega_v}{2}\ \Delta_q\ \Big[\eta^* p_H\gamma(-\frac{\partial\frac{1}{p'_H}}{\partial \hat{c}})+(1-\eta^*)\Delta_p\gamma(-\frac{\partial\frac{1}{p'_H}}{\partial \hat{c}})+(1-\gamma)\Delta_p(-\frac{\partial\frac{1}{p_0}}{\partial \hat{c}})\Big]+\frac{\omega_v}{2}\ \Delta_q\ \Delta_p(-\frac{\partial\frac{1}{p_0}}{\partial \hat{c}})-1\\
&=\frac{\omega_p}{2}\ \Delta_q\ \eta^*\Big[\frac{\Delta_p\Delta_q(1-\eta^*)g(\hat{c})}{[(q+\Delta_qG(\hat{c}))+(1-q-\Delta_qG(\hat{c}))(1-\eta^*)]^2}(R-\gamma\frac{1}{p'_H}-(1-\gamma)\frac{1}{p_0})\\
&+\gamma p'_H\frac{g(\hat{c})\Delta_p\Delta_q(1-\eta^*)}{[(q+\Delta_qG(\hat{c}))p_H+(1-q-\Delta_qG(\hat{c}))p_L(1-\eta^*)]^2}+(1-\gamma)(p'_H-p_L)\frac{g(\hat{c})\Delta_p\Delta_q}{p_0^2}\Big]\\
&+\frac{\omega_v}{2}\ \Delta_q\ \Big[\gamma[\eta^*(1-\eta^*)p_H+(1-\eta^*)^2\Delta_p]\frac{g(\hat{c})\Delta_q\Delta_p}{[(q+\Delta_qG(\hat{c}))p_H+(1-q-\Delta_qG(\hat{c}))p_L(1-\eta^*)]^2}\\
&+(1-\gamma)\Delta_p\frac{g(\hat{c})\Delta_p\Delta_q}{p_0^2}\Big]+\frac{\omega_v}{2}\ \Delta_q\ \Big[\Delta_p\frac{g(\hat{c})\Delta_p\Delta_q}{p_0^2}\Big]-1\\
&\le\frac{\omega_p}{2}\ \Delta_q\ \eta^*\Big[\frac{\Delta_p\Delta_q(1-\eta^*)g(\hat{c})}{[(q+\Delta_qG(\hat{c}))+(1-q-\Delta_qG(\hat{c}))(1-\eta^*)]^2}\frac{\frac{(q+\Delta_qG(\hat{c}))}{(q+\Delta_qG(\hat{c}))+(1-q-\Delta_qG(\hat{c}))(1-\eta^*)}\Delta_p}{p_Lp'_H}\\
&+\gamma g(\hat{c})\frac{(1-\eta^*)}{(q+\Delta_qG(\hat{c}))+(1-q-\Delta_qG(\hat{c}))(1-\eta^*)}\frac{\Delta_p\Delta_q}{(q+\Delta_qG(\hat{c}))p_H+(1-q-\Delta_qG(\hat{c}))p_L(1-\eta^*)}\\
&+(1-\gamma)g(\hat{c})\frac{\Delta_p^2\Delta_q}{p_0^2}\Big]\\
&+\frac{\omega_v}{2}\ \Delta_q\ \Big[\gamma\Delta_p\frac{g(\hat{c})\Delta_p\Delta_q}{[(q+\Delta_qG(\hat{c}))p_H+(1-q-\Delta_qG(\hat{c}))p_L(1-\eta^*)]^2}+(1-\gamma)\Delta_p\frac{g(\hat{c})\Delta_p\Delta_q}{p_0^2}\Big]\\
&+\frac{\omega_v}{2}\ \Delta_q\ \Big[\Delta_p\frac{g(\hat{c})\Delta_p\Delta_q}{p_0^2}\Big]-1\\
&\le\frac{\omega_p}{2}\ \Delta_q\ \eta^*\Big[\frac{g(\hat{c})}{[(q+\Delta_qG(\hat{c}))+(1-q-\Delta_qG(\hat{c}))(1-\eta^*)]^2}\\
&\frac{\Delta_p^2\Delta_q(1-\eta^*)(q+G(\hat{c})\Delta_q)}{p_L[(q+\Delta_qG(\hat{c}))p_H+(1-q-\Delta_qG(\hat{c}))p_L(1-\eta^*)]}\\
&+\gamma g(\hat{c})\frac{\Delta_p\Delta_q}{(q+\Delta_qG(\hat{c}))p_H+(1-q-\Delta_qG(\hat{c}))p_L(1-\eta^*)}+(1-\gamma)g(\hat{c})\frac{\Delta_p^2\Delta_q}{p_0^2}\Big]\\
&+\frac{\omega_v}{2}\ \Delta_q\ \Big[\gamma\Delta_p\frac{g(\hat{c})\Delta_p\Delta_q}{[(q+\Delta_qG(\hat{c}))p_H+(1-q-\Delta_qG(\hat{c}))p_L(1-\eta^*)]^2}+(1-\gamma)\Delta_p\frac{g(\hat{c})\Delta_p\Delta_q}{p_0^2}\Big]\\
&+\frac{\omega_v}{2}\ \Delta_q\ \Big[\Delta_p\frac{g(\hat{c})\Delta_p\Delta_q}{p_0^2}\Big]-1\\
&\le\omega_p\Delta_q^2\ g(\hat{c})+\omega_v\Delta_q^2\ g(\hat{c})-1<0
\end{aligned}
$$

where the last inequality follows from the fact that $g(c)\le\frac{1}{\Delta_q^2}$. Further, Assumption 1.2 ensures that $p_L\ge max\{\frac{1}{2},(1-q)\}p_H$ which implies $qp_H\ge\Delta_p$ and thereby $G(\hat{c})p_H\ge qp_H\ge\Delta_p$. Assumption 1.2 also guarantees that $p_L\ge\Delta_p$. Further, $[\eta^*(1-\eta^*)p_H+(1-\eta^*)^2\Delta_p]$ is maximized at $\eta^{max}=: max\{1-\frac{1}{2}\frac{p_H}{p_L};0\}$. Since $p_L\ge\frac{1}{2}p_H$, $\eta^{max}=0$. Plugging in yields $[\eta^*(1-\eta^*)p_H+(1-\eta^*)^2\Delta_p]\le\Delta_p$.

Given the unique cutoff $\hat{c}$ and the resulting prior probability $q+\Delta_q G(\hat{c})$ of S_H, there exists a unique, optimal trading strategy η^* for the blockholder and thus a unique equilibrium by the proof of Proposition 1.1 where $q+\Delta_q G(\hat{c})$ is substituted in for $\hat{q}$.

Step 2: There exists $\underline{\gamma}^E, \overline{\gamma}^E$ such that $0<\underline{\gamma}^E<\overline{\gamma}^E<1$ and

1. for all $\gamma \leq \underline{\gamma}^E$, $\eta^*=1$;
2. for all $\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)$, $\eta^* \in (0,1)$ and strictly decreases in γ;
3. for all $\gamma \geq \overline{\gamma}^E$, $\eta^*=0$.

Fix an equilibrium with cutoff $\hat{c}$. Then, plugging in $q+G(\hat{c})\Delta_q$ for $\hat{q}$ in the proof of Proposition 1.1 gives the trading incentives for the blockholder. Since Assumption 1.2 ensures, as Assumption 1.1 for Proposition 1.1, that $\eta^*=0$ is the unique equilibrium exit strategy for all $\gamma \geq \hat{\gamma}$. the unique η^* is given by Proposition 1.1: There exists, $\underline{\gamma}^E$ such that $\eta^*=1$ for all $\gamma \leq \underline{\gamma}^E$. Further, there is a $\overline{\gamma}^E$ such that for all $\gamma \geq \overline{\gamma}^E$, $\eta^*=0$. Finally, for all $\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)$, $\eta^* \in (0,1)$ and strictly decreases in γ.

Step 3: For all $\gamma \leq \underline{\gamma}^E$, $\hat{c}$ is a strictly increasing function of γ.

$$
\begin{aligned}
\frac{\partial h(\hat{c},\hat{c})}{\partial \hat{c}}\Big|_{\gamma\leq\underline{\gamma}^E} =\ & \frac{\omega_p}{2}\ \Delta_q\ \eta^*\Big[\frac{\Delta_p\Delta_q(1-\eta^*)g(\hat{c})}{[(q+\Delta_q G(\hat{c}))+(1-q-\Delta_q G(\hat{c}))(1-\eta^*)]^2}(\overline{R}-\gamma\frac{1}{p_H'}-(1-\gamma)\frac{1}{p_0})\\
& +\gamma p_H'\frac{g(\hat{c})\Delta_p\Delta_q(1-\eta^*)}{[(q+\Delta_q G(\hat{c}))p_H+(1-q-\Delta_q G(\hat{c}))p_L(1-\eta^*)]^2}+(1-\gamma)(p_H'-p_L)\frac{g(\hat{c})\Delta_p\Delta_q}{p_0^2}\Big]\\
& +\frac{\omega_v}{2}\ \Delta_q\ \Big[\gamma[\eta^*(1-\eta^*)p_H+(1-\eta^*)^2\Delta_p]\frac{g(\hat{c})\Delta_q\Delta_p}{[(q+\Delta_q G(\hat{c}))p_H+(1-q-\Delta_q G(\hat{c}))p_L(1-\eta^*)]^2}\\
& +(1-\gamma)\Delta_p\frac{g(\hat{c})\Delta_p\Delta_q}{p_0^2}\Big]+\frac{\omega_v}{2}\ \Delta_q\ \Big[\Delta_p\frac{g(\hat{c})\Delta_p\Delta_q}{p_0^2}\Big]-1\\
=\ & \frac{\omega_p}{2}\ \Delta_q\Big[(1-\gamma)\Delta_p\frac{g(\hat{c})\Delta_q\Delta_p}{p_0^2}\Big]+\frac{\omega_v}{2}\ \Delta_q\ \Big[(1-\gamma)\Delta_p\frac{g(\hat{c})\Delta_q\Delta_p}{p_0^2}\Big]+\frac{\omega_v}{2}\ \Delta_q\ \Big[\Delta_p\frac{g(\hat{c})\Delta_q\Delta_p}{p_0^2}\Big]\\
& -1<0,
\end{aligned}
$$

where the equality follows from the fact that for $\gamma \leq \underline{\gamma}^E$, $\eta^*=1$. Further,

$$
\frac{\partial h(\hat{c},\hat{c})}{\partial \gamma}\Big|_{\gamma\leq\underline{\gamma}^E}=\frac{\omega_p}{2}\Big[p_H(\frac{1}{p_0}-\frac{1}{p_H})+p_L(\frac{1}{p_L}-\frac{1}{p_0})\Big]+\frac{\omega_v}{2}\Big[p_H(\frac{1}{p_0}-\frac{1}{p_H})+p_L(\frac{1}{p_L}-\frac{1}{p_0})\Big]>0.
$$

Together this implies that

$$
\begin{aligned}
& \frac{\partial \hat{c}}{\partial \gamma}\Big|_{\gamma\leq\underline{\gamma}^E}=-\frac{\frac{\partial h(\hat{c},\hat{c})}{\partial\gamma}}{\frac{\partial h(\hat{c},\hat{c})}{\partial\hat{c}}}\Big|_{\gamma\leq\underline{\gamma}^E}\\
& =\frac{\frac{\omega_p}{2}\Big[p_H(\frac{1}{p_0}-\frac{1}{p_H})+p_L(\frac{1}{p_L}-\frac{1}{p_0})\Big]+\frac{\omega_v}{2}\Big[p_H(\frac{1}{p_0}-\frac{1}{p_H})+p_L(\frac{1}{p_L}-\frac{1}{p_0})\Big]}{1-\frac{\omega_p}{2}\ \Delta_q\Big[(1-\gamma)\Delta_p\frac{g(\hat{c})\Delta_q\Delta_p}{p_0^2}\Big]-\frac{\omega_v}{2}\ \Delta_q\ \Big[(1-\gamma)\Delta_p\frac{g(\hat{c})\Delta_q\Delta_p}{p_0^2}\Big]-\frac{\omega_v}{2}\ \Delta_q\ \Big[\Delta_p\frac{g(\hat{c})\Delta_q\Delta_p}{p_0^2}\Big]}\\
& =\frac{\frac{\omega_p+\omega_v}{2}\frac{\Delta_p}{p_0}}{1-\frac{\omega_p+\omega_v}{2}\ \Delta_q^2(1-\gamma)\frac{g(\hat{c})\Delta_p^2}{p_0^2}-\frac{\omega_v}{2}\ \Delta_q^2\ \frac{g(\hat{c})\Delta_p^2}{p_0^2}}>0.
\end{aligned}
$$

Step 4: For all $\gamma \geq \overline{\gamma}^E$, $\hat{c}$ is constant γ.

For all $\gamma \geq \overline{\gamma}$, $\eta^* = 0$. Thus,

$$h(\hat{c},\hat{c}) = \omega_v \Delta_q \Big(p_H (R - \frac{1}{p_0}) - p_L (R - \frac{1}{p_0}) \Big) - \hat{c} = \omega_v \Delta_p \Delta_q (R - \frac{1}{p_0}) - \hat{c},$$

and, hence, $\hat{c}$ does not depend on γ for $\gamma \geq \overline{\gamma}$.

Step 5: For all $\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)$, $\hat{c}$ strictly decreases in γ.

From the proof of Proposition 1.1, I know that for $\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)$, $\eta^* \in (0,1)$ and hence the blockholder needs to be indifferent between exit and no exit. Plugging in $\hat{q} = q + G(\hat{c})\Delta_q$ yields

$$\frac{\partial \eta^*}{\partial \gamma} = -\frac{1}{(\overline{R} - \frac{1}{p_0})(1 - q - G(\hat{c})\Delta_q) p_L} < 0.$$

Further, $\Pi^E - \Pi^{NE}(\eta^*) = 0$ requires that

$$\frac{d(\Pi^E - \Pi^{NE}(\eta^*))}{d\gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} = \frac{\partial(\Pi^E - \Pi^{NE}(\eta^*))}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} + \frac{\partial(\Pi^E - \Pi^{NE}(\eta^*))}{\partial \eta^*}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} \frac{\partial \eta^*}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} = 0.$$

such that for

$$\begin{aligned} \frac{d(\Pi^E - \Pi^{NE}(\eta^*))}{d\gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} = & \underbrace{\frac{\partial(\Pi^E)}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)}}_{<0} + \underbrace{\frac{\partial(\Pi^E)}{\partial \eta^*}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)}}_{=0} \underbrace{\frac{\partial \eta^*}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)}}_{<0} \\ & - \underbrace{\frac{\partial(\Pi^{NE})}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}, \overline{\gamma})}}_{>0} - \underbrace{\frac{\partial(\Pi^{NE})}{\partial \eta^*}\Big|_{\gamma \in (\underline{\gamma}, \overline{\gamma})}}_{>0} \underbrace{\frac{\partial \eta^*}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}, \overline{\gamma})}}_{<0} = 0. \end{aligned}$$

Hence, it follows that

$$\frac{d\Pi^{NE}(\eta^*)}{d\gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} = \underbrace{\frac{\partial(\Pi^{NE})}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)}}_{>0} + \underbrace{\frac{\partial(\Pi^{NE})}{\partial \eta^*}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)}}_{>0} \underbrace{\frac{\partial \eta^*}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)}}_{<0} < 0,$$

Plugging in $\frac{\partial \Pi^{NE}(\eta^*)}{\partial \gamma} = \frac{\partial \frac{\alpha}{2} V(S_L,0)}{\partial \gamma}$ and $\frac{\partial \Pi^{NE}(\eta^*)}{\partial \eta} = \frac{\partial \frac{\alpha}{2} V(S_L,0)}{\partial \eta^*}$, yields

$$\frac{d\frac{\alpha}{2}(V(S_L,0) + V(S_L,-\phi))}{d\gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} = \frac{\partial \frac{\alpha}{2} V(S_L,0)}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} + \frac{\partial \frac{\alpha}{2} V(S_L,0)}{\partial \eta^*}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} \frac{\partial \eta^*}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} < 0.$$

Since

$$\frac{\partial \Pi^{NE}(\eta^*)}{\partial \gamma} = \frac{\partial \frac{\alpha}{2} V(S_L,0)}{\partial \gamma} = \alpha \frac{1}{2} p_L \frac{(\pi(0) - q - G(\hat{c})\Delta_q)\Delta_p}{p_0(\pi(0)p_H + (1-\pi(0))p_L)},$$
$$\frac{\partial \Pi^{NE}(\eta^*)}{\partial \eta^*} = \frac{\partial \frac{\alpha}{2} V(S_L,0)}{\partial \eta^*} = \alpha \frac{1}{2} \gamma p_L \frac{(1 - q - G(\hat{c})\Delta_q)(q + G(\hat{c})\Delta_q)\Delta_p}{([qp_H + (1-q)(1-\eta^*)p_L]^2},$$
$$\frac{\partial \frac{\alpha}{2} V(S_H,0)}{\partial \gamma} = \alpha \frac{1}{2} p_H \frac{(\pi(0) - q - G(\hat{c})\Delta_q)\Delta_p}{p_0(\pi(0)p_H + (1-\pi(0))p_L)} = (\frac{\Delta_p}{p_L} + 1)\frac{\partial \frac{\alpha}{2} V(S_L,0)}{\partial \gamma},$$
$$\frac{\partial \frac{\alpha}{2} V(S_H,0)}{\partial \eta^*} = \alpha \frac{1}{2} \gamma p_H \frac{(1 - q - G(\hat{c})\Delta_q)(q + G(\hat{c})\Delta_q)\Delta_p}{([qp_H + (1-q)(1-\eta^*)p_L]^2} = (\frac{\Delta_p}{p_L} + 1)\frac{\partial \frac{\alpha}{2} V(S_L,0)}{\partial \eta^*},$$

one can conclude that

$$\begin{aligned}
&\frac{d(\frac{\alpha}{2} V(S_H,0) + \frac{\alpha}{2} V(S_H,-\phi))}{d\gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} \\
&= \frac{\partial \frac{\alpha}{2} V(S_H,0)}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} + \frac{\partial \frac{\alpha}{2} V(S_H,0)}{\partial \eta^*}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} \frac{\partial \eta^*}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} \\
&= (\frac{\Delta_p}{p_L} + 1)\frac{\partial \frac{\alpha}{2} V(S_L,0)}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} + (\frac{\Delta_p}{p_L} + 1)\frac{\partial \frac{\alpha}{2} V(S_L,0)}{\partial \eta^*}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} \frac{\partial \eta^*}{\partial \gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} \\
&= (\frac{\Delta_p}{p_L} + 1)[\frac{d(\frac{\alpha}{2} V(S_L,0) + \frac{\alpha}{2} V(S_L,-\phi))}{d\gamma}] < 0.
\end{aligned}$$

As a consequence,

$$\begin{aligned}
&\frac{d(\frac{\alpha}{2} V(S_H,0) + \frac{\alpha}{2} V(S_H,-\phi) - \frac{\alpha}{2} V(S_L,0) - \frac{\alpha}{2} V(S_L,-\phi))}{d\gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} \\
&= \frac{\Delta_p}{p_L}\frac{d(\frac{\alpha}{2} V(S_L,0) + \frac{\alpha}{2} V(S_L,-\phi))}{d\gamma}\Big|_{\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)} < 0.
\end{aligned}$$

This implies for $\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)$ that

$$\begin{aligned}
0 &> \frac{d(\frac{\alpha}{2} V(S_H,0) + \frac{\alpha}{2} V(S_H,-\phi) - \frac{\alpha}{2} V(S_L,0) - \frac{\alpha}{2} V(S_L,-\phi))}{d\gamma} \\
&= \frac{d(\frac{\alpha}{2} V(S_H,0) + \frac{\alpha}{2} V(S_H,-\phi) - \frac{\alpha}{2} P(-\phi) - \frac{\alpha}{2} P(-2\phi))}{d\gamma} \\
&= \frac{\alpha}{2}\frac{d(V(S_H,0) - P(-2\phi))}{d\gamma} = \frac{\alpha}{2}\frac{d(V(S_H,0) - V(S_L,0))}{d\gamma}.
\end{aligned}$$

The equality signs follows from B's indifference, and from $V(S_H,-\phi)$, $P(-\phi)$ as well as $V(S_L,-\phi)$ being independent of γ. Recall that the managerial cutoff is the solution to

$$\begin{aligned}
h(\hat{c},\hat{c}) = \frac{\omega_p}{2}\ \Delta_q\ \eta^* \Big(P(0) - P(-2\phi)\Big) + \frac{\omega_v}{2}\ \Delta_q\ \eta^* \Big(V(S_H,0) - V(S_L,-2\phi)\Big) \\
+\frac{\omega_v}{2}\ \Delta_q\ (1-\eta^*) \Big(V(S_H,0) - V(S_L,0)\Big) + \frac{\omega_v}{2}\ \Delta_q \Big(V(S_H,-\phi) - V(S_L,-\phi)\Big) - \hat{c} = 0,
\end{aligned} \tag{1.31}$$

First, note that

$$P(0) - P(-2\phi) = V(S_L, 0) + (p'_H - p_L)V(S_L, 0) - P(-2\phi),$$

$$\frac{\partial(p'_H - p_L)}{\partial\eta^*} = \frac{\Delta_p(q + G(\hat{c})\Delta_q)(1 - q - G(\hat{c})\Delta_q)}{[(q + G(\hat{c})\Delta_q) + (1 - (q - G(\hat{c})\Delta_q)(1 - \eta^*)]^2} > 0 \text{ and}$$

$$\frac{d(p_H - p'_H)V(S_L, 0)}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)} = (p'_H - p_L)\Big[\underbrace{\frac{\partial V(S_L, 0)}{\partial\gamma}}_{>0} + \underbrace{\frac{\partial V(S_L, 0)}{\partial\eta^*}\frac{\partial\eta^*}{\partial\gamma}}_{<0}\Big] + \underbrace{\frac{\partial(p'_H - p_L)}{\partial\eta^*}V(S_H, 0)}_{>0}\underbrace{\frac{\partial\eta^*}{\partial\gamma}}_{<0} < 0.$$

Consequently, since $\frac{d(V(S_L,0)-P(-2\phi))}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)} = 0$, it follows that $\frac{dP(0)-P(-2\phi))}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)} < 0$.

$$\begin{aligned}
&\frac{dh(\hat{c},\hat{c})}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)} \\
&= \frac{\partial h(\hat{c},\hat{c})}{\partial\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)} + \frac{\partial h(\hat{c},\hat{c})}{\partial\eta^*}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)}\frac{\partial\eta^*}{\partial\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)} \\
&= \frac{\omega_p}{2}\ \eta^*\ \frac{d(P(0) - P(-2\phi))}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)} + \frac{\omega_v}{2}\ \eta^*\ \frac{d(V(S_H, 0) - P(-2\phi))}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)} \\
&+ \frac{\omega_v}{2}\ (1 - \eta^*)\ \frac{d(V(S_H, 0) - V(S_L, 0))}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)} + \frac{\omega_v}{2}\ \frac{d(V(S_H, -\phi) - V(S_L, -\phi))}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)} \\
&+ \Big[\frac{\omega_p}{2}(P(0) - P(-2\phi)) + \frac{\omega_v}{2}(V(S_H, 0) - P(-2\phi)) - \frac{\omega_v}{2}(V(S_H, 0) - V(S_L, 0))\Big]\frac{\partial\eta^*}{\partial\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)}.
\end{aligned}$$

Plugging in and $\frac{dP(0)-P(-2\phi))}{d\gamma} < 0$, $\frac{d(V(S_H,0)-P(-2\phi))}{d\gamma} < 0$, $\frac{d(V(S_H,0)-V(S_L,0))}{d\gamma} < 0$, $\frac{d(V(S_H,-\phi)-V(S_L,-\phi))}{d\gamma} = 0$ at $\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E)$ yield

$$\begin{aligned}
&\frac{dh(\hat{c},\hat{c})}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)} \\
&= \frac{\omega_p}{2}\ \eta^*\ \underbrace{\frac{d(P(0) - P(-2\phi))}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)}}_{<0} + \frac{\omega_v}{2}\ \eta^*\ \underbrace{\frac{d(V(S_H, 0) - P(-2\phi))}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)}}_{<0} \\
&+ \frac{\omega_v}{2}\ (1 - \eta^*)\ \underbrace{\frac{d(V(S_H, 0) - V(S_L, 0))}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)}}_{<0} \\
&+ \Big[\underbrace{\frac{\omega_p}{2}\Big(p'_H(\overline{R} - \gamma\frac{1}{p'_H} - (1 - \gamma)\frac{1}{p_0}) - p_L(\overline{R} - \gamma\frac{1}{p_L} - (1 - \gamma)\frac{1}{p_0})\Big)}_{>0} + \underbrace{\frac{\omega_v}{2}p_L\gamma(\frac{1}{p_L} - \frac{1}{p'_H})\Big]}_{>0}\underbrace{\frac{\partial\eta^*}{\partial\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)}}_{<0} < 0
\end{aligned}$$

Therefore,

$$\frac{\partial\hat{c}}{\partial\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)} = -\frac{\frac{dh(\hat{c},\hat{c})}{d\gamma}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)}}{\frac{\partial h(\hat{c},\hat{c})}{\partial\hat{c}}\Big|_{\gamma\in(\underline{\gamma}^E,\overline{\gamma}^E)}} < 0.$$

Step 6: The optimal maturity structure is $\gamma^* = \underline{\gamma}^E$.

By the previous steps, $\hat{c}$ strictly increases in γ for all $\gamma \leq \underline{\gamma}^E$, decrease for all $\gamma \in (\underline{\gamma}^E, \overline{\gamma}^E))$, and is constant for all $\gamma \geq \overline{\gamma}^E$. Hence, $\gamma^* = \underline{\gamma}^E$ maximizes $\hat{c}$ and, thereby, overall firm value. Since creditors always obtain an expected payment of 1, by their break-even constraints, maximizing $\hat{c}$ also maximizes shareholder value. □

Proof of Lemma 1.2

Proof. Step 1: Suppose $\alpha \geq \phi(\alpha)$, then there is a $\overline{\gamma}^E(\alpha) < \hat{\gamma}$ such that for all $\gamma \geq \overline{\gamma}^E(\alpha)$, $\eta^* = 0$ is the unique equilibrium exit probability.

If η^*, exit induces off-path beliefs whenever $Q = -2\phi$. By the same arguments as in the proof Proposition 1.1, $D1$ selects $\pi(-2\phi) = 0$ as the unique off-path beliefs. $\eta^* = 0$ is indeed an equilibrium exit strategy if

$$\Pi^E - \Pi^{NE}(\eta^* = 0) = \frac{\phi(\alpha)}{2}\Big[(q + G(\hat{c})\Delta_q)\Delta_p(\overline{R} - \frac{1}{p_0})\Big] - \frac{\alpha}{2}\gamma\frac{(q + G(\hat{c})\Delta_q)\Delta_p}{p_0} \leq 0.$$

Setting equal to zero yields $\frac{\phi(\alpha)}{\alpha}(p_0\overline{R} - 1) = \gamma =: \overline{\gamma}^E(\alpha)$. Since $\hat{\gamma} = (\overline{R}p_0 - 1)\frac{p_L}{(q+G(\hat{c})\Delta_q)\Delta_p} > (\overline{R}p_0 - 1) \geq \frac{\phi(\alpha)}{\alpha}(p_0\overline{R} - 1) = \overline{\gamma}^E(\alpha)$, independent of α, $\eta^* = 0$ is an equilibrium exit probability for all $\gamma \geq \overline{\gamma}^E(\alpha)$. Premature liquidation never occurs on the equilibrium path and debt face values are given by (1.24) with $\hat{q} = q + G(\hat{c})\Delta_q$. I show the $\eta^* = 0$ is unique equilibrium exit probability in two steps.
First, for $\gamma > \hat{\gamma}$, if $\eta^* > 0$ was expected, deviating to $\eta = 0$ would be strictly profitable for B conditional on S_L since

$$\begin{aligned}
\Pi^{NE}(\eta^*) =& \alpha\frac{1}{2}p_L(\overline{R} - \gamma\frac{D^1_{ST}}{p_{H'}} - (1-\gamma)D_{LT}) + \alpha\frac{1}{2}p_L(\overline{R} - \gamma\frac{D^1_{ST}}{p_0} - (1-\gamma)D_{LT}) \\
>& \alpha p_L(\overline{R} - \gamma\frac{D^1_{ST}}{p_0} - (1-\gamma)D_{LT}) \\
\geq& \phi\frac{1}{2}p_0(\overline{R} - \gamma\frac{D^1_{ST}}{p_0} - (1-\gamma)D_{LT}) + (\alpha - \phi)\frac{1}{2}p_L(\overline{R} - \gamma\frac{D^1_{ST}}{p_0} - (1-\gamma)D_{LT}) \\
&+ \alpha\frac{1}{2}p_L\underbrace{max\{\overline{R} - \gamma\frac{D^1_{ST}}{p_L} - (1-\gamma)D_{LT}; 0\}}_{=0 \text{ by definition of } \hat{\gamma}},
\end{aligned}$$

where D^1_{ST} is given by (1.25) and the second inequality rearranges to $p_L \geq \hat{q}\Delta_p$ which holds true by Assumption 1.1.
Second, if $\gamma \leq \hat{\gamma}$, debt face values are given by (1.24). $\eta^* = 0$ is unique equilibrium exit probability in this case since

$$\begin{aligned}\Pi^E - \Pi^{NE}(\eta^*) &= \frac{\phi(\alpha)}{2}\Big[(q+G(\hat{c})\Delta_q)\Delta_p(\overline{R}-\frac{1}{p_0}) - \gamma\frac{p'_H - p_L}{p'_H}\Big] - \frac{(\alpha-\phi(\alpha))}{2}\gamma\frac{p'_H - p_L}{p'_H}\\ &= \frac{\phi(\alpha)}{2}\Big[(q+G(\hat{c})\Delta_q)\Delta_p(\overline{R}-\frac{1}{p_0}) - \gamma\frac{(q+G(\hat{c})\Delta_q)\Delta_p}{(q+G(\hat{c})\Delta_q)p_H + (1-q-G(\hat{c})\Delta_q)(1-\eta^*)p_L}\Big]\\ &- \frac{(\alpha-\phi(\alpha))}{2}\gamma\frac{(q+G(\hat{c})\Delta_q)\Delta_p}{(q+G(\hat{c})\Delta_q)p_H + (1-q-G(\hat{c})\Delta_q)(1-\eta^*)p_L}\end{aligned}$$

strictly falls in η^* such that if $\Pi^E - \Pi^{NE}(\eta^* = 0) \leq 0$, it holds true that $\Pi^E - \Pi^{NE}(\eta^*) \leq 0 \ \ \forall \eta^* \in [0,1]$.

Step 2: Suppose $\alpha \geq \phi(\alpha)$, then there is a $\underline{\gamma}^E(\alpha) \in (0, \overline{\gamma}^E(\alpha))$ such that for all $\gamma \leq \underline{\gamma}^E(\alpha)$, $\eta^* = 1$ is the unique equilibrium exit probability.

$\eta^* = 1$ is a an equilibrium exit probability if

$$\begin{aligned}\Pi^E - \Pi^{NE}(1) &= \frac{\phi(\alpha)}{2}\Big[(q+G(\hat{c})\Delta_q)\Delta_p(\overline{R}-\frac{1}{p_0})\\ &+ p_L(\overline{R}-\gamma\frac{1}{p_L} - (1-\gamma)\frac{1}{p_0}) - p_L(\overline{R}-\gamma\frac{1}{p_H} - (1-\gamma)\frac{1}{p_0})\Big]\\ &+ \frac{(\alpha-\phi(\alpha))}{2}p_L\Big[(\overline{R}-\gamma\frac{1}{p_L} - (1-\gamma)\frac{1}{p_0}; 0) - (\overline{R}-\gamma\frac{1}{p_H} - (1-\gamma)\frac{1}{p_0})\Big]\\ &= \frac{\phi}{2}(q+G(\hat{c})\Delta_q)\Delta_p(\overline{R}-\frac{1}{p_0}) - \frac{\alpha}{2}\gamma\frac{\Delta_p}{p_H} \geq 0.\end{aligned}$$

Setting equal to zero yields

$$\underline{\gamma}^E(\alpha) := \gamma = \frac{\phi}{\alpha}(q+G(\hat{c})\Delta_q)p_H(\overline{R}-\frac{1}{p_0}) \in (0, \overline{\gamma}^E(\alpha)).$$

Hence, for $\gamma \leq \underline{\gamma}^E(\alpha)$, $\eta^* = 1$ is an equilibrium exit probability. $\eta^* = 1$ is unique equilibrium exit probability since $\Pi^E - \Pi^{NE}(\eta^*)$ strictly falls in η^* such that if $\Pi^E - \Pi^{NE}(\eta^* = 1) \geq 0$, it holds true that $\Pi^E - \Pi^{NE}(\eta^*) \geq 0 \forall \eta^* \in [0,1]$. Finally, since $\phi(\alpha) = \zeta(1-\alpha) \geq \zeta(1-\frac{1}{2}) > 0$, $\underline{\gamma}^E(\alpha) > 0$.

Step 3: For $\gamma \in (\underline{\gamma}(\alpha), \overline{\gamma}(\alpha))$, it holds that the unique equilibrium exit probability $\eta^* \in (0,1)$.

$$\begin{aligned}\Pi^E - \Pi^{NE}(\eta^*) &= \frac{\phi(\alpha)}{2}\Big[(q+G(\hat{c})\Delta_q)\Delta_p(\overline{R}-\frac{1}{p_0}) - \gamma\frac{p'_H - p_L}{p'_H}\Big] - \frac{(\alpha-\phi(\alpha))}{2}\gamma\frac{p'_H - p_L}{p'_H}\\ &= \frac{\phi(\alpha)}{2}\Big[(q+G(\hat{c})\Delta_q)\Delta_p(\overline{R}-\frac{1}{p_0}) - \gamma\frac{(q+G(\hat{c})\Delta_q)\Delta_p}{(q+G(\hat{c})\Delta_q)p_H + (1-q-G(\hat{c})\Delta_q)(1-\eta^*)p_L}\Big]\\ &- \frac{(\alpha-\phi(\alpha))}{2}\gamma\frac{(q+G(\hat{c})\Delta_q)\Delta_p}{(q+G(\hat{c})\Delta_q)p_H + (1-q-G(\hat{c})\Delta_q)(1-\eta^*)p_L}\end{aligned}$$

Indifference requires that $\Pi^E - \Pi^{NE}(\eta^*) = 0$. Rearranging yields

$$\eta^* = 1 - \frac{\frac{\alpha}{\phi(\alpha)} \frac{\gamma}{(R-\frac{1}{p_0})} - (q + G(\hat{c})\Delta_q)p_H}{(1-q-G(\hat{c})\Delta_q)p_L},$$

and

$$\frac{\partial \eta^*}{\partial \gamma} = -\frac{\alpha}{\phi(\alpha)} \frac{1}{(\overline{R}-\frac{1}{p_0})(1-q-G(\hat{c})\Delta_q)p_L}.$$

Hence, if α increases, η^* decreases at a faster rate.

Step 4: $(\underline{\gamma}^E(\alpha), \overline{\gamma}^E(\alpha))$ both strictly decrease in α.

Follows directly from $\frac{\partial(\frac{\phi(\alpha)}{\alpha})}{\partial\alpha} = \frac{\partial(\frac{\zeta(1-\alpha)}{\alpha})}{\partial\alpha} = \frac{-\zeta\alpha-\zeta(1-\alpha)}{\alpha^2} = -\frac{\zeta}{\alpha^2} < 0.$ and the respective expression.

Step 5: There is a unique equilibrium.

Step $1-4$ characterized the unique η^*. η^* follows the same pattern as before such that plugging in $(\underline{\gamma}^E(\alpha), \overline{\gamma}^E(\alpha))$ into the proof of Proposition 1.2, yields the unique cutoff $\hat{c}$ as given by equation (1.30). Thus, there is a unique equilibrium. Further, by Proposition 1.2, for all $\gamma < \underline{\gamma}^E(\alpha)$, $\hat{c}$ strictly increases in γ and for all $\gamma \in (\underline{\gamma}^E(\alpha), \overline{\gamma}^E(\alpha))$, $\hat{c}$ strictly decreases in γ. For all $\gamma \geq \overline{\gamma}^E(\alpha)$, $\hat{c}$ is minimal and constant. $\hat{c}$ is maximized at $\gamma^{*E}(\alpha) = \underline{\gamma}^E(\alpha)$.

Step 6: For any $\gamma \in [0,1]$, $\hat{c}$ weakly decreases in α.

Consider two values of $\alpha' > \alpha \geq \phi(\alpha)$. Then, $\underline{\gamma}^E(\alpha') < \underline{\gamma}^E(\alpha)$ and for all $\gamma \in [0, \underline{\gamma}^E(\alpha')]$, $\hat{c}(\alpha) = \hat{c}(\alpha')$ since α affects $\hat{c}(\alpha)$ only through $\eta^*(\alpha)$.
For $\gamma \in (\underline{\gamma}^E(\alpha'), \underline{\gamma}^E(\alpha)]$, $\hat{c}(\alpha)$ increases in γ whereas $\hat{c}(\alpha')$ decreases due to the decrease in $\eta^*(\alpha')$. Therefore, $\hat{c}(\alpha) > \hat{c}(\alpha')$ for all $\gamma \in (\underline{\gamma}^E(\alpha'), \underline{\gamma}^E(\alpha)]$.
For $\gamma > \underline{\gamma}^E(\alpha)$, also $\hat{c}(\alpha)$ decreases in γ and for all $\gamma \geq \overline{\gamma}^E(\alpha)$, $\hat{c}(\alpha) = \hat{c}(\alpha')$ because $\eta^*(\alpha) = \eta^*(\alpha') = 0$. It remains to be shown that $\hat{c}(\alpha) \geq \hat{c}(\alpha')$ for all $\gamma \in (\underline{\gamma}^E(\alpha), \overline{\gamma}^E(\alpha'))$
Now I establish that $\hat{c}$ decreases in η^*.

$$\begin{aligned}
\frac{\partial h(\hat{c},\hat{c})}{\partial \eta^*} =& \Big[\frac{\omega_p}{2}\Big(p'_H(\overline{R}-\gamma\frac{1}{p'_H}-(1-\gamma)\frac{1}{p_0}) - p_L(\overline{R}-\gamma\frac{1}{p_L}-(1-\gamma)\frac{1}{p_0})\Big) + \frac{\omega_v}{2} p_L \gamma (\frac{1}{p_L} - \frac{1}{p'_H})\Big] \\
&+ \frac{\omega_p}{2}\ \Delta_q\ \eta^* \frac{\partial\Big(P(0)-P(-2\phi)\Big)}{\partial\eta^*} + \frac{\omega_v}{2}\ \Delta_q\ \eta^* \frac{\partial\Big(V(S_H,0)-V(S_L,-2\phi)\Big)}{\partial\eta^*} \\
&+ \frac{\omega_v}{2}\ \Delta_q\ (1-\eta^*)\frac{\Big(V(S_H,-\phi)-V(S_L,-\phi)\Big)}{\partial\eta^*} > 0
\end{aligned}$$

Thus,

$$\frac{\partial \hat{c}}{\partial \eta^*} = -\frac{\frac{\partial h(\hat{c},\hat{c})}{\partial \eta^*}}{\frac{\partial h(\hat{c},\hat{c})}{\partial \hat{c}}} > 0 \tag{1.32}$$

Since $\hat{c}(\alpha)$ is a continuous, strictly decreasing function of η^* for all $\gamma \in (\underline{\gamma}^E(\alpha), \overline{\gamma}^E(\alpha))$ and and η^* decreases faster in γ for larger values of α, $\hat{c}(\alpha) > \hat{c}(\alpha')$ for $\gamma \in (\underline{\gamma}^E(\alpha'), \overline{\gamma}^E(\alpha))$. Thus, for any γ, $\hat{c}$ weakly decreases in α.

□

Proof of Proposition 1.3

Proof. Step 1: For any $\gamma \in [0,1]$, $\overline{k}(\frac{\zeta}{1+\zeta}) \geq \overline{k}(\alpha)$ for all $\alpha \in [0,1]$. Further, for any $\gamma \in [0,1]$, $\alpha^* = \frac{\zeta}{1+\zeta}$ if $k \leq \overline{k}(\gamma, \frac{\zeta}{1+\zeta})$ and $\alpha^* = 0$ otherwise.

First, consider some $\alpha < \frac{\zeta}{1+\zeta}$. Then, for any $\gamma \in (0,1]$, $\eta^* = 0$ since B cannot camouflage and, thus, B makes a strict loss by her exit. Thus, $\hat{c}$ is minimal. If $\gamma = 0$, $\eta^* = 1$ may be an equilibrium for $\alpha < \frac{\zeta}{1+\zeta}$ as there is no downside from exit. However, if $\gamma = 0$ and $\alpha = \frac{\zeta}{1+\zeta}$, $\eta^* = 1$ as well such that $\hat{c}(\alpha) = \hat{c}(\frac{\zeta}{1+\zeta})$. Second, if $\alpha > \frac{\zeta}{1+\zeta}$, by the proof of Lemma 1.2, $\eta^*(\frac{\zeta}{1+\zeta}) \geq \eta^*(\alpha)$ and $\hat{c}(\frac{\zeta}{1+\zeta}) \geq \hat{c}(\alpha)$ for any $\gamma \in [0,1]$. Hence, $\alpha^* = \frac{\zeta}{1+\zeta}$ weakly maximizes $\hat{c}$ for any $\gamma \in [0,1]$.
Lastly, since $\overline{k}(\gamma,\alpha) = \Delta_p\Delta_q\overline{R}[G(\hat{c}(\alpha) - G(\hat{c}(0)]$ strictly increases in $\hat{c}(\alpha)$ the claim holds true. A direct consequence is that $\alpha^* = \frac{\zeta}{1+\zeta}$ if $k \leq \overline{k}(\gamma, \frac{\zeta}{1+\zeta})$ and $\alpha^* = 0$ otherwise.

Step 2: $\overline{k}(\gamma, \frac{\zeta}{1+\zeta})$ increases in γ for all $\gamma \leq \underline{\gamma}^E(\frac{\zeta}{1+\zeta})$ and decreases in γ for all $\gamma \geq \underline{\gamma}^E(\frac{\zeta}{1+\zeta})$

The claim follows from the fact that $\frac{\partial \overline{k}}{\partial \gamma} = \Delta_p\Delta_q\overline{R}g(\hat{c}(\alpha))\frac{\partial \hat{c}(\alpha)}{\partial \gamma}$ where $\frac{\partial \hat{c}(\alpha)}{\partial \gamma} > 0$ for $\gamma < \underline{\gamma}^E(\frac{\zeta}{1+\zeta})$, $\frac{\partial \hat{c}(\alpha)}{\partial \gamma} < 0$ for $\gamma \in (\underline{\gamma}^E(\frac{\zeta}{1+\zeta}), \overline{\gamma}^E(\frac{\zeta}{1+\zeta}))$, and $\frac{\partial \hat{c}(\alpha)}{\partial \gamma} = 0$ for $\gamma \geq \overline{\gamma}^E(\frac{\zeta}{1+\zeta})$, by Lemma 1.2.

Step 3: $\alpha^* = 0$ for all $\gamma \geq \overline{\gamma}^E$.

By definition of $\overline{\gamma}^E$, $\eta^* = 0$ and there is no benefit of concentrated ownership. Since $k > 0$, $\alpha^* = 0$.

Step 4: The jointly optimal ownership and maturity structure (α^*, γ^*) is $(\frac{\zeta}{1+\zeta}, \underline{\gamma}^E(\frac{\zeta}{1+\zeta}))$ if $k \leq \overline{k}(\underline{\gamma}^E(\frac{\zeta}{1+\zeta}), \frac{\zeta}{1+\zeta})$ and $(0,\gamma)$ for any $\gamma \in [0,1]$ otherwise.

By Step 2, for any α, $\underline{\gamma}^E(\alpha)$ maximizes $\overline{k}(\gamma,\alpha)$. Since $\alpha^* = \frac{\zeta}{1+\zeta}$ maximizes $\underline{\gamma}^E(\alpha)$, the claim follows. If $k > \overline{k}(\underline{\gamma}^E(\frac{\zeta}{1+\zeta}), \frac{\zeta}{1+\zeta})$, it follows that $k > \overline{k}(\gamma, \alpha)$ for any (α, γ) such that $\alpha = 0$ is optimal and the level of short-term debt does not affect firm value. □

Proof of Proposition 1.4

Proof. Step 1: There is a unique equilibrium.

Note that $\mathbb{P}[S_H|a_m=1] = q+\Delta_q G^m(\hat{c}) = q+\Delta_q \frac{G(\hat{c})}{G(\overline{c}^m)} > q+\Delta_q G(\hat{c}) = \mathbb{P}[S_H|a_m=0]$. Since $\mathbb{P}[S_H|a_m]$ raises p_0 and $p'_H(\eta^* \in (0,1))$, $\hat{c}$ is larger for $a_m=1$ than for $a_m=0$ (consider equation (1.30)). Further, B's payoff difference conditional on S_H relative to S_L is given by

$$V(S_H,0)+V(S_H,-\phi)-V(S_L,0)-V(S_L,-\phi) = \Delta_p(\overline{R}-\gamma\frac{1}{p'_H}-(1-\gamma)\frac{1}{p_0})+\Delta_p(\overline{R}-\frac{1}{p_0}), \text{or}$$
$$V(S_H,0)+V(S_H,-\phi)-P(-\phi)-P(-2\phi) = (p_H-p_0)(\overline{R}-\frac{1}{p_0})+\Delta_p(\overline{R}-(1-\gamma)\frac{1}{p_0})+\gamma(\frac{p_L}{p_L}-\frac{p_H}{p'_H}),$$

if share retention or exit is more profitable, respectively. Since either payoff difference increases in p'_H and p_0, the benefit from monitoring is larger if monitoring is expected in equilibrium, i.e.,

$$\begin{aligned}&[G^m(\hat{c}(a_m=1))-G(\hat{c}(a_m=1))]\ \Delta_q\ \Big(\mathcal{V}_H(\hat{c}(a_m=1))-\mathcal{V}_L(\hat{c}(a_m=1))\Big) > \\ &[G^m(\hat{c}(a_m=0))-G(\hat{c}(a_m=0))]\ \Delta_q\ \Big(\mathcal{V}_H(\hat{c}(a_m=0))-\mathcal{V}_L(\hat{c}(a_m=0))\Big).\end{aligned}$$

Consequently, B's unique equilibrium monitoring decision is to take $a_m=1$ if and only if

$$\kappa \leq [G^m(\hat{c}(a_m=1))-G(\hat{c}(a_m=1))]\ \Delta_q\ \Big(\mathcal{V}_H(\hat{c}(a_m=1))-\mathcal{V}_L(\hat{c}(a_m=1))\Big),$$

and $a_m=0$ otherwise. M's unique effort cutoff is given (1.30) where one inserts $q+\Delta_q G^m(\hat{c})$ instead of $q+\Delta_q G(\hat{c})$ whenever it is optimal for the blockholder to monitor. One can conclude by previous arguments that $D^1_{ST}, D^2_{ST}(0), D^2_{ST}(-\phi)$ and D_{LT} are all smaller than $\overline{R}$ by plugging in $q+\Delta_q G^m(\hat{c})$ or $q+\Delta_q G(\hat{c})$ in the proof of Lemma 1.1. Again plugging in $q+\Delta_q G^m(\hat{c})$ or $q+\Delta_q G(\hat{c})$ for $\hat{q}$, it is also clear from the proof of Proposition 1.1 that there exists a unique equilibrium trading strategy $\eta^* \in [0,1]$ maximizing B's profit from trading in period $t=2$, which completes this step.

Step 2: There is a $\underline{\gamma}^V > 0$ such that for all $\gamma < \underline{\gamma}^V$, $\eta^*=1$. There is a $\overline{\gamma}^V \in (\underline{\gamma}^V, 1)$ such that for all $\gamma \in (\underline{\gamma}^V, \overline{\gamma}^V)$, $\eta^* \in (0,1)$ and for all $\gamma \geq \overline{\gamma}^V$, $\eta^*=0$.

Follows directly from arguments of the proof of Proposition 1.1.

Step 3:

1. $\overline{\kappa}$ increases for all $\gamma \leq \underline{\gamma}^V$.
2. $\overline{\kappa}$ decreases for all $\gamma \in (\underline{\gamma}^V, \overline{\gamma}^V)$.
3. $\overline{\kappa}$ is constant for all $\gamma \geq \overline{\gamma}^V$).

Denote $\psi := \mathcal{V}_H(\hat{c}) - \mathcal{V}_L(\hat{c})$.
I) For $\gamma \leq \underline{\gamma}^V$, I want to show that $\frac{d\overline{\kappa}(\gamma)}{d\gamma}|_{\gamma\leq\underline{\gamma}^V} > 0$, i.e.,

$$\begin{aligned}
&\frac{d\overline{\kappa}(\gamma)}{d\gamma}\Big|_{\gamma\leq\underline{\gamma}^V} = \frac{\partial\overline{\kappa}(\gamma)}{\partial\gamma}\Big|_{\gamma\leq\underline{\gamma}^V} + \frac{\partial\overline{\kappa}(\gamma)}{\partial\hat{c}}\Big|_{\gamma\leq\underline{\gamma}^V}\frac{\partial\hat{c}}{\partial\gamma}\Big|_{\gamma\leq\underline{\gamma}^V}\\
&= \frac{1}{2}\frac{\Delta_p}{p_0}G(\hat{c})[\frac{1}{G(\overline{c}^m)}-1]\Delta_q\\
&+\Big[G(\hat{c})[\frac{1}{G(\overline{c}^m)}-1]\Delta_q\frac{1}{2}g^m(\hat{c})\Delta_p\Delta_q\Big([(1-q-G^m(\hat{c})\Delta_q)+(1-\gamma)]\frac{\Delta_p}{p_0^2}-(\overline{R}-\frac{1}{p_0})\Big)\\
&+g(\hat{c})[\frac{1}{G(\overline{c}^m)}-1]\Delta_q(1-q)\Delta_p\frac{1}{2}(\overline{R}-\frac{1}{p_0})+\frac{1}{2}\Delta_p(\overline{R}-(1-\gamma)\frac{1}{p_0})\Big]\underbrace{\frac{\partial\hat{c}}{\partial\gamma}}_{\in(0,1)}>0,
\end{aligned}$$

which holds true since

$$\begin{aligned}
\psi|_{\gamma\leq\underline{\gamma}^V} &= \frac{1}{2}\alpha V(S_H,-\phi)+\frac{1}{2}\alpha V(S_H,0)-\frac{1}{2}P(-\phi)+\frac{1}{2}P(-2\phi)\\
&=(p_H-p_0)\Delta_p\frac{1}{2}(\overline{R}-\frac{1}{p_0})+\frac{1}{2}\Delta_p(\overline{R}-(1-\gamma)\frac{1}{p_0}),
\end{aligned}$$

$$\begin{aligned}
\frac{\partial\psi}{\partial\hat{c}}\Big|_{\gamma\leq\underline{\gamma}^V} &= \frac{1}{2}(1-q-G^m(\hat{c})\Delta_q)\Delta_p(-\frac{\partial\frac{1}{p_0}}{\partial\hat{c}})+\frac{1}{2}(1-\gamma)\Delta_p(-\frac{\partial\frac{1}{p_0}}{\partial\hat{c}})-\frac{1}{2}\frac{\partial p_0}{\partial\hat{c}}(\overline{R}-\frac{1}{p_0})\\
&=\frac{1}{2}[(1-q-G^m(\hat{c})\Delta_q)+(1-\gamma)]\Delta_p\frac{g^m(\hat{c})\Delta_p\Delta_q}{p_0^2}-\frac{1}{2}g^m(\hat{c})\Delta_p\Delta_q(\overline{R}-\frac{1}{p_0})\\
&=\frac{1}{2}g^m(\hat{c})\Delta_p\Delta_q\Big([(1-q-G^m(\hat{c})\Delta_q)+(1-\gamma)]\frac{\Delta_p}{p_0^2}-(\overline{R}-\frac{1}{p_0})\Big),
\end{aligned}$$

and $\frac{\partial\hat{c}}{\partial\gamma}\in(0,1)$ due to the fact that (from the proof of Proposition 1.2)

$$\begin{aligned}
\frac{\partial\hat{c}}{\partial\gamma}\Big|_{\eta^*=1} &= \frac{\frac{\omega_p+\omega_v}{2}\frac{\Delta_p}{p_0}}{1-\frac{\omega_p+\omega_v}{2}(1-\gamma)\frac{g^m(\hat{c})\Delta_q^2\Delta_p^2}{p_0^2}-\frac{\omega_v}{2}\frac{g^m(\hat{c})\Delta_q^2\Delta_p^2}{p_0^2}}\\
&\leq\frac{\Delta_p p_0}{p_0^2-\Delta_q^2\Delta_p^2}\leq 1
\end{aligned}$$

where the last inequality is equivalent to $p_0\geq\Delta_p+\frac{\Delta_q^2\Delta_p^2}{p_0}$ and holds true since

$$\begin{aligned}
&\Delta_p+\frac{\Delta_q^2\Delta_p^2}{p_0}\leq\Delta_p+\Delta_q^2\Delta_p\\
&\leq qp_H+(1-q)\Delta_p\leq qp_H+(1-q)p_L\\
&\leq(q+G^m(\hat{c})\Delta_q)p_H+(1-q-G^m(\hat{c})\Delta_q)p_L=p_0,
\end{aligned}$$

where I used that $qp_H\geq\Delta_q$, $\Delta_p\leq p_L\leq p_0$ and $\Delta_q\leq 1-q$. The fact that $\frac{\partial\hat{c}}{\partial\gamma}>0$, can easily be seen by substituting the truncation G^m for the original cdf G in the proof of Proposition 1.2. Finally, to show that $\frac{d\overline{\kappa}(\gamma)}{d\gamma}|_{\gamma\leq\underline{\gamma}^V}>0$, it is then sufficient to show that

$$\frac{1}{2}\frac{\Delta_p}{p_0}[G(\hat{c})[\frac{1}{G(\overline{c}^m)}-1]\Delta_q \geq G(\hat{c}[\frac{1}{G(\overline{c}^m)}-1]\Delta_q\frac{1}{2}g^m(\hat{c})\Delta_p\Delta_q(\overline{R}-\frac{1}{p_0}).$$

Since

$$\frac{1}{2}g(\hat{c})\Delta_p\Delta_q^2 \underbrace{(\overline{R}-\frac{1}{p_0})}_{\leq\frac{(q+G^m(\hat{c})\Delta_q)\Delta_p}{p_L p_0}} \leq \frac{1}{2}\Delta_p\Delta_q^2\frac{(q+G^m(\hat{c})\Delta_q)}{p_0},$$

it is sufficient to show that

$$\begin{aligned}\frac{1}{2}\frac{\Delta_p}{p_0} &\geq \frac{1}{2}\Delta_p\Delta_q^2\frac{(q+G^m(\hat{c})\Delta_q)}{p_0}\\ \iff 1 &\geq \Delta_q^2(q+G^m(\hat{c})\Delta_q)\end{aligned}$$

which obviously holds true and the claim follows.

II)

$$\begin{aligned}&\frac{d\overline{\kappa}(\gamma)}{d\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)} = \frac{\partial\overline{\kappa}(\gamma)}{\partial\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)} + \frac{\partial\overline{\kappa}(\gamma)}{\partial\hat{c}}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}\frac{\partial\hat{c}}{\partial\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}\\
&= \underbrace{G(\hat{c}(a_m=1))[\frac{1}{G(\overline{c}^m)}-1]\Delta_q}_{>0}\underbrace{\Big[\underbrace{\frac{\partial\psi(\gamma,a_m=1)}{\partial\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{>0} + \underbrace{\frac{\partial\psi(\gamma,a_m=1)}{\partial\eta^*}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{>0}\underbrace{\frac{\partial\eta^*}{\partial\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{<0}\Big]}_{<0\text{ (by indifference of }B\text{ and proof of Proposition 1.2, plug in }G^m\text{ for }G)}\\
&+\Big[\underbrace{g(\hat{c}(a_m=1))[\frac{1}{G(\overline{c}^m)}-1]\Delta_q\psi(\gamma,a_m=1)}_{>0}+\underbrace{\frac{\partial\psi(\gamma,a_m=1)}{\partial\hat{c}}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}\Big]}_{>0\text{ shown below}}\cdot\\
&\underbrace{\Big[\underbrace{\frac{\partial\hat{c}}{\partial\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{>0}+\underbrace{\frac{\partial\hat{c}}{\partial\eta^*}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{>0}\underbrace{\frac{\partial\eta^*}{\partial\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{<0}\Big]}_{<0\text{ (shown in proof of Proposition 1.2, plug in }G^m\text{ for }G)}<0,\end{aligned}$$

where

$$\begin{aligned}\frac{\partial\psi}{\partial\hat{c}}\Big|_{\mathcal{V}=\frac{1}{2}V(S_L,-\phi)+\frac{1}{2}V(S_L,0)} &= \frac{1}{2}p_H(-\frac{\partial\frac{1}{p_0}}{\partial\hat{c}}) + \frac{1}{2}\gamma p_H(-\frac{\partial\frac{1}{p'_H}}{\partial\hat{c}}) + \frac{1}{2}(1-\gamma)p_H(-\frac{\partial\frac{1}{p_0}}{\partial\hat{c}}) - \frac{1}{2}p_L(-\frac{\partial\frac{1}{p_0}}{\partial\hat{c}})\\ &- \frac{1}{2}p_L\gamma(-\frac{\partial\frac{1}{p'_H}}{\partial\hat{c}}) - \frac{1}{2}p_L(1-\gamma)(-\frac{\partial\frac{1}{p_0}}{\partial c}) - 1\\ &= \frac{1}{2}\Delta_p(-\frac{\partial\frac{1}{p_0}}{\partial\hat{c}}) + \frac{1}{2}\gamma\Delta_p(-\frac{\partial\frac{1}{p'_H}}{\partial\hat{c}}) + \frac{1}{2}(1-\gamma)\Delta_p(-\frac{\partial\frac{1}{p_0}}{\partial\hat{c}}) - 1\\ &= \frac{1}{2}[1+(1-\gamma)]\Delta_p\frac{g^m(\hat{c})\Delta_p\Delta_q}{p_0^2}\\ &+ \frac{1}{2}\gamma\Delta_p\frac{g^m(\hat{c})\Delta_q\Delta_p(1-\eta)}{[(q+G^m(\hat{c})\Delta_q)p_H+(1-q-G^m(\hat{c})\Delta_q)p_L(1-\eta^*)]^2} > 0.\end{aligned}$$

III) Lastly,

$$\frac{d\overline{\kappa}(\gamma)}{d\gamma}|_{\gamma\geq\overline{\gamma}^V} = 0$$

since by definition of $\overline{\gamma}^V$, $\eta^* = 0$ for all $\gamma \geq \overline{\gamma}^V$. Share prices are thus uninformative, and short- and long-term debt face values are the same. Therefore, γ does not influence payments to creditors or shareholders.

Step 4: The firm value optimal maturity structure is given by $\gamma^{V*} = \underline{\gamma}^V$.

By the proof of Proposition 1.2, $\underline{\gamma}^V$ maximizes $\hat{c}$. Further, by the previous step, $\overline{\kappa}$ increases in γ for all $\gamma \leq \underline{\gamma}^V$ and decreases for all $\gamma > \underline{\gamma}^V$. Hence, $\gamma^{V*} = \underline{\gamma}^V$.

□

Proof of Lemma 1.3

Proof. Given $\beta^* > 0$, the market maker's posterior is $\pi(Q < 0) = 0 < \frac{q}{q+(1-q)e^{-\beta^*\lambda}} = \pi(Q \geq 0)$. Suppose the price would still be the same, i.e., $P(Q \geq 0) = P(Q < 0)$. Then, D^2_{ST} is same for all values if Q and, due to market maker's break-even condition, it has to hold that

$$\begin{aligned}[\frac{q}{q+(1-q)e^{-\beta^*\lambda}}p_H + \frac{(1-q)e^{-\beta^*\lambda}}{q+(1-q)e^{-\beta^*\lambda}}p_L]max\{\overline{R} - \gamma D^2_{ST} - (1-\gamma)D_{LT}); 0\}\\ = p_L max\{\overline{R} - \gamma D^2_{ST} - (1-\gamma)D_{LT}; 0\}\end{aligned}$$

which rearranges to

$$\frac{q}{q+(1-q)e^{-\beta^*\lambda}}\Delta_p max\{\overline{R} - \gamma D^2_{ST} - (1-\gamma)D_{LT}); 0\} = 0. \quad (1.33)$$

However, equation (1.33) cannot hold true since $max\{R - \gamma D^2_{ST} - (1-\gamma)D_{LT}); 0\} > 0$ as creditors would otherwise obtain the entire return $\mathbb{E}[R] > 1$ and, thus, could not break even. Therefore, if $\beta^* > 0$, $P(Q \geq 0) \neq P(Q < 0)$. □

Proof of Proposition 1.5

Proof. B's optimal trading volume is the solution to

$$\begin{aligned}
&\max_{\beta\le\alpha} \beta \int_\beta^\infty P(Q\geq 0)\lambda e^{-\lambda x}dx + \beta\int_0^\beta P(Q<0)\lambda e^{-\lambda x}dx + (\alpha-\beta)\int_\beta^\infty V(S_L,Q\geq 0)\lambda e^{-\lambda x}dx\\
&\quad +(\alpha-\beta)\int_0^\beta V(S_L,Q<0)\lambda e^{-\lambda x}dx\\
&= \max_{\beta\le\alpha} \beta \int_\beta^\infty P(Q\geq 0) - V(S_L,Q\geq 0)\lambda e^{-\lambda x}dx + \beta\int_0^\beta \underbrace{P(Q<0)-V(S_L,Q<0)}_{=0}\lambda e^{-\lambda x}dx\\
&\quad +\alpha\int_\beta^\infty V(S_L,Q\geq 0)\lambda e^{-\lambda x}dx + \alpha\int_0^\beta V(S_L,Q<0)\lambda e^{-\lambda x}dx. \qquad (1.34)
\end{aligned}$$

The first order condition is given by

$$(P(Q\geq 0)-V(S_L,Q\geq 0))\ [\int_\beta^\infty \lambda e^{-\lambda x}dx - \beta\lambda e^{-\lambda\beta}] - \alpha\lambda e^{-\lambda\beta}V(S_L,Q\geq 0) + \alpha\lambda e^{-\lambda\beta}V(S_L,Q<0) = 0$$

which rearranges to

$$\beta = \frac{1}{\lambda} - \alpha\cdot\frac{V(S_L,Q\geq 0)-V(S_L,Q<0)}{P(Q\geq 0)-V(S_L,Q\geq 0)}. \qquad (1.35)$$

Since, $V(S_L,Q\geq 0)$ and $P(Q\geq 0)$ depend on the equilibrium conjecture $\hat{\beta}$, I obtain a fixed point problem. To establish existence and uniqueness of a solution $\tilde{\beta}$ to (1.35) denote

$$\begin{aligned}
v(\beta,\gamma) :=& \frac{1}{\lambda} - \alpha\cdot\frac{V(S_L,Q\geq 0)-V(S_L,Q<0)}{P(Q\geq 0)-V(S_L,Q\geq 0)} - \beta\\
=& \frac{1}{\lambda} - \alpha\frac{p_L\gamma(D^2_{ST}(Q<0)-(D^2_{ST}(Q\geq 0))}{q\Delta_p(\overline{R}-\gamma D^2_{ST}(Q\geq 0)-(1-\gamma)D_{LT})}(q+(1-q)e^{-\beta\lambda}) - \beta.
\end{aligned}$$

First, I show that $\frac{\partial v(\beta,\gamma)}{\partial\beta} < 0$. To this end, note that $D^2_{ST}(Q\geq 0) = \frac{(q+(1-q)e^{-\beta\lambda})}{qp_H+(1-q)p_Le^{-\beta\lambda}}$. Taking the derivative w.r.t. β yields

$$\begin{aligned}
\frac{\partial D^2_{ST}(Q\geq 0)}{\partial\beta} =& \frac{(-\lambda)(1-q)e^{-\beta\lambda}(qp_H+(1-q)p_Le^{-\beta\lambda}) - (-\lambda)(1-q)p_Le^{-\beta\lambda}(q+(1-q)e^{-\beta\lambda})}{(qp_H+(1-q)p_Le^{-\beta\lambda})^2}\\
=& \frac{-\lambda(1-q)e^{-\beta\lambda}q\Delta_p}{(qp_H+(1-q)p_Le^{-\beta\lambda})^2} < 0,
\end{aligned}$$

and

$$\frac{\partial v(\gamma,\beta)}{\partial\beta} =$$

$$-\alpha\Big[\frac{p_L\gamma(D_{ST}^2(Q<0)-D_{ST}^2(Q\geq 0))}{q\Delta_p(\overline{R}-\gamma D_{ST}^2(Q\geq 0)-(1-\gamma)D_{LT})}(1-q)e^{-\beta\lambda}(-\lambda)$$

$$+\frac{(q+(1-q)e^{-\lambda\beta})p_L\gamma}{q\Delta_p}\frac{\frac{\lambda(1-q)e^{-\beta\lambda}q\Delta_p}{(qp_H+(1-q)p_Le^{-\beta\lambda})^2}[(\overline{R}-\gamma D_{ST}^2(Q\geq 0)-(1-\gamma)D_{LT})-\gamma(D_{ST}^2(Q<0)-D_{ST}^2(Q\geq 0))]}{(\overline{R}-\gamma D_{ST}^2(Q\geq 0)-(1-\gamma)D_{LT})^2}\Big]$$

$$-1$$

$$=-\frac{\alpha p_L\gamma}{q\Delta_p}\Big[\frac{(D_{ST}^2(Q<0)-D_{ST}^2(Q\geq 0))}{(\overline{R}-\gamma D_{ST}^2(Q\geq 0)-(1-\gamma)D_{LT})}(1-q)e^{-\beta\lambda}(-\lambda)$$

$$+(q+(1-q)e^{-\lambda\beta})\frac{\frac{\lambda(1-q)e^{-\beta\lambda}q\Delta_p}{(qp_H+(1-q)p_Le^{-\beta\lambda})^2}[(\overline{R}-\gamma D_{ST}^2(Q<0)-(1-\gamma)D_{LT})]}{(\overline{R}-\gamma D_{ST}^2(Q\geq 0)-(1-\gamma)D_{LT})^2}\Big]-1$$

$$=-\frac{\alpha p_L\gamma(1-q)\lambda e^{-\lambda\beta}}{q\Delta_p(\overline{R}-\gamma D_{ST}^2(Q\geq 0)-(1-\gamma)D_{LT})}\Big[-(D_{ST}^2(Q\geq 0)-D_{ST}^2(Q<0))$$

$$+(q+(1-q)e^{-\lambda\beta})\frac{\frac{q\Delta_p}{(qp_H+(1-q)p_Le^{-\beta\lambda})^2}[(\overline{R}-\gamma D_{ST}^2(Q<0)-(1-\gamma)D_{LT})]}{(\overline{R}-\gamma D_{ST}^2(Q\geq 0)-(1-\gamma)D_{LT})}\Big]-1$$

A sufficient condition for $\frac{\partial v(\gamma,\beta)}{\partial\beta}<0$ is therefore

$$\frac{\alpha p_L\gamma(1-q)\lambda e^{-\lambda\beta}}{q\Delta_p(\overline{R}-\gamma D_{ST}^2(Q\geq 0)-(1-\gamma)D_{LT})}[D_{ST}^2(Q\geq 0)-D_{ST}^2(Q<0)]\leq 1 \tag{1.36}$$

Plugging in $(D_{ST}^2(Q<0)-D_{ST}^2(Q\geq 0))=\frac{q\Delta_p}{p_L(qp_H+(1-q)e^{-\beta\lambda}p_L)}$ and rearranging (1.36) yields

$$\frac{\alpha\gamma}{(\overline{R}-\gamma D_{ST}^2(Q\geq 0)-(1-\gamma)D_{LT})}\leq\frac{(qp_H+(1-q)e^{-\beta\lambda}p_L)}{(1-q)\lambda e^{-\lambda\beta}} \tag{1.37}$$

Note that Assumption 1.3 implies $\frac{\alpha\lambda}{(\overline{R}-\frac{1}{p_0})}\leq p_0$ where $\frac{\alpha\lambda}{(\overline{R}-\frac{1}{p_0})}\geq\frac{\alpha\gamma}{(\overline{R}-\gamma D_{ST}^2(Q\geq 0)-(1-\gamma)D_{LT})}$ and $p_0\leq\frac{(qp_H+(1-q)e^{-\beta\lambda}p_L)}{q+(1-q)\lambda e^{-\lambda\beta}}\leq\frac{(qp_H+(1-q)e^{-\beta\lambda}p_L)}{(1-q)\lambda e^{-\lambda\beta}}$. Together, this guarantees that the sufficient condition (1.37) holds true and, thus, $\frac{\partial v(\gamma,\beta)}{\partial\beta}<0$.
I now establish that there is a unique solution $\tilde{\beta}\in(0,\infty)$ to $v(\gamma,\beta)=0$. Evaluating $v(\beta,\gamma)$ at $\beta=0$ yields

$$v(0,\gamma)=\frac{1}{\lambda}-\alpha\frac{p_L\gamma(\frac{1}{p_L}-\frac{1}{p_0})}{q\Delta_p(\overline{R}-\frac{1}{p_0})}1-0=\frac{1}{\lambda}-\alpha\frac{\gamma\frac{1}{p_0}}{(\overline{R}-\frac{1}{p_0})}\geq\frac{1}{\lambda}-\alpha\frac{\frac{1}{p_0}}{(\overline{R}-\frac{1}{p_0})}.$$

Since $\frac{1}{\lambda}-\alpha\frac{\frac{1}{p_0}}{(\overline{R}-\frac{1}{p_0})}>0$ if $p_0(\overline{R}-\frac{1}{p_0})>\alpha\lambda$ which is guaranteed by Assumption 1.3, $v(0,\gamma)>0$. Further, $v(\infty,\gamma)<0$, since $v(\beta,\gamma)+\beta<\infty$. Since $v(\beta,\gamma)$ is continuous and strictly decreasing in β, there is a unique $\tilde{\beta}\in(0,\infty)$ satisfying $v(\gamma,\beta)=0$.
Now fix the equilibrium conjecture $\hat{\beta}$ at $\tilde{\beta}$. The second derivative of the objective function

is given by w.r.t. β is

$$\begin{aligned}&[P(Q\geq 0)-V(S_L,Q\geq 0)]\ (-\lambda)e^{-\lambda\beta}-\lambda e^{-\lambda\beta}[P(Q\geq 0)-V(S_L,Q\geq 0)]\\ &-\lambda(-\lambda)e^{-\lambda\beta}[\beta(P(Q\geq 0)-V(S_L,Q\geq 0))+\alpha V(S_L,Q\geq 0)-\alpha V(S_L,Q<0)]<0,\end{aligned} \tag{1.38}$$

which rearranges to

$$(P(Q\geq 0)-V(S_L,Q\geq 0))(\lambda\beta-2)+\lambda\alpha(V(S_L,Q\geq 0)-V(S_L,Q<0))<0. \tag{1.39}$$

Plugging in $\beta=\frac{1}{\lambda}-\alpha\cdot\frac{V(S_L,Q\geq 0)-V(S_L,Q<0)}{P(Q\geq 0)-V(S_L,Q\geq 0)}$ under equilibrium conjecture $\hat{\beta}=\tilde{\beta}$ yields

$$-(P(Q\geq 0)-V(S_L,Q\geq 0))<0,$$

which holds true and, thus, $\tilde{\beta}$ is a local maximum. Since $\tilde{\beta}$ is the unique local maximum, only $\beta\in\{0,\infty\}$ need to be checked for the global maximum given an equilibrium conjecture $\hat{\beta}=\tilde{\beta}$. Since (1.39) is, for a fixed equilibrium conjecture $\hat{\beta}=\tilde{\beta}$, strictly increasing in β, the second order condition is also strictly smaller than zero evaluated at any $\beta<\tilde{\beta}$. Further, for fixed equilibrium conjecture $\hat{\beta}=\tilde{\beta}$, the objective function evaluated at $\beta=\infty$ is $V(S_L,Q<0)$. In contrast, $\tilde{\beta}$ yields with positive probability $P(Q>0)>V(S_L,Q<0)$. Hence, $\tilde{\beta}$ is the global maximum if $\tilde{\beta}$ is conjectured equilibrium. Thus, $\tilde{\beta}$ is an equilibrium trading volume of the unconstrained problem.
Now I establish that $\tilde{\beta}$ is the unique equilibrium trading volume of the unconstrained problem. Since the first order condition yields a unique solution given by $\tilde{\beta}$, the only other candidates for equilibrium trading volumes are $\beta\in\{0,\infty\}$. Recall the first order condition is

$$\begin{aligned}&(P(Q\geq 0)-V(S_L,Q\geq 0))\ [\int_{\beta}^{\infty}\lambda e^{-\lambda x}dx-\beta\lambda e^{-\lambda\beta}]-\alpha\lambda e^{-\lambda\beta}V(S_L,Q\geq 0)+\alpha\lambda e^{-\lambda\beta}V(S_L,Q<0)\\ =&q\Delta_p(\overline{R}-\frac{1}{p_0})e^{-\lambda\beta}(1-\beta\lambda)-\alpha\lambda e^{-\lambda\beta}p_L\gamma\frac{q\Delta_p}{p_Lp_0}\\ =&q\Delta_p(\overline{R}-\frac{1}{p_0})-\alpha\lambda\gamma\frac{q\Delta_p}{p_0}>0\end{aligned}$$

where the first equality follows if the equilibrium conjecture $\hat{\beta}=0$, the second equality follows if the actual $\beta=0$ and the inequality follows form Assumption 1.3. Hence, $\beta=0$ cannot be an equilibrium. Moreover, if $\hat{\beta}=\infty$ and $\beta=\infty$, B's per share profit is $p_L(\overline{R}-\gamma\frac{1}{p_L}-(1-\gamma)\frac{1}{p_0})$ (since B is uncovered with certainty). If the conjectured $\hat{\beta}=\infty$, a deviation to $\beta=0$ would yield $p_L(\overline{R}-\gamma\frac{1}{p_H}-(1-\gamma)\frac{1}{p_0})$ which is strictly profitable. Thus, (1.35) yields the unique equilibrium of the unconstrained problem. Together with the short-selling restriction $\beta\leq\alpha$, this yields

$$\beta^*=min\{\frac{1}{\lambda}-\alpha\cdot\frac{V(S_L,Q\geq 0)-V(S_L,Q<0)}{P(Q\geq 0)-V(S_L,Q\geq 0)};\alpha\}. \tag{1.40}$$

in the unique equilibrium of the original game.

I next establish that $\tilde{\beta}$ is decreasing in γ, that is, I want to show that

$$\frac{\partial\tilde{\beta}}{\partial\gamma} = -\frac{\frac{\partial v(\tilde{\beta},\gamma)}{\partial\gamma}}{\frac{\partial v(\tilde{\beta},\gamma)}{\partial\tilde{\beta}}} < 0.$$

What remains to be shown is thus $\frac{\partial v(\tilde{\beta},\gamma)}{\partial\gamma} < 0$. To this end, note that

$$\frac{\partial P(Q \geq 0) - V(S_L, Q \geq 0)}{\partial\gamma} = \frac{q}{q + (1-q)e^{-\tilde{\beta}\lambda}}\Delta_p(D_{LT} - D^2_{ST}(Q \geq 0)) > 0, \tag{1.41}$$

and

$$\frac{\partial V(Q \geq 0) - V(S_L, Q < 0)}{\partial\gamma} = p_L(D_{LT} - D^2_{ST}(Q \geq 0)) + p_L(D^2_{ST}(Q < 0) - D_{LT}) > 0, \tag{1.42}$$

and thus

$$\begin{aligned}
\frac{\partial v(\tilde{\beta},\gamma)}{\partial\gamma} &= -\alpha\frac{p_L(D^2_{ST}(Q<0) - (D^2_{ST}(Q \geq 0))[q\Delta_p(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT})]}{[q\Delta_p(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT})]^2}(1-q)e^{-\tilde{\beta}\lambda} \\
&\quad - \alpha\frac{(D_{LT} - D^2_{ST}(Q \geq 0))q\Delta_p[p_L\gamma(D^2_{ST}(Q<0) - (D^2_{ST}(Q \geq 0))]}{[q\Delta_p(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT})]^2}(1-q)e^{-\tilde{\beta}\lambda} \\
&= -\alpha\frac{(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT}) - (D_{LT} - D^2_{ST}(Q \geq 0))\gamma}{[q\Delta_p(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT})]^2}(1-q)e^{-\tilde{\beta}\lambda} \\
&= -\alpha\frac{\overline{R} - D_{LT}}{[q\Delta_p(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT})]^2}(1-q)e^{-\tilde{\beta}\lambda} < 0,
\end{aligned} \tag{1.43}$$

which completes the proof.

□

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Chapter 2

Strategic Information Transmission and Efficient Corporate Control

Joint with Marius Kulms

2.1 Introduction

Insider information held by a company's management is one of the fundamental frictions in corporate governance. Takeovers are no exception since incumbent's managerial skills and future strategies are private information. Shareholders' outside option of selling their shares to a potential acquirer is thus determined by management's insider information. This information asymmetry raises the question of how takeovers can guarantee the efficient allocation of control rights as suggested by Manne (1965).

One potential answer is the regulation of (mandatory) management disclosure and the provision of fairness opinions that gives shareholders the right to force management to provide (additional) information when a takeover is initiated.[1] The rationale underlying such regulation seems straightforward: better informed shareholders will make superior decisions, thus improving the allocation of control rights and firm value. We show, however, that this intuition is misleading because the tender offer by the potential acquirer depends on the shareholders' information and therefore on the management's communication strategy. In fact, we find that target shareholders' ignorance towards incumbent management's private information is *necessary* to obtain allocative efficiency.[2]

[1]For a detailed discussion, see Grossman and Hart (1980a), Bainbridge (1999) and Becht et al. (2003) who argue that both management and the potential acquirer need to disclose material information during a takeover. Kisgen, Song, et al. (2009) show that fairness opinions are prevalent and present legal cases that imply that shareholders can force management to conduct fairness opinions. At the end of the Introduction, we comment on why fairness opinions may optimally be uninformative.

[2]We are, of course, not the first to show that more information for some agents can be socially suboptimal, for instance, see Hirshleifer (1971).

To study the informational frictions and their potential remedies in takeovers, we present a model where both, incumbent management and external bidder are privately informed about the firm value under their respective control.[3] We investigate whether takeovers allow for efficient trade in the market for corporate control under such two-sided asymmetric information. In particular, we analyze three salient channels of information transmission prevalent in practice that may facilitate the efficient control allocation. First, the external bidder can signal private information via his tender offer. Second, frequently observed management recommendations can provide some of the insider's private information. Third, shareholders can acquire additional information from other sources, be it through fairness opinions or forcing management to disclose additional information. In addition, we identify properties of executive compensation that foster efficient communication between incumbent management and shareholders. Our model predicts various stylized facts with respect to the relation of executive compensation and takeover outcomes. These are validated by empirical findings (see Section 2.8). We also identify empirical questions regarding managerial influence in takeovers that are not yet addressed by the existing literature.

The main contribution of this chapter is to show that strategic management recommendations can implement the first-best control allocation. Crucially, first-best is attainable *only if* shareholders cannot acquire additional information regarding firm value. If shareholders have access to more – albeit costless – information than revealed by the incumbent's recommendation, too few takeovers occur in equilibrium. Similar to Grossman and Hart (1980b), who argue in favor of a (partial) exclusion of initial shareholders from post-takeover profits, we show that excluding shareholders from learning about the value of the firm can be welfare-improving. Strategic management communication is efficient in our setting because it serves a dual role: on the one hand, it provides information about management's inside information. On the other hand, it can be used to incentivize the bidder to fully reveal his private information.

In the basic model, an external bidder is privately informed about his ability to manage the company once he is in charge. To obtain control, he can submit a public tender offer to acquire a controlling stake in the company from the single initial shareholder. After the bidder's tender offer, the incumbent manager sends a cheap talk message to the shareholder which is based on his private information and the

[3] The fact that the potential acquirer also possesses private information regarding the target firm value under his control was first taken into account by (Shleifer and Vishny, 1986).

bidder's offer.[4] The manager, maximizing the value of his share endowment,[5] compares the firm value under his management with the firm value under the external bidder's management when he sends his message. In contrast, the shareholder wants to tender only if her expected payoff from selling shares (which contains the price offer) exceeds the expected firm value under incumbent management. The level of (dis)agreement in the cheap talk stage is thus given by the difference between (expected) bidder type (incumbent's view) and tender offer (shareholder's objective). As the tender offer is an equilibrium object, the level of conflict in the cheap talk stage arises endogenously.

As a benchmark, we let the shareholder freely choose the level of information she obtains. As she faces a pure decision problem at the tendering stage, she will always choose to become fully informed.[6] We show that this outcome is not efficient and leads to misallocations of control: too few takeovers occur in equilibrium. The reason is that the bidder has an incentive to post an inefficiently low tender offer when facing a fully informed shareholder.

Alternatively, in the absence of shareholder learning and without strategic management recommendations, there only exist equilibria where all bidder types above some cutoff take over the company with certainty (partial pooling). All types below the cutoff never gain control. Not surprisingly, such cutoff equilibria never attain the optimal control allocation.

Our main result focuses on cheap talk recommendations by the incumbent manager when shareholders cannot acquire additional information. We construct an equilibrium in which the manager sends a binary recommendation in favor of or against a takeover that is followed by the shareholder. The anticipation of this message makes the bidder fully reveal his type via his tender offer. Thus, cheap talk enables both information provision regarding the incumbent's type and screening of the bidder's type. This is feasible because anticipating the informative management recommendation, the bidder trades off the probability of a takeover with profits earned from a takeover. Higher prices are costly to the bidder, but they will, in equilibrium, imply a higher takeover probability because they signal a higher type.

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[4] The takeover of BEA Systems, Inc. by Oracle in 2007/08 highlights that management may not be able to disclose verifiable information about all important matters but is able to give a cheap talk recommendation to shareholders:
'BEA has said it cannot fully disclose to the public why it rejected Oracle's offer because the information is confidential [...]. Some analysts have speculated that the company may have secret products in development that it believes will be blockbusters.' *https://www.reuters.com/article/us-bea-icahn/bea-giving-confidential-information-to-carl-icahn-idUSWNAS031920071105*, date 9/30/2019.

[5] We further extend our model and introduce private benefits the manager enjoys from being in charge and show how golden parachutes can be used to mitigate the problems associated with private benefits.

[6] To focus on allocative efficiency, we abstract from any costs associated with additional information acquisition.

We show that control allocation is first-best with such a strategic management recommendation. Strategic information transmission by the incumbent management thus improves the allocation of control rights compared to both, a fully informed and an uninformed shareholder.

The intuition is follows: with strategic communication, the shareholder only receives a binary message regarding the firm value under incumbent management. As interests of shareholder and manager are not perfectly aligned, more precise strategic information transmission is not feasible. In equilibrium, the manager sends a cheap talk message in favor of the takeover if and only if his type is below the expected bidder type, given the tender offer. Hence, the cheap talk message only informs the shareholder whether the tender offer is more profitable than retaining incumbent management. This allows the external bidder to extract all gains from the takeover, leaving the shareholder's payoff at her outside option of keeping the incumbent. Therefore, it is a best response for the shareholder to follow the message if she has no further information at her disposal.

On the other hand, if the shareholder can freely choose the level of information she receives, she will become fully informed.[7] In this case, a takeover occurs only if the incumbent's type is below the price offer (as opposed to the signaled bidder's type). It can be shown that first-best in this case requires all bidder types to earn zero profits on the takeover. This can, however, never be an equilibrium, as imitating lower bidder types, who also have the chance to realize a takeover, will yield strictly positive profits. Hence, fully informed shareholders make first-best infeasible, implying a tension between shareholders and society regarding the optimal provision of information.

We extend our model to a general ownership structure with finitely many shareholders. Further, we introduce private benefits from retaining control for incumbent management. Two differences arise: multiple shareholders give rise to equilibria suffering from coordination failures, and private benefits from remaining in charge hamper communication and introduce a wedge between the incumbent's incentives and first-best. We show, however, that with finitely many shareholders, the equilibrium with informative cheap talk also exists for sufficiently small private benefits. We further establish that if the private benefits are not too large, then the above equilibrium dominates the setting with fully informed shareholders in terms of welfare. In that sense, our equilibrium with informative cheap talk is robust in both dimensions.

This chapter has implications for optimal managerial salary schemes during takeovers, regulation of fairness opinions,[8] and disclosure requirements. First, we

[7] Any message she would receive from the incumbent is of course irrelevant in this case.

[8] A fairness opinion comprises a brief letter stating the fairness of the offered price and additional

provide a novel rationale for equity compensation of managers that does not rely on the well-known moral hazard argument due to the separation of ownership and control (Jensen and Meckling, 1976). In our model, it is the management's advisory role in takeovers that requires equity compensation to achieve efficiency. Second, it is crucial that the manager maintains his share position for a holding period after he steps down from office.[9] Indeed, many companies offer vested shares to their named executive officers as part of the compensation package. Holders of these contracts become owners of the shares only gradually over time to provide incentives to remain with the company. Often, compensation agreements specify that the shares – after termination of employment following the change in control – do not vest immediately, but within a specified time period of up to two years (Shearman & Sterling LLP, 2016).

Third, our model relates severance payments to management's advisory role. Large severance payments in the event that top executives are let go – or *golden parachutes* – are often subject to public criticism and seen as a sign of management entrenchment. A recent example is the following excerpt from a *Financial Times* article regarding the takeover of Mead Johnson by Reckitt Banckiser (2017):

'*Mead introduced a "golden parachute" pay scheme if [executives] are let go within two years of a takeover... [T]he prospect of being paid because you decide to leave a job may seem decidedly odd. Not, sadly, in the wider context of executive pay agreements, where Mead's example is anything but unusual.*'[10]

However, through the lens of our model, golden parachutes can be efficient. They serve to improve the advisory role of management, which typically obtains some private benefits from remaining in charge. Rewarding incumbent management after a successful takeover may thus help to balance management's interests between remaining in charge and stepping down. Ultimately, this helps to maximize firm value. Of course, the golden parachute should be contingent on a takeover and not be triggered by a dismissal due to mismanagement or other reasons.[11]

Fourth, consulting an outside advisor (such as an investment bank) who provides information beyond the manager's recommendation is common within the realm of

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material such as data, methods, and computations used for valuation (Bebchuk and Kahan, 1989). In 1986, for example, Connecticut National Bank issued a fairness opinion for the takeover of Nutrisystem, Inc. stating that the "$7.16 a share price was fair to shareholders because the company was worth between $6.50 and $8.50 a share." See *https://casetext.com/case/herskowitz-v-nutrisystem-inc*, date 3/19/2019.

[9] An alternative would be to pay the manager a bonus for a high post-takeover shareholder value. In the present chapter, this holding period need not necessarily be required by law since ex post, it is in the manager's best interest to tender none of his shares.

[10] See *https://www.ft.com/content/c63591b0-ea08-11e6-893c-082c54a7f539*, date 12/2/2019.

[11] This was true in the case of Mead Johnson.

corporate takeovers (Kisgen, Song, et al., 2009). Furthermore, management may be subject to mandatory disclosure rules (Bainbridge, 1999).[12] Such fairness opinions and similar disclosure of information should not be required by law since they may destroy firm value.[13] Importantly, as the current shareholders in our model want more information at the time of their tendering decision, they may be prone to force management to procure an expert opinion or provide additional disclosure under threat of a lawsuit. Eliminating the possibility of successful lawsuits may increase allocative efficiency. Our model also provides a rationale for uninformative fairness opinions: fairness opinions that are just uninformative rubber-stamping of management's recommendation can actually be an optimal response to legally required fairness opinions, provided that management has discretion over how informative the report is.

The rest of this chapter is organized as follows. In the remainder of this section, we highlight the relationship between our results and related work. Section 2.2 introduces our basic model. We present a benchmark in Section 2.3. In section 2.4, we solve our main model. In Section 2.5, we investigate several extensions to our basic model. In Section 2.6, we show how our results can be used to design optimal golden parachutes in takeovers. Section 2.7 highlights an interesting connection of our model with auction theory. Section 2.8 develops predictions and relates them to empirical findings from the literature. Finally, Section 2.9 concludes. All proofs are delegated to an appendix.

Literature on Corporate Takeovers

In the following, we highlight papers from the literature on corporate takeovers that are most related to ours. For a detailed review of the literature, see, for example, Burkart and Panunzi (2008). In their seminal paper, Grossman and Hart (1980b) argue that widely held companies are less prone to takeovers because shareholders can free-ride by not selling their shares and benefit from post-takeover profits. To make efficient takeovers possible, a corporate charter can incorporate exclusionary devices such as dilution of property rights to overcome the free-rider problem. Bagnoli and Lipman (1988) have shown that profitable takeovers of widely held firms are possible without exclusion.[14] The crucial feature is having *finitely* many shareholders, which

[12] In the US, if an attempt to purchase more than five percent of the shares of a target company is initiated, both the bidder and current management are legally compelled to disclose a statement (Bainbridge, 1999).

[13] Although not explicitly required by law, there is evidence that managers acquire fairness opinions as protection against lawsuits initiated by unsatisfied shareholders (Kisgen, Song, et al., 2009).

[14] Also Shleifer and Vishny (1986) and Müller and Panunzi (2004) present ways to alleviate the free-rider problem. Shleifer and Vishny (1986) show that toehold acquisitions before the takeover attempt can make takeovers profitable, and Müller and Panunzi (2004) demonstrate how dilution of the target firm's share value can be attained via leveraged *bootstrap* acquisitions.

enables the bidder to make some shareholders pivotal to impede free-riding. As our model contains a finite number of shareholders, we abstract from the free-rider problem and focus instead on informational frictions. Similar to the exclusion of shareholders to overcome the free-rider problem as in Grossman and Hart (1980b), we show that excluding shareholders from learning additional information can be welfare increasing.

Our work is also related to Levit (2017), wherein one party (a board) has private information and advises shareholders about a potential takeover in the form of cheap talk communication. The bidder in Levit (2017) does not possess private information, which shuts down signaling. In contrast, the interaction of costly signaling by the bidder and cheap talk by the incumbent drives our main result.

Marquez and Yılmaz (2008) analyze a framework in which shareholders privately observe conditionally independent signals about the potential value improvement of a takeover with an uninformed bidder. Takeovers may not be feasible as the bidder faces a lemons problem. Ekmekci and Kos (2016) are able to resolve this issue by introducing a large minority shareholder. Ekmekci and Kos (2014) allow for information acquisition by the bidder and the shareholders. It is shown that unilateral access to information for the bidder is of no use to him because all his information will be encoded in the price offer. Shareholders in their model prefer imprecise information because very detailed information provision may lead to a complete market breakdown. Marquez and Yılmaz (2012) compare public signals with information dispersed across shareholders and study the effects on the tender offer. Interestingly, only the precision of the dispersed information matters for the expected tender offer. Ekmekci et al. (2016) derive the optimal mechanism for the sale of a company when the buyer privately knows both, the security benefits he will create and his private benefits of control. There is no private information on the incumbent's side. Bernhardt et al. (2018) introduce heterogeneous private valuations of investors in a takeover model and study the consequences for the tender offer characteristics.

In our model, the bidder signals his private information via his tender offer, and we construct a fully revealing equilibrium (on the bidder's side). In this way, our model is related to Hirshleifer and Titman (1990) and Burkart and Lee (2015) who focus on private information of the external bidder. In Hirshleifer and Titman (1990), there exist mixed equilibria in which the bidder completely reveals his type. In our setting, mixed tendering strategies are not sufficient to induce bidder separation. Further, Burkart and Lee (2015) show how an external bidder can reveal his type by committing to relinquish private benefits. We find an alternative way of to screen bidder types that works even in a setting with two-sided asymmetric information: strategic management recommendations.

In the context of mergers, Hansen (1987), Berkovitch and Narayanan (1990), and Eckbo et al. (1990) study a setting in which separation can be obtained by a mix of cash and equity offers. We are interested in the allocation of control rights, whereas they consider the case in which two companies want to exploit synergies of a merging assets. As a consequence, in their setting, a lemon's problem arises.

Literature on Communication and Corporate Governance

Up to now, a plethora of papers have analyzed strategic communication in manifold economic environments. The seminal paper on cheap talk by Crawford and Sobel (1982) analyzes a situation with one informed sender and one uninformed receiver with a continuous action space. We combine costly signaling and cheap talk in a sequential model: an informed sender (the bidder) sends a costly message (his price offer), to which an informed receiver (the incumbent manager) reacts by sending a cheap talk recommendation. Accordingly, the manager is sender and receiver of information in one.

This chapter features an endogenous conflict of interest of shareholder and management as in Antic and Persico (2018); Antic and Persico (2019). They provide a model of information transmission in which an expert shareholder chooses how much information to communicate about the return of an investment to a controlling shareholder who then decides on the investment strategy. A main innovation is that the bias in the cheap talk stage is determined endogenously, through share acquisitions in a competitive market prior to the communication stage. As a result, perfect information transmission is obtained. In our model, the conflict of interest is not determined by the communicating parties (management and shareholders), but through the price offer of the external bidder. In contrast to Antic and Persico (2018); Antic and Persico (2019), full information transmission is not feasible.

Malenko and Tsoy (2019) show that advisors in English auctions (such as managers in takeovers) who are biased towards overbidding can increase expected revenues and allocative efficiency via cheap talk messages. In their paper, cheap talk advice influences the bidders' optimal price offer, whereas in our model, the bidder's price offer affects the cheap talk message. Adams and Ferreira (2007) analyze the monitoring and advisory role of a board. It is shown that, to facilitate communication between the board and CEO, the optimal board is not completely independent. Almazan et al. (2008) consider a model where a manager communicates via cheap talk to (potential) investors and is thereby able to increase shareholder value if the company is severely undervalued. Harris and Raviv (2008) examine the optimal board size and composition in the light of communication within the board. Kakhbod et al. (2019) study the design of an advisory committee when heterogeneous shareholders can acquire information and communicate. Malenko (2013) considers communication of directors from a company board in the presence of conformity motives. Interestingly, Malenko (2013) shows that communication may be fostered if directors' preferences are more heterogeneous. Chakraborty and Yılmaz (2017) show that even a board solely advising management may optimally withhold information. Levit (2018) shows how the threat of voice, and in some cases also exit, can help activist shareholders to communicate more effectively. Finally, Levit (2020) shows that a principal's ability to communicate is strengthened if he cannot intervene after the receiver takes some action.

2.2 Basic Model

Environment An external bidder E considers the acquisition of a company. The target company has a continuum of shares of measure one outstanding. The bidder makes a publicly observable tender offer by posting a price $p_E \in \mathbb{R}_+$. For a successful takeover, he must acquire at least a fraction $\lambda > 0$ of the outstanding shares. The offer is conditional: if a fraction less than λ of the shares is tendered, the offer becomes void.

The company is currently owned by a single (initial) shareholder (she) and the incumbent manager (I). We generalize the ownership structure to any finite number of shareholders in Section 2.5. Manager I owns a fraction $s \in (0, \lambda)$ of the shares, making the initial shareholder hold a controlling stake in the company of $1-s$.[15] The incumbent cannot make a counteroffer and he is not allowed to tender his shares.[16] It will become clear that I has, endogenously, no incentive to trade his shares during the takeover.

The game has three periods indexed by $t \in \{1, 2, 3\}$. At $t = 1$, the external bidder posts his tender offer p_E. At $t = 2$ and after observing the price, I sends a cheap talk message m_I. Finally, at $t = 3$ and given p_E and m_I, the shareholder decides which fraction $\gamma \in [0, 1]$ of her share endowment $1 - s$ to tender. In particular, neither the incumbent manager can commit to tell the truth nor can the shareholder commit to a tender rule ex ante. The timing of events is summarized in Figure 2.1.

[15] As noted in the introduction, the shareholder may also own all shares if I is interested in the well-being of the company even after a successful takeover due to compensation schemes such as gradually vesting equity, stock options, or bonus payments.

[16] The reasons for this selling restriction are manifold and include, for instance, insider trading restrictions and incentive features in his employment contract such as stock options and vesting equity not immediately tradable. Further, employment contracts often specify retention periods even after the managers leave the company. Our results will imply that these features are highly desirable to increase efficiency in takeovers.

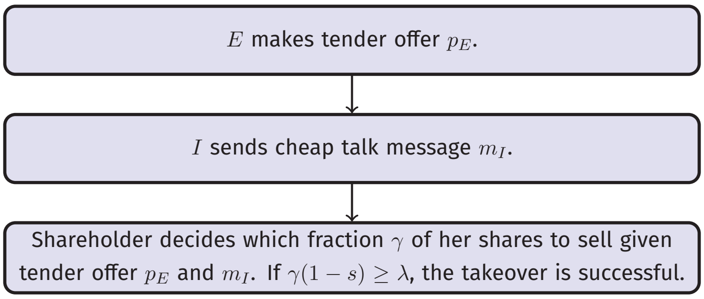

Figure 2.1 Timing

Information As a novelty in the literature on corporate takeovers, whether a takeover is socially efficient depends on both the bidder's and the incumbent's private information. The bidder privately observes his type ω_E, which comprises information about his ability to run the company after a successful takeover. Furthermore, the manager has private *inside* information about the company's future profits under his management denoted by ω_I.[17] The shareholder does not know either of the two types. The bidder's and the incumbent's types are independently distributed on $[0, 1]$ according to continuous and commonly known cdfs F_E and F_I. The fact that the types are (potentially) distributed according to different cdfs allows us to capture the differences in expected firm values and uncertainty under the respective management. Generally, the firm value under different managements will be correlated. The correlated part, however, is non-specific to management and therefore not private information of either management. It is thus likely to be reflected in the current share price and our model specification is a mere normalization of this common part to zero. Both cdfs admit densities f_E and f_I with full support. Finally, we denote $\mu_E \mathbb{E}[\omega_E]$ and $\mu_I \mathbb{E}[\omega_I]$.

Payoffs The firm's profits π are given by ω_E if the takeover attempt is successful and ω_I if the incumbent stays in charge. If no takeover occurs, the shareholder will earn ω_I per share irrespective of her tendering decision. Conditional on a successful takeover, tendering a fraction γ of her share endowment yields p_E per share and security benefits of ω_E on the residual $(1-\gamma)(1-s)$ shares. This results in the

[17]Even though the manager runs the company at the time of the tender offer, he still typically will possess superior, inside information about the future profitability under his management. He may know, for example, about the state of an R&D project, or secret negotiations with a large potential customer. In general, the empirical literature suggests that the strongest form of the efficient market hypothesis does not hold true and not all insider information is incorporated in the market price.

following shareholder utility:

$$v = \begin{cases} (1-s)\Big(\gamma p_E + (1-\gamma)\omega_E\Big), & \text{if takeover successful} \\ (1-s)\omega_I, & \text{otherwise.} \end{cases}$$

The incumbent's utility is given by his share endowment under either control allocation. In Section 2.5, we generalize his payoff structure and include private benefits from retaining control. In the current version of the model, the incumbent's utility is given by

$$u_I = \begin{cases} s\omega_E, & \text{if takeover successful} \\ s\omega_I, & \text{otherwise.} \end{cases}$$

Observe that even without private benefits of control, the interests of the incumbent and the shareholder are generally not perfectly aligned because the shareholder's payoff is a function of the tender offer p_E, which is an equilibrium outcome. Conversely, in case of a takeover, the incumbent is solely interested in the bidder's type. The bidder's utility is given by:

$$u_E = \begin{cases} \gamma(1-s)(\omega_E - p_E), & \text{if takeover successful} \\ 0, & \text{otherwise.} \end{cases}$$

E derives constant utility normalized to zero if no takeover occurs, and if the tender offer is successful, E buys a fraction of $\gamma(1-s) \geq \lambda$ shares from the shareholder at per-share costs of p_E and gains ω_E on the shares acquired.[18]

Strategies Given the observed tender offer p_E and the incumbent's message m_I, a (pure) strategy for the shareholder specifies a fraction γ of tendered shares, i.e., $\gamma : \mathbb{R}_+ \times M_I \to [0,1]$ where $M_I = [0,1]$ denotes the message space. An incumbent's strategy is a mapping from the set of price offers and his type space into the message space, i.e., $m_I : \mathbb{R}_+ \times [0,1] \to [0,1]$. Finally, a (pure) strategy for the bidder $p_E : [0,1] \to \mathbb{R}_+$ specifies a tender offer for any type ω_E. Throughout this chapter, we assume that indifference on the shareholder side is broken in favor of a takeover.[19] Our solution concept is perfect Bayesian equilibrium in pure strategies, henceforth referred to as equilibrium. Whenever necessary, we restrict attention to off-path beliefs satisfying the intuitive criterion by Cho and Kreps (1987). An equilibrium requires that (equilibrium objects are denoted with a star):

[18] As we abstract from the free-rider problem, there is no need to model private benefits for the external bidder to make takeovers feasible.

[19] This assumption is made to circumvent an openness problem and to ensure existence of equilibria.

1. given tender offer p_E^* and message m_I^*, the shareholder chooses optimally how many shares to tender, i.e., she chooses γ^* to maximize $\mathbb{E}[v|p_E^*, m_I^*]$.
2. Given p_E^* and γ^*, I chooses $m_I^* \in argmax\ \mathbb{E}[u_I|p_E^*, \omega_I, \gamma^*]$.
3. Given m_I^* and γ^*, E chooses p_E^* to maximize his expected profits $\mathbb{E}[u_E|\omega_E, m_I^*, \gamma^*]$.
4. Whenever possible, all players update their posterior belief according to Bayes' rule.

First-best Allocation In our setting, ex post efficiency requires that the potential manager with the higher type leads the company. The following definition establishes the notion of first-best in our setting. We call any equilibrium (firm value-) optimal or first-best if it leads to a takeover if and only if $\omega_E \geq \omega_I$.

2.3 Informed Shareholder

Before we analyze the implications of strategic information transmission by the incumbent, we turn to the case of an informed shareholder who privately[20] knows ω_I. In Section 2.4.3, we argue that, endogenously, the shareholder prefers to be well-informed.[21] For a given price offer p_E and induced posterior type $\mathbb{E}[\omega_E|p_E]$, a shareholder who knows ω_I will want to tender whenever there is some $\gamma \geq \frac{\lambda}{(1-s)}$ such that

$$\gamma p_E + (1-\gamma)\mathbb{E}[\omega_E|p_E] \geq \omega_I. \tag{2.1}$$

A takeover is desired by the shareholder if there is a convex combination of the posted price and posterior expected bidder type (with $\gamma \geq \frac{\lambda}{(1-s)}$) that weakly exceeds the benefits from leaving the incumbent in charge. Given the equilibrium tendering decision of the shareholder and his private type ω_E, the external bidder chooses a price $p_E \in \mathbb{R}_+$ to maximize his expected utility. The following proposition establishes that, in any equilibrium, the bidder's tender offer and the shareholder's tendering decision are jointly inconsistent with the first-best allocation, i.e., ex post inefficient.

Proposition 2.1 *Suppose the shareholder is perfectly informed about ω_I. Then, there is no equilibrium in which the first-best allocation is implemented.*

The intuition behind Proposition 2.1 is as follows. In order to obtain first-best, the shareholder's tendering inequality (2.1) must be equivalent to $\omega_E \geq \omega_I$. The proof shows that this is only the case if $p_E = \omega_E$, so first-best is only attainable

[20] E remains uninformed about ω_I.
[21] We complement the analysis with a discussion of potential information channels.

if E makes zero profits and fully reveals his type. We show, however, that zero profits cannot be part of an equilibrium with full separation that is ex post efficient because higher types would imitate price offers of lower types: in a fully separating equilibrium that implements the first-best allocation, every bidder type has a strictly positive takeover probability. Consequently, for all $\omega_E > 0$ there is a deviation to a lower price that secures strictly positive profits. First-best is therefore not attainable with full information about ω_I.

Remark 2.1 *Our setting is restricted to price offers, and there is no commitment regarding the allocation rule: the shareholder will tender only if she finds it optimal given p_E and ω_I. For the case where all shares must be traded for a change in control, i.e., $\lambda = 1 - s$, Proposition 2.1 follows from the classical impossibility result in bilateral trade by Myerson and Satterthwaite (1983), and (ex post) efficient trade is also not feasible in the more general mechanism design problem. For $\lambda < 1 - s$, the impossibility of first-best does not follow from Myerson and Satterthwaite (1983) because we consider interdependent values. If the shareholder does not tender her entire share endowment, i.e., $\gamma < 1$, the shareholder participates in the expected value improvement by the bidder. Hence, there is some degree of alignment of interests among shareholder and external bidder that may give rise to efficient trade. Proposition 2.1 shows, however, that ex post efficiency is still not attainable with take-it-or-leave-it price offers.*

2.4 Strategic Management Recommendation

We now analyze the case in which the shareholder's only source of information regarding ω_I is the incumbent's cheap talk message. We show that there exists an equilibrium in which the bidder perfectly reveals his type *because of* the incumbent's cheap talk recommendation. Beyond this, we establish that informative cheap talk can implement the first-best control allocation and thus dominates a setting where the shareholder is fully informed in terms of welfare. Then, we derive the set of equilibria when cheap talk is uninformative and show that separation of the bidder's type cannot be attained in this case.

2.4.1 Informative Cheap Talk

Cheap talk not only (partially) informs the shareholder about ω_I, but also induces the bidder to fully reveal his type. As a shortcut, we will refer to an equilibrium with full information about the bidder's type as *fully revealing* or *fully separating.* In contrast to the previous benchmark, as shareholder's and incumbent's interests are not completely aligned, cheap talk prevents the shareholder from becoming fully informed. This, however, will turn out to be beneficial for the control allocation.

Tendering Decision and Cheap Talk Message As the shareholder plays a pure strategy in $t = 3$, there are only two outcomes with respect to the final control allocation given p_E and m_I and the associated posteriors: a takeover occurs either with certainty or never. At the cheap talk stage, the manager knows p_E, and therefore, he knows (on the equilibrium path) whether a takeover will occur if he sends some message m_I. He is indifferent between both outcomes whenever $s\mathbb{E}[\omega_E|p_E] = s\omega_I$, which in turn implies that a takeover is endorsed by I whenever

$$\omega_I \leq \omega_I^*(p_E)\mathbb{E}[\omega_E|p_E]. \tag{2.2}$$

The indifference type ω_I^* equals the posterior expected type of E and is thus a function of p_E. When it is clear from the context, we drop the price. Note that, by the common support assumption, for any p_E and induced posterior belief about ω_E there is a unique cutoff type $\omega_I^* \in [0, 1]$ at which the incumbent is indifferent.

The implication of informative cheap talk is illustrated in Figure 2.2. If the incumbent manager is not well-equipped to steer the company (low ω_I) and if he has a sufficiently high posterior expectation about the bidder's type, he prefers the shareholder to tender her shares. Conversely, if the manager knows that he is very skilled, he recommends not to tender. Hence, he sends at most two non-outcome equivalent messages.

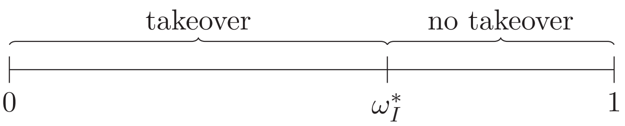

Figure 2.2 The ω_I-Type Space with Cutoff Type ω_I^*

Bidder's Payoff If the shareholder follows I's recommendation, the bidder's expected utility is given by

$$F_I(\omega_I^*(p_E))\ \gamma(p_E)(1-s)\ [\omega_E - p_E]. \tag{2.3}$$

When the bidder chooses his tender offer at $t = 1$, the incumbent's message is not known since it will depend on I's private type ω_I. The bidder's expected utility thus equals the probability that the incumbent's type is below the cutoff type – $F_I(\omega_I^*(p_E))$ – and the amount of shares tendered $\gamma(p_E)(1-s)$ times the profit earned on each share acquired by the bidder $(\omega_E - p_E)$. Equation (2.3) illustrates that, if the shareholder follows I's message, the final allocation (probability) is fixed by the incumbent's indifference type $\omega_I^*(p_E)$ for any p_E and the corresponding expected posterior type $\mathbb{E}[\omega_E|p_E]$. The following main result characterizes a fully separating equilibrium with informative cheap talk.

Theorem 2.1 *There is an equilibrium in which E fully reveals his type by posting*

$$p_E^* = \mathbb{E}[\omega_I|\omega_I \leq \omega_I^*(\omega_E)].$$

Furthermore,

1. *if $\omega_I \leq \omega_I^*(p_E)$, then $m_I^* \in [0, \omega_I^*(p_E)]$, and a takeover occurs with probability one;*
2. *if $\omega_I > \omega_I^*(p_E)$, then $m_I^* \in (\omega_I^*(p_E), 1]$, and a takeover occurs with probability zero.*

Finally, it holds that $\gamma^*(m_I^*(\omega_I \leq \omega_I^*(p_E)) = \frac{\lambda}{1-s}$.

Theorem 2.1 establishes that there exists an equilibrium in which the bidder fully reveals his type via his tender offer. Given p_E^*, the incumbent's posterior belief assigns probability one to the true bidder type on the equilibrium path, and I's indifferent type becomes $\omega_I^* = \omega_E$. The manager sends a binary cheap talk message in favor of or against the takeover. And finally, the shareholder finds it optimal to follow I's message given p_E^* and her posterior beliefs of ω_E and ω_I. If a takeover occurs, then she tenders as few shares as possible, i.e., $\gamma^*(m_I^*(\omega_I \leq \omega_I^*)) = \frac{\lambda}{1-s}$. In the following, we convey the intuition underlying the equilibrium in two steps.

Tender Offer After informative cheap talk, the fully revealing equilibrium exists because of the recommendation by the manager: it enables separation by introducing a way to compensate higher bidder types for posting higher prices. To see this, consider the bidder's per share profit $F_I(\omega_I^*(p_E))[\omega_E - p_E]$. If I's type is below ω_I^*, he recommends a takeover, and if the shareholder follows I's message, the takeover probability is given by $F(\omega_I^*)$. Since $\omega_I^* = \mathbb{E}[\omega_E|p_E]$, the takeover probability strictly increases in the posterior expected bidder type induced by the tender offer p_E. Separation is feasible because increasing p_E induces a higher posterior expectation and therefore a higher takeover probability, but also is costly to the bidder.

In particular, for a fully separating equilibrium to exist, there has to be a strictly increasing (and thus invertible) function $p_E : [0,1] \to \mathbb{R}_+$ such that, given any ω_E, when E chooses his bid[22] $p \in \mathbb{R}_+$ optimally, we have

$$p = p_E(\omega_E) \in argmax \;\; F_I[\omega_I^*(p_E^{-1}(p))](\omega_E - p). \tag{2.4}$$

[22]We introduce the notation of p here to distinguish between the bid function p_E and a specific bid p (number).

For any ω_E, this maximization yields the bidder-optimal price offer given that the shareholder and incumbent form posterior expectation according to p_E and the shareholder follows I's message. For any particular bid p, the takeover probability is thus determined by $F_I[\omega_I^*(p_E^{-1}(p))]$. The unique solution to (2.4) is $p_E^*(\omega_E) = \mathbb{E}[\omega_I|\omega_I \leq \omega_I^*]$, where, in the fully separating equilibrium, $\omega_I^* = \omega_E$. It is then easy to verify that, given the incumbent manager and the shareholder form beliefs according to $p_E^*(\omega_E)$, it is indeed optimal for type ω_E to bid $p = p_E^*(\omega_E)$ relative to any other bid $p \in [p_E^*(0), p_E^*(1)]$.

Moreover, no bidder type wants to deviate to an (off-path) tender offer above $p_E^*(1)$ because $p_E^*(1)$ ensures a takeover with probability one. Hence, independent of off-path beliefs, deviating to a higher price only increases the costs but leaves the benefits unaffected. Further, as $p_E^*(0) = 0$ and $p \in \mathbb{R}_+$, off-path downward deviations are not feasible.

Observe that (2.4) only considers the per share profits. It is sufficient to solve for the bidder's per share profit because, in equilibrium given $m_I^*(\omega_I \leq \omega_I^*)$, the total amount of tendered shares equals $\frac{\lambda}{1-s}$ – independent of the posted price $p \in [0, p_E^*(1)]$. To see this, observe that $p_E^*(\omega_E) = \mathbb{E}[\omega_I|\omega_I \leq \omega_E] < \omega_E$, where the last inequality follows from the full support assumption. Hence, the post-takeover security benefits (ω_E) exceed the tender offer $p_E^*(\omega_E)$ for all bidder types such that the shareholder will tender as few shares as possible that still make the takeover succeed. This also implies that p_E^* guarantees at least the outside option of zero to all bidder types, i.e., $\omega_E \geq p_E^*(\omega_E)$ for any $\omega_E \in [0, 1]$.

Cheap Talk Constraints In the equilibrium constructed in Theorem 2.1, the shareholder follows the incumbent's recommendation. To verify that this is indeed optimal for the shareholder, one has to show that, given the equilibrium price p_E^* and message $m_I^*(\omega_I \leq \omega_I^*)$, such that the incumbent endorses a takeover, the shareholder prefers tendering $\gamma \geq \frac{\lambda}{1-s}$ shares over leaving the incumbent in charge. That is, for some $\gamma \geq \frac{\lambda}{1-s}$, it has to hold that

$$\gamma p_E^*(\omega_E) + (1-\gamma)\mathbb{E}[\omega_E|p_E^*(\omega_E)] \geq \mathbb{E}[\omega_I|\omega_I \leq \omega_I^*(\omega_E)]. \tag{2.5}$$

Conversely, suppose that the manager does not recommend a takeover (i.e., $m_I^*(\omega_I > \omega_I^*)$) at $p_E^*(\omega_E)$. Then, the shareholder finds it optimal to follow the recommendation if

$$\gamma p_E^*(\omega_E) + (1-\gamma)\mathbb{E}[\omega_E|p_E^*(\omega_E)] < \mathbb{E}[\omega_I|\omega_I > \omega_I^*(\omega_E)]. \tag{2.6}$$

It is sufficient to check inequality (2.6) for $\gamma = \frac{\lambda}{(1-s)}$ because $\mathbb{E}[\omega_E|p_E^*] > p_E^*$ holds true in equilibrium as shown above.

Observe that the bidder's tender offer, $p_E^* = \mathbb{E}[\omega_I|\omega_I \leq \omega_E]$, is the shareholder's outside option of leaving the incumbent in charge given that the incumbent sends a message in favor of a takeover. As the shareholder receives exactly her outside option on the shares tendered, E obtains all expected gains he creates by taking control over the company. The shareholder participates in the bidder's value improvement via the shares that are not tendered $(1 - s - \lambda)$.

Efficient Control Allocation An important corollary of Theorem 2.1 is that this fully revealing equilibrium induces the first-best allocation of control rights and consequently, is more efficient than a situation with a fully informed shareholder (Section 2.3).

Corollary 2.1 *The equilibrium with informative cheap talk in Theorem 2.1 induces the first-best control allocation. In particular, it exhibits a strictly higher expected firm value than any equilibrium in which the shareholder is fully informed about ω_I.*

The intuition is straightforward: as $\omega_I^* = \omega_E$, the incumbent recommends a takeover if and only if it is efficient. As the shareholder finds it in her best interest to follow the recommendation, the first-best control allocation is obtained. Observe that there will never be perfect information transmission in the separating equilibrium: the cutoff type ω_I^* equals ω_E, and I merely sends a cutoff message revealing whether $\omega_I \leq \omega_E$ or not. Rather surprisingly, the equilibrium with informative cheap talk welfare-dominates our benchmark setup in which the shareholder is fully informed about ω_I. The intuition is as follows: The external bidder will post prices below his true type to make a profit on the takeover. If information is controlled by the incumbent manager via his message, he recommends a takeover whenever $\mathbb{E}[\omega_E|p_E^*] \geq \omega_I$. In equilibrium, the shareholder cannot do better than following I's recommendation. Conversely, if the shareholder is fully informed about ω_I and the bidder's price offer is fully separating,[23] she tenders if and only if $\frac{\lambda}{1-s} p_E^*(\omega_E) + (1 - \frac{\lambda}{1-s})\omega_E \geq \omega_I$. Denote by $\tilde{\omega}_I \frac{\lambda}{(1-s)} p_E^*(\omega_E) + (1 - \frac{\lambda}{(1-s)})\omega_E$ the incumbent type at which a fully informed shareholder is exactly indifferent between a takeover and leaving the incumbent in charge. Then, $\tilde{\omega}_I < \omega_E$ holds since $p_E(\omega_E) = \omega_E$ can never be part of an equilibrium because this would imply zero profits (see Section 2.3). Therefore, there are types $\omega_I \in (\tilde{\omega}_I, \omega_E)$ for which a takeover does not occur with a fully informed shareholder, but the first-best allocation would require it.

Put differently, in the cheap talk equilibrium of Theorem 2.1, the message of I pools cases where the shareholder prefers to tender with cases where the shareholder

[23] If it is not fully separating, the efficient control allocation cannot be implemented (see Section 2.3).

would be better off not tendering.[24] To see this, note that $\tilde{\omega}_I < \omega_E = \omega_I^*$. Consequently, given ω_E and $p_E^*(\omega_E)$, for all $\omega_I \leq \tilde{\omega}_I$, the shareholder would tender if she knew ω_I. Conversely, for all $\omega_I > \tilde{\omega}_I$, the shareholder would leave the incumbent in charge as she does not fully internalize all gains from trade. If the shareholder can base her decision solely on m_I, she can only tell whether ω_I is larger or smaller than ω_I^*, but – as $\tilde{\omega}_I < \omega_I^*$ – she never infers if $\omega_I \in (\tilde{\omega}_I, \omega_I^*]$, where she would keep her shares with full information but I recommends to tender. The fact that she is *not perfectly informed* about the firm value is what enables the first-best allocation of control rights.

Remark 2.2 *In our setting, we focus on cheap talk to alleviate the informational frictions because this seems to be the prevalent channel in practice. Alternatively, a shareholder could delegate (without commitment) the control right to the incumbent manager, who then decides whether a takeover occurs or not at a given price offer. Due to the binary action, delegation and informative management recommendations are outcome-equivalent in our setting.*[25] *In this sense, delegation can be an alternative instrument to achieve the first-best control allocation.*

2.4.2 Uninformative Cheap Talk

Since the recommendation of the manager is cheap talk, there always exists an equilibrium in which his message is uninformative. A message $m_I(p_E, \omega_I)$ is uninformative (or *babbling*) if, for all $p_E \in \mathbb{R}_+$, $m_I(p_E, \omega_I)$ is independent of ω_I. Alternatively, one can interpret the results of this subsection as a benchmark in which the incumbent manager is not able to give a recommendation to the shareholder. Given an uninformative message of the manager, the next proposition characterizes the set of equilibria.

Proposition 2.2 *In any babbling equilibrium, there exists a cutoff price $\hat{p}_E < 1$ such that:*

if $\omega_E < \hat{p}_E$, a takeover never occurs;

if $\omega_E \geq \hat{p}_E$, E posts $\hat{p}_E$ and a takeover occurs with probability one.

Finally, it holds that $\gamma^*(\hat{p}_E) = \frac{\lambda}{1-s}$.

The result states that all equilibria with uninformative cheap talk are partially pooling, in that all bidder types larger than some cutoff post the same price resulting in a takeover. For simplicity, we simply call these *pooling equilibria*. Further, in every pooling equilibrium, the shareholder tenders as few shares as possible such that a takeover still occurs.

[24]This misalignment is the reason why the message by the incumbent can never be fully revealing.

[25]See Dessein (2002) for an analysis of communication versus delegation with commitment and continuous action space.

$\gamma^*(\hat{p}_E) = \frac{\lambda}{1-s}$ holds true in any pooling equilibrium because $\hat{p}_E < 1$ implies that $\mathbb{E}[\omega_E|\hat{p}_E] > \hat{p}_E$. Consequently, whenever $\gamma(\hat{p}_E) > \frac{\lambda}{1-s}$, then the shareholder could profitably deviate to tendering fewer shares, gaining $\mathbb{E}[\omega_E|\hat{p}_E] - \hat{p}_E$ and still making the takeover successful. Moreover, Proposition 2.2 shows that without informative cheap talk, no separation can be induced with respect to the bidder's type apart from a single cutoff. The intuition behind this observation is that for any finer separation, one has to incentivize higher bidder types to post larger prices with a higher probability of obtaining control. But such a screening device is missing here.

Hirshleifer and Titman (1990) show that in a model with a continuum of shareholders, separation of the bidder may be attainable if shareholders play mixed strategies.[26] Although we abstract from mixing, observe that even if we allowed the shareholder to play mixed strategies, full separation is not feasible in our model. To see this, note that the shareholder is indifferent between selling and keeping her shares if and only if

$$\gamma p_E + (1-\gamma)[\omega_E|p_E] = \mu_I, \tag{2.7}$$

for some $\gamma \geq \frac{\lambda}{1-s}$. The first observation is that if there is full separation, zero profits for bidder types $\omega_E > 0$ cannot be part of an equilibrium.[27] Hence, $\omega_E > p_E$ holds and therefore, the shareholder tenders as few shares as possible, i.e., $\gamma = \frac{\lambda}{(1-s)}$. Now denote the probability of a takeover, given that the shareholder is indifferent at p_E, by $\phi(p_E)$. By monotonicity of the bidder's payoff, higher types have a higher willingness to pay for a given takeover probability. To induce full separation, the bidder's strategy must strictly increase in ω_E. For this to be optimal, higher types need to be compensated with a higher takeover probability. As the shareholder needs to mix at any price after which a takeover occurs with non-zero probability except for the price posted by $\omega_E = 1$, the indifference constraint (2.7) would need to hold for any type pair $0 < \omega_E < \omega_E' < 1$ posting prices $p_E < p_E'$ with $0 < \phi(p_E) < \phi(p_E')$.[28] But since $\frac{\lambda}{(1-s)}p_E' + (1-\frac{\lambda}{(1-s)})\omega_E' > \frac{\lambda}{(1-s)}p_E + (1-\frac{\lambda}{(1-s)})\omega_E$, she cannot be indifferent at both prices, which yields a contradiction. Therefore, in contrast to Hirshleifer and Titman (1990), full separation is not feasible through mixing.

Figure 2.3 shows the control allocation in a pooling equilibrium as described in Proposition 2.2. Independent of ω_I, a takeover occurs whenever $\omega_E \geq \hat{p}_E$, so the blue area depicts those type pairs for which a takeover is realized. All optimal

[26] It is noteworthy, however, that mixing will always cause welfare losses, and first-best can never be implemented as the allocation of control is probabilistic.

[27] The precise argument requires a little work. If there is full separation, we know that there exists an $\tilde{\omega}_E < 1$ such that all $\omega_E \in [\tilde{\omega}_E, 1]$ have a strictly positive takeover probability. If that was not true, any type close enough to 1 could offer μ_I and take over the company with certainty, making strictly positive profits. Hence, for all $\omega_E > \tilde{\omega}_E$, zero profits cannot be an equilibrium outcome, as these types could deviate to the price offer $p_E(\tilde{\omega}_E)$ and realize a strictly positive profit.

[28] Such a type pair always exists because $\mu_I < 1$.

allocations, however, lie above the 45 degree line. Thus, there are pairs for which inefficient takeovers occur (blue triangle below the 45 degree line) and pairs for which I remains in charge although E would be optimal (white triangle above the 45 degree line). Not surprisingly, first-best cannot be attained in a pooling equilibrium, as no information is transmitted about ω_I and only very little about ω_E.

Remark 2.3 *Without informative cheap talk, the first-best allocation of control rights is not attainable.*[29]

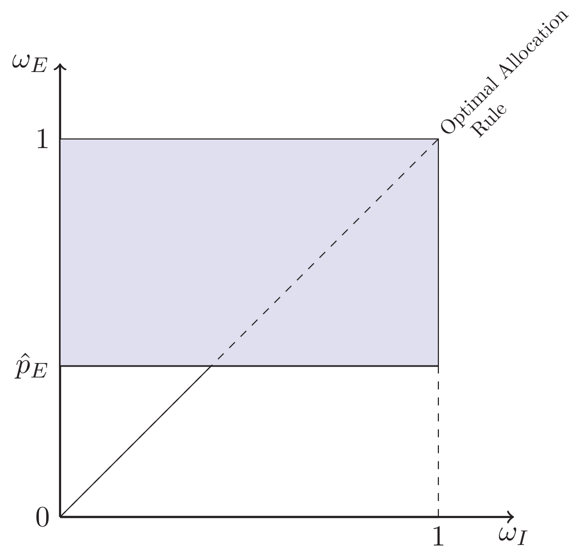

Figure 2.3 Optimal Allocation vs. Pooling Equilibria

2.4.3 Endogenous Shareholder Learning

As noted in Section 2.3, a shareholder who is fully informed about the current firm value prevents the first-best allocation of control rights whereas cheap talk is able to implement first-best. A problem arises when shareholders themselves can choose the information they obtain. In practice, when a corporate bidder aims at taking over a target company, outside experts or advisors such as investment banks and consulting firms are frequently hired to conduct a fairness opinion. The aim of such assessments is to credibly inform the shareholders about the value of the company (Kisgen, Song, et al., 2009). Another interpretation of shareholders' additional learning is that regulation forces management to provide (credible) information to shareholders. Corporate law gives shareholders the opportunity to enforce a fairness opinion and/or management disclosure (Kisgen, Song, et al., 2009; Bainbridge, 1999).

[29] We only illustrate the point graphically here because the formal proof is obvious.

Irrespective of the source of information, consider now a situation where the shareholder has observed p_E and m_I. Then, if she can freely choose the level of information about ω_I, she will always choose the fully informative signal because she faces a pure decision-theoretic problem at this stage (a formal treatment can be found in Lemma 2.1 in Appendix 2.10).

Remark 2.4 *If possible, the shareholder acquires the fully informative signal about* ω_I.

When the shareholder perfectly learns ω_I, m_I is irrelevant, and E will anticipate that the shareholder will become fully informed. From Section 2.3, we know that first-best is not attainable in this situation. Through the lens of our model, a setting in which shareholders can force management to conduct a fairness opinion or disclose additional information is welfare-destroying. Our results therefore suggest that management recommendations may suffice to overcome the informational frictions in the market for corporate control and that additional sources of information may, in fact, harm efficiency.

2.5 Extensions

We now generalize the model in two important directions. First, most companies are not owned by a single shareholder but have multiple owners. We allow for this possibility by assuming that the target firm is owned by some finite number of shareholders. It will turn out that our results remain true with any finite number of shareholders. The only difference is that there exist equilibria that exhibit coordination failures.

Second, typically, the incumbent manager of a company will enjoy private benefits B_I from remaining in charge. For instance, B_I may stem from a fixed above market wage or general benefits from being in charge (such as status, amenities, etc.). Private benefits will make the manager more reluctant to recommend a takeover and drive a wedge between the optimal allocation rule and the preferences of the incumbent. We will prove, however, that an equilibrium similar to Theorem 2.1 still exists. This equilibrium again welfare-dominates a situation with informed shareholders, provided that B_I is sufficiently small relative to I's share endowment s. In Section 2.6, we discuss how the managerial salary scheme can be adjusted to implement first-best in the presence of private benefits.

2.5.1 A Model with Multiple Shareholders and Private Benefits

The company is now owned by $j \in \{1, \dots, J\}$ initial shareholders and I. A typical shareholder j owns a fraction of s_j shares, and all shareholders jointly own $\sum_{j=1}^{J} s_j =$

$1-s>\lambda$. The incumbent still owns the remaining $s<\lambda$ shares. The game evolves as before: first, E posts a tender offer p_E to which I responds with a cheap talk message m_I. In the final stage of the game, the shareholders decide individually and simultaneously which fraction $\gamma_j \in [0,1]$ of their share endowment s_j to tender given p_E and m_I. Let T denote the total amount of shares tendered, i.e., $T \sum_{j=1}^{J} s_j \gamma_j$.

The payoff of shareholder j is composed as follows. If no takeover occurs, shareholder j will earn ω_I per share irrespective of her tendering decision. Conditional on a successful takeover, tendering γ_j of the s_j shares yields p_E per share and security benefits of ω_E on the residual fraction $1-\gamma_j$ of her share endowment. This results in the following utility of shareholder j:

$$v_j = \begin{cases} s_j\Big(\gamma_j p_E + (1-\gamma_j)\omega_E\Big), & \text{if takeover successful} \\ s_j \omega_I, & \text{otherwise.} \end{cases}$$

As noted above, besides being interested in the value of his shares, the incumbent also enjoys private benefits $B_I \geq 0$ from being in charge. B_I is common knowledge. Let $b_I \frac{B_I}{s}$ denote I's private benefit per share. We will refer to b_I as I's *bias*. The incumbent's utility is given by:

$$u_I = \begin{cases} s\omega_E, & \text{if takeover successful} \\ s\omega_I + B_I, & \text{otherwise.} \end{cases}$$

The bidder's utility is as follows:

$$u_E = \begin{cases} T(\omega_E - p_E), & \text{if takeover successful} \\ 0, & \text{otherwise.} \end{cases}$$

Strategies Given the observed tender offer p_E and the incumbent's message m_I, a (pure) strategy for shareholder j specifies a fraction γ_j of tendered shares, i.e., $\gamma_j : \mathbb{R}_+ \times M_I \to [0,1]$ where $M_I = [0,1]$ again denotes the message space. An incumbent's strategy is a mapping from the set of price offers and his type space into the message space, i.e., $m_I : \mathbb{R}_+ \times [0,1] \to [0,1]$. Finally, a (pure) strategy for the bidder $p_E : [0,1] \to \mathbb{R}_+$ specifies a tender offer for any type ω_E. We still assume that indifference on the shareholder side is broken in favor of a takeover. The solution concept remains perfect Bayesian equilibrium in pure strategies, and if necessary, we keep restricting attention to off-path beliefs satisfying the intuitive criterion by Cho and Kreps (1987). An equilibrium requires that:

1. given tender offer p_E^*, message m_I^*, and given the tendering decision of the other shareholders, γ_{-j}^*, any shareholder j chooses optimally how many shares

to tender, i.e. she chooses γ_j^* that maximizes $\mathbb{E}[v_j|p_E^*, m_I^*, \gamma_{-j}^*]$.

2. Given p_E^* and γ_j^* $(j = 1, \ldots, J)$, I chooses $m_I^* \in argmax\ \mathbb{E}[u_I|p_E^*, \omega_I, \gamma_j^*]$.
3. Given m_I^* and γ_j^* $(j = 1, \ldots, J)$, E chooses p_E^* to maximize his expected profits $\mathbb{E}[u_E|\omega_E, m_I^*, \gamma_j^*]$.
4. Whenever possible, all players update their posterior belief according to Bayes' rule.

2.5.2 Results

Fully Informed Shareholders As before, if shareholders are perfectly informed about ω_I, the first-best allocation of control rights is not attainable. Observe that in this scenario, the incumbent and thus also his bias have no influence. The only difference is at the tendering stage. Since the company is owned by multiple shareholders, it may be the case that no single shareholder holds a majority stake individually ($s_j < \lambda$ for all j). Hence, now there also exist equilibria exhibiting a coordination failure as follows: if a shareholder expects all other shareholders not to tender, her decision does not have any influence on the outcome, and thus she may as well not tender. In equilibrium, no shareholder ever tenders.[30] It is intuitive that the potential coordination failure will not improve welfare in our setting. The following proposition extends the result from Section 2.4 to the general ownership structure.

Proposition 2.3 *Suppose shareholders are perfectly informed about ω_I. Then, there is no equilibrium in which the first-best allocation is implemented.*

The same logic as in the proof of Proposition 2.1 obtains here (and the proof is thus omitted): a necessary condition for first-best is full separation on the bidder's side, but in any ex post efficient fully separating equilibrium, the bidder must gain strictly positive expected profits. Thus, the equilibrium price must be lower than the bidder type. As shareholders compare a convex combination of price and expected security benefits with firm value under incumbent management, there will always be misallocations of control.

Uninformative Cheap Talk As the manager still sends a cheap talk message, there always exist babbling equilibria. Since no information is transmitted in such equilibria, I's bias b_I again does not matter for the equilibrium outcome. b_I will, however, define a set in which babbling is the unique outcome of the cheap talk stage. Babbling equilibria will, similar to the basic model, either feature a cutoff structure

[30] This relies on the conditional form of the offer, which becomes void if a total fraction less than λ shares is tendered.

or have no takeover as the certain outcome. The next proposition describes the set of these equilibria.

Proposition 2.4 *There always exists a babbling equilibrium. In any such equilibrium,*

1. *either a takeover never occurs;*

2. *or there exists a cutoff price $\hat{p}_E < 1$ such that:*
   if $\omega_E < \hat{p}_E$, a takeover occurs with probability zero,
   if $\omega_E \geq \hat{p}_E$, E posts $\hat{p}_E$ and a takeover occurs with probability one,
   further, it holds that $T^*(\hat{p}_E) = \lambda$;

3. *or $\hat{p}_E = 1$ and a takeover occurs if and only if $\omega_E = 1$. It holds that $T^*(\hat{p}_E) \geq \lambda$.*

Proposition 2.4 shows existence of three different kinds of equilibria: First, a takeover may never occur if no shareholder individually holds a majority stake. As no shareholder is pivotal on her own, never selling any shares constitutes an equilibrium, independent of price offers and beliefs about ω_E and ω_I.

Second, there are cutoff equilibria as in Proposition 2.2. In those, shareholders jointly tender $T^* = \lambda$ shares whenever a takeover occurs. The underlying argument goes back to Bagnoli and Lipman (1988), who analyze a complete information takeover game with finitely many shareholders. The idea is that in equilibrium, whenever the price p_E lies strictly below the security benefits after a successful takeover, the gain from keeping a share is larger than from tendering if this decision does not affect the overall success of the takeover. Hence, in any pure strategy equilibrium with a takeover, every shareholder is pivotal with all the shares she tenders. If any shareholder tendered more shares, she would have a profitable deviation to tender fewer shares while still making the takeover successful. As our setting entails asymmetric information, the true security benefits are generally not known to shareholders. One can, however, easily see that whenever $p_E < \mathbb{E}[\omega_E|p_E]$, the logic by Bagnoli and Lipman (1988) applies.

As the first equilibrium type, case three only exists if no shareholder individually holds a majority stake. Then, for all $p_E < 1$, no shareholder ever tenders sufficiently many shares to make another shareholder pivotal. Thus, at any $p_E < 1$, selling no shares is a best response for shareholders. $p_E = 1$ is only posted by $\omega_E = 1$ because all other types would make strictly negative profits. As post-takeover security benefits equal the price offer, i.e., $p_E = \mathbb{E}[\omega_E|p_E] = 1$, shareholders are indifferent between any γ_j that makes the takeover succeed and therefore, $T^*(1) \in [\lambda, 1-s]$.

Informative Cheap Talk We now analyze equilibria with informative cheap talk. As the incumbent enjoys private benefits $B_I \geq 0$ from remaining in charge, I is now indifferent between a takeover and remaining in charge if $s\omega_I + B_I = s\mathbb{E}[\omega_E|p_E]$. Recalling that $b_I = \frac{B_I}{s}$, his indifferent type is then

$$\omega_I^* \max\{\mathbb{E}[\omega_E|p_E] - b_I; 0\}.$$

The intuition is the same as before: whenever $\omega_I \leq \omega_I^*$, the incumbent favors a takeover. In contrast to the basic model without bias, informative cheap talk is harder to attain. Intuitively, if the incumbent only cares about remaining in charge, independent of ω_E and ω_I, there cannot be any meaningful communication.

The following result shows that with multiple shareholders and strictly positive bias, there also exists an equilibrium with informative cheap talk in which the bidder fully reveals his type via his tender offer.

Theorem 2.2 *There exists a $\overline{b}_I > 0$ such that for all $b_I \leq \overline{b}_I$, there is an equilibrium in which E fully reveals his type by posting*

$$p_E = \begin{cases} \mathbb{E}[\omega_I|\omega_I \leq \omega_I^*(\omega_E)] + b_I, & \text{if } \omega_E \geq b_I \\ \omega_E, & \text{otherwise.} \end{cases}$$

Furthermore,

1. *if $\omega_I \leq \omega_I^*(p_E)$, then $m_I^* \in [0, \omega_I^*(p_E)]$, and a takeover occurs with probability one;*
2. *if $\omega_I > \omega_I^*(p_E)$, then $m_I^* \in (\omega_I^*(p_E), 1]$, and a takeover occurs with probability zero;*

and $T^*(m_I^*(\omega_I \leq \omega_I^*(p_E)) = \lambda$.

The statement of Theorem 2.2 is similar to Theorem 2.1. E fully reveals his type via the price offer. The incumbent sends, conditional on p_E, a binary cheap talk message in favor or against the takeover, and shareholders follow I's message in equilibrium and tender jointly as few shares as possible such that the takeover is realized.

The equilibrium only exists for small enough biases. Intuitively, if b_I grows very large (the private benefit B_I is large relative to the share endowment s), the incumbent always prefers retaining control. Hence, his message is never informative, and there is no scope to screen the bidder's type.

If the equilibrium exists, i.e., b_I is smaller than $\overline{b}_I$, there are some noteworthy differences relative to the basic model. The allocation is still determined by an incumbent's indifference type. As the incumbent is now biased against a takeover, this type has shifted downwards to $\omega_I^* = max\{\omega_E - b_I; 0\}$. As a consequence, there is an interval of bidder types $\omega_E \in [0, b_I)$ for which the incumbent never recommends a takeover. As shareholders still follow the message in equilibrium, these bidder types will never obtain control over the target company. Therefore, in equilibrium, they are indifferent between posting any price $[0, b_I)$, as all imply zero profits, and it is a best response to post the true type as tender offer. The interesting case contains the bidder types strictly larger than b_I.[31] These have, on the equilibrium path, a strictly positive takeover probability. The equilibrium price changes in two aspects. First, note that $\mathbb{E}[\omega_I|\omega_I \leq \omega_I^*(\omega_E)] = \mathbb{E}[\omega_I|\omega_I \leq \omega_E - b_I]$. Conditional on a message in favor of the takeover by the incumbent, shareholders learn that $\omega_I \leq \omega_I^* = \omega_E - b_I$, i.e., shareholders are more pessimistic about their outside option of leaving the incumbent in charge for any $\omega_E \geq b_I$. This decreases the first component of the price relative to Theorem 2.1. On the other hand, the price now includes b_I itself with an additive component. The intuition is that a large bias will make the incumbent less likely to endorse the takeover. As shareholders follow I's message in equilibrium, this makes it more difficult for the bidder to realize the takeover. As a result, he is willing to ramp up his price offer relative to $\mathbb{E}[\omega_I|\omega_I \leq \omega_E - b_I]$.

Further, and similar to the basic model, $T^*(m_I^*(\omega_I \leq \omega_I^*(p_E)) = \lambda$ such that all shareholders are pivotal with all the shares they tender. Hence, given the other shareholders' strategy, no shareholder wants to tender fewer shares, as this would make the takeover fail.

Welfare Comparison As the incumbent is biased against the takeover, first-best will generally not be implementable with informative cheap talk. We can, however, show that there is an interval of biases $[0, \bar{b}_I^{FV}]$ such that if $b_I \in [0, \bar{b}_I^{FV}]$, the equilibrium with informative cheap talk illustrated in Theorem 2.2 improves the allocation of control rights compared to a situation where 1) shareholders are not informed at all (babbling equilibrium), and 2) shareholders are fully informed (for example through endogenous learning).

Proposition 2.5 *There exists a $\bar{b}_I^{FV} > 0$ such that for all $b_I \leq \bar{b}_I^{FV}$, there is an equilibrium with informative cheap talk by the incumbent that improves expected firm value compared to*

1. *any equilibrium without (informative) communication;*
2. *any equilibrium where shareholders are fully informed about ω_I.*

Further, if b_I vanishes, expected firm value approaches first-best with informative cheap talk.

[31] If $\omega_E = b_I$, the takeover probability is exactly zero. Further, the equilibrium price is continuous and $p_E(b_I) = b_I$.

Proposition 2.5 establishes that even for a biased incumbent manager, cheap talk outperforms both equilibria with fully informed and completely uninformed shareholders. The intuition is again that in both cases, the optimal allocation is bounded away from first-best, whereas welfare in the informative cheap talk equilibrium approaches first-best as b_I converges to zero: according to Theorem 2.2, a takeover occurs if and only if $\omega_I \leq max\{\omega_E - b_I; 0\}$. As b_I converges to zero, this becomes the first-best allocation rule.

The following section gives precise solutions for the case of uniformly distributed types. It turns out that welfare with informative cheap talk dominates the other two informational regimes for a relatively large interval of biases.

2.5.3 The Uniform Case

We now provide a numerical example of our results for the uniform case. To be precise, in this subsection, we assume that ω_I and ω_E are i.i.d. random variables that are distributed according to the uniform distribution on $[0,1]$. For simplicity, we further assume that $J = 1$ and $\lambda = 1 - s$. Here, we identify welfare with ex ante firm value and do not include B_I in this welfare measure. Note, however, that if one weighs the firm value with 1 instead of s in the incumbent's payoff, it equals the welfare including B_I. The equilibrium with informative cheap talk characterized in Theorem 2.2 exists for $b_I \leq \bar{b}_I = \frac{3}{2} - \sqrt{\frac{5}{4}} \approx 0.382$. On that account, a separating equilibrium can be supported for relatively large biases. The tender offer price is then given by $p_E = \frac{1}{2}\omega_E + \frac{1}{2}b_I$. Expected welfare is $\frac{2}{3} - b_I^2$, which converges to $\frac{2}{3}$ as b_I goes to zero – the first-best firm value.[32]

We now derive the maximal bias such that informative cheap talk increases firm value. To this end, we consider the (unique)[33] equilibrium without informative cheap talk: E offers $p_E = \frac{1}{2} = \mu_I$ if $\omega_E \geq \frac{1}{2}$ and a takeover occurs; otherwise, no takeover occurs. The (highest) ex ante firm value without communication equals $[\omega_I \mathbf{1}_{\{\omega_E < \mu_I\}}] + [\omega_E \mathbf{1}_{\{\omega_E \geq \mu_I\}}] = \frac{5}{8}$, which is smaller than $\frac{2}{3} - b_I^2$ for $b_I \leq \frac{1}{\sqrt{24}} \approx 0.204$.

If the shareholder knows the current firm value, she tenders if and only if the tender offer is larger than ω_I. The (unique) equilibrium price in this setting is $p_E^* = \frac{1}{2}\omega_E$. Thus, welfare equals $[\omega_I \mathbf{1}_{\{\omega_I > \frac{1}{2}\omega_E\}}] + [\omega_E \mathbf{1}_{\{\frac{1}{2}\omega_E \geq \omega_I\}}] = \frac{5}{8}$ which is – maybe surprisingly – the same as under uninformative cheap talk. It follows that for $b_I \leq \frac{1}{\sqrt{24}}$, informative cheap talk improves welfare compared with a situation where the shareholder becomes fully informed about ω_I.

Apart from aggregate welfare considerations, the numerical example allows us to shed light on the distribution of payoffs among I, E, and the initial shareholder:

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[32] $\frac{2}{3}$ equals the expected value of the first-order statistic of two random variables distributed uniformly on the unit interval.

[33] Uniqueness stems from the fact that $\lambda = 1 - s$ and $J = 1$.

if both equilibria exist, i.e., $b_I \le \bar{b}_I$, the manager always prefers informative cheap talk compared with the babbling equilibrium. His ex ante payoff in the fully revealing equilibrium with cheap talk is $s[\omega_I \mathbf{1}_{\{\omega_I > \omega_I^*\}}] + s[\omega_E \mathbf{1}_{\{\omega_I \le \omega_I^*\}}] + \mathbb{P}(\omega_I > \omega_I^*)B_I = \frac{2}{3}s + \frac{1}{2}B_I$, which clearly exceeds his payoff for the case without cheap talk $s[\omega_I \mathbf{1}_{\{\omega_E < \mu_I\}}] + \mathbb{P}(\omega_E < \mu_I)B_I + s[\omega_E \mathbf{1}_{\{\omega_E \ge \mu_I\}}] = \frac{5}{8}s + \frac{1}{2}B_I$. Further, as the manager can only communicate if $b_I \le \bar{b}_I$, increasing his private benefits B_I and thereby b_I slightly at $\bar{b}_I$ leads to a discontinuous drop in his payoff. Hence, the manager would like to limit his private benefits of control at $\bar{b}_I$.[34] The shareholder obtains an expected payoff of $(1-s)(\frac{1}{2} + \frac{b_I}{2} - \frac{5}{4}b_I^2)$ with informative cheap talk and $\frac{1}{2}(1-s)$ without cheap talk. As a consequence, whenever cheap talk is feasible, the shareholder prefers it. The intuition behind this is that she only follows the manager's recommendation if she benefits on average. Finally, the external bidder receives $\frac{1}{8}(1-s)$ without any information provision. When the shareholder follows management's recommendation, he obtains $(1-s)(\frac{1}{6} - \frac{1}{2}b_I + \frac{1}{4}b_I^2)$. He thus prefers no information whenever $b_I > 1 - \sqrt{\frac{5}{6}} \approx 0.087$. Cheap talk is costly to the bidder for high biases because takeovers become scarce and expensive.

Even though aggregate welfare is the same without cheap talk and with a fully informed shareholder, the distribution of payoffs differs substantially. When the shareholder is fully informed, her payoff amounts to $[v] = (1-s)([\omega_I \mathbf{1}_{\{\omega_I > \frac{1}{2}\omega_E\}}] + \frac{1}{2}[\omega_E \mathbf{1}_{\{\frac{1}{2}\omega_E \ge \omega_I\}}]) = (1-s)(\frac{11}{24} + \frac{1}{2}\frac{4}{24}) = (1-s)\frac{13}{24}$. She prefers to be informed by the manager over being fully informed if $b_I \in [0.12, 0.28]$.[35] The intuition is as follows: For low values of b_I, the shareholder only receives a small part of the payoff increase created by the takeover. Increasing b_I induces the bidder to post higher prices, and the shareholder prefers cheap talk. However, if b_I becomes very large, takeovers become too scarce and full information is again preferred by the shareholder.

With a fully informed shareholder, E obtains $[u_E] = (1-s)[(\omega_E - p_E^*)\mathbf{1}_{\{\frac{1}{2}\omega_E \ge \omega_I\}}] = \frac{1}{2}(1-s)[\omega_E \mathbf{1}_{\{\frac{1}{2}\omega_E \ge \omega_I\}}] = (1-s)\frac{2}{24}$. Consequently, E prefers the manager's recommendation over the shareholder learning the current firm value if $b_I \le 0.18$. Cheap talk helps E to extract full gains of trade if $b_I = 0$. As b_I increases, however, takeovers become too scarce and he prefers the shareholder being fully informed. Observe that E always prefers an uninformed over a fully informed shareholder. Finally, in the latter case, I receives $[u_I] = s\frac{5}{8} + \frac{1}{4}B_I$, which is worse than in the other two cases. Table 1 provides an overview for all these cases.

[34] Of course, beyond $\bar{b}_I$, I's ex ante payoff is increasing in B_I again.
[35] These are rounded values.

Information	E	I	S
Full Information	$\frac{2}{24}(1-s)$	$\frac{5}{8}s+\frac{1}{4}B_I$	$\frac{13}{24}(1-s)$
Cheap Talk	$(\frac{1}{6}-\frac{1}{2}b_I+\frac{1}{4}b_I^2)(1-s)$	$\frac{2}{3}s+\frac{1}{2}B_I$	$(\frac{1}{2}+\frac{1}{2}b_I-\frac{5}{4}b_I^2)(1-s)$
No Information	$\frac{1}{8}(1-s)$	$\frac{5}{8}s+\frac{1}{2}B_I$	$\frac{1}{2}(1-s)$

Table 1: Distribution of Expected Payoffs Across Players

2.6 Managerial Compensation and Golden Parachutes

In our model, efficient management advice can only be provided during a takeover if I possesses some share endowment. One can interpret this result as an additional argument for equity compensation beyond the classical moral hazard rationale (Jensen and Meckling, 1976).

Furthermore, it is important that the manager obtains security benefits of the company after the bidder gains control over the target firm. Hence, frequently observed[36] vested share schemes can also be rationalized by our model.

Recall that $b_I = \frac{B_I}{s}$. From our results, we know that $b_I = 0$ implements the first-best control allocation and that small biases are welfare-superior to full information and no information on the shareholder side. To obtain a small b_I, one can either try to lower the private benefit from being in charge, B_I, or to increase the incumbent's share endowment s. B_I will typically not be easy to control (think of intangible benefits of control such as social status). The first-best allocation of control rights may, however, still be attainable because one can compensate the manager in case of a takeover for his loss of B_I. The practice of golden parachutes,[37] which are often subject to public criticism as they seemingly reward executives for failure, may be optimal in our model, as they enable the manager to increase welfare via his advisory role. To be precise, denote the amount the golden parachute pays in case

[36]See Edmans et al. (2017) for a recent summary of data regarding executive compensation and vesting methods.

[37]We are by no means the first to consider the problem of golden parachutes or severance pay. None of the following papers considers, however, how golden parachutes influence management's advisory role in takeovers. Eisfeldt and Rampini (2008) show how bonuses (i.e., golden parachutes) can be used to induce managers to present unfavorable news to investors leading to a capital reallocation. Bebchuk and Fried (2004) argue that golden parachutes are a sign of managerial rent extraction. Lambert and Larcker (1985) develop a model where the probability that management gives up control increases if a golden parachute is adopted. Harris (1990) shows how anti-takeover measures can increase a CEO's bargaining position in a merger. To induce the manager to sometimes give up control, golden parachutes may be necessary. Both models build on the idea that management can directly block a takeover and therefore needs to be convinced to make a takeover successful. Knoeber (1986) argues that golden parachutes can be seen as a commitment device to pay managers after takeovers and not engage in "opportunism." Almazan and Suarez (2003) show how severance pay can commit a "strong" board not to fire a CEO to induce him to take desired actions.

of a takeover by $G \in \mathbb{R}_+$. Then, I is indifferent between a takeover and no takeover if and only if

$$s\mathbb{E}[\omega_E|p_E] + G = s\omega_I + B_I,$$

and it directly follows that $G = B_I$ implements the first-best outcome. Hence, in the likely scenario that private benefits B_I of control are non-negative, golden parachutes enable the manager to fulfill his advisory role during takeovers. In our model, golden parachutes have no downside as we abstract from any moral hazard problem of the manager. Inderst and Müller (2010) show how severance pay (e.g., golden parachutes) after terminating a bad CEO's contract rewards failure and thus makes incentivizing effort more difficult. In their model, steep incentives (high equity compensation) alleviate the problem by making continuation costly for bad CEOs. In our model, equity compensation and severance pay are substitutes regarding the manager's advisory role (both a large s and G make I more willing to endorse a takeover). Hence, Inderst and Müller (2010) suggests that G should be limited and incumbent management's advisory role should be strengthened through s.[38] Finally, it is important to stress that our model provides a rationale for golden parachutes that are triggered if management is let go within a takeover process. This squares with empirical findings that, as noted in the Introduction, companies frequently adopt golden parachutes *conditional* on takeovers.

2.7 An Equivalence of Cheap Talk and Auctions

An interesting connection between auctions and cheap talk arises in our model. To see this, suppose now that there are three potential managers: two external bidders E_1 and E_2 and one unbiased incumbent manager I, the firm value under each of which is i.i.d. distributed according to some cdf F on $[0, 1]$. For ease of exposition, further suppose that $\lambda = 1 - s$ and $J = 1$.

First, suppose the company was auctioned off among the two external bidders E_1 and E_2 in a sealed-bid first-price auction such that the bidder with the higher bid receives the fraction λ of shares and thus control over the target firm. E_i's private value is ω_{E_i}, $i = 1, 2$, and the manager remains silent. Then, we know from standard auction results (see e.g., Krishna (2009)) that each bidder will bid according to

$$p^*_{E_i}(\omega_{E_i}) = \mathbb{E}[\omega_{Ej}|\omega_{Ej} \leq \omega_{E_i}], \text{ for } i \neq j.$$

Now compare this setting with our model with one bidder E_1 and a cheap talk message by the incumbent. We know from Theorem 2.1 that there is an equilibrium

[38] To analyze a "complete" model with takeovers and managerial private information and moral hazard seems an interesting avenue for future research and may provide clear answers.

where E_1 bids according to

$$p^*_{E_1}(\omega_{E_1}) = \mathbb{E}[\omega_I | \omega_I \leq \omega_{E_1}],$$

and one can immediately see that the bid is the same as if the external bidder faced a competitor from outside the target firm. In both cases, the good is allocated to the potential manager (E_1, E_2 or I) with the higher type. It follows that the expected firm value in our model with a single bidder facing an incumbent manager who sends a cheap talk message is the same as if the allocation mechanism was a first-price auction among two external bidders. Further, by revenue equivalence, the same holds true if we substitute the first-price auction with any other standard auction format that yields the same allocation rule and gives the lowest type the same expected utility as the first-price auction (see e.g., Krishna (2009)). Of course, this relies on all potential managers having i.i.d. types. Hence, our model shows that the competition induced by a simple cheap talk message by the incumbent is as powerful (with respect to allocative efficiency) as bidding competition.

Interestingly, as the incumbent has the toehold s in our model, Burkart (1995) shows that if he gave a bid, he might overbid. This is why a counterbid by the incumbent may differ from a cheap talk message by the incumbent in terms of allocative efficiency.

2.8 Empirical Predictions

In our model, the incumbent's bias against a takeover is given by the difference of private benefits of remaining in charge minus the golden parachute that is triggered upon CEO replacement during a takeover, divided by the incumbent's share endowment, formally

$$\frac{B - G}{s}. \tag{2.8}$$

According to (2.8) and provided that $G \leq B$, the takeover premium should decrease with the adoption of golden parachutes. Further, our model predicts that the success probability increases with a golden parachute. Both results are confirmed by the empirical literature (Hartzell et al., 2004; Fich et al., 2011; Qiu et al., 2014). Bebchuk et al. (2014) also find a positive correlation of takeover likelihood and the adoption of golden parachutes. In line with our model, they show that the increase in takeover probability is due to management's increased incentives for takeovers. In contrast to most of the literature, they find a positive effect of golden parachutes on acquisition premia. Particularly related to our results are Fich et al. (2013) who investigate effective golden parachutes, i.e., the size of the golden parachute net of future lost benefits of the CEO due to the takeover. This comes closest to our measure of alignment. They confirm our theoretical findings: the larger the golden parachute, the smaller is the taget shareholders' takeover premium and the larger is the takeover probability. Further, acquirers' expected profits are shown to be increasing in the relative size of the golden parachute, which is in line with our results. This stems from the fact that, in our model, a golden parachute outweighing the CEO's private benefits enables the bidder to extract all gains of the takeover on the shares tendered to him.

Since the CEO is retaining his shares in our model, the control rights of his shares do not matter. Thus, the dollar value of the inside stock ownership relative to the private benefits of remaining in charge are essential and we predict the takeover probability to be increasing and the takeover premium to be decreasing in the dollar amount of stock ownership. Up to now, the empirical literature has focused on relative ownership as a proxy for CEO control rights and produced mixed, often insignificant results (Fich et al., 2011; Fich et al., 2013; Qiu et al., 2014). An interesting avenue for future research may be investigating the effect of share and option value relative to the private benefits lost due to the takeover with particular focus on vesting equity compensation to exclude the possibility that shares are traded by the CEO during the takeover.

From the empirical literature, one can infer that CEO's incentives clearly matter for takeover outcomes. The CEO's net bias against a takeover increases takeover premium and decreases takeover likelihood, as our model predicts. The central question remains whether a CEO's net bias impacts takeover outcomes via our proposed communication channel, or rather due to the possibility that managers use takeover defense tactics, such as poison pills (Lambert and Larcker, 1985), or a mix of the two. Since incumbent managers will find it difficult to remain in charge if shareholders have the opinion that management grossly acts against shareholder interest. If managers use takeover defense tactics against the will of shareholders or deny merger negotiations, they open themselves up for proxy battles. The takeover of BEA Systems, Inc. by Oracle in 2007/08 gives an example of such a scenario. Here, activist investor and large shareholder of BEA Systems, Carl Icahn, threatened a proxy fight to replace management if it did not accept the offer. In our model with private, insider information, shareholders agree with management given their information set, and it would be an interesting direction for future empirical research to investigate the precise channels by which management affects takeovers. One first step would be to study the effect of golden parachutes in a subsample of takeovers in which no takeover defense tactics were at management's disposal.

2.9 Concluding Remarks

We investigate the optimal control allocation in corporate takeovers. In our model, a bidder posts a tender offer and the incumbent manager reacts by sending a cheap talk recommendation to the shareholders. We show that with an informative message by the (potentially biased) manager, there exists an equilibrium in which the bidder fully reveals his type and that, for vanishing bias, the efficient control allocation is implemented. In practice, takeovers often involve costly provision of fairness opinions by outside parties such as investment banks. In our model, initial shareholders always prefer more information about the firm value than management is willing to provide. We show that the strategic and only partially informative recommendation by the manager is superior to a fully informative signal about the firm value under current management. This gives rise to two policy implications.

First, managerial salary is crucial to enable informative management recommendations. Our model rationalizes several features prevalent in reality: abstracting from moral hazard, steep incentives for the manager via equity compensation are useful, as they enable communication in our model. Further, retention periods for managers' equity position after a takeover benefit the incumbent's capability to credibly communicate with shareholders. In our model, it is crucial for effective strategic communication that the manager's bias (private benefit per share) of remaining in charge is sufficiently small. Golden parachutes, often criticized, may actually be beneficial for allocative efficiency because they reduce management's bias and can strengthen its advisory role. Of course, they should be contingent on a successful takeover and not be triggered when management is replaced due to poor performance.

Second, legally prescribed fairness opinions and mandatory disclosure are generally not efficient, as they can prevent value-increasing takeovers. As shareholders always prefer more information, they are inclined to force management to disclose additional information to increase their rents from a successful takeover. Similar to Grossman and Hart (1980b), who advocate (partial) exclusion of shareholders from post-takeover security benefits, excluding shareholders from obtaining excessive information may thus increase allocative efficiency.

2.10 Appendix

Proofs

Proof of Proposition 2.1. Step 1: If E does not fully separate in an equilibrium, then first-best is not achieved in this equilibrium.

Suppose, on the way to a contradiction that this was not true, i.e. there exist some bidder types ω_E, ω'_E with $\omega_E > \omega'_E$ but $p_E(\omega_E) = p_E(\omega'_E)$. By the common support assumption, there exists an open interval of incumbent types $(\underline{\omega}_I, \overline{\omega}_I) \neq \emptyset$ such that $(\underline{\omega}_I, \overline{\omega}_I) \subset (\omega'_E, \omega_E)$. For all $\omega_I \in (\underline{\omega}_I, \overline{\omega}_I)$, first-best requires that a takeover does not occur at ω'_E, but at ω_E. But since $p_E(\omega_E) = p_E(\omega'_E)$, either a takeover occurs at both types or at none. Hence, whenever the bidder does not fully separate, first-best cannot be achieved.

Step 2: If E fully separates, first-best requires zero profits for all bidder types.

Whenever E fully reveals his type, the shareholder prefers a takeover whenever there is some $\gamma \geq \frac{\lambda}{(1-s)} > 0$ such that $\gamma p_E + (1-\gamma)\omega_E \geq \omega_I$. This coincides with the optimal allocation rule (that a takeover occurs if and only if $\omega_E \geq \omega_I$) if and only if $p_E = \omega_E$. Of course, $p_E = \omega_E$ implies zero profits for E.

Step 3: Suppose an equilibrium was fully separating and implements first-best, then there is a non-degenerate interval of bidder types with a profitable deviation.

Suppose all bidder types make zero profits, so $\omega_E = p_E$ (strictly negative profits can of course never be part of an equilibrium). Then, any type $\omega_E > 0$ could deviate to some type $\omega''_E \in (0, \omega_E)$ and the takeover probability at $p_E = \omega''_E$ is $F_I(\omega''_E) > 0$. $F_I(\omega''_E)$ is strictly positive because first-best requires that a takeover occurs for all $\omega_I \in [0, \omega''_E)$. Therefore, the proposed deviation yields strictly positive profits of $[\omega_E - \omega''_E]\ F_I(\omega''_E) > 0$. Hence, we obtain a contradiction and can conclude that first-best is not attainable with fully informed shareholders.

□

Proof of Theorem 2.1. We start by establishing that given the incumbent sends a cheap talk message according to

$$m_I \in \begin{cases} [0, \omega_I^*], & \text{if } \omega_I \leq \omega_I^* \\ (\omega_I^*, 1], & \text{otherwise} \end{cases}$$

and the shareholder follows this message, the bidder finds it indeed optimal to post $p_E^* = \mathbb{E}[\omega_I | \omega_I \leq \omega_I^*(\omega_E)]$. Afterwards, we verify that, given m_I^*, p_E^* and her posteriors, the shareholder optimally tenders $\gamma^* = \frac{\lambda}{(1-s)}$ shares if $m_I^* \in [0, \omega_I^*]$ and zero otherwise.

In $t = 3$, as she plays a pure strategy, given any p_E, m_I and the respective posteriors of ω_I, ω_E, a takeover occurs with probability one or zero: $\mathbb{P}(\text{takeover}|p_E, m_I) \in \{0, 1\}$. Hence, the incumbent can send at most two-non outcome equivalent messages.

Step 0: Single crossing and I's equilibrium message

In $t = 2$, for a fixed p_E and posterior of ω_E, I's utility from no takeover is $s\omega_I$ and thus strictly increasing in ω_I. His expected utility from a takeover is $s\mathbb{E}[\omega_E|p_E]$ and thus independent of ω_I. Therefore, the difference in his expected utility from sending a message m_I that induces a takeover and a message m_I' that does not is given by $\mathbb{E}[u_I|p_E, m_I, \omega_I] - \mathbb{E}[u_I|p_E, m_I', \omega_I] = s\mathbb{E}[\omega_E|p_E] - s\omega_I$ and thus strictly decreasing in ω_I. By this single crossing argument, all types below $\omega_I^* = \mathbb{E}[\omega_E|p_E]$ prefer a takeover. In the conjectured equilibrium, the shareholder always follows the incumbent's message. Hence, I has no incentive to deviate as he obtains his maximal payoff.

Step 1: Necessary condition for a fully separating bidder strategy

Suppose the bidder plays a fully separating strategy, i.e. p_E is strictly increasing in ω_E (and thus invertible). As noted in the proof of Proposition 2.1, in any fully separating equilibrium $p_E < \omega_E$ holds and thus $\gamma^* = \frac{\lambda}{1-s}$ independent of p_E (below, we show this more formally). Then, given his true type ω_E, the bidder's optimal bid p is given by

$$\underset{p \in \mathbb{R}_+}{argmax} \;\; F_I[\omega_I^*(p_E^{-1}(p)] \; \lambda \; [\omega_E - p].$$

The first-order condition (FOC) is

$$f_I[\omega_I^*(p_E^{-1}(p)] \; \omega_I^{*'}(p_E^{-1}(p)) \; p_E^{-1}(p)' \; [\omega_E - p] - F_I[\omega_I^*(p_E^{-1}(p))] = 0.$$

Observe that p_E is strictly increasing and it follows that $\omega_I^* = [\omega_E|p_E] = \omega_E$. Further, at the equilibrium bid $p = p_E(\omega_E)$, this can be rewritten as the following

ODE:

$$p'_E(\omega_E) = \frac{f_I[\omega_I^*(\omega_E)]}{F_I[\omega_I^*(\omega_E)]}\Big(\omega_E - p_E(\omega_E)\Big) = \frac{f_I(\omega_E)}{F_I(\omega_E)}\Big(\omega_E - p_E(\omega_E)\Big). \tag{2.9}$$

Notice that equation (2.9) is reminiscent to the symmetric two player first-price auction where both players have i.i.d. private values distributed according to F_I (for comments on the relation of our results to auction theory, we refer to Section 2.7). It can be shown that the general solution to (2.9) is given by[39]

$$p_E(\omega_E) = \frac{\int_0^{\omega_E} f_I(z)zdz + C}{F_I(\omega_E)}, \tag{2.10}$$

where C is a constant that pins down the solution depending on the initial value. As the lowest bidder type $\omega_E = 0$ can only bid zero in equilibrium, we know that $C = 0$. Hence,

$$p_E^*(\omega_E) = \frac{\int_0^{\omega_E} f_I(z)zdz}{F_I(\omega_E)} = \mathbb{E}[\omega_I|\omega_I \leq \omega_E].$$

Step 2: Sufficiency

We now show that the bidder's objective function is concave evaluated at the price function derived above and that any bidder type ω_E optimally chooses $p = p_E^*(\omega_E)$, i.e. $p_E^*(\omega_E)$ indeed constitutes an equilibrium price function. The objective of the bidder (up to the amount of shares he acquires that is independent of p_E), evaluated at $p_E^*(\omega_E)$ becomes

$$F_I[p_E^{-1}(p)]\ [\omega_E - \frac{\int_0^{p_E^{-1}(p)} \omega_I f_I(\omega_I)d\omega_I}{F_I[p_E^{-1}(p)]}] = \omega_E\ F_I[p_E^{-1}(p)] - \int_0^{p_E^{-1}(p)} \omega_I f_I(\omega_I)d\omega_I. \tag{2.11}$$

To see that it is indeed optimal to post $p = p_E^*(\omega_E)$, denote $\hat{\omega}_E := p_E^{*-1}(p)$ such that the objective function becomes

$$\omega_E\ F_I[\hat{\omega}_E] - \int_0^{\hat{\omega}_E} \omega_I f_I(\omega_I)d\omega_I.$$

Taking the derivative w.r.t. $\hat{\omega}_E$ yields

$$f_I(\hat{\omega}_E)\ [\omega_E - \hat{\omega}_E],$$

[39] Applying Leibniz's integral rule and taking the derivative with respect to ω_E yields $p'_E(\omega_E) = \frac{f_I(\omega_E)\omega_E F_I(\omega_E) - \left(\int_0^{\omega_E} f_I(z)zdz + C\right) f_I(\omega_E)}{F^2(\omega_E)}$ which can be written as $\frac{f_I(\omega_E)\omega_E}{F_I(\omega_E)} - \frac{f_I(\omega_E)}{F^2(\omega_E)}\left(\int_0^{\omega_E} f_I(z)zdz + C\right)$. Comparing (2.9) with (2.10) shows the claim.

which is zero at $\hat{\omega}_E = \omega_E$, strictly positive whenever $\hat{\omega}_E < \omega_E$ and strictly negative for $\hat{\omega}_E > \omega_E$. Hence, the bidder indeed finds it optimal to post $p_E^*(\omega_E)$ given the other players expect him to play $p_E^*(\omega_E)$.

Step 3: Shareholder does sell after $(p_E^*, m_I^*(\omega_I \leq \omega_I^*))$

For p_E^* and $m_I^*(\omega_I \leq \omega_I^*)$, it has to hold that there is a $\gamma \geq \frac{\lambda}{1-s}$ such that

$$\gamma p_E^*(\omega_E) + (1-\gamma)\mathbb{E}[\omega_E | p_E^*(\omega_E)] \geq \mathbb{E}[\omega_I | \omega_I \leq \omega_I^*(\omega_E)].$$

Plugging in p_E^* and ω_I^*, this becomes

$$\gamma \mathbb{E}[\omega_I | \omega_I \leq \omega_E] + (1-\gamma)\omega_E \geq \mathbb{E}[\omega_I | \omega_I \leq \omega_E],$$

which holds true for any $\gamma \in [0,1]$ since $\mathbb{E}[\omega_I | \omega_I \leq \omega_E] < \omega_E$ by full support.

Step 4: Shareholder does not sell after $(p_E^*, m_I^*(\omega_I > \omega_I^*))$

For p_E^* and $m_I^*(\omega_I > \omega_I^*)$, there is no $\gamma \geq \frac{\lambda}{1-s}$ such that

$$\gamma p_E^*(\omega_E) + (1-\gamma)\mathbb{E}[\omega_E | p_E^*(\omega_E)] \geq \mathbb{E}[\omega_I | \omega_I > \omega_I^*(\omega_E)].$$

To see this, plug in p_E^* and the latter inequality becomes

$$\gamma \mathbb{E}[\omega_I | \omega_I \leq \omega_E] + (1-\gamma)\omega_E \geq \mathbb{E}[\omega_I | \omega_I > \omega_E].$$

The right-hand side is strictly larger than the left-hand side by the full support assumption. Hence, the shareholder does not want to sell *any amount of shares* if current management does not recommend to do so.

Step 5: Shareholder does not sell more than $\gamma^* = \frac{\lambda}{1-s}$ shares

Suppose this was not true, and she sells, after observing p_E^* and $m_I^*(\omega_I \leq \omega_I^*)$, a fraction of $\hat{\gamma} > \gamma^* = \frac{\lambda}{1-s}$. It must then hold that

$$\hat{\gamma} p_E^*(\omega_E) + (1-\hat{\gamma})\omega_E \geq \frac{\lambda}{1-s} p_E^*(\omega_E) + (1 - \frac{\lambda}{1-s})\omega_E.$$

As $p_E^* < \omega_E$, the left-hand side is strictly smaller than the right hand-side. Thus, the inequality is violated and we can conclude that $\gamma^* = \frac{\lambda}{1-s}$ whenever a takeover occurs.

Step 6: Individual rationality

Since $p_E^*(\omega_E) = \mathbb{E}[\omega_I|\omega_I \leq \omega_E] < \omega_E$ implies strictly positive expected profits for $\omega_E > 0$ and zero for $\omega_E = 0$, $p_E^*(\omega_E)$ is individually rational.

Step 7: There are no profitable deviations to prices not played on the equilibrium path.

As $F_I(p_E^*(1)) = 1$, a takeover occurs with certainty when the bidder posts the highest equilibrium price. Posting any price above $p_E^*(1)$ can thus never be profitable as it only increases the costs of a takeover. Further, as $p_E^*(0) = 0$ and $p_E \in \mathbb{R}_+$, there are no downward deviations to off-path prices.

□

Proof of Proposition 2.2. We want to establish that, in any babbling equilibrium, there exists a single price such that a takeover occurs with certainty at this price and that all types above this price post it. We perform the proof in four steps.

Step 1: If there is a $p_E < 1$ such that all $\omega_E \geq p_E$ post p_E and $\gamma^*(p_E) \geq \frac{\lambda}{(1-s)}$, then $\gamma^*(p_E) = \frac{\lambda}{(1-s)}$.

Suppose, on the way to a contradiction, this was not true, i.e. $\exists p_E < 1$ such that $\gamma^*(p_E) > \frac{\lambda}{(1-s)}$ and all $\omega_E \geq p_E$ post p_E. Then, $\mathbb{E}[\omega_E|p_E] > p_E$ by full support. As a consequence, the shareholder could lower γ^* to $\gamma'\gamma^* - \epsilon$ for an $\epsilon > 0$ such that $\gamma' \geq \frac{\lambda}{(1-s)}$ still holds. As $\mathbb{E}[\omega_E|p_E] > p_E$, this is a strictly profitable deviation.

Step 2: $\exists p_E < 1$ such that $\gamma^*(p_E) \geq \frac{\lambda}{(1-s)}$.

As I does not provide any information, the shareholder's tendering decision is

$$\gamma p_E + (1-\gamma)\mathbb{E}[\omega_E|p_E] \geq \mu_I, \tag{2.12}$$

for $\gamma \geq \frac{\lambda}{(1-s)}$ to make the takeover successful. From the full support assumption, we know that $\mu_I < 1$. Now suppose, on the way to a contradiction, there is an equilibrium where no takeover occurs for all bidder types. In this equilibrium, all bidder types post prices $p_E < \mu_I$ as otherwise a takeover would occur. There are now two possibilities: after some deviation to $p'_E \in [\mu_I, 1)$, either off-path beliefs yield $\mathbb{E}[\omega_E|p'_E] \geq p'_E$ or $\mathbb{E}[\omega_E|p'_E] < p'_E$. In the former case, the shareholder would tender a fraction $\frac{\lambda}{1-s}$ (or any $\gamma \geq \frac{\lambda}{1-s}$ in case of strict inequality) of her shares. Any bidder type $\omega_E > p'_E$ makes strictly positive profits by deviating to p'_E as opposed to zero on the proposed equilibrium path.

If off-path beliefs are such that $\mathbb{E}[\omega_E|p'_E] < p'_E$, then the shareholder optimally tenders (as $p'_E \geq \mu_I$) all of her shares and the takeover succeeds. Again this is a profitable deviation for $\omega_E > p'_E$. This yields the contradiction. It is then clear that there exists at least one price $p_E < 1$ such that a takeover occurs with probability one, i.e. $\gamma^*(p_E) \geq \frac{\lambda}{(1-s)}$. Denote $\hat{p}_E$ as the minimal price such that the takeover succeeds. In any equilibrium, $\hat{p}_E$ exists as we have established that there is some price after which a takeover occurs. Since there is no openess problem, $\hat{p}_E$ has to exist.

Step 3: All types $\omega_E \geq \hat{p}_E$ post $\hat{p}_E$.

We show that there is no price $p'_E > \hat{p}_E$ such that some bidder type posts p'_E. If this was true, bidder types need to be compensated by receiving a larger fraction of shares, i.e. we need $\gamma^*(p'_E) > \gamma^*(\hat{p}_E) \geq \frac{\lambda}{(1-s)}$. Suppose this was the case. It follows that $p'_E = \mathbb{E}[\omega_E|p'_E]$ because if it were true that $p'_E < \mathbb{E}[\omega_E|p'_E]$ and $\gamma^*(p'_E) > \frac{\lambda}{(1-s)}$, the shareholder would have a profitable deviation to tendering fewer shares but still making the takeover successful. Since $p'_E = \mathbb{E}[\omega_E|p'_E]$ holds, one can infer that $p'_E = \omega_E$. The shareholder's decision becomes $p'_E > \mu_I$ and they may tender a fraction larger than $\frac{\lambda}{(1-s)}$. This, however, yields zero profits for E who has now an incentive to deviate and post the price $\hat{p}_E$. Hence, all types above $\hat{p}_E$ post $\hat{p}_E$.

Step 4: For all $p_E < \hat{p}_E$, no takeover occurs.

Suppose this was not true, i.e. $\exists p_E < \hat{p}_E$ and $\gamma^* \geq \frac{\lambda}{1-s}$ at p_E. Then, all types above $\hat{p}_E$ would deviate to p_E.

$\square$

Proof of Proposition 2.4. As we consider babbling equilibria, suppose $m_I^*(p_E)$ is uninformative for all $p_E \in \mathbb{R}_+$.

Step 1: Suppose $s_j < \lambda, \forall j$. Then, there always exists an equilibrium in which no takeover ever occurs.

We show by construction that the following equilibrium always exists provided no shareholder is pivotal on her own.

1. $\gamma_j^*(p_E, m_I) = 0, \forall j, p_E, m_I,$
2. $p_E^* = 0, \forall \omega_E,$

3. $m_I^* = 1, \forall \omega_I, p_E$.

Given $\gamma_j^*(p_E, m_I) = 0 \; \forall j, p_E, m_I$, no shareholder j has an incentive to deviate as she cannot induce a takeover unilaterally. And as $\gamma_j^* = 0$ independent of m_I and p_E, the incumbent knows that shareholders will not react on his message and therefore it is optimal for him to send an uninformative message e.g. $m_I^* = 1$ for all ω_I.

As all prices lead to no takeover and thus zero profits, any bidder type finds it optimal to post, for example, $p_E^* = 0$. Off-path beliefs regarding ω_I and ω_E are irrelevant given the coordination failure.

Step 2: There exists an equilibrium with a cutoff price $\hat{p}_E < 1$ such that:
if $\omega_E < \hat{p}_E$, a takeover occurs with probability zero;
if $\omega_E \geq \hat{p}_E$, E posts $\hat{p}_E$ and a takeover occurs with probability one.
Finally, it holds that $T^*(\hat{p}_E) = \lambda$.

Let m_I^* be uninformative w.r.t. ω_I. Further, there is a price $\hat{p}_E \in (0, 1)$ such that all shareholders tender $\gamma_j^* = \gamma^* = \frac{\lambda}{1-s}$ whenever $p_E \geq \hat{p}_E$. For $p_E < \hat{p}_E$, shareholders tender zero shares. Let $\hat{p}_E$ be the price that makes shareholders exactly indifferent between tendering and not tendering given the on-path expected posterior bidder type, i.e.

$$\frac{\lambda}{1-s}\hat{p}_E + (1 - \frac{\lambda}{1-s})[\omega_E | \omega_E \geq \hat{p}_E] = \mu_I.$$

This equilibrium is, for instance, supported by an off-path belief yielding posterior expected type bidder type of $\mathbb{E}[\omega_E | \omega_E \leq p_E]$ for $p_E < \hat{p}_E$ and of $\mathbb{E}[\omega_E | \omega_E \geq p_E]$ for $p_E > \hat{p}_E$.

By their symmetric tendering strategy $\gamma^* = \frac{\lambda}{1-s}$, each shareholder is pivotal at any $p_E \geq \hat{p}_E$. Further, at $\hat{p}_E$, each shareholder is indifferent between tendering γ^* shares and not tendering thereby letting the takeover fail. Hence, it is (weakly) optimal for shareholders to tender exactly a fraction of $\frac{\lambda}{1-s}$.

For any $p_E > \hat{p}_E$, any shareholder strictly prefers a takeover to occur and tendering at least γ^* shares. No shareholder has an incentive to tender more than γ^* shares because according to above off-path beliefs: $\mathbb{E}[\omega_E | \omega_E \geq p_E]$ for $p_E > \hat{p}_E$, and expected security benefits strictly exceed the price.[40] As $\sum_j^J s_j = 1 - s$, it follows that $T^* = \sum_j^J s_j \gamma_j^* = \lambda$.

For E, deviating to a price above $\hat{p}_E$ yields to a purchase of λ shares with certainty but at a higher cost. Deviating to a price smaller than $\hat{p}_E$ yields no takeover and zero profits. Hence, E does not want to deviate.

[40] Except for $p_E = 1$ at which E makes at most zero profits. Hence, this can never be a profitable deviation.

Step 3: Suppose $s_j < \lambda$ for all $j \in \{1, \ldots, J\}$. Then, there is an equilibrium where $p^*_E(\omega_E = 1) = 1$ and $\omega_E = 1$ is the only bidder type who secures a takeover. Further, $T^*(p^*_E(1)) \geq \lambda$.

Suppose $\gamma^*_j(p_E) = 0$ for all $p_E < 1$ and $\gamma^*_j(p_E = 1) = \frac{\lambda}{1-s}$ for all $j = 1, \ldots, J$. Further suppose that $p^*_E(\omega_E) = 0$ for all $\omega_E < 1$ and $p^*_E(\omega_E = 1) = 1$. In the conjectured equilibrium, a takeover occurs only after $p^*_E = 1$. Any $T^*(p^*_E = 1) \geq \lambda$ can be supported in equilibrium because $p_E = \omega_E = 1$ and shareholders are thus indifferent between security benefits after a successful takeover and the tender price. If a shareholder was pivotal at $p^*_E = 1$, i.e. she could block the takeover by not tendering she would refrain from doing so as $\mu_I < 1 = p_E = \omega_E$ by the full support assumption. Therefore, $T^*(p^*_E(1)) \geq \lambda$.

No bidder type $\omega_E < 1$ has an incentive to deviate to $p_E = 1$ as this would imply strictly negative profits. Independent of off-path beliefs, it is optimal for any shareholder not to tender after any price $p_E < 1$ because she is not pivotal ($s_j < \lambda$ for all $j \in \{1, \ldots, J\}$). Bidder type $\omega_E = 1$ does not want to deviate downwards as this would also imply zero profits.

Step 4: In any equilibrium in which a takeover occurs with non-zero probability, there exists a unique price $\hat{p}_E \leq 1$ such that $\mathbb{P}[takeover|\hat{p}_E] = 1$.

Suppose, on the way to a contradiction, this was not the case, i.e., there are at least two prices $\hat{p}_E \neq p'_E$ s.t. $\mathbb{P}[takeover|\hat{p}_E] = \mathbb{P}[takeover|p'_E] = 1$. W.l.o.g. assume $\hat{p}_E < p'_E$. Then, for bidder types that post p'_E on the equilibrium path, it must hold that $T^*(p'_E) > T^*(\hat{p}_E) \geq \lambda$ as otherwise p'_E implies higher costs but leaves the takeover probability and the amount of shares acquired constant.

For $T^*(p'_E) > \lambda$ to be part of an equilibrium and conditional on making the takeover successful, shareholders must be indifferent between selling and keeping their shares at p'_E, i.e. $p'_E = \mathbb{E}[\omega_E|p'_E]$ must hold true. Otherwise, if $p'_E < \mathbb{E}[\omega_E|p'_E]$, $T^*(p'_E)$ cannot be an equilibrium object because any shareholder tendering a positive amount would sell less shares to enjoy the larger security benefits and still making the takeover succeed. By the full support assumption and incentive compatibility, $p'_E = \mathbb{E}[\omega_E|p'_E]$ is only possible if type $\omega_E = p'_E$ alone posts p'_E. But this implies zero profits, so this type has a profitable deviation to $\hat{p}_E$.

Step 5: All types $\omega_E \geq \hat{p}_E$ post $\hat{p}_E$.

Since there is a unique price on the equilibrium path that leads to a takeover, the only other possibility is that these types post a price that does not realize a takeover.

This, however, would imply zero profits and is therefore no profitable deviation.

Step 6: All $\omega_E < \hat{p}_E$ post a price that does not realize a takeover.

Posting $p_E \geq \hat{p}_E$ implies strictly negative profits. Any $p_E < \hat{p}_E$ cannot yield $T^*(p_E) \geq \lambda$ as otherwise $\hat{p}_E$ would not be the unique price after which a takeover is implemented.

Step 7: $T^*(\hat{p}_E) = \lambda$ for $\hat{p}_E < 1$.

Suppose not. However, we know that $\hat{p}_E$ is unique and that all $\omega_E \geq \hat{p}_E$ post $\hat{p}_E$ on the equilibrium path. Hence, $\mathbb{E}[\omega_E|\hat{p}_E] > \hat{p}_E$ for all $\hat{p}_E < 1$. Thus, if $T^*(\hat{p}_E) > \lambda$, any shareholder could profitably deviate and tender strictly less shares but make the takeover still succeed.

□

Proof of Theorem 2.2. We want to establish that the following constitutes an equilibrium:

1. The bidder fully reveals ω_E via p_E^*, where

$$p_E^* = \begin{cases} \mathbb{E}[\omega_I|\omega_I \leq \omega_I^*(\omega_E)] + b_I, & \text{if } \omega_E \geq b_I \\ \omega_E, & \text{otherwise.} \end{cases}$$

2. Given p_E^*, the incumbent's belief assigns probability one to $\omega_E = p_E^{*-1}(p_E(\omega_E)))$. Hence, $\omega_I^* = max\{\omega_E - b_I; 0\}$ and I sends

$$m_I \in \begin{cases} [0, \omega_I^*], & \text{if } \omega_I \leq \omega_I^* \\ (\omega_I^*, 1], & \text{otherwise.} \end{cases}$$

3. Given p_E^* and m_I^*, shareholder j assigns probability one to $\omega_E = p_E^{*-1}(p_E(\omega_E)))$ and updates his belief about the incumbent's type conditional on m_I^* to $f_I(\omega_I|\omega_I \leq \omega_I^*)$ and $f_I(\omega_I|\omega_I > \omega_I^*)$, respectively. Whenever $m_I^* \in [0, \omega_I^*]$, then $\sum_j^J \gamma_j^* s_j = \lambda$. If $m_I^* \in (\omega_I^*, 1]$, then $\gamma_j^* = 0$ for all j.

4. Off-path beliefs by incumbent and shareholders after some price offer p_E that is not played on the equilibrium path are restricted to those surviving the intuitive criterion by Cho and Kreps (1987).

In $t = 3$, as shareholders play pure strategies, given any p_E, m_I and the respective posteriors of ω_I, ω_E, a takeover occurs with probability one or zero: $\mathbb{P}(\text{takeover}|p_E, m_I) \in \{0, 1\}$. Hence, the incumbent can send at most two-non outcome equivalent messages.

In $t = 2$, for a fixed p_E and posterior of ω_E, the incumbent's utility from no takeover is $s\omega_I + B_I$ and thus strictly increasing in ω_I. His expected utility from a takeover is $s\mathbb{E}[\omega_E|p_E]$ and thus independent of ω_I. Therefore, the difference in his expected utility from sending a message m_I inducing a takeover and a message m_I' not inducing a takeover is given by $\mathbb{E}[u_I|p_E, m_I, \omega_I] - \mathbb{E}[u_I|p_E, m_I', \omega_I] = s\mathbb{E}[\omega_E|p_E] - s\omega_I - B_I$ and thus strictly decreasing in ω_I. All types above ω_I^* prefer keeping control over the company. In the conjectured equilibrium, shareholders always follow the incumbent's message. Hence, he has no incentive to deviate as he obtains his maximal payoff.

Now consider $t = 1$ and the bidder's choice of p_E. For ease of exposition, we start by solving the bidder's problem for the special case of $J = 1$ and $\lambda = 1 - s$. Hence, a shareholder tenders all of her shares if and only if $p_E \geq \mathbb{E}[\omega_I|p_E, m_I(p_E)]$. By restricting attention to $J = 1$ and $\lambda = 1 - s$, we can focus on E's equilibrium price and leave the shareholders' tender weights γ_j aside. Afterwards we generalize our proof.

Step 1: Necessary condition for a fully separating bidder strategy

Suppose the bidder plays a fully separating strategy p_E, i.e. p_E is strictly increasing in ω_E (and thus invertible). In any fully separating equilibrium, $\gamma^* = \frac{\lambda}{1-s}$ must hold. The reason is that, as in the case without bias, the equilibrium has to entail $p_E^*(\omega_E) < \omega_E$. To see this, recall that in the conjectured equilibrium, all types larger than b_I have a positive takeover probability. Thus, all bidder types $\omega_E \geq b_I$ can imitate the equilibrium price offer by some type $\omega_E' \in [b_I, \omega_E)$ yielding a profitable deviation. Therefore, in any fully separating equilibrium, $p_E^*(\omega_E) < \omega_E$ must hold. Hence, if $\gamma^* > \frac{\lambda}{1-s}$, the shareholder has a profitable deviation to tender fewer shares, still making the takeover possible and gain on the expected increase in firm value.

Let ω_E be the bidder's true type. As γ^* is independent of p_E, the bidder's optimal bid price p is given by

$$\underset{p \in \mathbb{R}_+}{argmax} \;\; F_I[\omega_I^*(p_E^{-1}(p)] \; \lambda \; [\omega_E - p],$$

where $\omega_I^* = \omega_E - b_I$ for $\omega_E \geq b_I$ and zero, otherwise.

Suppose $\omega_E \geq b_I$. Replicating the same steps as in the proof of Theorem 2.1 (with $b_I = 0$) yields

$$p'_E(\omega_E) = \frac{f_I(\omega_E - b_I)}{F_I(\omega_E - b_I)}\Big(\omega_E - p_E(\omega_E)\Big). \tag{2.13}$$

It can be shown that the general solution to (2.13) is given by

$$p_E^*(\omega_E) = \frac{\int_{b_I}^{\omega_E} f_I(z - b_I)zdz + C}{F_I(\omega_E - b_I)}, \tag{2.14}$$

where $C = 0$ in equilibrium because the type $\omega_E = b_I$ has a takeover probability of zero.

Observe that we can further rewrite the price function stated in (2.14):

$$\begin{aligned}
&\frac{\int_{b_I}^{\omega_E} f_I(z - b_I)zdz}{F_I(\omega_E - b_I)} \\
&= \frac{\int_0^{\omega_E - b_I} f_I(z)(z + b_I)dz}{F_I(\omega_E - b_I)} = \frac{\int_0^{\omega_E - b_I} f_I(z)zdz}{F_I(\omega_E - b_I)} + b_I \frac{\int_0^{\omega_E - b_I} f_I(z)dz}{F_I(\omega_E - b_I)} \\
&= \mathbb{E}[\omega_I | \omega_I \leq \omega_I^*] + b_I.
\end{aligned}$$

Hence, $p_E^*(\omega_E) = \mathbb{E}[\omega_I | \omega_I \leq \omega_E - b_I] + b_I$ for $\omega_E \geq b_I$.

For $\omega_E < b_I$, a takeover never occurs in equilibrium because $\omega_I^* = 0$. Thus, all types below b_I do not want to deviate to a price posted by some $\omega_E \geq b_I$ since this would yield strictly negative profits. Hence, offering the true type $p_E = \omega_E < b_I$ is optimal.

Step 2: Sufficiency

This step is identical to the case with $b_I = 0$.

Step 3: Verification of Constraints

We must check that the shareholder follows I's recommendation and individual rationality for the bidder. To be precise, we must verify that the following constraints hold given p_E^*, m_I^* and γ^*:

$$[I] \qquad p_E^*(\omega_E) \geq \mathbb{E}[\omega_I|\omega_I \leq \omega_I^*],$$
$$[II] \qquad p_E^*(\omega_E) < \mathbb{E}[\omega_I|\omega_I > \omega_I^*],$$
$$[III] \qquad \omega_E \geq p_E^*(\omega_E).$$

We show that none of the constraints are binding and that the solution to the unconstrained problem derived above is also the solution to the constrained optimization problem.

We begin with the case that $\omega_E \leq b_I$. Note that we do not need to check constraint $[I]$ for $\omega_E \leq b_I$ since for these types a takeover occurs with probability zero. Similarly, constraint $[III]$ only has to hold if E's takeover probability is strictly positive. Thus, we do not need to check it for $\omega_E \leq b_I$.

Claim: Suppose $\omega_E \leq b_I$. Then, $b_I \leq \mu_I$ is a necessary and sufficient condition for constraint $[II]$ to hold.

1. $[II]$ holds only if $b_I \leq \mu_I$: Suppose, on the way to a contradiction, this was not true, i.e. $b_I > \mu_I$. Then, there exists $\omega_E' \in (\mu_I, b_I)$ by full support. As $\omega_E' < b_I$ it follows that $\omega_I^*(\omega_E') = 0$ and hence $[II]$ requires that $p_E(\omega_E') < \mathbb{E}[\omega_I|\omega_I > \omega_I^*(\omega_E') = 0] = \mu_I$. But then there is a profitable deviation for ω_E' by posting a price p_E' such that $\mu_I < p_E' < \omega_E' < b_I$ which generates a strictly positive profit because $\omega_E' > \mu_I$ by assumption. Since $p_E' > \mathbb{E}[\omega_I|\omega_I > (\omega_I^*(\omega_E') = 0)] = \mu_I$ the second constraint cannot be fulfilled and we have a contradiction.
2. Sufficiency: Assume $b_I \leq \mu_I$. Then, $\omega_E \leq b_I \leq \mu_I = \mathbb{E}[\omega_I|\omega_I > \omega_I^*(\omega_E) = 0]$. $[II]$ follows immediately because posting any p_E can generate at most zero profits: For any price inducing a takeover, we need $p_E \geq \mu_I = \mathbb{E}[\omega_I|\omega_I > \omega_I^*(\omega_E) = 0]$ which yields strictly negative profits and hence $p_E < \mathbb{E}[\omega_I|\omega_I > \omega_I^*(\omega_E)]$.

We now turn to $\omega_E > b_I$ and verify constraints $[I]$, $[II]$ and $[III]$. We begin with constraint $[I]$:

$$p_E^* \geq \mathbb{E}[\omega_I|\omega_I \leq \omega_E - b_I].$$

Plugging in p_E^* yields

$$\mathbb{E}[\omega_I|\omega_I \leq \omega_E - b_I] + b_I \geq \mathbb{E}[\omega_I|\omega_I \leq \omega_E - b_I],$$

which is trivially true because $b_I \geq 0$. In particular, the constraint is never binding for any $b_I > 0$.

We now turn to $[II]$, i.e. we want to show that

$$p_E^* < \mathbb{E}[\omega_I|\omega_I > \omega_I^*],$$

which can be written as

$$\mathbb{E}[\omega_I|\omega_I \leq \omega_E - b_I] + b_I < \mathbb{E}[\omega_I|\omega_I > \omega_E - b_I],$$

or

$$b_I < \mathbb{E}[\omega_I|\omega_I > \omega_E - b_I] - \mathbb{E}[\omega_I|\omega_I \leq \omega_E - b_I],$$

and the right-hand side is strictly positive by full support. By continuity, there exists a bias $\bar{b}_I^1$ such that the constraint is fulfilled for any $b_I \leq \bar{b}_I^1$.

Finally, we check $[III]$. Plugging in the price function yields $p_E^* = \mathbb{E}[\omega_I|\omega_I \leq \omega_E - b_I] + b_I < \omega_E - b_I + b_I = \omega_E$ and individual rationality obtains.

All in all, the solution to the unconstrained problem is also the solution to the constrained problem for sufficiently small bias b_I.
Although maximizing expected utility gives the optimal p_E^* on the interval of equilibrium prices $[0, p_E^*(1)]$, we have yet to check whether there exist profitable deviations by posting off-path prices above this interval (below is not feasible as $p_E \in \mathbb{R}_+$).

Step 4: Off-path Upward Deviation

To prove that there are no profitable upward deviations, we must show the following:

$$\forall \omega_E \in [0,1] \nexists \epsilon > 0 : \tag{2.15}$$
$$p_E^*(1) + \epsilon \geq \mathbb{E}[\omega_I|\omega_I > \omega_I^*(p_E^*(1) + \epsilon)] \text{ and } \mathbb{P}(\omega_I \leq \omega_I^*)u_E(\omega_E, p_E^*(1)) < u_E(\omega_E, p_E^*(1) + \epsilon).$$

Condition (2.15) requires that it is not profitable for any bidder type to post a price above $p_E^*(1)$, the price the highest type would post, to secure the takeover with probability one. This will not be profitable since ϵ, the premium paid beyond $p_E^*(1)$ to convince the shareholder to always tender, will be too large – at least for small b_I. We call this deviation price p^{dev}. After inserting ω_I^*, the inequality in condition (2.15) can be written as

$$p^{dev} \geq [\omega_I|\omega_I > [\omega_E|p^{dev}] - b_I].$$

By the intuitive criterion, off-path beliefs assign all probability mass to $\omega_E \geq p^{dev}$

because all other types would make strictly negative profits by such a deviation. It follows:

$$p^{dev} \geq [\omega_I | \omega_I > [\omega_E | p^{dev}] - b_I] \geq [\omega_I | \omega_I > p^{dev} - b_I].$$

Now, by continuity and full support, there is a $\bar{b}_I^2 > 0$ such that $[\omega_I | \omega_I > p^{dev} - \bar{b}_I^2] > p^{dev}$ which yields a contradiction and no upward deviation is profitable for $b_I \leq \bar{b}_I^2$. Take $\min\{\bar{b}_I^1, \bar{b}_I^2, \mu_I, \mu_E\}$ and the claim follows.

Step 5: General Case

We now extend the last result to a general condition λ and multiple shareholder ownership $j \in \{1, \ldots, J\}$. We conjecture that

$$p_E^* = \begin{cases} \mathbb{E}[\omega_I | \omega_I \leq \omega_I^*(\omega_E)] + b_I, & \text{if } \omega_E \geq b_I \\ \omega_E, & \text{otherwise.} \end{cases}$$

is an optimal price. Given this price function, we know that in the proposed equilibrium $\omega_E > p_E^*$ holds for all $\omega_E > b_I$, i.e. for all bidder types who have a strictly positive probability of taking over the company.

We claim that shareholders will jointly tender $T^* = \lambda$ if a takeover occurs. Suppose this was not true, i.e. $T^* > \lambda$. Consider some shareholder j who tenders a fraction $\hat{\gamma}_j > 0$ of her shares. Then, shareholder j can lower $\hat{\gamma}_j$ by some strictly positive amount and the takeover would still occur. This is a strictly profitable deviation because $\omega_E > p_E^*$ given the proposed price function.

Thus, for any λ, the amount of shares tendered cancels out of the first-order condition and the optimal p_E^* remains $\mathbb{E}[\omega_I | \omega_I \leq \omega_I^*] + b_I$, formally:

$$\underset{p \in \mathbb{R}_+}{max} \;\; F_I[\omega_I^*(p_E^{-1}(p)] \;\lambda\; [\omega_E - p] = \underset{p \in \mathbb{R}_+}{max} \;\; F_I[\omega_I^*(p_E^{-1}(p)] \; [\omega_E - p],$$

where $\omega_I^* = \omega_E - b_I$ for $\omega_E > b_I$ and zero otherwise. We now establish that all shareholders tendering $\gamma_j^* > 0$ still want to follow m_I^*. This is sufficient because all shareholders with $\gamma_j^* = 0$ do not tender any shares and the constraints do not have to hold for them.

As argued above, the solution to the unconstrained problem remains $p_E^* = \mathbb{E}[\omega_I | \omega_I \leq \omega_I^*] + b_I$. We now verify E's constraints.

Constraint $[I]$ becomes $\gamma_j^* p_E^* + (1 - \gamma_j^*)\mathbb{E}[\omega_E | p_E^*] \geq \mathbb{E}[\omega_I | \omega_I \leq \omega_I^*]$. Again we know that in a fully revealing equilibrium, it must hold that $\mathbb{E}[\omega_E | p_E^*] = \omega_E$. By the same reasoning as in the case with $J = 1$, we know that $\omega_E \geq p_E^*$. Thus, we can rewrite constraint $[I]$ as $\gamma_j^* p_E^* + (1-\gamma_j^*)\omega_E \geq p_E^* \geq \mathbb{E}[\omega_I|\omega_I \leq \omega_I^*]$. The last inequality is true because of the same argument as in the single shareholder case.

Now observe that if $\gamma_{-j}^*(p_E^*, m_I^*(\omega_I > \omega_I^*)) = (0,\ldots,0)$, then for any individual shareholder j it is a best response not to tender as well if she is not pivotal on her own (i.e. $s_j < \lambda$). Consequently, obedience in the multiple shareholder case is easier to support in equilibrium. We will show, however, that for sufficiently small bias, we need not exploit the coordination failure but can show that even if a shareholder was pivotal with some $\gamma_j^* > 0$, she would not like to tender. To see this, note that constraint $[II]$ becomes $\gamma_j^* p_E^* + (1-\gamma_j^*)\mathbb{E}[\omega_E|p_E^*] < \mathbb{E}[\omega_I|\omega_I > \omega_I^*]$. We focus on the case where b_I becomes small and plug in our expression for p_E^* to arrive at

$$\gamma_j^*(\mathbb{E}[\omega_I|\omega_I \leq \omega_I^*] + b_I) + (1-\gamma_j^*)\mathbb{E}[\omega_E|p_E^*] < \mathbb{E}[\omega_I|\omega_I > \omega_I^*].$$

The left-hand side converges to $\gamma_j^*\mathbb{E}[\omega_I|\omega_I \leq \omega_E] + (1-\gamma_j^*)\omega_E$ and the right-hand side becomes $\mathbb{E}[\omega_I|\omega_I > \omega_E]$ as b_I goes to zero. Thus, in the limit we have

$$\gamma_j^*\mathbb{E}[\omega_I|\omega_I \leq \omega_E] + (1-\gamma_j^*)\omega_E < \omega_E < \mathbb{E}[\omega_I|\omega_I > \omega_E],$$

where the strict inequalities follow from the full support assumption. Again, by continuity, there is a bias $\bar{b}_I^{J1} > 0$ such that for all smaller biases the constraint is fulfilled.

Constraint $[III]$ can be shown to hold in the same fashion as in the case where all shares are tendered.

Step 6: Off-path Upward Deviation for $J > 1$.

By definition, there exists no off-path upward deviation if

$$\begin{aligned}
&\forall \omega_E \in [0,1] \nexists \epsilon > 0: \\
&\gamma_j^*(p_E^*(1)+\epsilon) + (1-\gamma_j^*)\mathbb{E}[\omega_E|p_E^*(1)+\epsilon] \geq \mathbb{E}[\omega_I|\omega_I > \omega_I^*(p_E^*(1)+\epsilon)] \\
&\text{ and } \mathbb{P}(\omega_I \leq \omega_I^*)u_E(\omega_E, p_E^*(1)) < u_E(\omega_E, p_E^*(1)+\epsilon).
\end{aligned}$$

The argument is similar to the single shareholder case. Again define the deviation price $p^{dev} p_E^*(1) + \epsilon$. Suppose such a deviation is profitable, then it holds

$$\gamma_j^* p^{dev} + (1-\gamma_j^*)[\omega_E|p^{dev}] \geq [\omega_I|\omega_I > [\omega_E|p^{dev}] - b_I]. \tag{2.16}$$

The intuitive criterion excludes off-path beliefs assigning positive probability to types

$\omega_E < p^{dev}$ as they would make a strict loss by such a deviation. Thus, $[\omega_E|p^{dev}] \geq p^{dev}$. As $\gamma_j^* \in (0,1]$, the LHS in (2.16) is weakly smaller than $[\omega_E|p^{dev}]$. Hence,

$$[\omega_E|p^{dev}] \geq [\omega_I|\omega_I > [\omega_E|p^{dev}] - b_I].$$

But by continuity and full support, there exists a $\bar{b}_I^{J2} > 0$ such that for all $b_I \leq \bar{b}_I^{J2}$: $[\omega_E|p^{dev}] < [\omega_I|\omega_I > [\omega_E|p^{dev}] - b_I]$ which yields a contradiction. Now define $\bar{b}_I := \min\{\bar{b}_I^{J1}, \bar{b}_I^{J2}, \bar{b}_I^1, \bar{b}_I^2, \mu_I, \mu_E\}$ and the equilibrium exists for every $b_I \leq \bar{b}_I$. $\square$

Proof of Proposition 2.5. In the fully revealing equilibrium of Theorem 2.2, a takeover occurs whenever $\omega_I \leq \omega_I^* = \mathbb{E}[\omega_E|p_E^*] - b_I = \omega_E - b_I$ and $\lim_{b_I \to 0} \omega_I^* = \omega_E$. The decision rule whether a takeover occurs or not is thus the optimal allocation rule in the sense of Definition 2.2. Hence, in the limit we attain first-best firm value. The existence of an upper bound $\bar{b}_I^{FV}$ on b_I follows from continuity of ω_I^* in b_I. $\square$

Information Structures and Shareholder Learning

Let X be a signal about ω_I with realization $x \in [0,1]$ and suppose the shareholder can choose an information structure G at zero costs as follows. Given the prior $F_I \in \Delta([0,1])$, the distribution of X induces a joint distribution over signals and states $G : [0,1] \times [0,1] \to [0,1]$. Given x, the shareholder forms a posterior mean $\mathbb{E}[\omega_I|x]$. At the time of tendering, her decision whether to tender or to keep the shares depends only on $\mathbb{E}[\omega_I|x]$. Hence, without loss of generality, we identify the signal with its induced posterior mean: $\mathbb{E}[\omega_I|x] = x$. Thus, the shareholder is only interested in the marginal distribution of the signal X. Doing so, we identify each signal with the cdf of its marginal distribution and denote it by G_X.[41] We define the set of admissible information structures as mean-preserving spreads (MPS) of the prior F_I:

$$\begin{aligned}\mathcal{G}\Big\{&G_X \text{ cdf over } [0,1] : \int_0^y F_I(\omega_I)d\omega_I \geq \int_0^y G_X(x)dx \ \forall \ y \in \ [0,1],\\ &\int_0^1 F_I(\omega_I)d\omega_I = \int_0^1 G_X(x)dx\Big\}.\end{aligned}$$

Lemma 2.1 *Let X be a signal about ω_I with realization $x \in [0,1]$ and suppose the shareholder can choose any information structure from $\mathcal{G}$ at zero costs. Then, the shareholder chooses the fully informative signal structure $\overline{G}_X$.*

[41] This is equivalent to saying that each signal x provides the shareholder with an unbiased estimate about ω_I. For two papers that model signals in the same way, see Roesler and Szentes (2017) and Ravid et al. (2019).

Proof of Lemma 2.1. Define $z\frac{\lambda p_E+(1-s-\lambda)\mathbb{E}[\omega_E|p_E]}{(1-s)}$. As $\gamma^* = \frac{\lambda}{1-s}$, the shareholder tenders whenever $z \geq x$. Given some $G_X \in \mathcal{G}$, the expected utility per share of the shareholder is then given by

$$\int_0^z zdG_X(x) + \int_z^1 xdG_X(x) = zG_X(z) + 1 - zG_X(z) - \int_z^1 G_X(x)dx = 1 - \int_z^1 G_X(x)dx. \tag{2.17}$$

Now take $\overline{G}_X$ which is an MPS of any $G_X \in \mathcal{G}$ and it follows from (2.17) that her utility under $\overline{G}_X$ minus her utility under G_X equals

$$1 - \int_z^1 \overline{G}_X dx - 1 + \int_z^1 G_X dx = \int_z^1 G_X - \overline{G}_X dx = \int_0^z \overline{G}_X - G_X dx \geq 0.$$

The inequality follows from $\overline{G}_X$ being an MPS of G_X. To see this, note that

$$\int_z^1 \overline{G}_X dx = \int_0^1 \overline{G}_X dx - \int_0^z \overline{G}_X dx,$$

and recall that $\int_0^1 \overline{G}_X dx = \int_0^1 G_X dx$. □

By Lemma 2.1 the shareholder, endogenously, wants to become perfectly informed. Thus, by Proposition 2.1, first-best is not attainable if shareholders can acquire additional information. This result also holds if the shareholder could acquire information about both states of the world:

Lemma 2.2 *Suppose the shareholder is perfectly informed about ω_E and ω_I. Then, the first-best allocation is never implemented.*

Proof of Lemma 2.2. Suppose the shareholder can choose information structures H_E and H_I at zero costs as follows: there are two independent signals $X_E, X_I \in [0,1]$ inducing joint distributions over signals and states $H_I : [0,1] \times [0,1] \to [0,1]$ and $H_E : [0,1] \times [0,1] \to [0,1]$. As before we focus on signals that fulfill $\mathbb{E}[\omega_E|x_E] = x_E$ and $\mathbb{E}[\omega_I|x_I] = x_I$. We denote the marginals by H_{X_E} and H_{X_I}. Now, the shareholder can acquire any information $(H_{X_E}, H_{X_I}) \in \mathcal{H}$ where

$$\mathcal{H}\Big\{(H_{X_E}, H_{X_I}) \text{ cdfs over } [0,1] :$$

$$\int_0^y F_I(\omega_I)d\omega_I \geq \int_0^y H_{X_I}(x_I)dx_I \ \forall\ y \in\ [0,1], \int_0^1 F_I(\omega_I)d\omega_I = \int_0^1 H_{X_I}(x_I)dx$$

$$\text{and} \int_0^y F_E(\omega_E)d\omega_E \geq \int_0^y H_{X_E}(x_E)dx_E \,\forall\, y \in\ [0,1], \int_0^1 F_E(\omega_E)d\omega_E = \int_0^1 H_{X_E}(x_E)dx\Big\}.$$

In the same way as in Lemma 2.1, one can show that it is optimal for her to acquire full information about ω_E, as well. Her tendering decision becomes $\gamma p_E+(1-\gamma)\omega_E \geq$

ω_I and suppose first-best is implementable, so it follows that $p_E = \omega_E$. Given full separation, we obtain the result with the same arguments as in the proof of Proposition 2.1. □

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Chapter 3

The Economics of Decoupling

Joint with Andre Speit

3.1 Introduction

Even if a company formally adheres to the "one-share one-vote" principle, this does not imply that the number of votes a shareholder can cast is actually aligned with his or her stake in the company. Financial innovation has created a vast set of "decoupling techniques" for activist investors to acquire votes without taking a long position, decoupling their voting power from their economic exposure. As the cases collected by Hu and Black (2008a),[1] the aggregate evidence found by Christoffersen et al. (2007) as well as Kalay et al. (2014), and the recent fight for control over Premier Foods (2018) show,[2] these decoupling techniques are very popular with activist investors. Thereby, it comes as no surprise that the practice caught the eye of the press and regulatory authorities alike.[3]

What stands out about the public cases of decoupling is the variety of techniques employed, ranging from the usage of repo contracts to the acquisition of shares and hedges. While all these techniques ultimately resulted in a misalignment of voting power and economic exposure, they differed substantially in the transactions, timing, and parties involved. This begs the question if from the activists' perspective, different decoupling techniques are mere substitutes or whether there are meaningful economic differences in the cost and incentives they impose on activist investors.

The second, complementary question is what motivates activist investors to employ these decoupling techniques. While decoupling has been used to improve cor-

[1] Henceforth, we quote Hu and Black (2008a) as the most recent overview of their extensive documentation of decoupling, Hu and Black (2006); Hu and Black (2007); Hu and Black (2008b); Hu and Black (2008a).

[2] Financial Times, July 15, 2018, "Market reverberates with accusations of empty voting," https://www.ft.com/content/0e28929e-85dd-11e8-a29d-73e3d454535d.

[3] See, for instance, the ESMA's "Call for evidence on empty voting" (September 2011), https://www.esma.europa.eu/press-news/consultations/call-evidence-empty-voting, or the "SEC Staff Roundtable on the Proxy Process" (July 2018), https://www.sec.gov/news/public-statement/statement-announcing-sec-staff-roundtable-proxy-process.

porate governance, the prospect of voting without bearing the effect on share value is undoubtedly of particular interest to activists who want to push their private agenda, instead of maximizing firm value.

"[Therefore,] [it] is a source of some concern that [...] important corporate actions [...] might be decided by persons who could have the incentive to [...] block actions that are in the interests of the shareholders as a whole" (SEC, Concept Release on the U.S. Proxy System, p. 139).[4]

In this chapter, we give structure to the vast amount of decoupling techniques by deriving three classes of economically equivalent decoupling techniques: *Buy&Hedge* techniques, *Hedge&Buy* techniques and *Vote Trading* techniques.[5]

Afterward, we analyze which of these three classes can be exploited profitably by a hostile activist who opposes a firm value increasing reform, and we uncover a clear ranking in welfare implications. We find that Vote Trading techniques allow the activist to push her private agenda and expropriate shareholders at zero costs, whereas Buy&Hedge techniques are constrained efficient because the activist suffers from a commitment problem. Hedge&Buy techniques fall in between, exhibiting inefficient and constrained-efficient equilibria.

By categorizing the decoupling techniques, we develop a framework to assess existing and novel financial transactions in their potential to promote hostile activism.[6] Thereby, we provide guidance on which financial transactions need the closest monitoring and, potentially, regulation. Further, our results match and help to better understand differences in empirical findings of decoupling via equity lending markets Christoffersen et al. (2007) and options markets Kalay et al. (2014).

Shareholder Voting Processes and Decoupling Techniques

Before we can classify the decoupling techniques and preview our results, we need to provide a short overview of the shareholder voting process and highlight how it is vulnerable to decoupling.

Shareholders can exercise their voting rights in ordinary, annual meetings, and special meetings. Proceedings conducted at a record date, held roughly 30 days prior to the meeting, determine which shareholders are eligible to vote how many

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[4] See https://www.sec.gov/rules/concept/2010/34-62495.pdf.

[5] In Chapter 4, we analyze the pros and cons of Vote Trading techniques as means of activist intervention compared to traditional forms of shareholder activism. In this chapter, we consider Vote Trading techniques as a benchmark.

[6] It is worth pointing out that our classification does not square with the one suggested in the 2010 SEC Concept Release on the U.S. Proxy System, https://www.sec.gov/rules/concept/2010/34-62495.pdf.

shares:[7] doing so, the shareholder structure is locked-in, such that later changes are not taken into account. At the meeting day, decisions are made either with a simple majority or a supermajority.

There are different features of this process that allow an activist investor to decouple her voting power from her economic exposure. First, the allocation of voting rights is agnostic toward coupled assets in the activist's portfolio. For example, the allocation does not take any hedges into account, allowing an activist to shed her economic exposure to retain only the voting right. Further, the shareholder structure is fixed after the record date, such that trades between the record date and meeting do not affect the number of votes a shareholder can cast. By acquiring shares before the record date (cum voting rights) and offloading them right after (ex voting rights), the activist can acquire voting rights without the economic exposure. Even more significant, the number of votes is determined by the temporary possession of the shares. Hence, the activist is eligible to vote borrowed shares, or shares that she has already sold for later delivery at the time of the record date.

Combined, these three features open the possibility for a multitude of decoupling techniques, which can substantially diverge in their economic implications depending on the timing, order of transactions, and counterparties involved. In any of these decoupling techniques, however, the activist has to achieve two goals. First, she has to obtain possession of the shares for the record date, either by buying or borrowing them. In case she purchased the share, she then has to shed the associated economic exposure. This can be done by either selling the shares after the record date or by hedging them. In fact, a hedge can be bought before or after acquiring the shares. Taken together, this gives rise to three classes of decoupling techniques.

Buy&Hedge In the first class of decoupling techniques, the activist buys the shares she wants to vote (prior to the record date) before hedging them. This hedging can be done, for instance, by acquiring options or simply selling the shares after the record date, retaining only the voting rights. In this class of decoupling techniques, the activist assumes positive economic exposure before reducing it again.

Hedge&Buy The second class of decoupling techniques simply flips the order of transactions of Buy&Hedge techniques. By hedging her economic exposure first, the activist is essentially short before acquiring the shares, such that she never takes a long position in the company.

Vote Trading The third class of decoupling techniques is composed of those which are equivalent to the outright trade of voting rights. Essentially, in these techniques, the shares and hedge are both provided by the same shareholder. Thereby, the economic exposure remains with the shareholder at all times, and only the voting rights

[7] The details of the process can vary across countries. However, it is easy to check that the lead time is irrelevant for the outcomes and incentives of the decoupling techniques analyzed.

ever change hand. Most importantly, Vote Trading techniques include the common practice of borrowing shares over the record date (Christoffersen et al., 2007), but also the usage of repos or synthetic assets. For instance, in a repo contract, the shares posted as collateral are already set to be repurchased, such that only the voting rights are reallocated.

Preview of Results

To analyze which classes of decoupling techniques can be exploited profitably by a hostile activist to push her private agenda, we consider a simple model in which dispersed shareholders vote on the implementation of a reform. Shareholders know the reform to be value increasing and, thus, support it. The hostile activist, on the other hand, derives a private benefit from the status quo and wants to prevent the reform. The activist's motives are common knowledge.

We find that because the activist's hostile motives are known, she does not benefit from hedging her economic exposure after acquiring the shares (Buy&Hedge technique): any rational and competitive market providing her with a hedge will charge her the fair value, taking into account the activist's motives. Consequently, the hedging market is irrelevant to the activist's incentives. The shares commit her to implement the reform unless her private benefit from the status quo exceeds the loss in share value on the blocking minority of shares. Thus, the outcome of decoupling via a Buy&Hedge technique is constrained efficient.

Still, a hedge may be beneficial to the activist when the order of transitions is flipped, that is when the activist uses a Hedge&Buy technique. By acquiring the hedge first, the activist builds a short position, which commits her to block the reform whenever she gets the chance. If shareholders anticipate that the activist will be successful in acquiring a blocking minority, they are willing to sell their shares at the depressed "no reform"-price. Thereby, shareholders suffer a loss in share value, and the activist can prevent the reform while earning a profit. On the other hand, if shareholders do expect the reform to pass, they demand the high "successful reform"-price, which the activist may not be willing to pay when her private benefit from the status quo is small. Thus, when the activist's private benefit is small, there are two types of self-fulfilling equilibria: ones in which the reform is blocked and ones in which the reform passes.

Last, Vote Trading techniques have a unique equilibrium in which the activist acquires the necessary voting rights at zero prices and always blocks the reform. When employing a Vote Trading technique, the activist essentially bundles the buy and hedge transaction and only trades with the shareholders. Thereby, shareholders always retain the economic exposure and only sell their voting right. When evaluating the offer by the hostile activist, shareholders value their voting right according to their expectation of whether it will change the outcome of the vote. When there are many shareholders, no individual shareholder is pivotal with positive probability, such that the voting right holds no value to him. As a result, there is no monetary transfer from the activist to the shareholders.

In conclusion, we can rank the three classes of decoupling techniques in order of their implications on (shareholder) welfare as

$$\text{Buy\&Hedge} \succ \text{Hedge\&Buy} \succ \text{Vote Trading.}$$

While Buy&Hedge techniques are constrained efficient, Hedge&Buy techniques have two types of equilibria: ones which are constrained efficient and inefficient ones, which allow the hostile activist to block the reform and earn a profit, even when her private benefit from the status quo is small. Vote Trading techniques only have inefficient equilibria and result in the lowest (zero) transfer from the activist to the shareholders.

We also analyze the interaction of decoupling techniques and dual-class structures. In dual-class structures, the activist only has to acquire voting-shares, reducing the economic exposure she has to assume to block the reform. Thereby, dual-class structures foster hostile activism through Buy&Hedge and Hedge&Buy techniques by reducing the private benefit required to make a hostile intervention profitable. In contrast, we find that dual-class structures have no impact on the inefficiency of Vote Trading techniques.

The rest of the chapter is structured into eight sections. After discussing the related literature in Section 3.2, we set up the model in Section 3.3. In Section 3.4 we analyze Buy&Hedge techniques, and in Section 3.5 Hedge&Buy techniques. In Section 3.6 we analyze Vote Trading techniques. We discuss the effect of dual-class structures in Section 3.7, relate our results to previous empirical findings in Section 3.8, and conclude in Section 3.9.

3.2 Literature

The early papers on the optimal design of voting rights in the corporation are primarily concerned with dual-class structures. Grossman and Hart (1988) as well as Harris and Raviv (1988) provide conditions under which a single share class is optimal in corporate control contests. The subsequent literature has also shown that dual-class structures can be useful in the context of corporate takeovers to overcome the free-rider problem (Grossman and Hart, 1980). In particular, non-voting shares can be used to increase private benefits of control (Burkart et al., 1998), or solve problems of asymmetric information (At et al., 2011), thereby enabling value-increasing takeovers. In a model with finitely many shareholders, Gromb (1992) shows that reducing the number of voting shares increases the pivotality probability and, thus, mitigates shareholders' free-riding behavior. For a detailed overview of the literature on dual-class structures, see Burkart and Lee (2008). Recently, Burkart and Lee (2015) demonstrate how synthetic assets can be used to overcome adverse selection problems and free-riding in takeovers.

As far as decoupling techniques go, Vote Trading techniques have received by far the most attention. In the context of corporate governance, Brav and Mathews (2011) and Eso et al. (2015) show that Vote Trading techniques may be beneficial for corporate governance when information about the optimal decision is dispersed. On the other hand, Casella et al. (2012) shows that there is generally no competitive equilibrium in the market for voting rights when market participants have different preferences about the outcome of the vote. Neeman (1999), Bó (2007), and Chapter 4 show in different models that Vote Trading techniques generally lead to inefficiently low vote prices, which can be exploited by a hostile activist. Further, in Chapter 4, we demonstrate that shareholders can learn from activist's willingness to employ a Vote Trading technique but that traditional forms of activist interventions are superior in communicating information. Blair et al. (1989) as well as Dekel and Wolinsky (2012) consider the effect of Vote Trading techniques on control contests. Blair et al. (1989) analyze the effect of taxation on the choice of vehicle by the contestants. Dekel and Wolinsky (2012) prove that Vote Trading techniques can be socially harmful by fostering welfare decreasing takeovers.

Levit et al. (2019) consider a model with heterogeneous shareholder preferences in which shareholders can trade shares before the voting stage. Trading opportunities render the shareholder base endogenous, introducing a feedback loop and self-fulfilling equilibria. In Kalay and Pant (2009), shareholders use the options market as a commitment device to improve their bargaining position in a subsequent control contest. This effect is similar to the one the activist exploits in our model when employing a Hedge&Buy technique.

3.3 Model

Investors Consider a public company owned by a continuum of shareholders with mass 1. Every shareholder owns one share, consisting of a cash-flow claim and a voting right. Further, there is an activist investor who owns no shares. All investors are risk neutral.

Shareholder meeting The company has an upcoming shareholder meeting with a single, exogenously given reform-proposal on the agenda. The vote is binding, and the reform is implemented if at least $\lambda \in (0,1)$ votes are cast in favor of it. Otherwise, the status quo prevails.

Payoffs If the company sticks with the status quo, the company's total value remains unchanged at $v > 0$; if the reform is implemented, the company's value increases by $\Delta > 0$ to $v + \Delta$. In spite of its positive effect on the firm value, the activist opposes the reform as she gains private benefits $b > 0$ if the status quo remains. These private benefits may, for instance, stem from other assets of her portfolio: debt in the same company reducing the risk appetite or cross ownership leading to different supplier preferences. Alternatively, the status quo may allow the activist to (continue to) extract b at a cost to the firm of $\Delta \geq b$. In any case, we take b to be exogenously given. If $b < \Delta$, the reform increases overall welfare, whereas the status quo is efficient whenever $b > \Delta$.

Voting Stage

We ignore the peculiar equilibria in which voters play weakly dominated strategies. Thus, investors always vote in favor of their preferred alternative, and the outcome of the vote is uniquely determined by who owns how many voting rights at the time of the meeting. In the following, we do not explicitly model the voting stage, but only use that the activist can block the reform if she controls at least $(1 - \lambda)$ of the voting rights.

3.4 Buy&Hedge Techniques

We first consider the class of decoupling techniques we call "Buy&Hedge" techniques. In this simplest form of decoupling, the hostile activist buys shares from the shareholders and hedges her position afterward, for instance, by procuring put options or reselling the shares after the record date has passed.

Order of Transactions

Suppose that the activist can make a public take-it-or-leave-it offer $p \in \mathbb{R}_+$ per share. She can restrict her offer to be valid for m shares she is willing to buy. If more shareholders decide to sell, they are rationed. It is without loss to assume that the activist makes offers for up to $m = 1 - \lambda$ shares.

Shareholders observe the offer p and decide whether they want to sell their share. To capture the predominant anonymity among shareholders, we consider symmetric strategies, denoted by their mixing probability $q : \mathbb{R}_+ \to [0,1]$.

Having acquired $\min\{q(p), m\}$ shares for p, the activist then has the option to hedge her entire position, guaranteeing her the "successful reform"-value $v + \Delta$. For instance, this can be done by buying put options with a strike price of $v + \Delta$.[8] We assume that the hedging market is rational and competitive, such that the activist needs to pay the fair value.

An explicit overview of the payoffs can be found in Appendix 3.10. Here, and henceforth in this chapter, we analyze subgame perfect equilibria.

Hedging Stage

Solving the model from the back, suppose that the activist acquired $q^*(p) < 1 - \lambda$ shares in the buying stage. In this case, she cannot swing the decision and the share value is $v + \Delta$. As a result, the hedge is free, and the activist is indifferent between acquiring or not.

Alternatively, suppose that the activist bought the necessary $1 - \lambda$ shares and also the hedge. Then, the value of her portfolio is fixed at $(1 - \lambda)(v + \Delta)$, meaning that it is strictly optimal for her to block the reform. In this case, the hedge has to pay out $(1 - \lambda)\Delta$. The rational and fully informed market providing the hedge expects this and charges $(1 - \lambda)\Delta$ for the hedge. As a result, the activist is, again, indifferent about hedging her shares, and her decision whether to block the reform is unaffected. Consequently, she will only block the reform if $b \geq (1 - \lambda)\Delta$.

Wrapping up, since hedging markets ask for the fair price, the ability to hedge does not affect the activist's payoffs or her decision: the activist will only block the reform in case she acquired $1 - \lambda$ shares (the blocking minority) and $b \geq (1 - \lambda)\Delta$ (blocking is profitable).

Buying Stage

When $b < (1 - \lambda)\Delta$, shareholders anticipate that the activist will never block the reform and are not willing to sell their share unless the activist pays them the "successful reform"-price of $v + \Delta$ per share. Therefore, the activist is indifferent between buying the shares and not. In any equilibrium, the reform passes, the firm value rises to $v + \Delta$, and the payoffs of the shareholders and the activist are unchanged.

When $b > (1 - \lambda)\Delta$, shareholders correctly anticipate that the reform is blocked if the activist can acquire sufficiently many shares, $q^*(p) \geq 1 - \lambda$. Depending on how shareholders coordinate, this gives rise to a continuum of equilibria where $p^* \in [v, v + \Delta]$ and reform is always blocked. Details can be found in the proof in the appendix.

[8] If the activist could choose the strike price and size of the hedge, insuring all of her shares at $v + \Delta$ would constitute a best response. Note that in contrast to the share market, the activist cannot exploit any potential coordination failure in the market for hedges (e.g. by splitting and randomizing her purchase of options) since non-shareholders make at least zero profits by standard participation constraints.

Proposition 3.1 *Suppose that the activist employs a Buy&Hedge technique,*

- *if $b < (1-\lambda)\Delta$, the reform passes and the firm value increases to $v + \Delta$ in any equilibrium. The shareholders' and the activist's payoffs are unchanged;*
- *if $b > (1-\lambda)\Delta$, the reform is blocked and the firm value remains at v in any equilibrium. Shares trade at prices between v and $v + \Delta$, such that the total loss incurred by shareholders is between $\Delta - (1-\lambda)\Delta$ and Δ. The activist's profit is between b and $b - (1-\lambda)\Delta$.*

If $b < (1-\lambda)\Delta$, shareholders are fully protected against hostile activism through Buy&Hedge techniques. Absent of asymmetric information, the activist cannot fool the hedging market and is, thereby, stuck with the economic exposure of the shares she seeks to vote. When the private benefit from the status quo is small, these shares commit her to implement the reform.

If $b > (1-\lambda)\Delta$, the economic exposure of the blocking minority of shares does not commit the activist to implement the reform, such that the reform is blocked. Depending on the coordination among shareholders, their aggregate loss is between $\lambda\Delta = \Delta - (1-\lambda)\Delta$ and Δ.

Note that the inefficient outcome in case $b > (1-\lambda)\Delta$ and $b < \Delta$ stems from the externality of voting. If a fraction $(1-\lambda)$ of voters were to equally share the benefit $b > (1-\lambda)\Delta$, they would block the reform without any regard to their externality on the other λ voters. In that sense, Buy&Hedge techniques result in efficient outcomes, constrained only by the inefficiency from the voting process itself.

For coherent exposition, we phrase the transaction in which the activist sheds her economic exposure in terms of a hedge, e.g., put options. As we mention in the introduction to this section, the same outcome can be achieved via share sales after the record date. In this case, a competitive and rational outside market will pay the activist the fair value for her share position, anticipating her actions.[9] In particular, when the activist sells all of her shares or none (cf. footnote 8), the outside market will pay her v per share. Therefore, the activist does not benefit from selling her shares, and she only blocks the reform if $b \geq (1-\lambda)\Delta$.

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[9] Alternatively, the activist could sell her shares to existing shareholders. In our model with a continuum of shareholders, existing shareholders have the same willingness to pay for the shares as an outside market. If the number of shareholders was finite, such that their decision whether to buy shares could affect the outcome of the vote, they would pay less: the incumbent shareholders would internalize that, with positive probability, their acquisition encourages the activist to block the reform, reducing the value of their existing share portfolio.

3.5 Hedge&Buy Techniques

In this section, we consider "Hedge&Buy" techniques. In this class of decoupling techniques, the hostile activist switches the order of transactions of the Buy&Hedge techniques, such that she uses the hedge to build a short position before acquiring the shares.

Order of Transactions

Suppose that the activist can buy a hedge from the outside market that guarantees her a firm value of $v + \Delta$; for instance, in the form of put options with a strike price at $v+\Delta$. It is without loss to assume that she either buys no hedge or insures $(1-\lambda)$ shares (cf. footnote 8). The hedging market is rational and competitive, so that the activist can acquire the hedge for its fair value

After deciding whether to buy a hedge, the activist can make a public take-it-or-leave-it offer $p \in \mathbb{R}_+$ for which she is willing to acquire shares. She can further set an upper bound on the number of shares she is willing to acquire, m. If more shareholders decide to sell their shares, they are rationed. Assume that the activist makes offers for up to $m = 1-\lambda$ shares. The activist conditions her offer on whether she acquired a hedge, such that her strategy becomes $p : \{0, 1-\lambda\} \to \mathbb{R}_+$.

Shareholders observe whether the activist hedged her position as well as the offer p and decide whether they want to sell their share. We denote shareholders' symmetric strategy by $q : \{0, 1-\lambda\} \times \mathbb{R}_+ \to [0, 1]$.

An explicit overview of the payoffs is in Appendix 3.10.

Buying Stage

In the body of text, we solve the game when the activist's private benefit is small, $b < (1-\lambda)\Delta$. The solution to the game with a large private benefit, $b > (1-\lambda)\Delta$, can be found in the proof to Proposition 3.2 in the appendix. Again we solve the game from the back.

The activist can only block the reform in case she offers a price p such that shareholders sell with probability $q^*(\cdot, p) \geq (1-\lambda)$. Further, she only wants to do so if she hedged her position beforehand. Otherwise, the economic exposure of the shares commits her to implement the value-increasing reform (cf. Section 3.4). If the activist does not own a hedge, shareholders know that the activist will implement the reform and demand the "successful reform"-price of $v + \Delta$. Thus, when the activist owns no hedge, the reform passes, the activist is indifferent between acquiring the shares or not, and her payoff is 0.

Now, suppose that the activist hedged her shares which commits her to block the reform. Shareholders anticipate this and base their decision whether to sell on the other shareholders' equilibrium decision. Since no shareholder is pivotal with positive probability, it is optimal for any shareholder to sell his share if $p \geq v$ and $q^*(1-\lambda, p) \geq 1-\lambda$, so that the reform is blocked, or whenever $p \geq v + \Delta$.[10] Not selling is optimal for the shareholder whenever $p \leq v + \Delta$ and $q^*(1-\lambda, p) < 1-\lambda$, meaning that the reform passes. The activist, on the other hand, has an incentive to pay any price $p \leq \frac{b}{1-\lambda} + v + \Delta$ as long as $q^*(1-\lambda, p) \geq (1-\lambda)$ because this provides her with a payoff of

$$V_{hedge}(p) = b + (1-\lambda)v + \underbrace{(1-\lambda)\Delta}_{\text{payout hedge}} - (1-\lambda)p > 0,$$

whereas any price p such that $q^*(1-\lambda, p) < (1-\lambda)$ results in a payoff of at most zero. Since a price $p > v + \Delta$ guarantees her $q^*(1-\lambda, p) \geq 1-\lambda$, the activist will always choose a price p^* such that $q^*(1-\lambda, p^*) \geq 1-\lambda$. This gives rise to a continuum of equilibria in the buying subgame in which the activist owns a hedge. For any $p^* \in [v, v+\Delta]$ there is an equilibrium in which $q^*(1-\lambda, p^*) \geq 1-\lambda$ and $q^*(1-\lambda, p) < (1-\lambda)$ for all $p < p^*$. Consequently, the value from owning a hedge is $V_{hedge}(p^*) \in [b, b + (1-\lambda)\Delta]$.[11]

Combined, there are two outcomes of the buying subgame: when the activist did not acquire a hedge, she does not block the reform and her payoff is 0. In case she did buy a hedge, she always blocks the reform and her payoff is $V_{hedge}(p^*) \in [b, b + (1-\lambda)\Delta]$.

Hedging Stage

If the activist decides to buy a hedge, she will always block the reform, such that the sellers of the hedge incur a loss of $(1-\lambda)\Delta$. The rational outside market anticipates this and demands the fair value for the hedge, $(1-\lambda)\Delta$.

As a result, it only pays for the activist to buy a hedge and block the reform in case the value from owning a hedge is $V_{hedge}(p^*) \geq (1-\lambda)\Delta$. Since $b < (1-\lambda)\Delta$, this means that there are two types of equilibria, depending on the equilibrium of the subsequent subgame: when $V_{hedge}(p^*) > (1-\lambda)\Delta$, the activist acquires the hedge and blocks the reform, whereas if $V_{hedge}(p^*) < (1-\lambda)\Delta$, she does not buy the hedge and the reform is implemented.

[10] If $q^*(1-\lambda, p) \leq 1-\lambda$ and $p \geq v + \Delta$, selling shareholders are not rationed and any shareholder is better off selling. If $q^*(1-\lambda, p) \geq 1-\lambda$, the reform is blocked which is compatible with any price $p \geq v$.

[11] Note that $p^* \leq v + \Delta$ because at any $p > v + \Delta$, $q^*(1-\lambda, p) = 1$, meaning that the activist is strictly better off lowering her offer to $p' = \frac{p+v+\Delta}{2}$.

Proposition 3.2 *Suppose that the activist employs a Hedge&Buy technique,*

- *if $b < (1-\lambda)\Delta$, there are two types of equilibria:*

  1. *either the activist buys the hedge for $(1-\lambda)\Delta$, acquires $(1-\lambda)$ shares, and blocks the reform. In this case, the firm value remains at v. Shares trade at prices between v and $v + \frac{b}{1-\lambda}$, such that the total loss incurred by shareholders is between $\Delta - b$ and Δ. The activist's profit is between b and 0.*
  2. *or the activist does not buy a hedge, so that the reform passes and the firm value increases to $v+\Delta$. The shareholders' and the activist's payoffs are unchanged.*

- *if $b > (1-\lambda)\Delta$, the reform is blocked and the firm value remains at v in any equilibrium. Shares trade at prices between v and $v+\Delta$, such that the total loss incurred by shareholders is between $\Delta - (1-\lambda)\Delta$ and Δ. The activist's profit is between b and $b-(1-\lambda)\Delta$.*

Since the hedging market anticipates the activist's actions, it charges the correct fair value for the hedge. Thus, the activist does not benefit directly from hedging her shares (cf. equation (3.1)). Nevertheless, acquiring a hedge before the shares can be beneficial for her because it ensures that the activist never holds a long position. Whereas in a Buy&Hedge technique, the interim ownership of the shares commits the activist with a low private value, $b < (1-\lambda)\Delta$, to pass the reform, buying the hedge first lifts this commitment. This gives rise to two types of self-fulfilling equilibria when $b < (1-\lambda)\Delta$.

In both types of equilibria, conditional on owning a hedge, the activist offers a price p^* such that she acquires the blocking minority of shares, $q^*(1-\lambda, p^*) \geq 1-\lambda$. Thus, if the activist buys the hedge and prevents the reform, her ex ante payoff is

$$(1-\lambda)v + b - (1-\lambda)p^* + \underbrace{(1-\lambda)\Delta}_{\text{payoff hedge}} - \underbrace{(1-\lambda)\Delta}_{\text{price hedge}}. \tag{3.1}$$

However, only when $p^* < v + \frac{b}{1-\lambda}$, it pays for the activist to buy the hedge and the blocking minority of shares. This is the first type of equilibrium. In the other type of equilibrium, $p^* > v + \frac{b}{1-\lambda}$, meaning that the activist's profits from acquiring the shares and blocking the reform do not suffice to cover the cost of the hedge, preventing her from doing so.

When $b > (1-\lambda)\Delta$, the case we mostly ignored in this section, the result is unchanged relative to the result of the Buy&Hedge technique. Since the activist has an incentive to prevent the reform independent of a hedge, the reform is blocked in any equilibrium and the price the activist pays is $p^* \in [v, v+\Delta]$, as in Section 3.4.

3.6 Vote Trading Techniques

Last, we turn to the class of decoupling techniques that are equivalent to the outright trade of voting rights, such as borrowing shares over the record date via the equity lending market. A more thorough analysis with a finite number of shareholders can be found in Chapter 4. Here, we keep the analysis Vote Trading techniques short and treat it primarily as a benchmark.

Suppose that before the record date, the activist can make a public take-it-or-leave-it offer $p \in \mathbb{R}_+$ per voting right.[12] Shareholders observe the offer and sell their voting right with probability $q : \mathbb{R}_+ \to [0, 1]$.

Appendix 3.10 provides an explicit overview of the payoffs.

Proposition 3.3 *In any equilibrium, the activist offers $p^* = 0$, shareholders sell with probability $q^*(0) \geq 1 - \lambda$, and the activist always blocks the reform.*

When the activist employs a Vote Trading technique, the economic exposure never leaves the original shareholders. Hence, the activist only needs to compensate shareholders for their voting rights. Since there are many shareholders, they correctly anticipate that their individual sale is not going to change the outcome of the vote, such that shareholders do not value their voting rights—the curse of pivotality. Thus, they are willing to sell their voting rights at any positive price. The activist, on the other hand, never assumes economic exposure herself, making it optimal for her to block the reform, independent of her private value, $b > 0$. As a result, the activist can always acquire the voting rights for free and prevent the reform.

3.7 Dual-class Structures

Up to now, we assumed that all shares are identical voting shares. To also cover dual-class structures, suppose there are $\phi \in (0, 1]$ voting and $1 - \phi$ non-voting shares. Every shareholder holds either one or the other. Given the dual-class structure, the activist can block the reform if she controls $(1 - \lambda)\phi$ shares.

Corollary 3.1 *All previous results remain valid for dual-class structures when replacing $(1 - \lambda)$ by $(1 - \lambda)\phi$.*

The proofs hold verbatim, replacing $(1 - \lambda)$ by $(1 - \lambda)\phi$. In dual-class structures, holders of non-voting shares get no say in the outcome of the vote, meaning that the inefficiency of voting increases: if $(1 - \lambda)\phi$ shareholders prefer a particular course of action, they ignore the effect on the $(1 - \phi) + \lambda\phi$ minority. As a result, Buy&Hedge techniques, as well as the first type of equilibria in Hedge&Buy techniques, remain

[12] The activist might restrict her offer to $(1-\lambda)$ voting rights as in the other decoupling techniques analyzed, but this does not affect the results.

constrained efficient given the inefficiency of voting in dual-class structures. Still, the private benefit required for a hostile activist to profit from blocking the reform decreases from $(1-\lambda)\Delta$ to $\phi(1-\lambda)\Delta$. Further, the total compensation to shareholders decreases. Vote Trading techniques, on the other hand, are unaffected by dual-class structures.[13]

Note that our analysis of Buy&Hedge techniques concluded that hedging after the acquisition of shares is never strictly profitable, such that the Buy&Hedge techniques are, essentially, "Buy" techniques. Thereby, the results for the Buy&Hedge techniques also cover the simple form of hostile activism in which the activist blocks the reform through the acquisition of (few) voting shares.

3.8 Empirical Implications

Our model predicts that the (implicit) prices for voting rights vary substantially, depending on the decoupling technique employed. When voting rights are acquired via a Vote Trading technique, prices are zero. This is in line with the empirical evidence from the equity lending market, which finds a significant trade volume and close to zero prices (Christoffersen et al., 2007).[14] Turning to Buy&Hedge and Hedge&Buy techniques, when $b < (1-\lambda)\Delta$, Buy&Hedge techniques are not profitable for the activist. Depending on the equilibrium selection, however, the activist may be able to block the reform using a Hedge&Buy technique. In this case, the implicit price of a voting right, i.e. the difference between the price offered by the activist and the value of the cash flow entitlement, is between 0 and $\frac{b}{1-\lambda}$. When $b > (1-\lambda)\Delta$, Buy&Hedge techniques as well as Hedge&Buy techniques, allow the activist to block the reform. Here, the implicit price of a voting right is between 0 and Δ, depending on the equilibrium selected. The positive prices are consistent with the findings by Kalay et al. (2014) who detect a spike in the options trading around the record date and find that the implicit prices for voting rights derived from options are strictly positive.

Moreover, our results show that hostile activism via Buy&Hedge techniques and Hedge&Buy techniques are particularly likely when λ is large, that is when the reform requires a supermajority. This is in line with most of the cases collected by Hu and Black (2008a), which predominantly involved supermajority decisions.

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[13] In the context of corporate takeovers, Hart (1995) points out that dual-class structures are irrelevant if voting rights and cash flow claims can be unbundled.

[14] Christoffersen et al. (2007) attribute their findings to the supposedly common interests of shareholders. However, this explanation seems to be at odds with the evidence by Hu and Black (2008a). As we argue more extensively in Chapter 4, low prices are the result of a market failure in the market for voting rights and not necessarily a sign of aligned interests.

3.9 Conclusion

Our analysis focuses on hostile activism in an environment without hidden motives. Thereby, we seek to bound the threat of hostile activism through decoupling techniques and abstract from any inefficiencies stemming from asymmetric information.[15] We find that the three classes of decoupling techniques can be ranked in terms of their implications on shareholder and overall welfare as

$$\text{Buy\&Hedge} \succ \text{Hedge\&Buy} \succ \text{Vote Trading}.$$

When $b < (1-\lambda)\Delta$, the activist cannot use a Buy&Hedge technique to block the reform, such that overall welfare is maximized. Hedge&Buy techniques, on the other hand, have two types of equilibria: equilibria in which the reform passes, reducing shareholder and overall welfare, and equilibria in which the reform is blocked. Thus, the result is ambiguous and relies on equilibrium selection. Last, Vote Trading techniques always result in a blocked reform and zero transfer to the shareholders. Therefore, this class of decoupling techniques is the worst in terms of shareholder and overall welfare.

When $b > (1-\lambda)\Delta$, all three classes of decoupling techniques allow the activist to block the reform. However, Vote Trading techniques guarantee that there is zero transfer from the activist to the shareholders, whereas Buy&Hedge as well as Hedge&Buy techniques can result in strictly positive transfers.

By ranking the three classes of decoupling techniques, we provide insights into which current and future transactions need the most rigorous monitoring and, potentially, regulation.[16] Further, we find that dual-class structures increase the threat of hostile activism via Buy&Hedge and Hedge&Buy techniques, whereas Vote Trading techniques, already least efficient, remain unaffected. Last, we note that simple majority rules are most robust to hostile activism via Buy&Hedge and Hedge&Buy techniques by maximizing the constrained-efficient parameter regions and minimize the loss to shareholders, independent of the labeling of the options.

[15] Whereas activists with an aligned agenda have ample opportunity to communicate and verify their best interests to implement value-increasing reforms, hostile activists must rely on methods that allow them to gain control of the company without bearing the full economic costs. Thus, while decoupling may also aid friendly activists, hostile activists set the benchmark for the efficiency loss from decoupling, cf. Chapter 4.

[16] For instance, our results show that share-blocking systems which prevent one type of Buy&Hedge technique have no benefit when there is no asymmetric information.

3.10 Appendix

Payoffs

Buy&Hedge and Hedge&Buy techniques

Shareholders When the activist offers p per share, a shareholder who sells his share and is not rationed receives a payoff of p. If the shareholder is rationed or rejects the offer, his payoff is equal to the firm value: if the reform is implemented it is $v + \Delta$, if the status quo remains it is v.

Activist If the activist does not buy a hedge, offers p per share, and receives $q(p)$ of the shares, her payoff is

$$\min\{q(p), 1 - \lambda\}(v - p) + b$$

in case she blocks the reform (which requires $q(p) \geq 1 - \lambda$), and

$$\min\{q(p), 1 - \lambda\}(v + \Delta - p)$$

when she does not block the reform.

If the activist buys a hedge for p_h, offers p per share, and receives $q(p)$ of the shares, her payoff is

$$\min\{q(p), 1 - \lambda\}(v - p) + b + (1 - \lambda)\Delta - p_h$$

when she blocks the reform (which requires $q(p) \geq 1 - \lambda$), and

$$\min\{q(p), 1 - \lambda\}(v + \Delta - p) - p_h$$

in case she does not.

Note that depending on the timing, in the second stage of the game, either the cost of the hedge, p_h, or the cost of the shares, $p \min\{q(p), 1 - \lambda\}$, are sunk.

Vote Trading Techniques

Shareholders When the activist offers p per voting right, a shareholder who sells his voting right and is not rationed receives a payoff of p plus the firm value: if the reform is implemented, his total payoff is $p + v + \Delta$, if the status quo remains, it its $p + v$. If the shareholder is rationed or rejects the offer, his payoff is equal to the firm value v or $v + \Delta$, respectively.

Activist If the activist offers p per voting right and receives $q(p)$ of the voting rights, her payoff is

$$b - q(p)p$$

when she blocks the reform (which requires that $q(p) \geq 1 - \lambda$), and

$$-q(p)p$$

in case she does not.

Proofs

Proof of Proposition 3.1

The case in which $b < (1-\lambda)\Delta$ is covered in the body of the text.

Since the outside market charges the fair value for the hedge, the activist is indifferent between hedging her position and not, and because $b > (1-\lambda)\Delta$, she always blocks the reform. Shareholders anticipate this. Since no shareholder is pivotal, they are willing to sell their shares for v if they anticipate that the activist will block the reform, $q^*(p) \geq 1 - \lambda$, or require $v + \Delta$ if they anticipate that the activist will not block the reform, $q^*(p) < 1-\lambda$. This means that when $q^*(p) < 1-\lambda$ but $p \leq v + \Delta$, they are (weakly) better off not selling, such that $q^*(p) \leq 1 - \lambda$ is a best response. If $q^*(p) \geq 1 - \lambda$ and $p \geq v$, they are (weakly) better off selling, such that $q^*(p) \geq 1 - \lambda$ is a best response.

Since $b > (1-\lambda)\Delta$, the activist makes a strict profit by offering p marginally above $v + \Delta$, where $q^*(p) = 1$. Therefore, it cannot be that the equilibrium price p^* is such that $q^*(p^*) < 1-\lambda$ and the activist makes (weakly) negative profits. Further, it has to hold that $p^* \leq v + \Delta$. Otherwise, $p' = \frac{p^*+v+\Delta}{2}$ would always be a profitable deviation. Thus, the equilibrium price has to be $p^* \leq v + \Delta$ and $q^*(p^*) \geq 1 - \lambda$, which implies that $p^* \geq v$.

The continuum of equilibria can be constructed by fixing any $p^* \in [v, v + \Delta]$. If $q^*(p^*) = 1$ and $p^* \geq v$, then selling is a best response for shareholders. For all $p < p^*$ and $q^*(p) = 0$, not selling is a best response. Since the activist chooses the lowest p such that $q^*(p) \geq 1 - \lambda$, the result follows.

Proof of Proposition 3.2

The case in which $b < (1-\lambda)\Delta$ is covered in the body of the text.

If $b > (1-\lambda)\Delta$ and the activist acquired $(1-\lambda)$ shares, the activist always blocks the reform, independent of any hedge. Let her payoff from the buying stage be $W_{hedge}(p_h^*)$ in case she owns a hedge and $W_{nohedge}(p_{nh}^*)$ in case she does not own a hedge.

If p^* is such that $q^*(\cdot, p^*) \geq 1 - \lambda$, then the activist's payoff from paying p^* is $W_{hedge}(p^*) = V_{hedge}(p^*)$ and $W_{nohedge}(p^*) = V_{hedge}(p^*) - (1-\lambda)\Delta$. Note that for p marginally above $v + \Delta$, it must be true that $q^*(\cdot, p) = 1$ such that $W_{hedge}(p) >$

$(1-\lambda)\Delta$, and $W_{nohedge}(p) > 0$. This means that in equilibrium, it has to hold for $p^* \in \{p_h^*, p_{nh}^*\}$ that $q^*(\cdot, p^*) \geq 1-\lambda$. Otherwise, the activist would make a (weakly) negative profit and could profitably deviate to a p marginally above $v+\Delta$. Further, because $p > v+\Delta$ guarantees $q^*(\cdot, p) = 1$, it follows that $p^* \leq v+\Delta$. Otherwise, the activist could always lower her offer to $p' = \frac{p^*+v+\Delta}{2}$ and achieve the same outcome at lower cost. Thereby, the equilibrium price has to be $p^* \leq v+\Delta$ and $q^*(\cdot, p^*) \geq 1-\lambda$, which implies that $p^* \geq v$.

For any $p^* \in [v, v+\Delta]$, there is an equilibrium in which $q^*(\cdot, p^*) \geq 1-\lambda$ and $q^*(\cdot, p) < 1-\lambda$ for all $p < p^* \leq v+\Delta$. Given that $p \leq v+\Delta$, if $q^*(\cdot, p) < 1-\lambda$, shareholders anticipate that the reform will pass and are (weakly) better off not selling. If $p \geq v$ and $q^*(\cdot, p) \geq 1-\lambda$, shareholders anticipate that the reform will pass and are (weakly) better off selling. As a result, there is a continuum of continuation payoffs: $W_{hedge}(p_h^*) \in [b, b+(1-\lambda)\Delta]$ and $W_{nohedge}(p_{nh}^*) \in [b-(1-\lambda)\Delta, b]$.

The outside market correctly anticipates that a hedged activist blocks the reform and charges the fair value $(1-\lambda)\Delta$ for the hedge. The activist buys it, depending on the value of the continuation game. Thus, the hedge has no direct effect on the activist's payoff, but may affect it through equilibrium selection in the continuation game. Taken together, the payoff of the activist is between $b-(1-\lambda)\Delta$ and b.

Proof of Proposition 3.3

Since no shareholder is pivotal with positive probability, the vote's outcome is independent of any individual shareholder's sale. As a result, no shareholder values his voting right, such that $q^*(p) = 1$ for any $p > 0$. It follows that $p^* = 0$. Otherwise, $p' = \frac{p^*}{2} > 0$ would be a profitable deviation for the activist because p' would also guarantee her the voting right, $q^*(p') = 1$, but at a lower cost. Further, $q^*(0) \geq 1-\lambda$. If it was the case that $q^*(0) < (1-\lambda)$, the activist would make zero profits. Hence, she could profitably deviate to a price p marginally above 0 at which $q^*(p) = 1$, securing her all the voting rights at essentially zero cost, thereby guaranteeing her a profit.

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Chapter 4

Shareholder Votes on Sale

Joint with Andre Speit

4.1 Introduction

Shareholder voting is one of the cornerstones of corporate governance. It equips shareholders with the power to enforce their demands, laying the foundation for shareholder activism. Typically, a shareholder's voting rights are determined by her shares on a pro-rata basis—one share, one vote—thereby linking a shareholder's influence to his economic interest. However, activist investors can subvert this principle by acquiring voting rights far in excess of their cash flow claims. While the outright trade of voting rights is illegal in most jurisdictions, financial innovation has created new techniques to decouple voting power and economic exposure—for instance, via the equity lending market. Activist investors were happy to add these new techniques to their toolbox,[1] whereas the decoupling raised eyebrows among policymakers[2] and the press.[3]

In this chapter, we analyze how decoupling techniques relate to traditional forms of shareholder activism, and examine the consequences for corporate governance. We focus on the class of decoupling techniques that are economically equivalent to the outright trade of voting rights, that is, the class of Vote Trading techniques (cf. Chapter 3). In the remainder of the chapter, we simply refer to (the usage of) these techniques as *vote trading*. Importantly, this class includes the most common practice of acquiring voting rights by borrowing shares over the record date

[1] Hu and Black (2006); Hu and Black (2007); Hu and Black (2008b); Hu and Black (2008a) document anecdotal evidence of decoupling. Henceforth, we reference Hu and Black (2008a) as the most recent overview.

[2] Consider, for example, the "SEC Concept Release on the U.S. Proxy System" (July 2010), https://www.sec.gov/rules/concept/2010/34-62495.pdf, the "SEC Staff Roundtable on the Proxy Process" (July 2018), https://www.sec.gov/news/public-statement/statement-announcing-sec-staff-roundtable-proxy-process, or the ESMA's "Call for evidence on empty voting" (September 2011), https://www.esma.europa.eu/press-news/consultations/call-evidence-empty-voting.

[3] The New York Times, April 26, 2012, "The Curious Case of the Telus Proxy Battle", https://dealbook.nytimes.com/2012/04/26/the-curious-case-of-the-telus-proxy-battle/.

(Christoffersen et al., 2007). Our analysis reveals that vote trading unilaterally benefits hostile activists and is not needed for friendly activists to guide corporate decision making as they can rely on traditional intervention techniques such as proxy campaigns.[4]

In a first analysis, we build a simple model in which a finite number of shareholders vote on the implementation of a reform. Shareholders know the reform to be value increasing and, thus, support it. In this setting, there is no need for value-increasing activism. Therefore, we concentrate on the case in which a hostile activist who derives private benefits from the company sticking with the status quo. Shareholders are fully aware of the activist's motives.

We show that despite the activist's transparent motives, the activist can acquire voting rights at prices close to zero and prevent the value increasing reform. This is the result of a market failure in the market for voting rights. The value of a voting right depends on the trading and voting decisions of the other market participants: it only bears value if it is decisive (pivotal) in the outcome of the vote, which is unlikely for any individual voting right. Thus, rational shareholders are willing to sell their voting rights at a price significantly below their individual loss from the blocked reform. This allows the hostile activist to block the value-increasing reform without compensating shareholders.

Competition in the market for voting rights does not fix the market failure and, hence, does not prevent hostile activism. Even if a blockholder is willing to act as a white knight and make a competing offer, he may be at a disadvantage depending on the majority rule. In particular, if the reform requires a supermajority to pass, it may be too expensive for the blockholder to acquire the necessary fraction of voting rights. Therefore, competition reduces the threat of hostile activism, but inefficient outcomes remain.

Our results give a new interpretation of the empirical and anecdotal observations on vote trading. Christoffersen et al. (2007) find that voting rights trade at near-zero prices, which they attribute to common interests of investors. On the other hand, Hu and Black (2008a) present anecdotal evidence of vote trading which yields—prima facie—inefficient outcomes. We reconcile these two seemingly contradictory findings in that we show that low prices need not be a sign of common interests, and inefficient outcomes do not require hidden motives. Instead, our analysis suggests that low prices are caused by a more fundamental market failure. Further, the competitive advantage of a hostile activist in supermajority decisions delivers an explanation for the disproportionate occurrence of vote trading in these decisions,

[4] Our results imply that activist chooses her intervention method as a function of her motives. Hence, the model explains why studies investigating "traditional" shareholder activism (such as Brav et al. (2008)) find positive effects of activism on shareholder value, whereas the evidence on vote trading suggests adverse effects on shareholder value (Hu and Black, 2008a).

as documented by Hu and Black (2008a).

In a second step, we consider the more complex setup in which the activist possesses superior information about the effect of the reform. We ask the question of whether vote trading may be advantageous for corporate governance by fostering information transmission from the activist to other shareholders,[5] and we compare vote trading to other traditional forms of activist interventions. To this end, we extend the model by an uncertain state that determines whether the reform proposal increases or decreases shareholder value. The activist privately knows the state.

If the activist and shareholders have aligned interests, that is, if the activist's private benefit from the status-quo is negligible, vote trading is not necessary for information transmission: the activist can also communicate her superior information via cheap talk, such as public endorsements.

We, thus, focus on the case in which the activist's private benefit from the status quo leads her to oppose the reform in either state, preventing cheap talk. Interestingly, despite the misaligned interests of shareholders and activist, vote trading can facilitate information, and improve firm value in this situation. Shareholders can learn from the activist's vote acquisition: when the activist is endowed with some shares, her willingness to pay for the voting rights is correlated with the state. This gives rise to a separating equilibrium in which the activist prevents the reform more often when it is in the shareholders' interest, increasing firm value. However, the ability to improve shareholder value depends on significant prices for voting rights since those are needed as a costly signal. When shareholdings are dispersed, the emerging low prices prevent an informational benefit. Absent of vote trading, the activist might use other costly signals to achieve the same, or even superior outcomes. Activist investors' traditional methods—the acquisition of a minority stake in the company, or costly proxy fights, for example—can achieve first-best communication, independent of the shareholder structure.

We conclude that vote trading benefits only hostile activists because they cannot rely on traditional forms of activist interventions. As a result, vote trading threatens corporate governance and shareholder value. This is true even in the (unlikely) best-case scenario in which shareholders are fully informed about the activist's motives. Thus, we advocate the regulation of vote trading.

Because inefficient outcomes from the market for voting rights occur even when motives are transparent, policy measures aimed at increasing transparency are not sufficient to restore efficiency and prevent hostile activism. At the same time, vote trading often emerges as a byproduct, such that banning transactions that may be used for vote trading is costly. Consequently, we recommend policy measures that

[5]The informational advantage of vote trading is stressed by Brav and Mathews (2011) as well as Eso et al. (2015).

regulate the eligibility to vote. In particular, we propose regulating entities instead of securities. That is, we argue that any entity who acquires voting rights through vote trading (through a Vote Trading technique, cf. Chapter 3) should not be eligible to vote. Further, our analysis reveals that decisions taken by supermajority rule are especially likely to be blocked by hostile activists. Consequently, our model suggests that simple majority voting helps to prevent hostile activism.

Trading Votes for Shareholder Meetings

In this chapter, we analyze the empirically most relevant decoupling techniques,[6] which are the ones that are economically identical to the outright trade of voting rights (Vote Trading techniques, cf. Chapter 3). For simplicity, we refer to (the usage of) these techniques as *vote trading*. When engaging in vote trading, the activist trades directly with the shareholders, and the economic exposure remains with the shareholders at all times. Only the voting right changes hands for a flat transfer.

In practice, the bulk of vote trading occurs via the equity lending market. Since the possession of a share at the record date suffices to obtain the voting right, an activist investor seeking to acquire voting rights only needs to borrow the shares she wants to vote over the record date. When the lending fee is independent of the share value, as is usually the case, the shareholder (lender) retains the economic exposure and only sells the voting right. The lending fee captures the cost of acquiring the voting right. Alternatively, the same outcome can be achieved through a repo contract in which the cash-providing side (the activist) obtains the shares for a limited amount of time, before selling it back to the collateral providing side (shareholder) at pre-negotiated terms. Again, the initial shareholder fully retains the economic exposure, whereas the activist only secures her right to vote, at a flat price. Last, it is easy to design synthetic assets that are economically equivalent to vote trading.[7]

Empirical Insights from the Equity Lending Market

Christoffersen et al. (2007) provide the first evidence of vote trading via the equity lending market. They find that a significant spike in the volume of share lending over the record date. Kalay et al. (2014) validate this result with a different estimation

[6] Financial innovation has created a multitude of decoupling techniques that diverge in their economic implications depending on the timing, order of transactions, and counterparties. For a more detailed account of the shareholder voting process and an overview over (other) decoupling techniques, see Chapter 3.

[7] For instance, the activist could engage in voting trading by buying synthetic calls, i.e. bundles of shares and a put option, from the shareholder. If the put option is at the money, the activist can exercise it right after the record date, such that she only retains the voting right. In case the activist is hostile and seeks to reduce share value, she will always exercise the option and the economic exposure remains with the shareholder.

approach.[8] Hu and Black (2008a), collect anecdotal evidence of decoupling between 1988 and 2008. They register over 40 decoupling cases, many of which rely on share lending. In those cases, the additional voting rights were used to influence decisions over diverse issues, ranging from management entrenchment to takeover approvals. The practice continues to be popular with activists, as the recent fight for control of Premier Foods (2018) highlights.[9] Arguably, one of the reasons for this popularity of the equity lending market as a platform for vote trading is its size and liquidity. Within the U.S. stock market, for instance, an average of 20% of a company's shares is available for borrowing (Campello et al., 2019).[10][11]

Besides providing empirical evidence of an active and sizable market for voting rights, Christoffersen et al. (2007) and Kalay et al. (2014) also estimate the market price of voting rights. Christoffersen et al. (2007) find no significant prices for voting rights, whereas Kalay et al. (2014) estimate significant but small prices. Christoffersen et al. (2007) interpret their findings as a sign of common values. Because all investors supposedly share the same interests, there is no need to charge positive prices for voting rights. Instead, investors are willing to delegate their voting rights to more informed parties. This argument, however, seems to be at odds the findings of Hu and Black (2008a); most of the their cases resulted in—prima facie—–inefficient outcomes and reduced shareholder value. While different in detail, the cases share a common feature in that voting rights acquired by a single hostile activist were used to block supermajority decisions.

Our theory reconciles the empirical findings of positive trading volume, low prices, and inefficient outcomes. We show that a market failure in the market for voting rights leads to low prices, enabling hostile activism. Those inefficient outcomes do not require hidden motives by the activist.[12]

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[8] Kalay et al. (2014) focus on decoupling techniques that work via the options market and are not equivalent to the outright trade of voting rights (i.e. no Vote Trading techniques, cf. Chapter 3), i.e. the class of decoupling techniques analyzed in this chapter. However, they also use their methodology to analyze data from the equity lending market.

[9] Financial Times, July 15, 2018, "Market reverberates with accusations of empty voting", https://www.ft.com/content/0e28929e-85dd-11e8-a29d-73e3d454535d.

[10] With the continuing growth in popularity of ETFs, which use share lending as an integral part of their business model, the size of this market is likely to expand—see, for example, Deutsche Bundesbank Monthly Report, October 2018, https://www.bundesbank.de/resource/blob/766600/2fd3ae4f0593fb2ce465c092ce40888b/mL/2018-10-exchange-traded-funds-data.pdf.

[11] Campello et al. (2019) show that companies try to limit the number of lendable shares with share buybacks, and argue that they do so to limit short-selling opportunities. Our results give another rationale for the buyback—namely that placing a limit on the number of lendable shares limits the number of votes that can be bought via the equity lending market.

[12] Hu and Black (2007) point out that there may be other issues, such as lack of transparency in the market for voting rights and pivotality considerations. We pick up on this issue of pivotality and formalize it.

The chapter is structured into five sections. Section 4.2 reviews the literature. In Section 4.3 we show that vote trading in a symmetric information setting uniquely benefits a hostile activist who can exploit a market failure in the market for voting rights. In Section 4.4 we investigate the effect of vote trading when the activist has superior information about the correct course of action. We compare vote trading with traditional forms of activist interventions. We draw conclusion from our findings in Sections 4.5, before developing policy recommendations in Section 4.6. All proofs are relegated to the appendix.

4.2 Literature

Decoupled economic interest and voting power has been studied in the context of dual-class share structures and takeovers. Grossman and Hart (1988) as well as Harris and Raviv (1988) provide conditions under which a single share class is optimal. Gromb (1992) proves that reducing the number of voting shares increases shareholders' likelihood of being pivotal, thereby reducing shareholders' free-riding incentives. Burkart et al. (1998) shows that if private benefits are an endogenous choice by the winning bidder after the takeover, reducing the number of voting shares necessary for control can increase welfare. When bidders have private information about the post-takeover value of the firm, At et al. (2011) show that dual-class shares can facilitate value-increasing corporate takeovers. For a detailed overview of the theoretical literature on dual-class shares and takeovers, compare Burkart and Lee (2008). Adams and Ferreira (2008) summarize the empirical literature on dual-class shares, stock pyramids, and cross-ownership. They find that the value of voting rights differs substantially across countries, time frames, and analysis, but can be quite significant. However, trading dual-class shares to decouple voting rights and economic interests is not equivalent to the outright trade of voting rights (i.e. no Vote Trading technique, cf. Chapter 3), such that it has different economic implications.

Burkart and Lee (2015) show how the free-rider problem and asymmetric information can be overcome by the usage of option contracts. In the context of contests for corporate control, Dekel and Wolinsky (2012) find that allowing for vote trading in addition to share trading may increase the probability that an inefficient bidder takes over the company. Neeman and Orosel (2006) consider a repeated control contest among an incumbent manager and a challenger in which vote trading can be used as a signaling device. Blair et al. (1989) analyze the effect of taxation in a takeover contest where shares and votes can be traded separately. In political economy, Dekel et al. (2008) consider a contest between two political party's which can either buy votes or bribe voters. The authors find that overall payments are substantially higher when parties can pay bribes. Dekel et al. (2009) introduce budget constraints to this setting. Their model is related to our competition game, as we discuss in Section 4.3. Casella et al. (2012) demonstrate that the market for voting rights does not have a competitive equilibrium; thus, they introduce an "ex-ante vote trading equilibrium." They identify conditions under which vote trading fails to aggregate preferences and generates welfare losses relative to simple majority voting.

Neeman (1999) and Bó (2007) argue that a single buyer can acquire voting rights at zero prices. Neeman (1999) shows that when the number of voters grows large, a zero-price equilibrium is the only pure strategy equilibrium robust to noise voters. Bó (2007) shows that when an activist can write arbitrary, outcome-dependent contracts, she can bribe voters to vote for her at zero cost.

Brav and Mathews (2011) examine the effects of vote trading in the presence of an informed activist who can either buy shares or sell them short. Shareholders are no strategic players, but are noise voters. By assumption, the activist can acquire a certain fraction of their voting rights for free. The activist is more likely to be pivotal when she has aligned interests because additional shares also provide her with additional voting rights. As a consequence, vote trading increases the expected welfare. In Eso et al. (2015), only shareholders with (conditionally) aligned interests participate in the market for voting rights. They use the market as a way to delegate their voting rights to the most informed parties, aiding information aggregation and ensuring that partisans are out-voted.

This chapter is also related to the literature on shareholder voting. Yermack (2010) summarizes the empirical literature on shareholder voting in United States based companies, whereas Iliev et al. (2015) present evidence for the importance of shareholder voting in non-U.S. firms. Shapiro and Bar-Isaac (2019) show that a blockholder may optimally abstain from voting all of his shares to not crowd out information of other shareholders. This requires alignment of interests among the blockholder and other shareholders. Levit and Malenko (2011) show that non-binding shareholder voting may fail to aggregate information when interests between management and shareholders only partially align. Malenko and Malenko (2019) study the effect of proxy advisors on information acquisition and voting behavior of shareholders. Levit et al. (2019) analyze the effect of share trading opportunities on shareholder voting, the shareholder base, and the optimal board design.

4.3 Symmetric Information

Model

We revisit the model of Chapter 3 but with a finite number of shareholders and an activist who may own shares in the company.

Investors Consider a public company with $n \in \mathbb{N}$ shares outstanding. Each share consists of a cash-flow claim and a voting right. The company is owned by two types of investors: an activist investor who owns $\alpha n \in \mathbb{N}_0$ shares and $(1-\alpha)n = n_S \geq 3$ ordinary shareholders who hold a single share each. Henceforth, we will refer to the activist shareholder as *activist*, A, and to the ordinary shareholders as *shareholders*, S, although the activist can be a shareholder herself. All investors are risk neutral.

Shareholder meeting The company has an upcoming shareholder meeting with a single, exogenously given reform proposal on the agenda. The vote is binding,[13] and the reform is implemented if at least $\lambda n \in \mathbb{N}$ votes are cast in favor of it. Otherwise, the status quo prevails. We assume that $1 - \lambda > \alpha$, such that the activist cannot block the reform unilaterally and that $1 < \lambda n < n_S$, meaning that an individual shareholder can neither block, nor implement the reform.

Payoffs If the company sticks with the status quo, the company's total share value remains unchanged at $v > 0$; if the reform is implemented, the company's value increases by $\Delta > 0$ to $v + \Delta$.

Despite the positive effect of the proposed reform on firm value, the activist may oppose it as she gains private benefits $b > 0$ from the status quo. These private benefits can, for instance, stem from other assets in her portfolio.[14] Debt in the same company may reduce the risk appetite, common ownership leading to anti-competitive preferences[15] or different supplier choices. Alternatively, the status-quo may allow the activist to (continue to) extract b at a cost to the firm of Δ. In any case, we take b to be exogenously given and fixed. In summary, the payoffs are

	activist	shareholder
status quo	$\alpha v + b$	$\frac{v}{n}$
reform	$\alpha(v + \Delta)$	$\frac{v+\Delta}{n}$.

When $b < \alpha\Delta$, the activist and the shareholders have aligned interests and both prefer to implement the reform; the activist is *friendly*. If $b > \alpha\Delta$, the activist prefers the company to stick with the status quo, in which case she is *hostile*. Since

[13] In the US binding shareholder voting occurs in the context of by-law amendments, acquisitions, and equity restructuring. In other countries, such as countries of the EU, shareholder decisions are usually binding.

[14] In 2004, during the acquisition of MONY by AXA, bond holdings introduced a wedge in the interest of MONY shareholders, compare https://www.nytimes.com/2004/05/19/business/holders-of-mony-approve-1.5-billion-sale-to-axa.html.

[15] Compare Azar et al. (2018) for empirical evidence on the effects of common ownership.

the friendly activist has no effect on the outcome of the decision under symmetric information, in this section we focus on this case of a hostile activist. Further, we think of the private benefit b as relatively small compared to the overall change in firm value Δ. In particular, we assume that $b < \Delta$, such that the reform increases welfare.[16]

Voting Stage

As usual, the voting stage has degenerate equilibria in which all investors either vote for the status quo or the reform. When no voter can swing the outcome of the vote unilaterally, voting independent of the own preferences is a best response. However, these strategies are weakly dominated and yield peculiar equilibria, such that we rule them out. We assume that if an investor's voting decision does not affect the outcome of the vote, she votes for her preferred alternative. Hence, the activist casts all of her votes in favor of the status quo and the shareholders in favor of the reform. The outcome of the vote is, thereby, uniquely determined by who owns how many voting rights at the time of the meeting.

In the following, we do not model the voting stage explicitly but only use that the activist can block the reform if she controls at least $(1-\lambda)n+1$ voting rights. Given that $\alpha < (1-\lambda)$, this means that she needs $m = (1-\lambda-\alpha)n+1$ additional voting rights to prevent the reform. Otherwise, the efficient reform is implemented.

Vote Trading

We now allow the activist to acquire voting rights, for instance by borrowing shares over the record date.

Suppose the activist can make a public take-it-or-leave-it offer $p \in \mathbb{R}_+$ per voting right. The offer is restricted, meaning that the activist can set an upper bound on the number of voting rights she is willing to acquire. If more shareholders sell to her, they are rationed. It is without loss to assume that the activist sets an upper bound at $m = (1-\lambda-\alpha)n+1$ voting rights. Having observed the offer p, shareholders simultaneously decide whether to sell. To capture the anonymity among shareholders, we consider symmetric strategies represented by a response function $q : \mathbb{R}_+ \rightarrow [0,1]$ mapping any offer p into an acceptance probability $q(p)$. As a result, the number of shareholders who accept is a binomial random variable $M(n_S, q(p)) \sim Bin(n_S, q(p))$. Since shareholders are rationed when $M(n_S, q(p)) > m$, the activist acquires $\bar{M}(n_S, q(p)) = \min\{M(n_S, q(p)), m\}$ voting rights.

Suppose that the activist offers price p and the shareholders respond by mixing with probability $q(p)$. If the activist buys fewer than m votes, the company's value

[16] If $b \geq \Delta$, the activist could simply take over the company and block the reform, maximizing welfare.

rises to $v+\Delta$. As a result, her payoff is $\alpha(v+\Delta)-pM(n_S,q(p))$. To the contrary, if $M(n_S,q(p))\geq m$, the firm value remains at v and the activist receives the private benefit b, such that her payoff is $\alpha v+b-pm$. Together, this yields an expected payoff of

$$\Pi_A(p;q)=\alpha(v+\Delta)+\mathbb{P}[M(n_S,q(p))\geq m](b-\alpha\Delta)-p\mathbb{E}[\bar{M}(n_S,q(p))]. \tag{4.1}$$

A shareholder's payoff depends on her selling decision as well as the behavior of the other n_S-1 shareholders. Fix one shareholder, suppose that the activist offers price p and that the other shareholders respond by mixing with probability $q(p)$. If the shareholder decides to sell his voting right but fewer than $m-1$ other shareholders also sell, the reform passes and the shareholder's payoff is $p+\frac{v+\Delta}{n}$. Conversely, if at least $m-1$ of the other shareholders also sell their voting rights, the reform is blocked and the share value remains at $\frac{v}{n}$. Further, if more than $m-1$ other shareholders sell, i.e. $M(n_S-1,q(p))>m-1$, the shareholder is rationed. In this case, his payoff is

$$p\frac{m}{M(n_S-1,q(p))+1}+\frac{v}{n}.$$

If the shareholder does not sell his voting right, but at least m other shareholders do, the reform is blocked and his payoff is $\frac{v}{n}$. Otherwise, it rises to $\frac{v+\Delta}{n}$. In expectation, this means that a shareholder's payoff is

$$\Pi_S(\text{sell};p,q)=\frac{v+\Delta}{n}-\mathbb{P}[M(n_S-1,q(p))\geq m-1]\frac{\Delta}{n}+p\frac{\mathbb{E}[\bar{M}(n_S,q(p))]}{n_Sq(p)}$$

if he sells his voting right and

$$\Pi_S(\text{keep};p,q)=\frac{v+\Delta}{n}-\mathbb{P}[M(n_S-1,q(p))\geq m]\frac{\Delta}{n}$$

if he keeps his voting right. The fraction $\frac{\mathbb{E}[\bar{M}(n_S,q(p))]}{n_Sq(p)}$ is the probability not to be rationed.[17]

We consider subgame perfect equilibria.

Proposition 4.1 *For any n, an equilibrium (p^*,q^*) exists. If $q^*(p^*)>0$ and, thereby, $\mathbb{P}[M(n_S,q^*(p^*))\geq m]>0$, then*

$$\underbrace{p^*\mathbb{E}[\bar{M}(n_S,q^*(p^*))]}_{\mathbb{E}[total\ transfer]}<m\underbrace{\frac{\Delta}{n}\cdot\mathbb{P}[M(n_S,q^*(p^*))\geq m]}_{\mathbb{E}[loss\ per\ shareholder]}. \tag{4.2}$$

Further,

[17] Compare (4.7) in the appendix for an explicit derivation of the expression.

- *there always is an equilibrium in which* $p^* = 0$ *and* $q^*(0) = 1$;
- *as* n *grows large, along any sequence of equilibria,*

$$\lim_{n\to\infty} \mathbb{P}[M(n_S, q^*(p^*)) \geq m] = 1 \quad \textit{and} \quad \lim_{n\to\infty} p^*\mathbb{E}[\bar{M}(n_S, q^*(p^*))] = 0.$$

Proposition 4.1 establishes that the activist can obtain the blocking minority without the need to (fully) compensate the shareholders (4.2). Whenever there is trade,[18] shareholders suffer a strict loss. This is possible because the activist can exploit two inefficiencies, which create a market failure in the market for voting rights.

First, there is the externality of voting. The λ-majority-rule implies that only $(1-\lambda)n+1$ votes have to be cast against the reform to block it. This blocking minority does not internalize the effect of their behavior on the rest of the shareholders. As a result, it would suffice if the activist compensated m shareholders for their individual loss of $\frac{\Delta}{n}$.

However, the activist can do even better and pays less than m times the expected loss of a shareholder (4.2). A shareholder's valuation for her voting right depends on the selling decisions of the other shareholders. The voting right is only valuable if it is decisive or pivotal in the vote—that is, if exactly $m-1$ other shareholders sell their voting rights. Therefore, any shareholder compares the expected payment the activist offers with the expected loss in case the reform is blocked, but weighs the expected loss with the probability to be pivotal. In particular, if the activist offers p and the other shareholders sell with probability $q(p)$, a shareholder prefers to sell if $\Pi_S(\text{sell}; p, q) \geq \Pi_S(\text{keep}; p, q)$, which rearranges to

$$\underbrace{p\frac{\mathbb{E}[\bar{M}(n_S, q(p))]}{n_S q(p)}}_{\mathbb{E}[payment]} \geq \underbrace{\mathbb{P}[M(n_S-1, q(p)) = m-1]}_{\mathbb{P}[pivotal]} \underbrace{\frac{\Delta}{n}}_{loss}. \tag{4.3}$$

As $m = (1-\lambda-\alpha)n+1 \in \{2, ..., n_S-1\}$, the probability of being pivotal is always strictly smaller than 1.[19] Hence, there is a dilution of control and the activist can acquire the voting rights at a discount.

The proof of Proposition 4.1 further shows that as the population of shareholders grows, the probability that any single shareholder is pivotal quickly converges to zero. Therefore, any equilibrium outcome approaches the most extreme one in which every shareholder sells his voting rights to the activist for free, and the activist always

[18] Whenever n and b are sufficiently small, there may also be an equilibrium in which $p^* = 0$ and $q^*(p^*) = 0$.

[19] If $q \in \{0, 1\}$, such that every other or no other shareholder sells, $\mathbb{P}[pivotal] = 0$ and the shareholder sells at any positive price. For all $q \in (0, 1)$, every or no shareholder sells with strictly positive probability, such that $\mathbb{P}[pivotal] < 1$.

blocks the reform.

When the number of shareholders is sufficiently large, the market failure that creates inefficient outcomes occurs across all symmetric equilibria, such that our result does not rely on an equilibrium selection. Further, Neeman (1999) shows that the zero-price equilibrium is the only asymmetric equilibrium robust to noise voters; this highlights the robustness of our results.

Conditional or Unrestricted Offers

Restricted offers are natural since an activist only needs to acquire a fraction of the voting rights. Further, shareholders correctly anticipate the possibility to be rationed (left side of (4.3)), and demand a higher price to compensate for the possibility. Thereby, the restriction has no effect on the transfers, and Proposition 4.1 is completely driven by the shareholders' pivotality considerations. If we were to consider unrestricted offers, the results would remain unchanged for large n. For small n and large b, the activist may choose a price that gives her, in expectation, more than m voting rights, to guarantee that she can block the reform. As a result, when there are few shareholders, the total transfer can exceed $m\frac{\Delta}{n}$. In the alternative case in which the activist can restrict the offer and condition it on the event that at least m shareholders agree to sell their voting right, the result of Proposition 4.1 is strengthened: for any n, only the zero-price equilibrium survives. We prove the results in Lemmas 4.7 and 4.8 in the appendix.

Competing Offers

We now investigate how the market failure and the resulting threat of hostile activism reacts to competition by a friendly blockholder. To that end, suppose that there is such a blockholder B who owns $\beta n \in \mathbb{N}$ shares but $\beta < \lambda$ such that he cannot implement the reform unilaterally. The number of ordinary shareholders is $n_S = (1-\alpha-\beta)n \in \mathbb{N}$. As before, activist A first makes an offer p_A for $m_A = (1-\lambda-\alpha)n+1$ voting rights. After observing A's offer, blockholder B, acting as a white knight who wants to implement the reform, jumps in and makes a counteroffer p_B for up to $m_B = (\lambda - \beta)n = n_S - m_A + 1$ voting rights. Thus, B's strategy is a function $p_B : \mathbb{R}_+ \to \mathbb{R}_+$ which maps any offer p_A into a counteroffer $p_B(p_A)$.

Note that for the shareholders, selling the voting rights to the blockholder dominates holding onto them. Thus, every shareholder (tries to) sell his voting right to either the activist or the blockholder. The symmetric best response function of shareholders is given by $q : \mathbb{R}_+ \times \mathbb{R}_+ \to [0, 1]$, where q is the probability that shareholders sell to A and $1 - q$ the probability that they sell to B. Further, define $\bar{M}_A = \max\{M(n_S, q), m_A\}$ and $\bar{M}_B = \max\{n_S - M(n_S, q), m_B\}$ as the random number of shares A and B actually acquire. Again, we consider subgame perfect equilibria.

Proposition 4.2 *For any n, an equilibrium (p_A^*, p_B^*, q^*) exists.*

1. *If $\frac{b-\alpha\Delta}{1-\lambda-\alpha} > \frac{\beta\Delta}{\lambda-\beta}$ and n is sufficiently large, the reform is always blocked, $q^*(p_A^*, p_B^*(p_A^*)) = 1$. Further,*
$$p_A^*\mathbb{E}[\bar{M}_A(n_S, q^*(p_A^*, p_B^*(p_A^*)))] = p_A^* m_A < \frac{1-\lambda-\alpha}{\lambda-\beta}\beta\Delta$$
but $\lim_{n\to\infty} p_A^*\mathbb{E}[\bar{M}_A(n_S, q^*(p_A^*, p_B^*(p_A^*)))] = \frac{1-\lambda-\alpha}{\lambda-\beta}\beta\Delta$.
2. *If $\frac{b-\alpha\Delta}{1-\lambda-\alpha} < \frac{\beta\Delta}{\lambda-\beta}$, as n grows large, along any sequence of equilibria, the reform becomes certain, $\lim_{n\to\infty}\mathbb{P}[M_A(n_S, q^*(p_A^*, p_B^*(p_A^*)) \geq m_A] = 0$, and transfers converge to zero, $\lim_{n\to\infty} p_A^* n_S = \lim_{n\to\infty} p_B^*(p_A^*) n_S = 0$.*

When the shareholdings are dispersed, i.e. n and m_A, m_B are large, no individual shareholder is pivotal with substantial probability. Thus, he simply sells to the investor who offers the higher expected payment, anticipating the different probabilities to be rationed. How much A and B are willing to offer depends on their willingness to pay, $b - \alpha\Delta$ and $\beta\Delta$, as well as the number of shares they have to acquire, $(1 - \lambda - \alpha)n + 1$ and $(\lambda - \beta)n$. In particular, the activist has a comparative advantage when she has to acquire fewer shares than the blockholder, $\frac{(1-\lambda-\alpha)n+1}{(\lambda-\beta)n} \approx \frac{1-\lambda-\alpha}{\lambda-\beta} < 1$. Note that this is true whenever λ is large, such that competition is unlikely to deter hostile activism in supermajority decisions. Further, the compensation shareholders receive when the activist blocks the reform is decreasing in λ. Surprisingly, when λ is large, the total transfer from the activist to the shareholders can be substantially below the expected loss of the blockholder. When the hostile activist succeeds and blocks the reform, welfare is reduced, although small shareholders may be (partially) compensated.

If the blockholder deters the activist from making an offer, vote prices in our model are close to zero. On the other hand, if the blockholder cannot deter the activist, the activist has to pay a strictly positive transfer. The analysis by Dekel et al. (2009) suggest that strictly positive prices may be the result of the offer structure. Dekel et al. (2009) show that the unique trading price is zero if the activist and the blockholder can sequentially adjust their offer upwards, and if there is a continuum of shareholders.[20] Therefore, (close to) zero prices and a positive trade volumes do not signal an absence of competition or aligned interests.

[20] Dekel et al. (2009) analyze a game with a continuum of voters in which the two contestants make alternating, increasing offers until one stops. By an unraveling argument, the loser does not compete because she would acquire a strictly positive fraction of the voting rights at a positive price without changing the outcome of the vote.

Discussion

In markets for standard assets without externalities, voluntary trade produces Pareto improvements. We show that this intuition cannot be transferred to the market for voting rights. Not only does voting create an externality of the majority on the minority, but there is a market failure in the voting right market that goes beyond the externality of voting. The activist does not even compensate m shareholders for their loss; she pays close to zero compensation. This market failure is the result of the relative value of a voting right, which depends entirely on the other investors' trading and voting decisions and is close to zero when the shareholdings are dispersed. Importantly, it does not depend on hidden motives by the activist or the details of the modeling approach.[21] As long as shareholders do not believe that they are pivotal with probability one, the voting rights trade at inefficiently low prices.

As we show further, competition in the market for voting rights does not eliminate the market failure and, by extension, cannot solve the problem of hostile activism. The threat of competition by a blockholder may deter hostile activists without raising voting right prices, but relies on the blockholder's willingness to pay as well as the number of voting rights he and the activist must acquire.

As pointed out previously, we do not consider a friendly activist in this section since she would not change the outcome of the vote. When the optimal decision is common knowledge, an activist only plays a role if she has misaligned interests, i.e. is hostile. Hence, in a symmetric information setting, vote trading uniquely aids hostile activists. In Section 4.4 we investigate the situation with asymmetric information.

Empirical predictions Our model jointly explains low prices for voting rights (Christoffersen et al. (2007), Kalay et al. (2014)) and inefficient outcomes caused by hostile activists which engage in vote trading (Hu and Black, 2008a).

Moreover, we show that active blockholders may deter hostile activists from acquiring voting rights, such that it is less likely to occur in companies with large, active blockholders. Interestingly, the competition does not need to increase prices in order to deter vote trading. Hence, the observed low prices in the market for voting rights do not necessarily indicate a lack of competition.

Last, our results imply that supermajority decisions are particularly likely to be targeted by hostile activists. In addition to market frictions, decisions that require a supermajority for approval give her a distinct advantage over any potential competitor. This fits the anecdotal evidence of Hu and Black (2008a) showing that most incidents of vote trading occurred when a hostile activist blocked a reform that required a supermajority.

[21] Casella et al. (2012) show that a competitive equilibrium does not exist. Instead, they consider a novel equilibrium concept, and show that vote trading can reduce (expected) welfare.

4.4 Asymmetric Information

In the previous section, we established that in a symmetric information setting, vote trading promotes hostile activism, threatening corporate governance and shareholder value. Certainly, activism can also be put to good use.[22] Shareholders often rely on activist investors for their professional insights and analysis to identify value-increasing reforms. However, this mutually beneficial relationship is hindered by ulterior motives of the activist which can make it hard for her to communicate with the shareholders. To solve this problem, activists engage in proxy fights and disclose their share position to convince shareholders of their best intentions.

In this section, we investigate the possibilities of vote trading to improve corporate governance under asymmetric information.[23] To this end, we consider a version of the model in which the activist possesses private information about the optimal reform decision. We compare vote trading with traditional forms of intervention, which we identify by their potential to (credibly) communicate the information. The analysis is split into two cases: when the activist and the shareholders have common interests (friendly activist), and when the activist always wants to block the reform (hostile activist).

Model

States and payoffs We extend the model by introducing an uncertain state $\omega \in \{Q, R\}$ with prior probability $\rho \in (0, \frac{1}{2})$ that the state is Q. The activist investor, A, knows the state, the shareholders, S, do not. Throughout Section 4.4, the activist has a strictly positive share endowment, $\alpha > 0$.

Again, the activist obtains private benefits whenever the status quo remains. The reform, however, is not uniformly beneficial for shareholders. In state Q, the reform reduces firm value by Δ, such that shareholders also prefer the status quo over the reform; in state R the reform raises firm value by Δ. As a result, the payoffs are

Q	activist	shareholder	R	activist	shareholder
status quo	$\alpha v + b$	$\frac{v}{n}$	status quo	$\alpha v + b$	$\frac{v}{n}$
reform	$\alpha(v - \Delta)$	$\frac{v-\Delta}{n}$	reform	$\alpha(v + \Delta)$	$\frac{v+\Delta}{n}$.

[22] Compare Brav et al. (2008); Brav et al. (2015) for an empirical analysis of the effects of hedge fund activism.

[23] Brav and Mathews (2011) and Eso et al. (2015) stress the positive effect of vote trading on information transmission and aggregation.

Voting Stage

Shareholders try to maximize their (expected) share value by matching the state. Let ξ be the shareholders' belief that the state is Q at the time of the vote. As before, we ignore degenerate equilibria where voters play weakly dominated strategies. This means that if $\xi < \frac{1}{2}$, shareholders vote for the reform, and if $\xi > \frac{1}{2}$, they vote for the status quo. Absent of any additional information $\xi = \rho < \frac{1}{2}$, meaning that shareholders vote for the reform. The activist knows the state and matches it whenever $b < \alpha\Delta$, but she always votes in favor of the status quo whenever $b > \alpha\Delta$. As noted before, we refer to these two cases as a *friendly activist* and *hostile activist*, respectively.

Friendly Activist, $b < \alpha\Delta$

When the activist has superior information valuable to shareholders, she can potentially improve corporate decision making. Therefore, we also need to analyze the friendly activist, who did not change the outcome of the decision in the symmetric information case.

Vote Trading

Suppose the activist can make a public take-it-or-leave-it offer $p \geq 0$ for up to m voting rights. Alternatively, the activist may make no offer, which we denote by $\emptyset$.[24] Since the activist's offer depends on the state, her strategy becomes $p : \{Q, R\} \to \mathbb{R}_+ \cup \emptyset$. Having observed the offer, any individual shareholder updates her belief to $\xi(p)$ and sells with probability $q(p) \in [0, 1]$.

Because the activist votes for the firm-value maximizing decision, shareholders benefit from selling their voting right to her. The activist, on the other hand, tries to acquire the voting rights or steer the decision at the lowest possible cost. The payoffs are stated explicitly in the proof of Lemma 4.1.

We solve the game for perfect Bayesian equilibria.

Lemma 4.1 *An equilibrium $(p^*, q^*; \xi^*)$ exists. In any equilibrium,*

- *the activist offers $p^*(\omega) = 0$ in at least one state $\omega \in \{h, \ell\}$;*
- *the reform is implemented in state R and the status quo remains in state Q.*

By Lemma 4.1, vote trading increases the probability that the state is matched from $1 - \rho$ to 1. Since this is in the best interest of both shareholders and the activist, welfare rises from $v + (1 - 2\rho)\Delta$ to $v + (1 - \rho)\Delta + \rho b$. This improvement

[24] Such an action would be (weakly) dominated by offering zero in the symmetric information game.

is achieved through one of two types of equilibria. In the “delegation equilibrium,” the activist acquires all voting rights for $p^*(Q) = p^*(R) = 0$. Shareholders know that the activist has aligned interests and that she implements the correct decision, such that they cede their voting rights to her.[25] In a “signaling equilibrium,” the friendly activist only offers to purchase the voting rights in one state. Therefore, the presence (or lack) of an offer reveals the state to the shareholders and they vote in favor of the correct decision.

Costless Communication

Whenever the activist is friendly, there are other forms of activist interventions by which she can ensure that the correct decision is implemented. She just has to communicate the optimal decision to the shareholders.

Formally, suppose that the activist cannot acquire voting rights but communicates with the shareholders before the meeting by sending a message from $\{0,1\}$. Thus, a strategy for the activist is a mapping from the state into the binary message space $\mu : \{Q, R\} \to \{0,1\}$. Having observed $\mu(\omega)$, shareholders form posterior $\xi(\mu(\omega))$ and vote for the status quo if $\xi(\mu(\omega)) > \frac{1}{2}$, and vote for the reform if $\xi(\mu(\omega)) < \frac{1}{2}$. We consider perfect Bayesian equilibria.

Lemma 4.2 *There is an equilibrium $(\mu^*; \xi^*)$ in which the activist sends $\mu^*(Q) \neq \mu^*(R)$, such that shareholders learn the state. Thereby, the reform is implemented in state R and the status quo remains in state Q.*

Since shareholders and the friendly activist have aligned interests, they follow her recommendation, such that the correct decision is taken and welfare is maximized. Thus, vote trading does not have a unique upside when the activist is friendly.

In practice, means of (cheap talk) communication are readily available and there is a long-standing tradition of activist investors endorsing company policies or publicly venting their discontent with management, be it through public statements, interviews, or 13D attachments. Further, the internet significantly simplifies the communication among shareholders, and regulatory authorities have deliberately removed legal obstacles to foster communication. For example, proxy rule amendments made in 2007 by the U.S. Securities and Exchange Commission (SEC) encourage electronic shareholder forums with this in mind. Christopher Cox, who served as SEC chairman at that time, summarized the reform, saying,[26]

[25] Observe that while such an equilibrium also exists in the game with a hostile activist, the rationale here is different. Shareholders benefit from delegating their voting rights, such that they strictly prefer to do so, independent of pivotality considerations.

[26] SEC press release, November 28, 2007, http://www.sec.gov/news/press/2007/2007-247.htm.

"Today's action is intended to tap the potential of technology to help shareholders communicate with one another and express their concerns to companies in ways that could be more effective and less expensive. The rule amendments are intended to remove legal concerns, such as the risk that discussion in an online forum might be viewed as a proxy solicitation, that might deter shareholders and companies from using this new technology."

Ultimately, there is another channel by which the correct decision can be implemented by the friendly activist: delegation. Uniformed shareholders have an incentive to give a proxy to the informed, friendly activist free of charge. This allows the friendly activist to implement the correct decision in their place, resulting in the same Pareto improvement that vote trading offers.

Hostile Activist, $b > \alpha\Delta$

As we have seen in the last section, vote trading as well as other forms of costless communication or delegation can improve corporate governance and shareholder value when the activist is friendly. When the activist is hostile, however, she always wants to block the reform, such that she cannot transmit information to shareholders via cheap talk, and shareholders are unwilling to delegate their voting rights. However, we show in this section that vote trading might still improve corporate governance and the expected firm value. We then investigate whether traditional forms of intervention can have similar benefits.

Vote Trading

Again, the activist can make a public take-it-or-leave-it offer p for up to m voting rights. Shareholders update their belief to $\xi(p)$ and decide with which probability to sell, $q(p)$. Thus, strategies are $p : \{Q, R\} \to \mathbb{R}_+$ and $q : \mathbb{R}_+ \to [0, 1]$.

The shareholders' posterior belief about the state, $\xi(p)$, affects their expected loss when the activist blocks the reform. When $\xi(p) > \frac{1}{2}$, shareholders actually prefer the status quo, fixing the firm value at v. In this case, shareholders' incentives are aligned with those of the activist and selling to the activist does not change the outcome of the vote, such that there is no expected loss in firm value when the activist blocks the reform. On the other hand, when $\xi(p) < \frac{1}{2}$, shareholders prefer the reform since it increases the expected firm value to $v+(1-2\xi(p))\Delta$. Thus, when the activist blocks the reform, shareholders incur a loss of $(1 - 2\xi(p))\frac{\Delta}{n}$.[27]

[27] Fully spelled out, this means that

$$\Pi_S(\text{sell}; p, q, \xi) = \frac{v}{n} + (1 - \mathbb{P}[M(n_S - 1, q(p)) \geq m - 1]) \max\{0, 1 - 2\xi(p)\}\frac{\Delta}{n} + p\frac{\mathbb{E}[\bar{M}(n_S, q(p))]}{n_S q(p)},$$

$$\Pi_S(\text{keep}; p, q, \xi) = \frac{v}{n} + (1 - \mathbb{P}[M(n_S - 1, q(p)) \geq m]) \max\{0, 1 - 2\xi(p)\}\frac{\Delta}{n}.$$

The activist's payoff is also influenced by the shareholders' belief, $\xi(p)$, because it determines their voting behavior. Suppose that $\xi(p) < \frac{1}{2}$, such that shareholders who do not sell their voting right vote for the reform. In state R, the activist's payoff is given by equation (4.1), whereas in state Q, it is

$$\Pi_A(p; q, \xi, Q) = \alpha(v - \Delta) + \mathbb{P}[M(n_S, q(p)) \geq m](b + \alpha\Delta) - p\mathbb{E}[\bar{M}(n_S, p(q))].$$

If $\xi(p) \geq \frac{1}{2}$ and shareholders who do not sell their voting right vote against the reform, the activist's payoff is $\alpha v + b - p\mathbb{E}[\bar{M}(n_S, p(q))]$, independent of the state.

Since $\alpha > 0$, the activist's willingness to pay for the voting rights is higher in state Q than in state R. As a result, there are separating perfect Bayesian equilibria in which vote trading can be welfare increasing. The following exemplary equilibrium illustrates this effect.

Example Suppose there are $n = 4$ shares and that the activist and three other shareholders each own one share. The reform changes firm value by $\Delta = 1$, whereas the status quo provides the activist with a private benefit of $b = \frac{1}{2}$. The prior probability of state Q is $\rho = \frac{1}{4}$, such that, in expectation, the shareholders benefit from the reform. The activist, on the other hand, wants to block the reform in either state. The reform requires a simple majority; in case of a tie, it is implemented as well. Thus, the activist needs to acquire $m = 2$ voting rights to prevent the reform.

There is an equilibrium in which $p^*(Q) = \frac{1}{8}, p^*(R) = 0, q^*(p^*(Q)) = 1$ and $q^*(p^*(R)) = 0$. In this separating equilibrium, the reform is implemented only in state R and welfare is maximized. Figure 4.1 illustrates the equilibrium strategies (p^*, q^*).

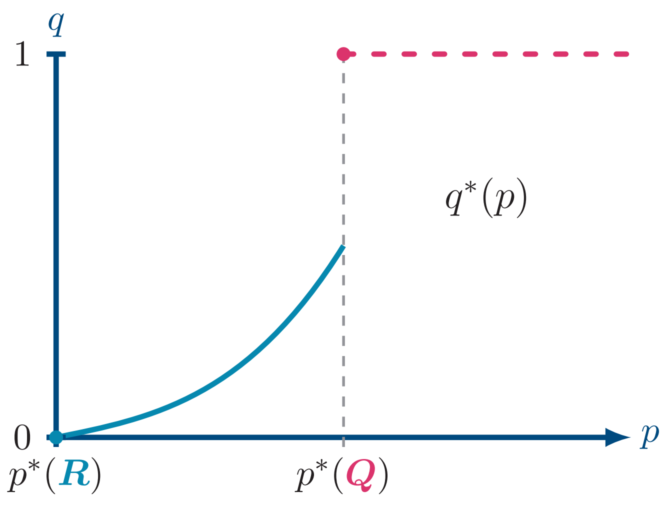

Figure 4.1 Example of a fully separating equilibrium.

To construct this equilibrium, suppose that $\xi^*(p) = 0$ for all $p \in [0, p^*(Q))$. Given this belief, let $q^*(p)$ be the smallest solution to the condition that shareholders are indifferent between selling and retaining their voting right

$$\underbrace{2(1-q)q}_{\mathbb{P}[M(n_S-1,q)=m-1]} \frac{\Delta}{n} = p \underbrace{\left[(1-q)^2 + 2q(1-q) + q^2 \frac{2}{3}\right]}_{\frac{\mathbb{E}[\bar{M}(n_S,q)]}{n_S q}}.$$

For all $p \geq p^*(Q)$, let $\xi^*(p) = 1$, such that it is strictly optimal for shareholders to sell, $q^*(p) = 1$. Naturally, the resulting q^* is a best response given their belief ξ^*.

When shareholders respond with q^*, in state R, the activist is indifferent between $p^*(R) = 0$ and $p^*(Q) = \frac{1}{8}$, $\Pi_A(p^*(R); q^*, \xi^*, R) = \Pi_A(p^*(Q); q^*, \xi^*, R) = \frac{1}{4}$. Further, we show in Appendix 4.7 that all prices except 0 and $\frac{1}{8}$ are dominated. Thus, $p^*(R)$ is a best response. In state Q, the activist's payoff from blocking the reform is higher than in state R, such that $p^*(Q) = \frac{1}{8}$ is the unique best response.

By construction, all investors play best responses and the beliefs are consistent, such that the proposed strategies and beliefs form a perfect Bayesian equilibrium.

As the next proposition shows, a separating perfect Bayesian equilibrium always exists but fails to improve expected firm value when n is large.

Proposition 4.3 *There always exists a separating equilibrium $(p^*, q^*; \xi^*)$, i.e. an equilibrium in which $p^*(Q) \neq p^*(R)$, such that shareholders learn the state. Further,*

1. *in any separating equilibrium $p^*(R) < p^*(Q)$ and $q^*(p^*(R)) < q^*(p^*(Q)) = 1$;*
2. *as n grows large, along any sequence of equilibria and for $\omega \in \{Q, R\}$,*

$$\lim_{n\to\infty} \mathbb{P}[M(n_S, q^*(p^*(\omega))) \geq m] = 1 \quad \textit{and} \quad \lim_{n\to\infty} p^*(\omega)\mathbb{E}[\bar{M}(n_S, q^*(p^*(\omega)))] = 0.$$

When the number of shareholders is small, the separating equilibrium can, as Example 4.1 demonstrates, raise the probability that the correct decision is implemented beyond the ex-ante probability of $1 - 2\rho$. Thus, vote trading can increase welfare, even when the activist is hostile, and even if the private benefit does not suffice to make up for the expected loss in firm value when the reform is blocked, $b < (1-\rho)\Delta - \rho\Delta = (1-2\rho)\Delta$.

This effect, however, utilizes vote trading as a costly signal, which can only work in case the voting rights are sufficiently expensive. As established by Proposition 4.1, vote prices quickly converge to zero when the firm is owned by more shareholders; if shareholdings are dispersed, the activist can acquire a blocking minority of voting rights at negligible cost and block the reform in either state. As a result, the expected firm value converges to $v < \rho(v - \Delta) + (1-\rho)(v + \Delta) = v + (1-2\rho)\Delta$, while the expected transfer converges to zero. When $b < (1-2\rho)\Delta$, overall welfare is reduced compared to the situation without vote trading.

Costly Communication

Vote trading may improve communication by acting as a costly signal, but so does any traditional form of costly intervention, yielding (weakly) superior outcomes.

To formalize the idea, suppose that, instead of buying voting rights, the activist can spend amount $\kappa \in \mathbb{R}_+$, for example, on running a costly but non-informative public proxy campaign. Thus, her strategy is $\kappa : \{Q, R\} \to \mathbb{R}_+$. Shareholders observe κ, form posterior $\xi(\kappa)$, and vote for the status quo if $\xi(\kappa) > \frac{1}{2}$; they vote for the reform if $\xi(\kappa) < \frac{1}{2}$. Again, we consider perfect Bayesian equilibria.

Proposition 4.4

1. *There is an equilibrium $(\kappa^*; \xi^*)$ in which the activist spends $\kappa^*(Q) = b - \alpha\Delta$ and $\kappa^*(R) = 0$. Shareholders learn the state, block the reform in state Q, and implement the reform in state R.*

2. *In every (other) equilibrium, the state is matched with probability of at least $1 - \rho$.*

Proposition 4.4 shows that a costly signal can also be used to credibly communicate that the state is Q. In any separating equilibrium, the activist needs to spend at least $\kappa^*(Q) = b - \alpha\Delta$ to signal that the state is Q, preventing the reform. At $\kappa^*(Q) = b - \alpha\Delta$ the activist in state R is exactly indifferent between spending $\kappa^*(Q)$ and remaining passive, $\kappa^*(R) = 0$: both yield her a payoff of v. In state Q, the activist strictly benefits from spending $\kappa^*(Q)$ because $\alpha v + b - \kappa^*(Q) > \alpha(v - \Delta)$.

Different from vote trading, in any separating equilibrium of the costly communication game, the first-best firm value is attained. In case the costly signal is not wasteful, this implies that welfare is maximized. Further, costly signaling can never reduce shareholder value relative to the pure voting benchmark. It, therefore, circumvents the risks of hostile activism inherent to vote trading.

Traditional forms of costly intervention include public proxy campaigns or the public acquisition of shares. Our results generate two new insights regarding the usage of these tools. First, even if the activist cannot provide evidence of her claims during the proxy fight, the fact that she is willing to engage in a costly proxy fight can suffice as a credible signal. Proxy fights are valuable not because they directly transmit information but because the associated costs give credence to the activist. Further, the public acquisition of shares not only aligns the activist and the shareholders' interests by raising α, but can be a credible signal that the activist wants to maximize shareholder value. Hence, the public disclosure of these acquisitions—through regulatory filings, for instance—serves an important function in the communication between investors.

4.5 Conclusion

Financial innovation has created manifold new ways to exchange voting rights; most notably using the equity lending market. Vote trading became a new force in shareholder activism, raising the question whether regulators should embrace or worry about vote trading. Our results show that regulators have reason to be concerned.

Vote trading does not yield Pareto improvements, but renders shareholders vulnerable to hostile activism—even in a best-case environment with transparent motives by the activist. It is true that when the activist has private information about the optimal decision, vote trading can be beneficial despite the activist's ulterior motives. Nevertheless, compared with traditional forms of intervention such as public endorsements, proxy campaigns, or share acquisitions, vote trading creates inferior outcomes. Note that we even consider a lower bound on the efficiency of these traditional forms of interventions by reducing them to their capacity to act as a costless or costly signal. For instance, we analyze models of non-verifiable information only. In practice, activist investors not only suggest certain courses of action but also (try to) provide evidence for their claims, which can be scrutinized by shareholders and outside analysts alike.

In conclusion, claims of more efficient corporate governance via vote trading seem unconvincing when compared with the traditional forms of intervention by activist investors. Instead, vote trading threatens shareholder value by enabling hostile activism. This goes to show that the long-standing tradition of outlawing the outright trade of voting rights in most countries is well founded. To prevent the new, indirect ways of vote trading, regulation has to be updated. We discuss some salient policy proposals in the final section.

4.6 Policy Implications

Transparency Measures

The market failure in the market for voting rights does not depend on hidden motives of the activist. As a result, policies aimed at increasing transparency, such as extended disclosure requirements[28] or rules of informed consent, do not suffice to prevent inefficient market outcomes and hostile activism. Nevertheless, additional transparency rules might be helpful, to prevent problems of asymmetric information and to monitor the extent of vote trading.

[28] Compare Hu and Black (2006) for a discussion of disclosure requirements with the SEC.

Self-regulation by Shareholders

Because shareholders *collectively* bear the cost of vote trading, they have an incentive to self-regulate. In this spirit, large asset managers such as BlackRock claim to recall shares in case of an "economically relevant vote."[29] Further, non-binding regulations such as stewardship codes have extended asset managers' "best practice" recommendations in the same direction. However, without some form of commitment, none of these self-imposed rules or "shareholder-cartels" are stable. Since it is *individually* optimal for shareholders to sell their voting rights if others do not, there can be no collective abstention from vote trading.

Forced Recalls

Regulatory authorities could require shareholders to recall their shares for the record date, forcing them to change the collateral their repo and cancel their lending agreements. While such measures would prevent the most relevant forms of vote trading, they would also come at a substantial cost. For instance, such regulation would imply a temporary shutdown of the equity lending market, thereby preventing (non-naked) short sales over the record date.

Excluding Bought Votes

One way to substantially reduce the ease of vote trading would be to suspend the voting rights of shares that were acquired in a way that can be exploited for vote trading. Shares borrowed or posted as collateral would, thus, lose their voting right until they were returned or resold to a third party.[30] This would leave the equity lending and repo markets unaffected in terms of their capacity to enable short selling or financing. However, this exclusion would not be a comprehensive solution since a hostile activist with a positive share endowment could still obtain control. When owning $\alpha > 0$ shares, the activist could borrow a fraction $\sigma > \frac{1-\alpha-\lambda}{1-\lambda}$ of the shares, implicitly voting σ as abstentions, thereby blocking the reform.

Excluding Vote Buyers

A more reliable solution than excluding bought votes would be to exclude the vote buyer from voting any of her shares. This solution not only has the same upsides as excluding borrowed votes but also prevents the acquisition of voting rights to void them.

[29] See https://www.ft.com/content/0e28929e-85dd-11e8-a29d-73e3d454535d.

[30] If a borrowed share would not regain its voting right, share lending would endogenously create non-voting shares, leading to additional problems.

Share Blocking, Lead Time of the Record Date

Prior to 2007, it was common in many EU countries that shares, when voted on, were blocked from trading before the meeting.[31] This was done in an effort to prevent investors from voting shares they no longer owned, aligning the economic interest and voting power. However, the class of decoupling techniques discussed in this chapter (Vote Trading techniques, cf. Chapter 3) is unaffected by such measures. In the case of vote trading via the equity lending market, for example, share blocking would only require the activist to borrow the shares for the whole lead time of the record date. The economic exposure would still remain with the initial shareholders whereas the activist would only receive the voting right.

Similarly, the lead time of the record date has no effect on the economic forces of vote trading and, thereby, the possibility to use vote trading for hostile activism. Consider, for instance, the most extreme case, in which the voting and the record date coincide. Such an arrangement would not prevent the activist from borrowing shares before the record/voting date and returning them afterwards, yielding the same outcome as the current practice.

Majority Rules

The anecdotal evidence of Hu and Black (2008a) suggests that decisions that require a supermajority are particularly vulnerable to hostile activism via vote trading. In Section 4.3 we give one reason for this effect: if the reform requires a supermajority, a blockholder is not able to deter a hostile activist because he is at a disadvantage relative to the activist, and the transfers from the activist to shareholders is particularly low. In addition to that, though the depth of the equity lending market may be sizeable, it is still limited. For both reasons, reducing the required majority towards a simple majority will help to deter hostile activism.

[31] See European Commission Staff Working Document SEC(2006) 181, https://ec.europa.eu/transparency/regdoc/rep/2/2006/EN/2-2006-181-EN-1-0.pdf.

4.7 Appendix

Identities

Lemma 4.3 $\mathbb{P}[M(n_S-1,q)=m-1]<1$ *and* $\lim_{n\to\infty}\mathbb{P}[M(n_S-1,q)=m-1]=0$.

Proof. The first assertion follows because $0<m<n_S-1$, such that $1=\sum_{i=0}^{n_S-1}\mathbb{P}[M(n_S-1,q)=i]>\mathbb{P}[M(n_S-1,q)=m-1]$.

For the second, note that $\mathbb{P}[M(n_S-1,q)=m-1]=\binom{n_S-1}{m-1}q^{m-1}(1-q)^{n_S-m}$ is maximized if

$$\begin{aligned} 0 &= \binom{n_S-1}{m-1}q^{m-2}(m-n_Sq+q-1)(1-q)^{-m+n_S-1} \\ \iff q &= \frac{m-1}{n_S-1}. \end{aligned}$$

Thus,

$$\mathbb{P}[M(n_S-1,q)=m-1]\le\binom{n_S-1}{m-1}(\frac{m-1}{n_S-1})^{m-1}(\frac{n_S-m}{n_S-1})^{n_S-m}. \tag{4.4}$$

Using Stirling's formula, $\binom{a}{b}=(1+o(1))\sqrt{\frac{a}{2\pi(a-b)b}}\frac{a^a}{(a-b)^{a-b}b^b}$, the right side of (4.4) becomes

$$=(1+o(1))\sqrt{\frac{n_S-1}{2\pi(n_S-m)(m-1)}}=(1+o(1))\sqrt{\frac{1}{2\pi(1-\eta)(n_S-1)\eta}}, \tag{4.5}$$

with $\eta=\frac{m-1}{n_S-1}$ (implying that $\eta\approx\frac{1-\lambda-\alpha}{1-\alpha}$). When n, n_S, and $m\to\infty$, the second assertion follows. $\square$

Lemma 4.4

$$\sum_{i=m-1}^{n_S-1}\mathbb{P}[M(n_S-1,q)=i]\frac{m}{i+1}=\mathbb{P}[M(n_S,q)\ge m]\frac{m}{n_Sq}. \tag{4.6}$$

$$\sum_{i=0}^{m-2}\mathbb{P}[M(n_S-1,q)=i]+\sum_{i=m-1}^{n_S-1}\mathbb{P}[M(n_S-1,q)=i]\frac{m}{i+1}=\frac{\mathbb{E}[\bar{M}(n_S,q)]}{n_Sq}. \tag{4.7}$$

$$\mathbb{P}[M(n_S-1,q)=m-1]=\frac{m}{n_Sq}\mathbb{P}[M(n_S,q)=m]. \tag{4.8}$$

Proof.

$$\begin{aligned}
\sum_{i=m-1}^{n_S-1} \mathbb{P}[M(n_S-1,q)=i]\frac{m}{i+1} &= \sum_{i=m-1}^{n_S-1} \binom{n_S-1}{i} q^i(1-q)^{n_S-1-i}\frac{m}{i+1} \\
&= \sum_{i=m-1}^{n_S-1} \frac{1}{n_S q}\binom{n_S}{i+1} q^{i+1}(1-q)^{n_S-(i+1)}m \\
&= \sum_{k=m}^{n_S} \frac{1}{nq}\binom{n_S}{k} q^k(1-q)^{n_S-k}m \\
&= \frac{m}{n_S q}\cdot \mathbb{P}[M(n_S,q)\geq m].
\end{aligned}$$

$$\begin{aligned}
\mathbb{E}[\bar{M}(n_S,q)] &= \mathbb{P}[M(n_S,q)\geq m]m + \sum_{i=0}^{m-1} \mathbb{P}[M(n_S,q)=i]i \\
&= \mathbb{P}[M(n_S,q)\geq m]m + \sum_{i=1}^{m-1} \binom{n_S}{i} q^i(1-q)^{n_S-i}i \\
&= \mathbb{P}[M(n_S,q)\geq m]m + \sum_{i=1}^{m-1} \binom{n_S-1}{i-1} n_S\cdot q\cdot q^{i-1}(1-q)^{n_S-i} \\
&= \mathbb{P}[M(n_S,q)\geq m]m + \sum_{k=0}^{m-2} \binom{n_S-1}{k} n_S\cdot q\cdot q^{k}(1-q)^{n_S-1-k} \\
&= n_S q\Big(\mathbb{P}[M(n_S,q)\geq m]\frac{m}{n_S q} - \mathbb{P}[M(n_S-1,q)\leq m-2]\Big),
\end{aligned}$$

and plugging (4.6) into the equation, (4.7) follows.

$$\begin{aligned}
\mathbb{P}[M(n_S-1,q)=m-1] &= \binom{n_S-1}{m-1} q^{m-1}(1-q)^{n_S-m} \\
&= \frac{(n_S-1)!}{(n_S-m)!(m-1)!} q^{m-1}(1-q)^{n_S-m} \\
&= \frac{(n_S)!}{(n_S-m)!(m)!}\frac{m}{n_S q} q^{m}(1-q)^{n_S-m} \\
&= \frac{m}{n_S q}\mathbb{P}[M(n_S,q)=m].
\end{aligned}$$

□

Lemma 4.5

$$\phi(q) = \frac{\mathbb{P}[M(n_S-1,q)=m-1]n_S q}{\mathbb{E}[\bar{M}(n_S,q)]}$$

is continuous, strictly concave, with a unique maximum $\bar{\phi} < 1$, *and* $\phi(0) = \phi(1) = 0$. *Also,* $\lim_{n\to\infty}\phi(q) = 0$ *for all* q. *Further, there are two continuous functions*

$q_-(\phi), q_+(\phi)$ with domain $[0, \bar{\phi}]$ of which q_- is strictly increasing and q_+ is strictly decreasing. For all $\phi \in [0, \bar{\phi})$ it holds that $q_-(\phi) < q_+(\phi)$ but $\bar{\phi} = \phi(q_-) = \phi(q_+)$. In particular, $q_-(0) = 0$ and $q_+(0) = 1$.

Proof.

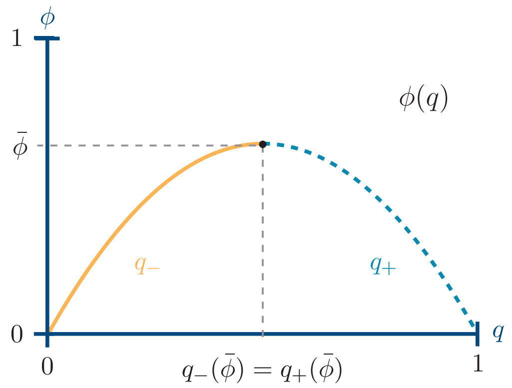

Figure 4.2 Form of $\phi(q)$ and definition of q_- and q_+.

Using (4.8), $\frac{1}{\phi(q)}$ can be rewritten as

$$\iff \frac{1}{\phi(q)} = \frac{\sum_{i=0}^{m} \mathbb{P}[M(n_S, q) = i]i + \mathbb{P}[M(n_S, q) > m]m}{m\mathbb{P}[M(n_S, q) = m]}$$

$$\iff \frac{1}{\phi(q)} = \frac{\sum_{i=1}^{m} \binom{n_S}{i} q^i (1-q)^{n_S - i} i + \sum_{i=m+1}^{n_S} \binom{n_S}{i} q^i (1-q)^{n_S - i} m}{m\binom{n_S}{m} q^m (1-q)^{n_S - m}}$$

$$\iff \frac{1}{\phi(q)} = \frac{1}{m\binom{n_S}{m}} [\sum_{i=1}^{m} \binom{n_S}{i} q^{i-m} (1-q)^{m-i} i + \sum_{i=m+1}^{n_S} \binom{n_S}{i} q^{i-m} (1-q)^{m-i} m]$$

$$\iff \frac{1}{\phi(q)} = \frac{1}{m\binom{n_S}{m}} [\sum_{i=1}^{m} \binom{n_S}{i} (\frac{q}{1-q})^{i-m} i + \sum_{i=m+1}^{n_S} \binom{n_S}{i} (\frac{q}{1-q})^{i-m} m].$$

Both summands are strictly convex in q such that $\frac{1}{\phi(q)}$ is strictly convex in q. Further, $\lim_{q \to 0} \frac{1}{\phi(q)} = \lim_{q \to 1} \frac{1}{\phi(q)} = \infty$, such that $\frac{1}{\phi(q)}$ is U-shaped. Since $\frac{1}{\phi(q)} \geq 0$, it follows that ϕ is hump-shaped with $\phi(0) = \phi(1) = 0$ and a unique maximum $\bar{\phi}$. Further, because

$$\phi(q) = \frac{\mathbb{P}[M(n_S - 1, q) = m - 1]n_S q}{\mathbb{E}[\min\{m, M(n_S, q)\}]} < \frac{\mathbb{P}[M(n_S - 1, q) = m - 1]n_S q}{n_S q},$$

Lemma 4.3 implies that $\bar{\phi} < 1$ and $\lim_{n \to \infty} \phi(q) = 0$.

Last, since ϕ is hump-shaped, with $\phi(0) = \phi(1) = 0$ and a unique maximum $\bar{\phi}$, for all $p < \bar{\phi}$, there are exactly two functions $q_-(p) < q_+(p)$, such that $p = \phi(q_-(p)) = \phi(q_+(p))$. Since ϕ is continuous, so are q_- and q_+. □

Proofs

Proof of Proposition 4.1

Note that $\Pi_S(\text{sell}; p, q) = \Pi_S(\text{keep}; p, q)$ rearranges to

$$\mathbb{P}[M(n_S - 1, q(p)) = m - 1]\frac{\Delta}{n} = p\frac{\mathbb{E}[\bar{M}(n_S, q(p))]}{n_S q(p)}. \tag{4.9}$$

Step 1 *There is always an equilibrium in which $p^* = 0$ and $q^*(0) = 1$.*

Since $1 < m < n_S$ and $n_S \geq 3$, if $q^*(0) = 1$, no shareholder is pivotal and selling the voting right is a best response. Since this is the lowest possible price, the activist has no profitable deviation.

Step 2 *If $q^*(p^*) > 0$ and, thereby, $\mathbb{P}[M(n_S, q^*(p^*)) \geq m] > 0$, then it has to hold that $p^*\mathbb{E}[\bar{M}(n_S, q^*(p^*))] < m\frac{\Delta}{n}\mathbb{P}[M(n_S, q^*(p^*)) \geq m]$.*

If $q^*(p^*) \in (0, 1)$, then (4.9) holds with equality. Further, by (4.8), equation (4.9) can restated as

$$p^*\mathbb{E}[\bar{M}(n_S, q^*(p^*))] = \mathbb{P}[M(n_S, q^*(p^*)) = m]m\frac{\Delta}{n} < \mathbb{P}[M(n_S, q^*(p^*)) \geq m]m\frac{\Delta}{n}.$$

Now suppose that $q^*(p^*) = 1$. Using Lemma 4.5, let $\bar{p} = \max_q \phi(q)\frac{\Delta}{n} < \frac{\Delta}{n}$. At any $p > \bar{p}$, equation (4.9) cannot hold with equality, such that $q^*(p) = 1$. It follows that if $q^*(p^*) = 1$, then $p^* \leq \bar{p}$, otherwise a deviation to a price $\frac{\bar{p}+p^*}{2}$ would be strictly profitable. Thereby, $p^*\mathbb{E}[\bar{M}(n_S, q^*(p^*))] < \frac{\Delta}{n}m = \frac{\Delta}{n}\mathbb{P}[M(n_S, q^*(p^*)) \geq m]$.

Step 3 *$\lim_{n\to\infty}\mathbb{P}[M(n_S, q^*(p^*)) \geq m] = 1$ and $\lim_{n\to\infty} p^*\mathbb{E}[\bar{M}(n_S, q^*(p^*))] = 0$.*

Suppose to the contrary that one of the statements was violated. In this case

$$\alpha(v + \Delta) + \mathbb{P}[M(n_S, q^*(p^*)) \geq m](b - \alpha\Delta) - p^*\mathbb{E}[\bar{M}(n_S, q^*(p^*))] < \alpha v + b$$

for n arbitrary large. Using Lemma 4.5, let $\bar{p} = \max_q \phi(q)\frac{\Delta}{n}$, and consider a deviation to $p' = \bar{p} + \frac{\epsilon}{m}$. Since $n \cdot \bar{p} \to 0$ and $q^*(p') = 1$, it follows that

$$\lim_{n\to\infty}\alpha(v + \Delta) + \mathbb{P}[M(n_S, q^*(p')) \geq m](b - \alpha\Delta) - p'\mathbb{E}[\bar{M}(n_S, q^*(p'))] = \alpha v + b - \epsilon,$$

such that the deviation is profitable when ϵ is small and n is large.

Step 4 *When b and n are small, there are equilibria in which there is no trade.*

Using Lemma 4.5, there is a best response $q^*(p) = q_-(p)$, which is continuous and strictly increasing on $[0, \bar{p}]$ with $\bar{p} = \max_q \phi(q)\frac{\Delta}{n}$. Further, $q^*(0) = 0$ and $q^*(p) = 1$ for all $p > \bar{p}$.

Suppose that the activist offers a price $p^* \in (0, \bar{p})$ such that $q^*(p^*) \in (0,1)$ and equality (4.9) holds. Since p^* is a best response, $\Pi_A(p^*; q^*) \geq \Pi_A(0; q^*) = \alpha(v + \Delta)$. Plugging (4.9) into $\Pi_A(p; q^*)$ and using (4.8), this can be rearranged to

$$\begin{aligned}\alpha(v+\Delta) - \mathbb{P}[M(n_S, q) = m]\Delta\frac{m}{n} + \mathbb{P}[M(n,q) \geq m](b - \alpha\Delta) \geq \alpha(v+\Delta)\\ \iff -\Delta\frac{m}{n} + \frac{\mathbb{P}[M(n_S, q) \geq m]}{\mathbb{P}[M(n_S,q) = m]}(b - \alpha\Delta) > 0.\end{aligned}$$

The likelihood ratio

$$\begin{aligned}\frac{\mathbb{P}[M(n_S,q) \geq m]}{\mathbb{P}[M(n_S,q) = m]} &= \frac{\sum_{i=m}^{n_S}\binom{n_S}{i}q^i(1-q)^{n-i}}{\binom{n_S}{m}q^m(1-q)^{n_S-m}} = \frac{1}{\binom{n_S}{m}}\sum_{i=m}^{n_S}\binom{n_S}{i}(\frac{q}{1-q})^{i-m} \qquad (4.10)\\ &= \frac{1}{\binom{n_S}{m}}\binom{n_S}{m}(\frac{q}{1-q})^0 + \sum_{i=m+1}^{n_S}\binom{n_S}{i}(\frac{q}{1-q})^{i-m} \overset{q \to 0}{\to} 1.\end{aligned}$$

Thus, for p (and, hence, $q^*(p)$) sufficiently low, $\Pi_A(p;q^*) < \Pi_A(0;q^*)$ when $-\Delta\frac{m}{n} + \frac{\mathbb{P}[M(n_S,q)\geq m]}{\mathbb{P}[M(n_S,q)=m]}(b - \alpha\Delta) \approx b - (1-\lambda)\Delta - \frac{1}{n}\Delta < 0$. Further, any price above $\frac{b}{m}$ is dominated by offering $p = 0$ and not trading. If b is sufficiently small, this means that we found a contradiction and $p = 0$ is the unique best response.

Proof of Proposition 4.2

To enhance clarity, we prove equilibrium existence separately in Lemma 4.6 and characterize the equilibrium first.

Suppose the activist offers p_A, the blockholder p_B, and shareholders mix with probability $q(p_A, p_B)$. Then, an individual shareholder (weakly) prefers to sell to A if and only if

$$\begin{aligned}&\mathbb{P}[M(n_S - 1, q(p_A, p_B)) < m_A - 1]\frac{\Delta}{n} + p_A\frac{\mathbb{E}[\bar{M}_A(n_S, q(p_A,p_B))]}{n_S q(p_A,p_B)}\\ &\qquad \geq \mathbb{P}[M(n_S - 1; q(p_A,p_B)) < m_A]\frac{\Delta}{n} + p_B\frac{\mathbb{E}[\bar{M}_B(n_S, q(p_A,p_B))]}{n_S(1 - q(p_A,p_B))}\\ &\iff p_A\frac{\mathbb{E}[\bar{M}_A(n_S,q)]}{n_S q} - \mathbb{P}[M(n_S - 1; q) = m_A - 1]\frac{\Delta}{n} \geq p_B\frac{\mathbb{E}[\bar{M}_B(n_S,q)]}{n_S(1-q)}. \qquad (4.11)\end{aligned}$$

The expected payoffs for the activist and blockholder are

$$\begin{aligned}&\Pi_A(p_A; p_B, q)\\ &= \alpha(v+\Delta) + \mathbb{P}[M(n_S, q(p_A,p_B)) \geq m_A](b - \alpha\Delta) - p_A\mathbb{E}[\bar{M}_A(n_S, q(p_A,p_B))],\\ &\Pi_B(p_B; p_A, q)\\ &= \beta(v+\Delta) + \mathbb{P}[M(n_S, q(p_A,p_B)) \geq m_A](-\beta\Delta) - p_B\mathbb{E}[\bar{M}_B(n_S, q(p_A,p_B))].\end{aligned}$$

In an effort to keep notation cleaner, we henceforth drop the explicit reference to the shareholders' strategy q.

For any n, let $p_{A;n}$ and $p_{B;n}$ be any two prices and let q^*_n be a best responses. Given q^*_n, let $p^*_{B;n}$ be a best response, and, given q^*_n and $p^*_{B;n}$, let $p^*_{A;n}$ be an equilibrium price. We take converging (sub)sequences of prices and probabilities as needed.

Step 0 *Suppose that* $\lim p_{A;n}n > 0$ *and/or* $\lim p_{B;n}n > 0$.

1. *If* $\lim \frac{p_{A;n}}{p_{B;n}} > \frac{1-\alpha-\beta}{1-\lambda-\alpha}$, *then* $q^*_n(p_{A;n}, p_{B;n}) = 1$ *when* n *is sufficiently large;*
2. *If* $\lim \frac{p_{A;n}}{p_{B;n}} > 1$ *but* $\lim \frac{p_{A;n}}{p_{B;n}} \leq \frac{1-\alpha-\beta}{1-\lambda-\alpha}$, *then* $\lim q^*_n(p_{A;n}, p_{B;n}) = \lim \frac{p_{A;n}}{p_{B;n}} \frac{1-\lambda-\alpha}{1-\alpha-\beta}$ *and* $\lim \mathbb{P}[M(n_S, q^*_n(p_{A;n}, p_{B;n})) \geq m_A] = 1$*;*
3. *If* $\lim \frac{p_{A;n}}{p_{B;n}} = 1$, *then* $\lim q^*_n(p_{A;n}, p_{B;n}) = \frac{1-\lambda-\alpha}{1-\alpha-\beta}$ *as well as* $\lim \mathbb{P}[M(n_S, q^*_n(p_{A;n}, p_{B;n})) \geq m_A] = \frac{1}{2}$*;*
4. *If* $\lim \frac{p_{A;n}}{p_{B;n}} < 1$ *but* $\lim \frac{p_{A;n}}{p_{B;n}} \geq \frac{\lambda-\beta}{1-\alpha-\beta}$, *then* $\lim q^*_n(p_{A;n}, p_{B;n}) = 1 - \lim \frac{p_{B;n}}{p_{A;n}} \frac{\lambda-\beta}{1-\alpha-\beta}$ *and* $\lim \mathbb{P}[M(n_S, q^*_n(p_{A;n}, p_{B;n})) \geq m_A] = 0$*;*
5. *If* $\lim \frac{p_{A;n}}{p_{B;n}} < \frac{\lambda-\beta}{1-\alpha-\beta}$, *then* $q^*_n(p_{A;n}, p_{B;n}) = 0$ *when* n *is sufficiently large.*

For ease of notation, let $q^*_n = q^*(p_{A,n}, p_{B,n})$.

By Lemma 4.3, for any q, $\lim \mathbb{P}[M(n_S - 1, q^*_n) = m_A - 1] = 0$. Further, by the LLN, if $\lim q^*_n > \frac{1-\lambda-\alpha}{1-\alpha-\beta}$, then $\lim \mathbb{P}[M(n_S, q^*_n) \geq m_A] = 1$, $\lim \frac{\mathbb{E}[\bar{M}_A(n_S, q^*_n)]}{n_S q^*_n} = \lim \frac{1-\lambda-\alpha}{q^*_n(1-\alpha-\beta)}$, and $\lim \frac{\mathbb{E}[\bar{M}_B(n_S, q^*_n)]}{n_S(1-q^*_n)} = 1$. If, on the other hand, $q^*_n < \frac{1-\lambda-\alpha}{1-\alpha-\beta}$, then $\lim \mathbb{P}[M(n_S, q^*_n) < m_A] = 1$, $\lim \frac{\mathbb{E}[\bar{M}_B(n_S, q^*_n)]}{n_S(1-q^*_n)} = \lim \frac{\lambda-\beta}{(1-q^*_n)(1-\alpha-\beta)}$, and $\lim \frac{\mathbb{E}[\bar{M}_A(n_S, q^*_n)]}{n_S q^*_n} = 1$. Last, if $\lim q^*_n = \frac{1-\lambda-\alpha}{1-\alpha-\beta}$, then $\lim \frac{\mathbb{E}[\bar{M}_A(n_S, q^*_n)]}{n_S q^*_n} = \lim \frac{\mathbb{E}[\bar{M}_B(n_S, q^*_n)]}{n_S(1-q^*_n)} = 1$ and $\lim \mathbb{P}[M(n_S, q^*_n(p_{A;n}, p_{B;n})) \geq m_A] = \frac{1}{2}$.

If $q^*_n = 1$ and n is arbitrary large, then inequality (4.11), $\lim \mathbb{P}[M(n_S - 1, q^*_n) = m_A - 1] = 0$, and $\lim p_{A;n}n > 0$ or $\lim p_{B;n}n > 0$ imply that $\lim \frac{p_{A;n}}{p_{B;n}} \geq \frac{\lambda-\beta}{1-\alpha-\beta}$. If $q^*_n = 0$ for n arbitrary large, the inequality of (4.11) reverses. Since $\lim \mathbb{P}[M(n_S - 1, q^*_n) = m_A - 1] = 0$, and $\lim p_{A;n}n > 0$ or $\lim p_{B;n}n > 0$, it follow that $\lim \frac{p_{A;n}}{p_{B;n}} \leq \frac{\lambda-\beta}{1-\alpha-\beta}$.

Suppose that $\lim \frac{p_{A;n}}{p_{B;n}} = \gamma > 1$. When $q^*_n < 1$ s.th. (4.11) holds with equality, $\lim \mathbb{P}[M(n_S - 1, q^*_n) = m_A - 1] = 0$, and $\lim p_{A;n}n > 0$ or $\lim p_{B;n}n > 0$, it follows that $\lim \frac{\mathbb{E}[\bar{M}_A(n_S, q^*_n)]}{\mathbb{E}[\bar{M}_B(n_S, q^*_n)]} \frac{1-q^*_n}{q^*_n} = \frac{1}{\gamma}$. By our earlier observation, this means that $\lim q^*_n > \frac{1-\lambda-\alpha}{1-\alpha-\beta}$, such that equality (4.11) implies that $\lim q^*_n = \gamma \frac{1-\lambda-\alpha}{1-\alpha-\beta} = \lim \frac{p_{A;n}}{p_{B;n}} \frac{1-\lambda-\alpha}{1-\alpha-\beta}$. If $\gamma > \frac{1-\alpha-\beta}{1-\lambda-\alpha}$, equality (4.11) cannot hold when n is large, such that $q^*_n = 1$. In either case $\lim \mathbb{P}[M(n_S, q^*_n) \geq m_A] = 1$. This proves properties *1* and *2*.

Next, consider the case in which $\lim \frac{p_{A;n}}{p_{B;n}} = \gamma < 1$. When $q^*_n > 0$ s.th. (4.11) holds with equality, $\lim \mathbb{P}[M(n_S - 1, q^*_n) = m_A - 1] = 0$, and $\lim p_{A;n}n > 0$ or $\lim p_{B;n}n > 0$, it follows that $\lim \frac{\mathbb{E}[\bar{M}_A(n_S, q^*_n)]}{\mathbb{E}[\bar{M}_B(n_S, q^*_n)]} \frac{1-q^*_n}{q^*_n} = \frac{1}{\gamma}$. By our earlier observation, this means that $\lim q^*_n < \frac{1-\lambda-\alpha}{1-\alpha-\beta}$, such that equality (4.11) implies that $\lim 1 - q^*_n = \lim \frac{p_{B;n}}{p_{A;n}} \frac{\lambda-\beta}{1-\alpha-\beta}$.

If $\gamma < \frac{\lambda-\beta}{1-\alpha-\beta}$, equality (4.11) cannot hold when n is large, such that $q_n^* = 0$. In either case $\lim \mathbb{P}[M(n_S, q_n^*) \geq m_A] = 0$. This proves properties *4* and *5*.

Last, if $\lim \frac{p_{A;n}}{p_{B;n}} = 1$, then equality (4.11), $\lim \mathbb{P}[M(n_S - 1, q_n^*) = m_A - 1] = 0$, and $\lim p_{A;n} n > 0$ or $\lim p_{B;n} n > 0$ imply that $\lim \frac{\mathbb{E}[\bar{M}_A(n_S, q_n^*)]}{\mathbb{E}[\bar{M}_B(n_S, q_n^*)]} \frac{1-q_n^*}{q_n^*} = 1$. By our observation, this is the case if and only if $\lim q_n^* = \frac{1-\lambda-\alpha}{1-\alpha-\beta}$. This proves property *3*.

Step 1 *If $\frac{b-\alpha\Delta}{1-\lambda-\alpha} > \frac{\beta\Delta}{\lambda-\beta}$ and n is sufficiently large, then $q_n^*(p_{A;n}^*, p_{B;n}^*(p_{A;n}^*)) = 1$. Further, $p_{A;n}^* \mathbb{E}[\bar{M}_A(n_S, q_n^*(p_{A;n}^*, p_{B;n}^*(p_{A;n}^*)))] = p_{A;n}^* m_A < \frac{1-\lambda-\alpha}{\lambda-\beta}\beta\Delta$, but $\lim_{n\to\infty} \mathbb{E}[\bar{M}_A(n_S, q_n^*(p_{A;n}^*, p_{B;n}^*(p_{A;n}^*)))] p_{A;n}^* = \frac{1-\lambda-\alpha}{\lambda-\beta}\beta\Delta$.*

Suppose to the contrary that $q_n^*(p_{A,n}^*, p_{B,n}^*(p_{A,n}^*)) < 1$ even when n is arbitrary large. When there is no room for confusion, we employ the convention that $q_n^* = q_n^*(p_{A,n}^*, p_{B,n}^*(p_{A,n}^*))$ and $p_{B,n}^* = p_{B,n}^*(p_{A,n}^*)$.

First, we consider the case in which $\lim q_n^* > \frac{1-\lambda-\alpha}{1-\alpha-\beta}$. Observe that

$$\lim \frac{1-q_n^*}{\sum_{i=0}^{m_A-1} \mathbb{P}[M(n_S, q_n^*) = i]} = \infty.$$

For $\lim q_n^* < 1$, this follows directly, when $\lim q_n^* = 1$, we apply L'Hopital[32] to receive

$$\lim \frac{1-q_n^*}{\sum_{i=0}^{m_A-1} \mathbb{P}[M(n_S, q_n^*) = i]} = \lim \frac{1}{\mathbb{P}[M(n_S - 1, q_n^*) = m_A - 1]} = \infty.$$

Since $\lim q_n^* > \frac{1-\lambda-\alpha}{1-\alpha-\beta}$ and $\lim \sum_{i=m_A}^{n_S-1} \mathbb{P}[M(n_S - 1, q_n^*) = i] = 1$, this means that

$$\begin{aligned}
&\frac{\mathbb{E}[\bar{M}_B(n_S, q_n^*)]}{n(1 - \mathbb{P}[M(n_S, q_n^*) \geq m_A])} \\
=&\frac{\sum_{i=0}^{m_A-1} \mathbb{P}[M(n_S, q_n^*) = i] m_B + \sum_{i=m_A}^{n_S} \mathbb{P}[M(n_S, q_n^*) = i](n_S - i)}{n \sum_{i=0}^{m_A-1} \mathbb{P}[M(n_S, q_n^*) = i]} \\
=&\frac{\sum_{i=0}^{m_A-1} \mathbb{P}[M(n_S, q_n^*) = i] m_B + \sum_{i=m_A}^{n_S-1} \binom{n_S-1}{i} (q_n^*)^i (1-q_n^*)^{n_S-1-i} (1-q_n^*) n_S}{n \sum_{i=0}^{m_A-1} \mathbb{P}[M(n_S, q_n^*) = i]} \\
=&\frac{m_B}{n} + (1-\alpha-\beta) \sum_{i=m_A}^{n_S-1} \mathbb{P}[M(n_S - 1, q_n^*) = i] \frac{1-q_n^*}{\sum_{i=0}^{m_A-1} \mathbb{P}[M(n_S, q_n^*) = i]}
\end{aligned}$$

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$$\begin{aligned}
&\frac{\partial}{\partial q} \sum_{i=0}^{m_A-1} \mathbb{P}[M(n_S, q_n^*) = i] \\
=& \sum_{i=1}^{m_A-1} \binom{n_S}{i} [i (q_n^*)^{i-1} (1-q_n^*)^{n_S-i}] - \sum_{i=0}^{m_A-1} \binom{n_S}{i} [(q_n^*)^i (1-q_n^*)^{n_S-i-1} (n_S - i)] \\
=& \sum_{i=0}^{m_A-2} \mathbb{P}[M(n_S - 1, q_n^*) = i] n_S - \sum_{i=0}^{m_A-1} \mathbb{P}[M(n_S - 1, q_n^*) = i] n_S = -\mathbb{P}[M(n_S - 1, q_n^*) = m_A - 1].
\end{aligned}$$

grows without bound. This growth implies that $\lim p^*_{B;n}n = 0$, because when $\lim p^*_{B;n}n > 0$ and n is large

$$\begin{aligned}&\beta(v+\Delta)+\mathbb{P}[M(n_S,q^*_n)\geq m_A](-\beta\Delta)-p_{B;n}\mathbb{E}[\bar{M}_B(n_S,q^*_n)]<\beta v\\ \iff\ &\beta\Delta<\frac{\mathbb{E}[\bar{M}_B(n_S,q^*_n)]}{n(1-\mathbb{P}[M(n_S,q^*_n)\geq m_A])}p_{B;n}n,\end{aligned}$$

such that a deviation by B to $p_B = 0$ is strictly profitable. If $\lim p^*_{B;n}n = 0$, then $\lim q^*_n \geq \frac{1-\lambda-\alpha}{1-\alpha-\beta}$ and Step 0 imply that $\lim p^*_{A;n}n = 0$. This means that when n is sufficiently large, B has an incentive to deviate to $p'_{B;n} = p^*_{A;n} + \frac{\epsilon}{n}$. By Step 0, when n is sufficiently large, $q^*_n(p^*_{A;n}, p'_{B;n}) = 0$, implying that

$$\Pi^n_B(p'_{B;n};p^*_{A;n})=\beta(v+\Delta)-n(\lambda-\beta)(p^*_{A;n}+\frac{\epsilon}{n}),$$

which is obviously larger than $\Pi^n_B(p^*_{B;n};p^*_{A;n})$ when ϵ is sufficiently small and n is large. Consequently, it cannot be that $q^*_n < 1$ for n arbitrary large, but $\lim q^*_n > \frac{1-\lambda-\alpha}{1-\alpha-\beta}$.

In a second step, suppose that $\lim q^*_n = \frac{1-\lambda-\alpha}{1-\alpha-\beta}$. If $\lim p^*_{A;n}n > 0$ or $\lim p^*_{B;n}n > 0$, then Step 0 implies that $\lim p^*_{A;n}n = \lim p^*_{B;n}n$ and $\lim \mathbb{P}[M(n_S, q^*_n) \geq m_A] = \frac{1}{2}$, such that

$$\lim \Pi^n_B(p^*_{B;n};p^*_{A;n})=\beta v+\frac{1}{2}\beta\Delta-\lim p_{B;n}n(\lambda-\beta).$$

Now consider a deviation by B to $p'_{B;n} = p^*_{B;n} + \frac{\epsilon}{n}$ which, by Step 0, guarantees that $\lim \mathbb{P}[M(n_S, q^*(p_{A;n}, p'_{B;n})) \geq m_A] = 0$ and, hence, yields

$$\lim \Pi^n_B(p'_{B;n};p^*_{A;n})=\beta v+\beta\Delta-\lim p^*_{B;n}n(\lambda-\beta)-\epsilon(\lambda-\beta).$$

When n is sufficiently large and ϵ sufficiently small, such a deviation is always profitable. When $\lim p^*_{A;n}n = \lim p^*_{B;n}n = 0$, the same deviation is profitable.

Last, suppose that $\lim q^*_n < \frac{1-\lambda-\alpha}{1-\alpha-\beta}$. Then $\lim \mathbb{P}[M(n_S, q^*_n) \geq m_A] = 0$, such that $\lim \Pi^n_A(p^*_{A;n}; p^*_{B;n}) \leq \alpha(v+\Delta)$. Now consider a deviation by A to $p'_{A;n} = \frac{\beta\Delta}{n(\lambda-\beta)}$ and B's possible responses. If B offers $p^*_{B;n}(p'_A)$ such that $\lim \frac{p'_{A;n}}{p^*_{B;n}(p'_{A;n})} < 1$, then, by Step 0, $\lim \mathbb{P}[M(n_S, q^*_n(p'_{A;n}, p^*_{B;n}(p'_{A;n}))) \geq m_A] = 0$, and because $\lim p^*_{B;n}(p'_{A;n})n > \frac{\beta\Delta}{(\lambda-\beta)}$, it follows that

$$\lim \Pi^n_B(p^*_{B;n}(p'_{A;n});p'_{A;n})<\beta(v+\Delta)-(\lambda-\beta)\frac{\beta\Delta}{(\lambda-\beta)}=\beta v,$$

which is dominated by $p_B = 0$ when n is sufficiently large. If B offers $p^*_{B;n}(p'_{A;n})$ such that $\lim \frac{p'_{A;n}}{p^*_{B;n}(p'_{A;n})} = 1$, then, by our observation above, B has a strict incentive to deviate upwards. Thus, B has to respond by offering $p^*_{B;n}(p'_{A;n})$ such that

$\lim \frac{p'_{A;n}}{p^*_{B;n}(p'_{A;n})} > 1$. As a result, $\lim \mathbb{P}[M(n_S, q^*(p'_{A;n}, p^*_{B;n}(p'_{A;n}))) \geq m_A] = 1$ and, in the limit, the deviation yields A the payoff

$$\lim \Pi^n_A(p'_{A;n}; p^*_{B;n}(p'_{A;n})) = \alpha v + b - (1 - \lambda - \alpha)\frac{\beta\Delta}{(\lambda - \beta)},$$

which is larger than $\alpha(v + \Delta)$ by assumption. Hence, the deviation is profitable for A when n is sufficiently large. This proves that $q^*_n = 1$ when n is sufficiently large.

When $q^*_n = 1$ and $p^*_{A;n} m_A = p^*_{A;n}\mathbb{E}[\bar{M}_A(n_S, q^*(p^*_{A;n}, p^*_{B;n}))] \geq \frac{1-\lambda-\alpha}{\lambda-\beta}\beta\Delta$, then $p^*_{A;n} \geq \frac{\beta\Delta}{n(\lambda-\beta)} - \frac{\beta\Delta}{m_A n(\lambda-\beta)}$. Suppose A chooses or deviates to $p'_{A;n} = \frac{\beta\Delta}{n(\lambda-\beta)} - \frac{\beta\Delta}{m_A n(\lambda-\beta)}$. If B offers $p^*_{B;n}(p'_{A;n})$ such that $\lim \frac{p'_{A;n}}{p^*_{B;n}(p'_{A;n})} < 1$, then $\lim p^*_{B;n}(p'_{A;n}) n > \lim \frac{\beta\Delta}{(\lambda-\beta)}$ and by Step 0, it follows that $\lim \mathbb{P}[M(n_S, q^*_n(p'_{A;n}, p^*_{B;n}(p'_{A;n}))) \geq m_A] = 0$. However, in this case,

$$\lim \Pi^n_B(p^*_{B;n}(p'_{A;n}); p'_{A;n}) < \beta(v + \Delta) - (\lambda - \beta)\frac{\beta\Delta}{(\lambda - \beta)} = \beta v,$$

such that $p^*_{B;n}(p'_{A;n})$ is dominated by $p_B = 0$ when n is sufficiently large. If B offers $p^*_{B;n}(p'_{A;n})$ such that $\lim \frac{p'_{A;n}}{p^*_{B;n}(p'_{A;n})} = 1$, then, by our observation above, B would have a strict incentive to deviate upwards. This means that B has to choose a $p^*_{B;n}(p'_{A;n})$ such that $\lim \frac{p'_{A;n}}{p^*_{B;n}(p'_{A;n})} > 1$, which implies, by our previous argument, that $q^*_n(p'_{A;n}, p^*_{B;n}(p'_{A;n})) = 1$ when n is large. Thereby, the deviation to $p'_{A;n}$ is profitable for A when n is sufficiently large. Further, because all expressions are continuous and inequalities strict, the same can be achieved with a $p'_{A;n}$ marginally below $\frac{\beta\Delta}{n(\lambda-\beta)} - \frac{\beta\Delta}{m_A n(\lambda-\beta)}$, meaning that $p'_{A;n} m_A = p'_{A;n}\mathbb{E}[\bar{M}_A(n_S, q^*(p'_{A;n}, p^*_{B;n}(p'_{A;n})))] < \frac{1-\lambda-\alpha}{\lambda-\beta}\beta\Delta$.

Last, if $\lim p^*_A \mathbb{E}[\bar{M}_A(n_S, q^*(p^*_A, p^*_B))] < \frac{1-\lambda-\alpha}{\lambda-\beta}\beta\Delta$, this means that $p^*_{A;n} < \frac{\beta\Delta}{n(\lambda-\beta)} - \frac{\epsilon}{n}$ for some $\epsilon > 0$ and any n sufficiently large. In this case, however, B could deviate to $p'_{B;n} = \frac{\beta\Delta}{n(\lambda-\beta)} - \frac{\epsilon}{2n}$. As a result, $\lim \mathbb{P}[M(n_S, q^*_n(p^*_{A;n}, p'_{B;n})) \geq m_A] = 0$ and

$$\lim \Pi^n_B(p'_{B;n}; p^*_{A;n}) = \beta(v + \Delta) - \beta\Delta + \epsilon\frac{\beta\Delta}{2(\lambda - \beta)} > \beta v,$$

such that the deviation is profitable when n is sufficiently large.

Step 2 *If $\frac{b-\alpha\Delta}{1-\lambda-\alpha} < \frac{\beta\Delta}{\lambda-\beta}$, as n grows large, along any sequence of equilibria, $\lim_{n\to\infty} \mathbb{P}[M_A(n_S, q^*_n(p^*_{A;n}, p^*_{B;n}(p^*_{A;n}))) \geq m_A] = 0$ and $\lim_{n\to\infty} p^*_{A;n} n_S = \lim_{n\to\infty} p^*_{B;n}(p^*_{A;n}) n_S = 0$.*

For ease of notation, let $q^*_n = q^*_n(p^*_{A,n}, p^*_{B,n}(p^*_{A,n}))$. When there is no room for confusion, we employ the convention that $p^*_{B,n} = p^*_{B,n}(p^*_{A,n})$.

First, suppose to the contrary that $\lim \mathbb{P}[M(n_S, q_n^*) \geq m_A] > 0$. Since $\Pi_A^n(p_{A;n}^*; p_{B;n}^*) \geq \Pi_A^n(0; p_{B;n}^*(0)) \geq \alpha(v + \Delta)$, it follow that

$$\begin{aligned}\Pi_A^n(p_{A;n}^*; p_{B;n}^*) &= \alpha(v + \Delta) + (b - \alpha\Delta)\mathbb{P}[M(n_S, q_n^*) \geq m_A] - p_{A;n}^*\mathbb{E}[\bar{M}_A(n_S, q_n^*)] \\ &\geq \alpha(v + \Delta).\end{aligned}$$

Since $\frac{\mathbb{E}[\bar{M}_A(n_S, q_n^*)]}{\mathbb{P}[M(n_S, q_n^*) \geq m_A]} \geq m_A$ and $m_A = n(1 - \lambda - \alpha) + 1$, it follows that in the limit

$$\lim p_{A;n}^* n \leq \frac{b - \alpha\Delta}{1 - \lambda - \alpha}.$$

Now consider a deviation by B from $p_{B;n}^*$ to $p'_{B;n} = p_{A;n}^* + \frac{\epsilon}{n}$. Because $\lim q_n^*(p_{A;n}^*, p'_{B;n}) > \frac{1-\lambda-\beta}{1-\alpha-\beta}$, it follows that $\lim \mathbb{P}[M(n_S, q_n^*(p_{A;n}^*, p'_{B;n})) \geq m_A] = 0$. Such deviation is profitable when $\epsilon > 0$ is small and n is large because

$$\begin{aligned}&\lim \Pi_B^n(p'_{B;n}; p_{A;n}^*) - \Pi_B^n(p_{B;n}^*; p_{A;n}^*) \\ &\geq \lim(1 - \mathbb{P}[M(n_S, q_n^* \geq m_A])[\beta\Delta - (\lambda - \beta)np_{A;n}^*] - \epsilon,\end{aligned}$$

where

$$\beta\Delta - (\lambda - \beta)np_{A;n}^* \geq \beta\Delta - (\lambda - \beta)\frac{b - \alpha\Delta}{1 - \lambda - \alpha} > 0.$$

This establishes that $\lim \mathbb{P}[M(n_S, q_n^*) \geq m_A] = 0$.

We now show that $\lim p_{A;n}^* n = \lim p_{B;n}^* n = 0$. First, suppose to the contrary that $\lim p_{A;n}^* n > 0$. In this case, it has to hold that $\lim q_n^* > 0$. Assume this was not true either, that is $\lim p_{A;n}^* n > 0$ and $\lim q_n^* = 0$. Then, there is a small $\epsilon > 0$ such that $\lim \frac{p_{A;n}^*}{p_{B;n}^* - \frac{\epsilon}{m_B}} \in (\frac{\lambda-\beta}{1-\alpha-\beta}, 1)$, which still implies that $\lim q_n^*(p_{A;n}^*, p_{B;n}^* - \frac{\epsilon}{m_B}) < \frac{1-\lambda-\alpha}{1-\alpha-\beta}$, and, thereby,

$$\lim \Pi_B^n(p_{B;n}^* - \frac{\epsilon}{m_B}; p_{A;n}^*) - \lim \Pi_B(p_{B;n}^*; p_{A;n}^*) = (\lambda - \beta)\epsilon,$$

making it a profitable deviation when n is large. Now, if $\lim q_n^* > 0$ and $\lim p_{A;n}^* n > 0$ but $\lim \mathbb{P}[M(n_S, q_n^*) \geq m_A] = 0$, then

$$\lim \Pi_A^n(p_{A;n}^*; p_{B;n}^*) = \alpha(v + \Delta) - \lim p_{A;n}^* q_n^* n < \alpha(v + \Delta) \leq \lim \Pi_A^n(0; p_{B;n}^*),$$

such that A would have profitable deviation to 0. Last, if $\lim p_{A;n}^* n = 0$, then $\lim p_{B;n}^* n = 0$. Otherwise, a deviation to $\frac{p_{B;n}^*}{2}$ would always be profitable for B when n is sufficiently large.

Lemma 4.6 *The competition game always has an equilibrium* (p_A^*, p_B^*, q^*).

Proof. We are going to show existence by construction. Fix some p_A. Then, shareholders are indifferent between selling to A and B if $p_B = \psi(q; p_A)$ where

$$\psi(q; p_A) = (p_A \frac{\mathbb{E}[\bar{M}_A(n_S, q)]}{n_S q} - \mathbb{P}[M(n_S - 1; q) = m_A - 1]\frac{\Delta}{n}) \frac{n_S(1-q)}{\mathbb{E}[\bar{M}_B(n_S, q)]}$$

is a polynomial of q and strictly increasing and continuous in p_A. For later use, we further note that the slope of $\psi(q; p_A)$ with respect to p_A is decreasing in q ($-\psi$ is supermodular): for any $p_A < p'_A$ and $q < q'$, it holds that

$$\psi(q; p'_A) - \psi(q; p_A) > \psi(q'; p'_A) - \psi(q'; p_A).$$

We can use $\psi(q; p_A)$ to define a best response for shareholders as

$$q^*(p_A, p_B) = \begin{cases} 1 \text{ for } p_B < \psi(1; p_A) \\ \min\{q \colon \psi(q; p_A) = p_B\} \text{ for } \psi(1; p_A) \leq p_B < \psi(0; p_A) \\ 0 \text{ for } p_B \geq \psi(0; p_A). \end{cases}$$

By construction, q^* is (weakly) decreasing and right-continuous in p_B. Note that $q^*(p_A, \psi(q; p_A)) \leq q$.

Step 1 *Given any offer* p_A*,* B *has at least one best response* $p_B^*(p_A)$*.*

Since q^* is (weakly) decreasing and right-continuous in p_B and all expressions are bounded, B's problem has at least one solution. We denote an arbitrary one by $p_B^*(p_A)$.

Step 2 B*'s problem can be restated as*

$$\begin{aligned} &\operatorname*{arg\,max}_{q \in \text{supp } q^*(p_A, \cdot)} \hat{\Pi}_B(q; p_A) \\ = &\operatorname*{arg\,max}_{q \in \text{supp } q^*(p_A, \cdot)} \beta(v + \Delta) - \mathbb{P}[M(n_S, q) \geq m]\beta\Delta - \psi(q; p_A)\mathbb{E}[\bar{M}_B(n_S, q)]. \end{aligned}$$

If $\hat{\Pi}_B(q; p_A) \geq \beta v$*, and* $q' < q$ *s.th.* $\psi(q; p_A) = \psi(q'; p_A)$*, then* $\hat{\Pi}_B(q'; p_A) > \hat{\Pi}_B(q; p_A)$*.*

The first restatement follows directly from the definition of ψ and q^*. For the second, note that $\hat{\Pi}_B(q; p_A) \geq \beta v$ can be rearranged to

$$\begin{aligned} &(1 - \mathbb{P}[M(n_S, q) \geq m_A])\beta\Delta - \psi(q; p_A)\mathbb{E}[\bar{M}_B(n_S, q)] \geq 0 \\ \iff &\mathbb{P}[M(n_S, q) < m_A](\beta\Delta - \psi(q; p_A)\frac{\mathbb{E}[\bar{M}_B(n_S, q)]}{\mathbb{P}[M(n_S, q) < m_A]}) \geq 0. \end{aligned} \tag{4.12}$$

We want to show that the left side of (4.12) is strictly decreasing in q. Since $\mathbb{P}[M(n_S, q) < m_A]$ is strictly decreasing in q and (4.12) is positive, it suffices to show that $\frac{\mathbb{E}[\bar{M}_B(n_S,q)]}{\mathbb{P}[M(n_S,q)<m_A]}$ is strictly increasing in q. Note that

$$\begin{aligned}\frac{\mathbb{E}[\bar{M}_B(n_S,q)]}{\mathbb{P}[M(n_S,q)<m_A]} &= \frac{\mathbb{P}[M(n_S,q)<m_A]m_B + \sum_{i=0}^{m_B-1}\mathbb{P}[M(n_S,1-q)=i]i}{\mathbb{P}[M(n_S,q)<m_A]} \\ &= m_B + \frac{\sum_{i=0}^{m_B-1}\mathbb{P}[M(n_S,1-q)=i]i}{\sum_{i=m_B}^{n_S}\mathbb{P}[M(n_S,1-q)=i]} \\ &= m_B + \frac{\sum_{i=0}^{m_B-1}\binom{n_S}{i}i(1-q)^i q^{n_S-i} i}{\sum_{i=m_B}^{n_S}\binom{n_S}{i}i(1-q)^i q^{n_S-i}} \\ &= m_B + \frac{\sum_{i=0}^{m_B-1}\binom{n_S}{i}i(\frac{1-q}{q})^{i-(m_B-1)} i}{\sum_{i=m_B}^{n_S}\binom{n_S}{i}(\frac{1-q}{q})^{i-(m_B-1)}},\end{aligned}$$

where the numerator is increasing in q for all $i \in (0, ..., m_B - 1)$, and the denominator is strictly decreasing in q for all $i \in (m_B, ..., n_S)$. Thereby, the assertion follows.

Step 3 *Any best response $p_B^*(p_A)$ is such that $q(p_A, p_B^*(p_A))$ is nondecreasing in p_A.*

Suppose to the contrary that $p'_A > p_A$, but $q' = q^*(p'_A, p_B^*(p'_A)) < q = q^*(p_A, p_B^*(p_A))$. If $q \in \text{supp } q^*(p'_A, \cdot)$ and $q' \in \text{supp } q^*(p_A, \cdot)$, then, by revealed preferences,

$$\hat{\Pi}_B(q'; p'_A) \geq \hat{\Pi}_B(q; p'_A) \quad \textit{and} \quad \hat{\Pi}_B(q; p_A) \geq \hat{\Pi}_B(q'; p_A). \tag{4.13}$$

Suppose that $q \notin \text{supp } q^*(p'_A, \cdot)$ but $\hat{\Pi}_B(q; p'_A) \geq \beta v$. Then, $q^*(p'_A, \psi(q; p'_A)) < q$ and revealed preferences imply that $\hat{\Pi}_B(q'; p'_A) \geq \hat{\Pi}_B(q^*(p'_A, \psi(q; p'_A)); p'_A) > \hat{\Pi}_B(q; p'_A)$. If $\hat{\Pi}_B(q; p'_A) < \beta v$, then $\hat{\Pi}_B(q'; p'_A) \geq \hat{\Pi}_B(q^*(0; p_A), p'_A) \geq \beta v$ implies that $\hat{\Pi}_B(q'; p'_A) \geq \hat{\Pi}_B(q; p'_A)$. The argument for q' follows symmetrically, such that (4.13) holds.

Rearranging equation (4.13) using Step 2 gives

$$\begin{aligned}&(\mathbb{P}[M(n_S,q) \geq m_A] - \mathbb{P}[M(n_S,q') \geq m_A])\beta\Delta \\ &\qquad \geq \mathbb{E}[\bar{M}_B(n_S,q')]\psi(q';p'_A) - \mathbb{E}[\bar{M}_B(n_S,q)]\psi(q;p'_A), \\ &(\mathbb{P}[M(n_S,q) \geq m_A] - \mathbb{P}[M(n_S,q') \geq m_A])\beta\Delta \\ &\qquad \leq \mathbb{E}[\bar{M}_B(n_S,q')]\psi(q';p_A) - \mathbb{E}[\bar{M}_B(n_S,q)]\psi(q;p_A).\end{aligned}$$

Combined, these yield

$$\begin{aligned}&\mathbb{E}[\bar{M}_B(n_S,q')]\psi(q';p_A) - \mathbb{E}[\bar{M}_B(n_S,q)]\psi(q;p_A) \\ &\qquad \geq \mathbb{E}[\bar{M}_B(n_S,q')]\psi(q';p'_A) - \mathbb{E}[\bar{M}_B(n_S,q)]\psi(q;p'_A),\end{aligned}$$

which rearranges to

$$\mathbb{E}[\bar{M}_B(n_S, q')](\psi(q'; p'_A) - \psi(q'; p_A)) \leq \mathbb{E}[\bar{M}_B(n_S, q)](\psi(q; p'_A) - \psi(q; p_A)).$$

Now, because $q' < q$, it follows that $\mathbb{E}[\bar{M}_B(n_S, q')] > \mathbb{E}[\bar{M}_B(n_S, q)]$ and since $\psi(q; p_A)$ is more increasing for lower q, $\psi(q'; p'_A) - \psi(q'; p_A) \geq \psi(q; p'_A) - \psi(q; p_A)$, such that (4.13) is violated. This completes the contradiction.

Step 4 *Without loss, $q^*(p_A, p^*_B(p_A))$ is right-continuous in p_A. Since $q^*(p_A, p^*_B(p_A))$ is nondecreasing in p_A (Step 3), A's maximization problem has at least one solution and an equilibrium exists.*

Suppose to the contrary that there exists a decreasing sequence $(p_{A;n})_{n\mathbb{N}}$ with $\lim p_{A;n} = p_A$, and that $\lim q^*(p_{A;n}, p^*_B(p_{A;n})) = q^+$, but $q^+ > q^*(p_A, p^*_B(p_A)) = q^-$.

We argue that it has to hold that

$$\hat{\Pi}_B(q^-; p_A) \geq \hat{\Pi}_B(q^*(p_A, \psi(q^+; p_A)), p_A) \geq \hat{\Pi}_B(q^+; p_A)$$
$$\hat{\Pi}_B(q^*(p_{A;n}; p^*_B(p_{A;n})); p_{A;n}) \geq \hat{\Pi}_B(q^*(p_{A;n}, \psi(q^-; p_{A;n})), p_{A;n}) \geq \hat{\Pi}_B(q^-; p_{A;n}).$$

By construction of q^*, for any q it is true that $q^*(\psi(q, p_A), p_A)$ is in the support of $q^*(p_A, \cdot)$ and $q^*(\psi(q, p_A), p_A) \leq q$. Thereby, the first inequality of either line is a result of p^*_B being a best response of B and the second inequality follows by Step 2.

Since ψ and, thereby, $\hat{\Pi}_B$ are continuous in p_A and q, and because $q^*(p_{A;n}, p^*_B(p_{A;n}))$ as well as $p_{A;n}$ converge, it follows that $\hat{\Pi}_B(q^-; p_A) = \hat{\Pi}_B(q^+; p_A)$. Therefore, it's without loss to change B's response function at p_A to $p^*_B(p_A) = \psi(q^+; p_A)$ and $q^*(p_A, p^*_B(p_A)) = q^+$.

Since $q^*(p_A, p^*_B(p_A))$ is nondecreasing and right-continuous in p_A and all expressions are bounded, $\Pi_A(p^*_A; p^*_B, q)$ has at least one maximizer, such that an equilibrium exists. □

Proof of Lemma 4.1

When the activist makes no offer, $\emptyset$, no shareholder can sell, $q(\emptyset) = 0$.

In state Q, the activist's payoff is

$$\Pi_A(p; q, \xi, Q) = \alpha v + b - p\mathbb{E}[\bar{M}(n_S, q(p))]$$

if $\xi(p) \leq \frac{1}{2}$ and shareholders vote against the reform, and

$$\Pi_A(p; q, \xi, Q) = \alpha(v - \Delta) + \mathbb{P}[M(n_S, q(p)) \geq m](b + \alpha\Delta) - p\mathbb{E}[\bar{M}(n_S, q(p))]$$

when $\xi(p) \geq \frac{1}{2}$ and shareholders vote in favor of the reform.

In state R, the activist's payoff is

$$\Pi_A(p;q,\xi,R) = \alpha v + b + \mathbb{P}[M(n_S,q(p)) \geq m](\alpha\Delta - b) - p\mathbb{E}[\bar{M}(n_S,q(p))]$$

in case $\xi(p) \leq \frac{1}{2}$ and shareholders vote against the reform, and

$$\Pi_A(p;q,\xi,R) = \alpha(v+\Delta) + b - p\mathbb{E}[\bar{M}(n_S,q(p))]$$

if $\xi(p) \geq \frac{1}{2}$ and shareholders vote in favor of the reform.

When $\xi(p) \geq \frac{1}{2}$ and shareholders block the reform, firm value is v; if the activist dictates the outcome of the vote, it rises in expectation by $(1-\xi(p))\Delta$. If $\xi(p) \leq \frac{1}{2}$ and shareholders implement the reform, expected firm value is $v+(1-2\xi(p))\Delta$, and rises in expectation by $\xi(p)\Delta$ when the activist dictates the outcome of the vote. Therefore, the shareholders' payoffs can be written as

$$\begin{aligned}\Pi_S(\text{sell};p,q,\xi) &= \frac{v}{n} + \max\{0,1-2\xi(p)\}\frac{\Delta}{n} \\ &\quad + \mathbb{P}[M(n_S-1,q(p)) \geq m-1]\min\{\xi(p),1-\xi(p)\}\frac{\Delta}{n} + p\frac{\mathbb{E}[\bar{M}(n_S,q(p))]}{n_S q(p)}, \\ \Pi_S(\text{keep};p,q,\xi) &= \frac{v}{n} + \max\{0,1-2\xi(p)\}\frac{\Delta}{n} \\ &\quad + \mathbb{P}[M(n_S-1,q(p)) \geq m]\min\{\xi(p),1-\xi(p)\}\frac{\Delta}{n}.\end{aligned}$$

Step 1 *There cannot be an equilibrium with $p^*(\omega) > 0$ in either state $\omega \in \{Q,R\}$.*

If A offers any price $p > 0$, all shareholders sell because they know that the friendly activist matches the state. Thus, if $p^*(\omega) > 0$, the activist has a profitable deviation to any $p' \in (0,p^*)$ because it reduces her transfer.

Step 2 *There cannot be an equilibrium where $p^*(\omega) \neq 0$ in both states $\omega \in \{Q,R\}$.*

Suppose A never offers $p^* = 0$. By Step 1, $p^*(Q) = p^*(R) = \emptyset$. Thus, shareholders do not learn from the activists action and implement the reform. In state Q, this means that the activist's payoff is $\alpha(v-\Delta)$. Consider a deviation to $\frac{\epsilon}{m} > 0$ in state Q. Being offered this positive price, all shareholders sell because they know that the friendly activist matches the state. Thus, the activist's payoff is $b+\alpha v-\epsilon$, such that the deviation is profitable when ϵ i sufficiently small. By Step 1 and Step 2, it follows that the activist offers $p^*(\omega) = 0$ in at least one state $\omega \in \{h,\ell\}$.

Step 3 *In any equilibrium, the reform is implemented in state R, but status quo remains in state Q.*

Given Step 1 and 2, there are two possibilities. If $p^*(Q) = p^*(R) = 0$, shareholders do not learn from the offer, $\xi^*(p^*(Q)) = \xi^*(p^*(R)) = \rho$. If they do not sell and implement the reform, they choose the wrong action with probability $1-\rho$. Since the friendly activist always matches the state, if $q^*(0) > 0$ and shareholders are pivotal with positive probability, it is strictly optimal for them to sell. In case $q^*(0) = 0$, the activist has a profitable deviation in state Q by offering a small positive price $\frac{\epsilon}{m}$, securing all voting rights, and blocking the reform (compare Step 2).

When $p^*(Q) = 0$ and $p^*(R) = \emptyset$, or $p^*(R) = 0$ and $p^*(Q) = \emptyset$, shareholders learn the state from the offer, and vote for the reform in state R and for the status quo in state Q. The activist also matches the state. Thus, when $p^*(\omega) = 0$, shareholders are indifferent between voting themselves or delegating their voting right to activist. Since the firm value is maximized and the activist has no cost, there are no profitable deviations.

Proof of Lemma 4.2

Suppose that $\mu^*(Q) = 1$ and $\mu^*(R) = 0$. Conditional on observing the message, shareholders learn the state, $\xi^*(0) = 0$ and $\xi^*(1) = 1$, implement the reform in state R, and block it in state Q. Since this maximizes firm value and the activist has aligned incentives, no investor has an incentive to deviate.

Proof of Proposition 4.3

Step 1 *There always exists a separating equilibrium.*

We construct an equilibrium of the following form:

- The activist offers $p^*(Q) > p^*(R) \geq 0$.
- Shareholders sell with probability $q^*(p) \begin{cases} = 1 & \text{if } p \geq p^*(Q) \\ < 1 & \text{if } p < p^*(Q). \end{cases}$
- On path beliefs are correct, $\xi^*(p^*(Q)) = 1$ and $\xi^*(p^*(R)) = 0$. Off-path beliefs are $\xi^*(p) = 0$ for all $p < p^*(Q)$ (shareholders believe that the state is R), and $\xi^*(p) = 1$ for all $p > p^*(Q)$.

Let $q^*(p) = q_-(p)$ as defined by (4.9) and Lemma 4.5 for all $p < \bar{p} = \max_q \phi(q)\frac{\Delta}{n}$ (where $\xi^*(p) = 0$), and $q^*(p) = 1$ for all $p \geq \bar{p}$.

If $\bar{p} \notin \arg\max_p \Pi_A(p; q^*, R)$, reduce $\bar{p}$ and modify q^* till it is. This has to be possible, because $\Pi_A(\bar{p}; q^*, R) = \alpha v + b - m\bar{p}$ is continuous and strictly decreasing in $\bar{p}$, whereas for any $p < \bar{p}$ it holds that $\Pi_A(p; q^*, R) \leq \alpha(v + \Delta) + \mathbb{P}[M(n_S, q^*(p)) \geq m](b - \alpha\Delta)$ and $\mathbb{P}[M(n_S, q^*(p)) \geq m]$ is bounded away from one.

When $\bar{p} \in \arg\max \Pi_A(p; q^*, R)$, select a $p' < \bar{p}$ and $q^*(p') = q_+(p')$ as defined in Lemma 4.5 such that $\Pi_A(\bar{p}; q^*, R) = \Pi_A(p'; q^*, R)$. Such a p' has to exist, because

$q_+(p')$ is continuous and strictly decreasing in p' with $q_+(0) = 1$, and $\Pi_A(p; q, R)$ is continuous in both, p and q. Notice that $p' < \bar{p}$ and $q^*(p') < 1 = q^*(\bar{p})$.

Let $p^*(R) = p'$, which, by construction, is a best response. Further, let $p^*(Q) = \bar{p}$ and notice that

$$\begin{aligned}\Pi_A(p; q^*, Q) &= \alpha(v - \Delta) + \mathbb{P}[M(n_S, q^*(p)) \geq m](b + \alpha\Delta) - p\mathbb{E}[\bar{M}(n_S, q^*(p))] \\ &= \Pi_A(p; q^*, R) - 2(1 - \mathbb{P}[M(n_S, q^*(p)) \geq m])\alpha\Delta \\ &< \Pi_A(\bar{p}; q^*, R) = \alpha v + b - \bar{p}m = \Pi_A(\bar{p}; q^*, Q)\end{aligned}$$

for all $p \neq \bar{p}$. All prices above $\bar{p}$ are dominated by $\bar{p}$. Thus, the activist has no profitable deviation in either state.

Last, shareholders do not want to deviate. If the price is $p > \bar{p}$, then $q^*(p) = 1$, such that no shareholder is pivotal and selling is a best response. At any price below $\bar{p}$, shareholders play a best response given their belief that the state is R. When the price is $p^*(R)$, this belief is correct.

Step 2 *In any separating equilibrium,* $p^*(R) < p^*(Q)$ *and* $q^*(p^*(R)) < q^*(p^*(Q)) = 1$.

Suppose to the contrary that $p^*(R) \neq p^*(Q)$ but $q^*(p^*(R)) \geq q^*(p^*(Q))$. In any separating equilibrium, after observing $p^*(Q)$, shareholders know that the activist has aligned interests.

If $p^*(Q) > 0$, shareholders sell with probability $q^*(p^*(Q)) = 1$. Thus, the claim can only be violated if $q^*(p^*(R)) = 1$. However, this contradicts the separation, $p^*(R) \neq p^*(Q)$, because the lower price dominates the higher price, such that the activist would want to deviate in one state.

If $p^*(Q) = 0$, shareholders either sell or vote to block the reform. In either case, the reform does not pass, meaning that any $p^*(R) > 0$ is dominated by $p^*(Q) = 0$, which contradicts the separation. Thereby, $q^*(p^*(R)) < q^*(p^*(Q))$.

If $p^*(R) \geq p^*(Q)$, then $p^*(Q)$ dominates $p^*(R)$ because $q^*(p^*(R)) < q^*(p^*(Q))$. Thereby, $p^*(R) < p^*(Q)$, completing the proof.

Step 3 *As n grows large, along any sequence of equilibria and for* $\omega \in \{Q, R\}$,

$$\mathbb{P}[M(n_S, q^*(p^*(\omega))) \geq m] \to 1 \quad \textit{and} \quad p^*(\omega)\mathbb{E}[\bar{M}(n_S, q^*(p^*(\omega)))] \to 0.$$

In the proof of Proposition 4.1, we derived that there is a price $\bar{p}$ such that $q^*(p) = 1$ for all $p > \bar{p}$, even when shareholders believe the state is R, $\xi^*(\bar{p}) = 0$, such that their expected loss is maximal. Further, $n\bar{p} \to 0$. Without loss, suppose that $q^*(\bar{p}) = 1$ as well. Then, $\lim \Pi_A(\bar{p}; q^*, \xi^*, \omega) = \alpha v + b$ in both state $\omega \in \{h, \ell\}$.

Suppose the assertion was violated and consider a sequence of separating equilibria. By Step 2, it suffices to show that $p^*(Q)\mathbb{E}[\bar{M}(n_S, q^*(p^*(Q)))] \to 0$ and

$\mathbb{P}[M(n_S, q^*(p^*(R))) \geq m] \to 1$. In a separating equilibrium, $\xi^*(p^*(Q)) = 1$, such that shareholders vote for the status quo and

$$\Pi_A(p^*(Q); q^*, \xi^*, Q) = \alpha v + b - p^*(Q)\mathbb{E}[\bar{M}(n_S, q^*(p^*(Q)))].$$

If $p^*(Q)\mathbb{E}[\bar{M}(n_S, q^*(p^*(Q)))] \not\to 0$, a deviation to $\bar{p}$ is profitable when n is sufficiently large. In state R, the belief is $\xi^*(p^*(R)) = 0$, meaning that shareholders vote for the reform and

$$\begin{aligned}\Pi_A(p^*(R); q^*, \xi^*, R) = \alpha(v + \Delta) + \mathbb{P}[M(n_S, q^*(p^*(R))) \geq m](b - \alpha\Delta) \\ - p^*(R)\mathbb{E}[\bar{M}(n_S, q^*(p^*(R)))].\end{aligned}$$

If $\mathbb{P}[M(n_S, q^*(p^*(R))) \geq m] \not\to 0$, a deviation to $\bar{p}$ is profitable when n is sufficiently large.

Next, consider a sequence of pooling equilibria, where $p^*(Q) = p^*(R) = p^*$, meaning that $\xi^*(p^*) = \rho$ and shareholders vote for the reform. Then,

$$\begin{aligned}\Pi_A(p^*; q^*, \xi^*, Q) &= \alpha(v - \Delta) + \mathbb{P}[M(n_S, q^*(p^*)) \geq m](b + \alpha\Delta) - p^*\mathbb{E}[\bar{M}(n_S, q^*(p^*))] \\ \Pi_A(p^*; q^*, \xi^*, R) &= \alpha(v + \Delta) + \mathbb{P}[M(n_S, q^*(p^*)) \geq m](b - \alpha\Delta) - p^*\mathbb{E}[\bar{M}(n_S, q^*(p^*))].\end{aligned}$$

When either assertion is violated, then $\Pi_A(p^*; q^*, \xi^*, \omega) < \alpha v + b$ for n arbitrary large, such that a deviation to $\bar{p}$ is profitable.

Proof of Proposition 4.4

The equilibrium is supported by off-path beliefs $\xi^*(\kappa) < \frac{1}{2}$ for any $\kappa \in (0, b - \alpha\Delta)$ and the correct on-path belief $\xi^*(0) = 0$. Thus, after any $\kappa < b - \alpha\Delta$, the reform is implemented, such that $\kappa = 0$ dominates all $\kappa < b - \alpha\Delta$. After observing $\kappa = b - \alpha\Delta$, the shareholders believe that the state is Q, $\xi^*(b - \alpha\Delta) = 1$, and the reform is blocked. Above $\kappa = b - \alpha\Delta$, the off-path beliefs are arbitrary. Thus, any $\kappa > b - \alpha\Delta$ is also dominated by either $\kappa = 0$ or $\kappa = b - \alpha\Delta$.

In state Q, the activist has an incentive to spend $\kappa = b - \alpha\Delta$, yielding a payoff of $b + \alpha v - \kappa = b + \alpha v - (b - \alpha\Delta) = \alpha(v + \Delta)$ instead of spending $\kappa = 0$, which yields her a profit of $\alpha(v - \Delta)$. In state R, the activist spends $\kappa = 0$ and receives $\alpha(v + \Delta)$ which yields the same payoff as spending $\kappa = b - \alpha\Delta$. Hence, $\kappa^*(R) = 0$ and $\kappa^*(Q) = b - \alpha\Delta$ is optimal for the activist and the on-path beliefs are consistent.

There cannot be an equilibrium in which the state is matched with probability strictly smaller than $(1 - \rho)$. In any separating equilibrium, shareholders learn the state and, therefore, the probability of matching the state is one. In any pooling equilibrium, shareholders vote according to their prior and implement the reform, such that the probability of matching the state is $(1 - \rho)$.

Unrestricted and Conditional Offers

Lemma 4.7 *When the activist cannot set a restriction, there are equilibria in which* $\mathbb{P}[M(n_S, q^*(p^*)) \geq m] > 0$ *but*

$$p^*\mathbb{E}[M(n_S, q^*(p^*))] > m\frac{\Delta}{n}\mathbb{P}[M(n_S, q^*(p^*)) \geq m].$$

Proof. Suppose that there is no restriction, such that the activist has to buy from all shareholder who sell to her. Given offer p and response $q(p)$, shareholders are willing to sell if

$$p \geq \mathbb{P}[M(n_S - 1, q(p)) = m - 1]\frac{\Delta}{n}. \tag{4.14}$$

We prove the result by an example.

Suppose that $\alpha = 0$, $n = 11$, and $m = 2$. Further, $\Delta = 1$ and $b = \frac{3}{4}$. In this case

$$\mathbb{P}[M(n_S - 1, q(p)) = m - 1] \leq \mathbb{P}[M(10, 0.1) = 1] = 0.38742.$$

Solving for $q(p)$ when (4.14) holds with equality, there is a continuous, strictly increasing best response q^* with $q^*(p) < 0.1$ for all $p < 0.38742\frac{\Delta}{n}$ and $q^*(p) = 1$ for all $p \geq 0.38742\frac{\Delta}{n}$.

It now follows that $p^* = 0.38742\frac{\Delta}{n}$ because for all $p < p^*$

$$\begin{aligned}\Pi_A^{\text{nr}}(p; q^*) &< b * \mathbb{P}[M(n_S, 0.1) \geq 2] \\ &= b * 0.302643 < b - n * 0.38742\frac{\Delta}{n} = b - 0.38742 = \Pi_A^{\text{nr}}(p^*; q^*).\end{aligned}$$

Any $p > p^*$ is dominated by p^*. Further, $\mathbb{E}[M(n_S, q^*(p^*))]p^* = 0.38742 > \frac{2}{11}\Delta$, completing the proof. □

Lemma 4.8 *When the activist can condition her restricted offer on success, in the unique equilibrium* $p^* = 0$ *and* $q^*(p^*) = 1$.

Proof. As in the case without the condition, $p^* = 0$ and $q^*(0) = 1$ constitute an equilibrium. We show that there is no other equilibrium.

Given any q and the conditional restricted offer p, a shareholder is indifferent between selling the and retaining the share if

$$p\sum_{i=m-1}^{n_S-1}\mathbb{P}[M(n_S - 1, q) = i]\frac{m}{i+1} = \frac{\Delta}{n}\mathbb{P}[M(n_S - 1, q) = m - 1]. \tag{4.15}$$

With (4.6) and (4.8) this rearranges to

$$
\begin{aligned}
p\mathbb{P}[M(n_S,q) \geq m]\frac{m}{qn_S} &= \frac{\Delta}{n}\mathbb{P}[M(n_S-1,q)=m-1] \\
\iff p\mathbb{P}[M(n_S,q) \geq m] &= \frac{\Delta}{n}\mathbb{P}[M(n_S,q)=m] \\
\iff p &= \frac{\Delta}{n}\frac{\mathbb{P}[M(n_S,q)=m]}{\mathbb{P}[M(n_S,q)\geq m]}.
\end{aligned}
$$

We now note that by (4.10), $\frac{\mathbb{P}[M(n_S,q)=m]}{\mathbb{P}[M(n_S,q)\geq m]}$ is monotonically decreasing in q with

$$
\lim_{q\searrow 0}\frac{\mathbb{P}[M(n_S,q)=m]}{\mathbb{P}[M(n_S,q)\geq m]} = 1 \qquad \lim_{q\nearrow 1}\frac{\mathbb{P}[M(n_S,q)=m]}{\mathbb{P}[M(n_S,q)\geq m]} = 0.
$$

By offering $p > 0$, either $q^*(p) = 1$ or q^* is determined by (4.15). In either case, for any $p > 0$ and any $\epsilon > 0$, there is a price $p_\epsilon < \epsilon$ such that $\frac{q^*(p_\epsilon)}{q^*(p)} \geq 1-\epsilon$. Hence, a profitable deviation always exists. This means that in equilibrium, it has to hold that $p^* = 0$ and $q^*(0) = 1$. $\square$

Proof of the Example

Most of the proof can be found in the body of the text. What remains to be shown is that in state R, the activist does not want to deviate from 0 to any $p \in (0,\bar{p})$.

At any $p \in (0,\bar{p})$, the shareholders' belief is $\xi^*(p) = 0$, and because $q^*(p) \in (0,1)$, q^* is determined by the shareholders' indifference condition (4.9). In state R, the activist's payoff function is given by (4.1). Plugging in (4.9), and using (4.8) gives

$$
\begin{aligned}
&\Pi_A(p;q^*,\xi^*,R) \\
&= \alpha(v+\Delta) + \mathbb{P}[M(n_S,q^*(p)) \geq m](b-\alpha\Delta) - m\mathbb{P}[M(n_S,q^*(p))=m]\frac{\Delta}{n} \\
&= \alpha(v+\Delta) + \mathbb{P}[M(n_S,q^*(p)) \geq m]((b-\alpha\Delta) - m\frac{\mathbb{P}[M(n_S,q^*(p))=m]}{\mathbb{P}[M(n_S,q^*(p))\geq m]}\frac{\Delta}{n})
\end{aligned}
$$

for all $p \in (0,\bar{p})$.

Since $\mathbb{P}[M(n_S,q) \geq m]$ is increasing in q, $\frac{\mathbb{P}[M(n_S,q)=m]}{\mathbb{P}[M(n_S,q)\geq m]}$ is decreasing in q (cf. equation (4.10)), and q^* is strictly increasing in p, there can be no interior optimum $p^* \in (0,\bar{p})$. Since every $p > \bar{p}$ is also dominated by $\bar{p}$, it follows that 0 and $\bar{p}$ are the only two non-dominated actions. Since the activist is indifferent between 0 and $\bar{p}$ when the state is R, there can be no profitable deviations.

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