Shareholder Governance and Debt Maturity Structure*

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Abstract

This paper studies 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 risk premia 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.

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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 & 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 paper 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 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 & Pfleiderer (2009) and Edmans (2009), the manager's payoff

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

[2] Among others, Parrino et al. (2003), Boehmer & Kelley (2009), Brockman & 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 6 for a more detailed discussion.

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 risk premia (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), 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 & 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

[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 & von Thadden (1998), Kahn & 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.

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 & 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 & Kahn 1991, Diamond & 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 & 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.

[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 & 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.

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. My paper 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 governance. Second, this paper is related to the literature on (short-term) debt and corporate governance. My paper adds to this literature by examining a setting in which creditors learn from share prices. Third, my paper 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 paper is organized as follows: Section 2 reviews the literature. Section 3 introduces the baseline model (Section 3.1), analyzes the blockholder's exit incentives (Section 3.2) and characterizes the unique equilibrium and managerial incentives (Section 3.3). Further, Section 3.4 derives the optimal ownership concentration. Section 4 analyzes the model with both voice and exit. Empirical predictions are derived in Section 5, and Section 6 concludes. Afterward, in Section 7, several extensions are discussed.

2 Related Literature

Shareholder Governance. Since Berle & 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 & 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 & Winton (1998) qualified the early findings by showing that increased stock market liquidity also increases ex ante block-formation incentives. Holmström & 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 & 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 & Gromb (2004) where outside speculators determine the share price informativeness.

Admati & 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 & Pfleiderer (2009) and Edmans (2009) and shows how the debt maturity structure of a firm can shape exit and voice. Edmans & 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 & 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 & 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 & Kahn 1991, Diamond & 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 improve incentives for managers by making their payoff more sensitive to their actions (Jensen & Meckling 1976, Innes 1990). Furthermore, debt can also increase the share price informativeness by increasing information acquisition incentives (Boot & 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 & von 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 & 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 & Shapiro (2017) study the interaction of credit rating agencies' incentives to inflate ratings and information acquisition incentives in the CDS market. Manso (2013), Goldstein & Huang (2020) and Walther & 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.

[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 & Heider (2020) show that short-term debt can arise endogenously for firms to commit themselves not to engage in risk shifting.

[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.

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 paper 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 & 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 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.

3 Debt Maturity Structure and Exit

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

[9] A more detailed discussion of the relation to this paper can be found in Section 7.2.

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 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_{ST}^1 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_{ST}^2 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

[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 $\frac{1}{\Delta_q^2} > 1$.

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 paper. 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.

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 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 paper 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 & 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

[11] Section 7.1 generalizes the results to a continuous trading technology and Section 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 7.4.

$t = 3$ minus the private effort cost c, i.e.

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

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 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 1.

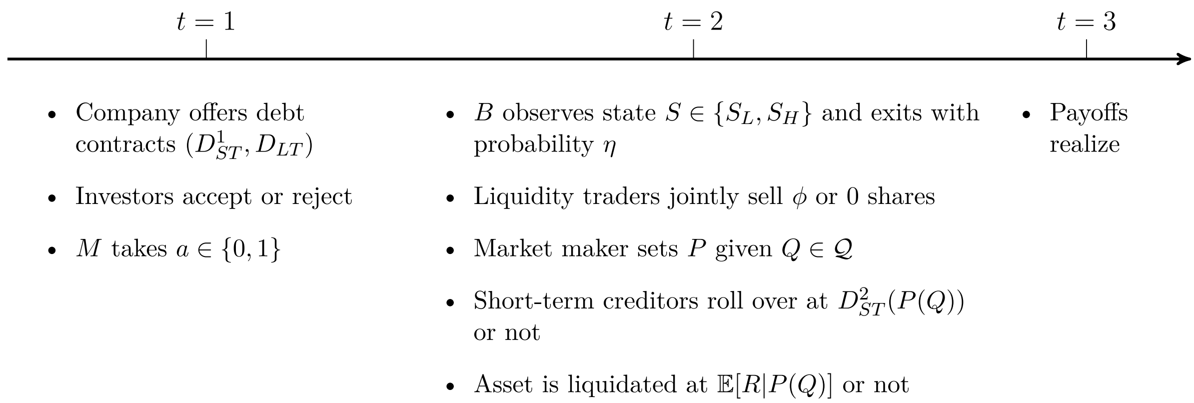

Figure 1: Timing Baseline Model

Strategies and Equilibrium Concept. The equilibrium concept is the Perfect Bayesian equilibrium refined by the $D1$ criterion (Cho & 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 $(\eta^*, P^*, \sigma_I^{1*}, \sigma_I^{2*}, D_{ST}^{1*}, D_{ST}^{2*}, D_{LT}^*)$.*

2. *η^* maximizes B's expected utility given $(\sigma_M^*, P^*, \sigma_I^{1*}, \sigma_I^{2*}, D_{ST}^{1*}, D_{ST}^{2*}, D_{LT}^*)$ 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 & Kreps 1987).*

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.,

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

According to the market maker's break-even condition (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

[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.

value of short-term debt which, in turn, is a function of the share price, (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 establishes that, in any equilibrium where the blockholder 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. *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 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 & 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

$$D^1_{ST} = [\pi(Q)p_H + (1 - \pi(Q))p_L]D^2_{ST}(Q). \tag{3}$$

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

Note that by Lemma 1, creditors' posterior belief can directly be conditioned on Q. The left side of equation (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 (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

$$D^2_{ST}(Q) \leq \frac{\overline{R} - (1-\gamma)D_{LT}}{\gamma}. \tag{4}$$

Hence, a short-term creditor cannot be induced to roll over if (3) and (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 (3) and (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]

[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 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 (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 welfare implications in my model, and would only tend to strengthen the effect of short-term debt on exit incentives, I abstract

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. *$p_L > \hat{q}\Delta_p$,*

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 requires that $p_L \geq \hat{q}\Delta_p$. Assumption 1 depends on an equilibrium object $\hat{q}$. When managerial incentives are analyzed, Assumption 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. *Suppose Assumption 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 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 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

form these self-fulfilling equilibria.

[18] See the proof of Proposition 1 for the explicit expressions.

[19] The precise argument for $P(-\phi) > 0$ is given in the proof of Lemma 1.

higher spreads. Since, in equilibrium, the stock market will incorporate the anticipated effect of higher credit spreads already when the blockholder trades (Equation (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 3.4, the effect is even stronger if $\alpha > \phi$.

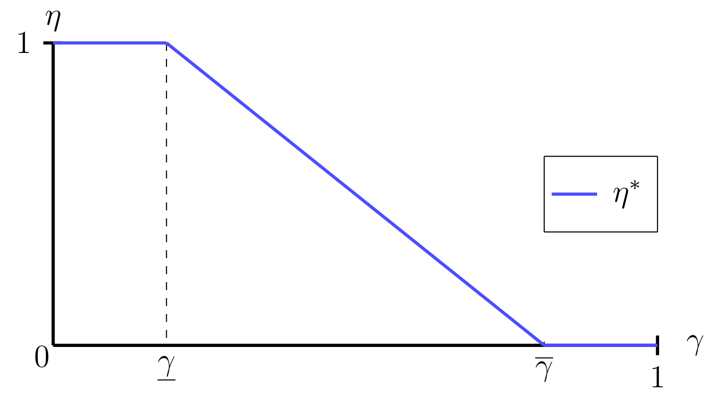

Figure 2: Equilibrium exit probability η^* as a function of the short-term debt level γ.

Figure 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 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

[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 $\Pi^{NE}(\eta^*)$.

$$\underbrace{\alpha\Big(\frac{1}{2}P(-\phi)+\frac{1}{2}P(-2\phi)\Big)}_{=\Pi^E}=\underbrace{\alpha\Big(\frac{1}{2}V(S_L,-\phi)+\frac{1}{2}V(S_L,0)\Big)}_{=\Pi^{NE}(\eta^*)}. \quad (5)$$

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 (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 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.

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) 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

$$\hat{c} = \omega_p \Delta_q \eta^* \frac{1}{2}\Big[P(0) - P(-2\phi)\Big] + \omega_v \Delta_q \frac{1}{2}\Big[\eta^* \Big(V(S_H, -\phi) + V(S_H, 0) - V(S_L, -2\phi) - V(S_L, -\phi)\Big) + (1 - \eta^*)\Big(V(S_H, -\phi) + V(S_H, 0) - V(S_L, -\phi) - V(S_L, 0)\Big)\Big]. \tag{6}$$

The right side of (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 (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.[22]

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

The first part of Assumption 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 evaluated at the upper bound of the prior success probability of 1. The second part of Assumption 2 is needed to guarantee that there is a unique cutoff $\hat{c}$ and thus a unique equilibrium.

Proposition 2. *Suppose Assumption 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.*
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.*

[21] See the proof of Proposition 2 for the expressions of M's payoff from working and shirking, respectively.

[22] By Hölmstrom (1979), the optimal contract puts all weight on ω_v since the final return is more informative about M's effort than the share price. This relies on the simplifying assumption that B directly observes the state. If he instead observes a, the optimal contract may put all weight on ω_p under the condition that the project return is less informative about the action than the share price. In either case, the results go through since I allow for $\omega_p = 0$ or $\omega_v = 0$, a contrast to the previous literature on blockholder exit. A comprehensive analysis of market monitoring and the resulting optimal executive contract can be found in Holmström & Tirole (1993).

4. The optimal maturity structure is given by $\gamma^{E*} = \underline{\gamma}^E$.

Proposition 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 2 also characterizes the equilibrium relationship of the level of short-term debt γ and managerial incentives $\hat{c}$, illustrated in Figure 3. The cutoffs $\underline{\gamma}^E$ and $\overline{\gamma}^E$ follow from Proposition 1 evaluated at $\hat{q} = q + G(\hat{c})\Delta_q$.

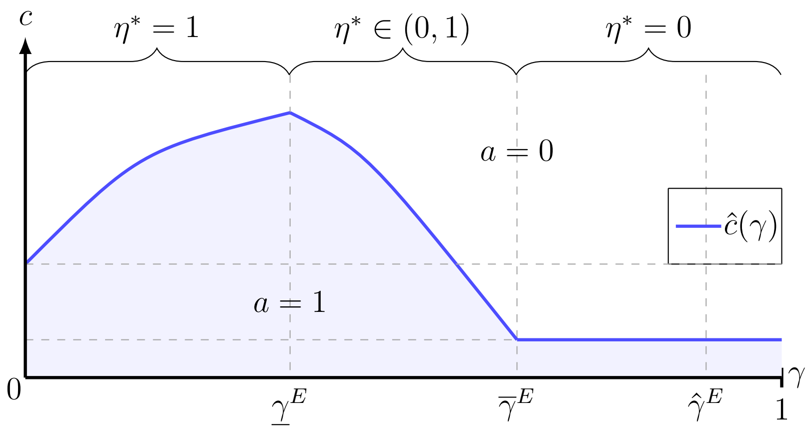

Figure 3: Managerial Incentives

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 (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 (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 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 (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 $\omega_p > 0$.[23] 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 & Kahn 1991).

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, 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

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

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.[24] 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 3.4 and I consider Perfect Bayesian equilibria under the $D1$ criterion.

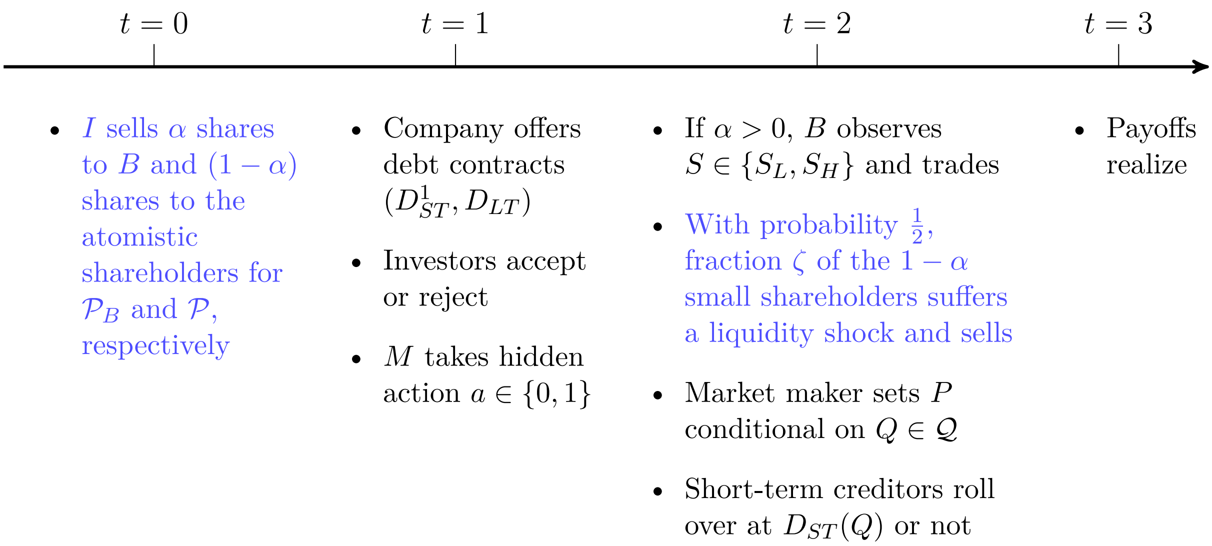

Figure 4: Timing with Endogenous Ownership Concentration

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 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.[25] Hence, the only interesting case is

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

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

$\alpha \geq \phi(\alpha)$. As the next lemma establishes, B's exit incentives decrease in α for this case.

Lemma 2. *Suppose Assumption 2 holds and $\alpha \geq \phi(\alpha)$. Then, there exists a unique equilibrium with the structure of Proposition 2. In particular, there is a cost cutoff $\hat{c}(\alpha) \in (0, \overline{c})$ 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.*
- *For any γ, $\hat{c}(\alpha)$ weakly decreases in α.*

Lemma 2 shows that there is a unique equilibrium with the same structure as in Section 3.3. Further, Lemma 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

$$\begin{aligned} \max_{\alpha \in [0,1], \mathcal{P}_B, \mathcal{P} \in \mathbb{R}_+} \quad & \alpha \mathcal{P}_B + (1-\alpha)\mathcal{P} \\ s.t. \quad & \alpha \mathcal{P}_B \leq \alpha \mathbb{E}[V^B(\hat{c}(\alpha))] - \mathbf{1}_{\alpha > 0} k \\ & \mathcal{P} \leq \mathbb{E}[V^S(\hat{c}(\alpha))] \end{aligned} \tag{7}$$

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 (7) will bind in equilibrium, I's problem becomes

$$\max_{\alpha\in[0,1]} \alpha\mathbb{E}[V^B(\hat{c}(\alpha))] - \mathbf{1}_{\alpha>0}k + (1-\alpha)\mathbb{E}[V^S(\hat{c}(\alpha))]$$
$$= \max_{\alpha\in[0,1]} \mathbb{E}[V(\hat{c}(\alpha))] - \mathbf{1}_{\alpha>0}k \tag{8}$$

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.,

$$k \leq \overline{k}(\gamma,\alpha) := \underbrace{\Delta_p\Delta_q\overline{R}[G(\hat{c}(\alpha) - G(\hat{c}(0))]}_{\text{benefit of concentrated ownership}}. \tag{9}$$

Inequality (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 3. *Suppose Assumption 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 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 5.

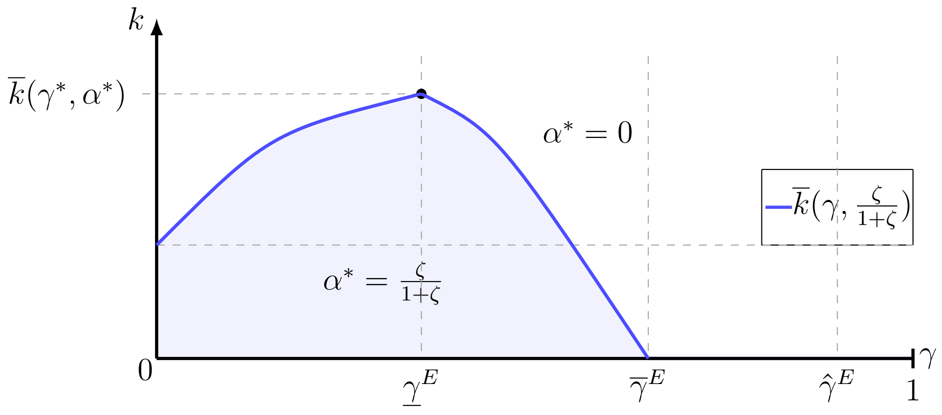

Figure 5: Value and Costs of Concentrated Ownership

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, $\alpha^* = 0$.

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 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.

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 3.1.

In addition to trading, the blockholder can improve managerial incentives in $t = 1$ by spending hidden[26] 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 $G^m[0, \bar{c}_m]$ with $g^m(c) \leq \frac{1}{\Delta_q^2}$, where G^m is a truncation of G at $\bar{c}_m \in (p_H R, \bar{c})$. Thus, $G^m(c) = \frac{G(c)}{G(\bar{c}_m)} > G(c)$ holds for any $c \in (0, \bar{c}_m]$. 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 & 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 3.1. In particular, the ownership concentration is fixed exogenously at $\alpha = \phi$. The timing is summarized in Figure 6.

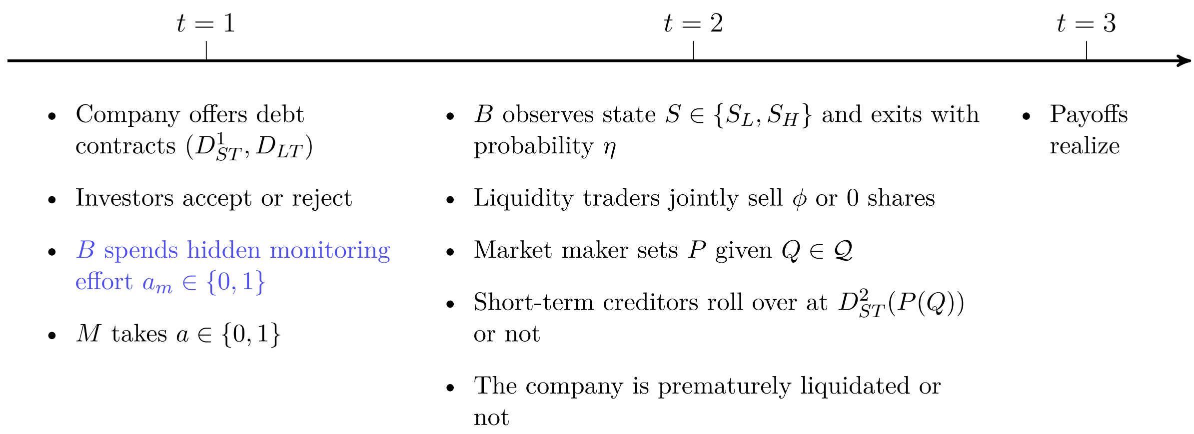

Figure 6: Timing Voice Model

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

$$(q + G^m(\hat{c})\Delta_q)\ \mathcal{V}_H + (1 - q - G^m(\hat{c})\Delta_q)\ \mathcal{V}_L - \kappa, \tag{10}$$

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 reten-

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

tion conditional on S_L. B's expected profits from deviating to $a_m = 0$ are

$$(q + G(\hat{c})\Delta_q)\ \mathcal{V}_H + (1 - q - G^m(\hat{c})\Delta_q)\ \mathcal{V}_L. \tag{11}$$

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 4. *Suppose Assumption 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 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 (10) and (11) is larger than zero, i.e., if

$$\kappa \leq \overline{\kappa} = \underbrace{[G^m(\hat{c}) - G(\hat{c})]\ \Delta_q \left(\mathcal{V}_H(\hat{c})\ -\ \mathcal{V}_L(\hat{c})\right)}_{\text{benefit of monitoring for } B}. \tag{12}$$

According to inequality (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 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 (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 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.

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 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 3.2), or the volume (Section 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 & Goodman 2007, Boehmer & Kelley 2009, Brockman & 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 3.4 and 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.[27]

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.

H7 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 & 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.

H8 Banks have low ownership concentration, and index funds hold a larger portion of their concentrated ownership. Shareholder governance in banks relies on voice.

[27] 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.

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 & 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.

7 Extensions

7.1 Continuous Liquidity Trader Demand

This section generalizes the results of Section 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

$$g(h) = \begin{cases} 0 & \text{if } h \leq 0 \\ \lambda e^{-\lambda h}, & \text{else.} \end{cases} \tag{13}$$

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

$$\pi(Q \geq 0) = \frac{q\lambda e^{-h\lambda}}{q\lambda e^{-h\lambda} + (1-q)\lambda e^{-(h+\hat{\beta})\lambda}} = \frac{q}{q + (1-q)e^{-\hat{\beta}\lambda}}. \tag{14}$$

The posterior (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 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, 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

$$\begin{cases} 1 = p_0 D_{LT} & \text{(long-term debt)}, \\ 1 = D^1_{ST} & \text{(short-term debt in } t = 1), \\ 1 = p_L D^2_{ST}(Q < 0) & Q < 0, \\ 1 = \frac{q}{q+(1-q)e^{-\hat{\beta}\lambda}} p_H D^2_{ST}(Q \geq 0) + \frac{(1-q)e^{-\hat{\beta}\lambda}}{q+(1-q)e^{-\hat{\beta}\lambda}} p_L D^2_{ST}(Q \geq 0) & Q \geq 0. \end{cases} \tag{15}$$

Given these conditions, the market maker determines the prices according to pricing rule (2), yielding

$$\begin{aligned} P(Q \geq 0) = & \frac{q}{q + (1-q)e^{-\hat{\beta}\lambda}} p_H(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT}) \\ & + \frac{(1-q)e^{-\hat{\beta}\lambda}}{q + (1-q)e^{-\hat{\beta}\lambda}} p_L(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT}) \end{aligned} \tag{16}$$

and

$$P(Q < 0) = p_L(\overline{R} - \gamma D^2_{ST}(Q < 0) - (1-\gamma)D_{LT}). \tag{17}$$

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. [28]

Assumption 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 5. *Suppose Assumption 3 holds true. Then, B's optimal trading volume is given by*

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

[28] 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.

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 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 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 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.

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 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 & 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

$$\frac{1}{3}\alpha[V(S_L, -\phi) + V(S_L, 0) + V(S_L, +\phi)], \tag{18}$$

whereas deviating to exit yields

$$\frac{1}{3}\alpha[P(-2\phi) + P(-\phi) + P(0)]. \tag{19}$$

$D^2_{ST}(-2\phi) = D^2_{ST}(-\phi) = \frac{D^1_{ST}}{p_L} \geq \frac{1}{p_L} > \overline{R}$ 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 (18) weakly exceeds (19), i.e., if

$$\frac{2}{3}\alpha p_L[\overline{R} - \frac{D^1_{ST}}{p_0}] \geq \frac{1}{3}\alpha p_0[\overline{R} - \frac{D^1_{ST}}{p_0}], \tag{20}$$

which rearranges to $p_L \geq q\Delta_p$ and holds true by Assumption 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 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.

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.

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 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 $t = 2$.[29] In $t = 3$, payoffs realize and the timing is summarized in Figure 7.4.

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 given by

$$\frac{1}{2}\alpha[P^{t=1}(-\phi) + P^{t=1}(-2\phi)] = \frac{1}{2}\alpha[p_0(\overline{R} - \frac{1}{p_0}) + p_L \underbrace{max\{\overline{R} - \frac{1}{p_L}; 0\}}_{=0}]. \tag{21}$$

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

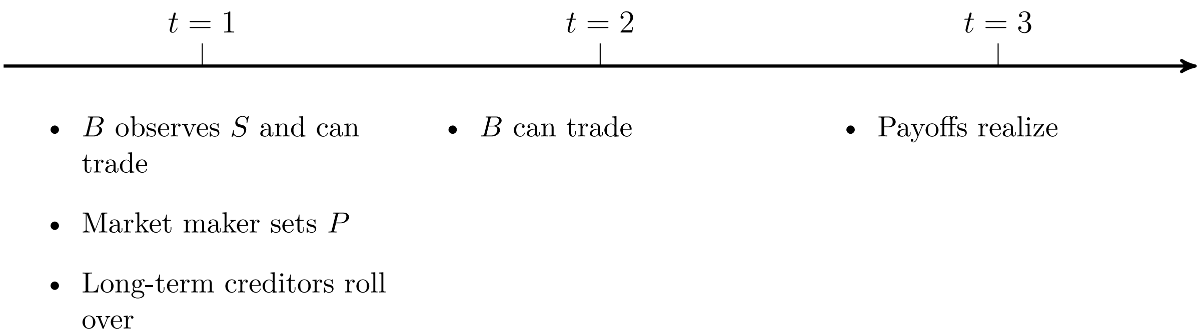

Figure 7: Timing Voice

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

$$\frac{1}{2}\alpha[P^{t=2}(-\phi) + P^{t=2}(-2\phi)] = \frac{1}{2}\alpha[p_0(\overline{R} - \frac{1}{p_0}) + p_L(\overline{R} - \frac{1}{p_0})]. \tag{22}$$

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.

A Appendix

Proof of Lemma 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

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

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

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 $Q = -2\phi$, (3) and (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

$$\overline{R} = \hat{\gamma}\frac{1}{p_L} + (1-\hat{\gamma})D_{LT}. \tag{23}$$

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 (3) and (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

$$\begin{cases} 1 = p_0 D_{LT} & \text{if long-term debt,} \\ 1 = D^1_{ST} & \text{if short-term debt in} t = 1, \\ 1 = [\pi(0)p_H + (1-\pi(0)p_L]D^2_{ST}(0) & \text{if } Q = 0, \\ 1 = p_0 D^2_{ST}(-\phi) & \text{if} Q = -\phi, \\ 1 = p_L D^2_{ST}(-2\phi) & \text{if} Q = -2\phi. \end{cases} \tag{24}$$

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

$$\begin{cases} 1 = \hat{q}p_H D_{LT} + (1-\hat{q})[(1-\eta^*) + \eta^*\frac{1}{2}]p_L D_{LT} + (1-\hat{q})\eta^*\frac{1}{2}p_L\overline{R} & \text{if long-term debt,} \\ 1 = \hat{q}D^1_{ST} + (1-\hat{q})[(1-\eta^*) + \eta^*\frac{1}{2}]D^1_{ST} + (1-\hat{q})\eta^*\frac{1}{2}p_L\overline{R} & \text{if short-term debt in } t = 1, \\ D^1_{ST} = [\pi(0)p_H + (1-\pi(0)p_L]D^2_{ST}(0) & \text{if } Q = 0, \\ D^1_{ST} = p_0 D^2_{ST}(-\phi) & \text{if } Q = -\phi, \\ D^1_{ST} = p_L D^2_{ST}(-2\phi) & \text{if } Q = -2\phi. \end{cases} \tag{25}$$

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

$$\begin{cases} P(0) = & p'_H\Big(\overline{R} - \gamma\frac{1}{p'_H} - (1-\gamma)\frac{1}{p_0}\Big), \\ P(-\phi) = & p_0\Big(\overline{R} - \gamma\frac{1}{p_0} - (1-\gamma)\frac{1}{p_0}\Big), \\ P(-2\phi) = & p_L\Big(\overline{R} - \gamma\frac{1}{p_L} - (1-\gamma)\frac{1}{p_0}\Big), \end{cases} \tag{26}$$

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

$$\begin{cases} P(0) = & p'_H\Big(\overline{R} - \gamma \frac{1}{p'_H} \frac{1-(1-\hat{q})\eta^* \frac{1}{2} p_L \overline{R}}{\hat{q}+(1-\hat{q})[(1-\eta^*)+\eta^* \frac{1}{2}]} - (1-\gamma) \frac{1-(1-\hat{q})\eta^* \frac{1}{2} p_L \overline{R}}{\hat{q}p_H+(1-\hat{q})[(1-\eta^*)+\eta^* \frac{1}{2}]p_L}\Big), \\ P(-\phi) = & p_0\Big(\overline{R} - \gamma \frac{1}{p_0} \frac{1-(1-\hat{q})\eta^* \frac{1}{2} p_L \overline{R}}{\hat{q}+(1-\hat{q})[(1-\eta^*)+\eta^* \frac{1}{2}]} - (1-\gamma) \frac{1-(1-\hat{q})\eta^* \frac{1}{2} p_L \overline{R}}{\hat{q}p_H+(1-\hat{q})[(1-\eta^*)+\eta^* \frac{1}{2}]p_L}\Big), \\ P(-2\phi) = & max\{p_L(\overline{R} - \gamma \frac{1}{p_L} \frac{1-(1-\hat{q})\eta^* \frac{1}{2} p_L \overline{R}}{\hat{q}+(1-\hat{q})[(1-\eta^*)+\eta^* \frac{1}{2}]} - (1-\gamma) \frac{1-(1-\hat{q})\eta^* \frac{1}{2} p_L \overline{R}}{\hat{q}p_H+(1-\hat{q})[(1-\eta^*)+\eta^* \frac{1}{2}]p_L}); 0\} = 0, \end{cases} \tag{27}$$

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 (25) and share prices by (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.

Further, if $\eta^* > 0$ was expected, deviating to $\eta = 0$ would be strictly profitable for B conditional on S_L since

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

where D^1_{ST} is given by (25) and the second inequality rearranges to $p_L \geq \hat{q}\Delta_p$ which holds true by Assumption 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 (2) and (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

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

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 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

$$\begin{aligned}
&\omega_p\Big[(q+\Delta_q)\Big(\frac{1}{2}P(-\phi) + \frac{1}{2}P(0)\Big) + (1-q-\Delta_q)\Big(\frac{1}{2}\eta^* P(-2\phi) + \frac{1}{2}P(-\phi) + (1-\eta^*)\frac{1}{2}P(0)\Big)\Big] \\
&+\omega_v\Big[(q+\Delta_q)\Big(\frac{1}{2}V(-\phi, S_H) + \frac{1}{2}V(0, S_H)\Big) \\
&+(1-q-\Delta_q)\Big(\frac{1}{2}\eta^* V(-2\phi, S_L) + \frac{1}{2}V(-\phi, S_L) + \frac{1}{2}(1-\eta^*)V(0, S_L)\Big)\Big] - c. \qquad (28)
\end{aligned}$$

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

$$\begin{aligned}
&\omega_p\Big[q\Big(\frac{1}{2}P(-\phi) + \frac{1}{2}P(0)\Big) + (1-q)\Big(\frac{1}{2}\eta^* P(-2\phi) + \frac{1}{2}P(-\phi) + (1-\eta^*)\frac{1}{2}P(0)\Big)\Big] \\
&+\omega_v\Big[q\Big(\frac{1}{2}V(-\phi, S_H) + \frac{1}{2}V(0, S_H)\Big) \\
&+(1-q)\Big(\frac{1}{2}\eta^* V(-2\phi, S_L) + \frac{1}{2}V(-\phi, S_L) + \frac{1}{2}(1-\eta^*)V(0, S_L)\Big)\Big]. \qquad (29)
\end{aligned}$$

Let the difference of (28) and (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

$$\begin{aligned}
h(c, \hat{c}) =& \frac{\omega_p}{2}\ \Delta_q\ \eta^*\ \Big(p'_H(\hat{c})(\overline{R} - \gamma\frac{1}{p'_H(\hat{c})} - (1-\gamma)\frac{1}{p_0(\hat{c})}) - p_L(\overline{R} - \gamma\frac{1}{p_L} - (1-\gamma)\frac{1}{p_0(\hat{c})})\Big) \\
&+ \frac{\omega_v}{2}\ \Delta_q\ \eta^*\ \Big(p_H(\overline{R} - \gamma\frac{1}{p'_H(\hat{c})} - (1-\gamma)\frac{1}{p_0(\hat{c})}) - p_L(\overline{R} - \gamma\frac{1}{p_L} - (1-\gamma)\frac{1}{p_0(\hat{c})})\Big) \\
&+ \frac{\omega_v}{2}\ \Delta_q\ (1-\eta^*)\ \Big(p_H(\overline{R} - \gamma\frac{1}{p'_H(\hat{c})} - (1-\gamma)\frac{1}{p_0(\hat{c})}) - p_L(\overline{R} - \gamma\frac{1}{p'_H(\hat{c})} - (1-\gamma)\frac{1}{p_0(\hat{c})})\Big) \\
&+ \frac{\omega_v}{2}\ \Delta_q\ \Big(p_H(\overline{R} - \gamma\frac{1}{p_0(\hat{c})} - (1-\gamma)\frac{1}{p_0(\hat{c})}) - p_L(\overline{R} - \gamma\frac{1}{p_0(\hat{c})} - (1-\gamma)\frac{1}{p_0(\hat{c})})\Big) - c. \qquad (30)
\end{aligned}$$

I can drop any *max*-operators since the limited liability of shareholders is never binding as, by Proposition 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 (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, $D_{ST}(-\phi) < \overline{R}$ 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_q G(\hat{c})) + (1-q-\Delta_q G(\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_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 \\
&\leq \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}\frac{\frac{(q+\Delta_q G(\hat{c}))}{(q+\Delta_q G(\hat{c}))+(1-q-\Delta_q G(\hat{c}))(1-\eta^*)}\Delta_p}{p_L p'_H} \\
&+ \gamma g(\hat{c})\frac{(1-\eta^*)}{(q+\Delta_q G(\hat{c})) + (1-q-\Delta_q G(\hat{c}))(1-\eta^*)}\frac{\Delta_p\Delta_q}{(q+\Delta_q G(\hat{c}))p_H + (1-q-\Delta_q G(\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_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 \\
&\leq \frac{\omega_p}{2}\;\Delta_q\;\eta^*\Big[\frac{g(\hat{c})}{[(q+\Delta_q G(\hat{c})) + (1-q-\Delta_q G(\hat{c}))(1-\eta^*)]^2} \\
&\frac{\Delta_p^2\Delta_q(1-\eta^*)(q+G(\hat{c})\Delta_q)}{p_L[(q+\Delta_q G(\hat{c}))p_H + (1-q-\Delta_q G(\hat{c}))p_L(1-\eta^*)]} \\
&+ \gamma g(\hat{c})\frac{\Delta_p\Delta_q}{(q+\Delta_q G(\hat{c}))p_H + (1-q-\Delta_q G(\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_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 \\
&\leq \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 $g(c) \leq \frac{1}{\Delta_q^2}$. Further, Assumption 2 ensures that $p_L \geq max\{\frac{1}{2}, (1-q)\}p_H$ which implies $qp_H \geq \Delta_p$ and thereby $G(\hat{c})p_H \geq qp_H \geq \Delta_p$. Assumption 2 also guarantees that $p_L \geq \Delta_p$. 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 $p_L \geq \frac{1}{2}p_H$, $\eta^{max} = 0$. Plugging in yields $[\eta^*(1-\eta^*)p_H + (1-\eta^*)^2\Delta_p] \leq \Delta_p$.
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 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 gives the trading incentives for the blockholder. Since Assumption 2 ensures, as Assumption 1 for Proposition 1, that $\eta^* = 0$ is the unique equilibrium exit strategy for all $\gamma \geq \hat{\gamma}$. the unique η^* is given by Proposition 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.

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

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

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

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, 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

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

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

$$h(\hat{c}, \hat{c}) = \frac{\omega_p}{2}\ \Delta_q\ \eta^*\ \Big(P(0) - P(-2\phi)\Big) + \frac{\omega_v}{2}\ \Delta_q\ \eta^*\ \Big(V(S_H, 0) - V(S_L, -2\phi)\Big)$$
$$+\frac{\omega_v}{2}\ \Delta_q\ (1-\eta^*)\ \Big(V(S_H, 0) - V(S_L, 0)\Big) + \frac{\omega_v}{2}\ \Delta_q\ \Big(V(S_H, -\phi) - V(S_L, -\phi)\Big) - \hat{c} = 0, \quad (31)$$

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

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

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 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, $D1$ 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 (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

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

where D^1_{ST} is given by (25) and the second inequality rearranges to $p_L \geq \hat{q}\Delta_p$ which holds true by Assumption 1.

Second, if $\gamma \leq \hat{\gamma}$, debt face values are given by (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 $\eta^* \in (0, 1)$.

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

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 2, yields the unique cutoff $\hat{c}$ as given by equation (30). Thus, there is a unique equilibrium. Further, by Proposition 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,

$$
\frac{\partial\hat{c}}{\partial\eta^*}=-\frac{\frac{\partial h(\hat{c},\hat{c})}{\partial\eta^*}}{\frac{\partial h(\hat{c},\hat{c})}{\partial\hat{c}}}>0 \tag{32}
$$

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 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 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 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 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 (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.,

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

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 (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. 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 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.

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 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

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

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 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

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

which obviously holds true and the claim follows.

II)

$$\frac{d\overline{\kappa}(\gamma)}{d\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)} = \frac{\partial\overline{\kappa}(\gamma)}{\partial\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)} + \frac{\partial\overline{\kappa}(\gamma)}{\partial\hat{c}}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}\frac{\partial\hat{c}}{\partial\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}$$
$$= \underbrace{G(\hat{c}(a_m=1))[\frac{1}{G(\overline{c}^m)} - 1]\Delta_q}_{>0} \underbrace{\Big[\underbrace{\frac{\partial\psi(\gamma,a_m=1)}{\partial\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{>0} + \underbrace{\frac{\partial\psi(\gamma,a_m=1)}{\partial\eta^*}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{>0}\underbrace{\frac{\partial\eta^*}{\partial\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{<0}\Big]}_{<0 \text{ (by indifference of } B \text{ and proof of Proposition 2, plug in } G^m \text{ for } G)}$$
$$+ \Big[\underbrace{g(\hat{c}(a_m=1))[\frac{1}{G(\overline{c}^m)} - 1]\Delta_q\psi(\gamma,a_m=1)}_{>0} + \underbrace{\frac{\partial\psi(\gamma,a_m=1)}{\partial\hat{c}}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{>0 \text{ shown below}}\Big]\cdot$$
$$\underbrace{\Big[\underbrace{\frac{\partial\hat{c}}{\partial\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{>0} + \underbrace{\frac{\partial\hat{c}}{\partial\eta^*}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{>0}\underbrace{\frac{\partial\eta^*}{\partial\gamma}|_{\gamma\in(\underline{\gamma}^V,\overline{\gamma}^V)}}_{<0}\Big]}_{<0 \text{ (shown in proof of Proposition 2, plug in } G^m \text{ for } G)} < 0,$$

where

$$\frac{\partial\psi}{\partial\hat{c}}\Big|_{\mathcal{V}=\frac{1}{2}V(S_L,-\phi)+\frac{1}{2}V(S_L,0)} = \frac{1}{2}p_H(-\frac{\partial\frac{1}{p_0}}{\partial\hat{c}}) + \frac{1}{2}\gamma p_H(-\frac{\partial\frac{1}{p_H'}}{\partial\hat{c}}) + \frac{1}{2}(1-\gamma)p_H(-\frac{\partial\frac{1}{p_0}}{\partial\hat{c}}) - \frac{1}{2}p_L(-\frac{\partial\frac{1}{p_0}}{\partial\hat{c}})$$

$$- \frac{1}{2}p_L\gamma(-\frac{\partial\frac{1}{p_H'}}{\partial\hat{c}}) - \frac{1}{2}p_L(1-\gamma)(-\frac{\partial\frac{1}{p_0}}{\partial c}) - 1$$

$$= \frac{1}{2}\Delta_p(-\frac{\partial\frac{1}{p_0}}{\partial\hat{c}}) + \frac{1}{2}\gamma\Delta_p(-\frac{\partial\frac{1}{p_H'}}{\partial\hat{c}}) + \frac{1}{2}(1-\gamma)\Delta_p(-\frac{\partial\frac{1}{p_0}}{\partial\hat{c}}) - 1$$

$$= \frac{1}{2}[1+(1-\gamma)]\Delta_p\frac{g^m(\hat{c})\Delta_p\Delta_q}{p_0^2}$$

$$+ \frac{1}{2}\gamma\Delta_p\frac{g^m(\hat{c})\Delta_q\Delta_p(1-\eta)}{[(q+G^m(\hat{c})\Delta_q)p_H + (1-q-G^m(\hat{c})\Delta_q)p_L(1-\eta^*)]^2} > 0.$$

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 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 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_{ST}^2 is same for all values if Q and, due to market maker's break-even condition, it has to hold that

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

which rearranges to

$$\frac{q}{q+(1-q)e^{-\beta^*\lambda}}\Delta_p max\{\overline{R} - \gamma D_{ST}^2 - (1-\gamma)D_{LT}); 0\} = 0. \tag{33}$$

However, equation (33) cannot hold true since $max\{R-\gamma D_{ST}^2-(1-\gamma)D_{LT}); 0\} > 0$ 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 5

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

$$\begin{aligned}
&\max_{\beta \leq \alpha} \beta \int_\beta^\infty P(Q \geq 0)\lambda e^{-\lambda x} dx + \beta \int_0^\beta P(Q < 0)\lambda e^{-\lambda x} dx + (\alpha - \beta) \int_\beta^\infty V(S_L, Q \geq 0)\lambda e^{-\lambda x} dx \\
&\quad + (\alpha - \beta) \int_0^\beta V(S_L, Q < 0)\lambda e^{-\lambda x} dx \\
&= \max_{\beta \leq \alpha} \beta \int_\beta^\infty P(Q \geq 0) - V(S_L, Q \geq 0)\lambda e^{-\lambda x} dx + \beta \int_0^\beta \underbrace{P(Q < 0) - V(S_L, Q < 0)}_{=0} \lambda e^{-\lambda x} dx \\
&\quad + \alpha \int_\beta^\infty V(S_L, Q \geq 0)\lambda e^{-\lambda x} dx + \alpha \int_0^\beta V(S_L, Q < 0)\lambda e^{-\lambda x} dx. \qquad (34)
\end{aligned}$$

The first order condition is given by

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

which rearranges to

$$\beta = \frac{1}{\lambda} - \alpha \cdot \frac{V(S_L, Q \geq 0) - V(S_L, Q < 0)}{P(Q \geq 0) - V(S_L, Q \geq 0)}. \qquad (35)$$

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 (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 $D^2_{ST}(Q \geq 0) = \frac{(q+(1-q)e^{-\beta\lambda})}{qp_H + (1-q)p_L e^{-\beta\lambda}}$. Taking the derivative w.r.t. β yields

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

and

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

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

$$\frac{\alpha p_L\gamma(1-q)\lambda e^{-\lambda\beta}}{q\Delta_p(\overline{R}-\gamma D^2_{ST}(Q\geq 0)-(1-\gamma)D_{LT})}[D^2_{ST}(Q\geq 0)-D^2_{ST}(Q<0)]\leq 1 \tag{36}$$

Plugging in $(D^2_{ST}(Q<0)-D^2_{ST}(Q\geq 0))=\frac{q\Delta_p}{p_L(qp_H+(1-q)e^{-\beta\lambda}p_L)}$ and rearranging (36) yields

$$\frac{\alpha\gamma}{(\overline{R}-\gamma D^2_{ST}(Q\geq 0)-(1-\gamma)D_{LT})}\leq\frac{(qp_H+(1-q)e^{-\beta\lambda}p_L)}{(1-q)\lambda e^{-\lambda\beta}} \tag{37}$$

Note that Assumption 3 implies $\frac{\alpha\lambda}{(\overline{R}-\frac{1}{p_0})}\leq p_0$ where $\frac{\alpha\lambda}{(\overline{R}-\frac{1}{p_0})}\geq\frac{\alpha\gamma}{(\overline{R}-\gamma D^2_{ST}(Q\geq 0)-(1-\gamma)D_{LT})}$ 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 (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 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

$$
\begin{aligned}
&[P(Q\geq 0)-V(S_L,Q\geq 0)]\,(-\lambda)e^{-\lambda\beta}-\lambda e^{-\lambda\beta}[P(Q\geq 0)-V(S_L,Q\geq 0)]\\
&-\lambda(-\lambda)e^{-\lambda\beta}[\beta(P(Q\geq 0)-V(S_L,Q\geq 0))+\alpha V(S_L,Q\geq 0)-\alpha V(S_L,Q<0)]<0,
\end{aligned}\tag{38}
$$

which rearranges to

$$(P(Q \geq 0) - V(S_L, Q \geq 0))(\lambda\beta - 2) + \lambda\alpha(V(S_L, Q \geq 0) - V(S_L, Q < 0)) < 0. \tag{39}$$

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 (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

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

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 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, (35) yields the unique equilibrium of the unconstrained problem. Together with the short-selling restriction $\beta \leq \alpha$, this yields

$$\beta^* = min\{\frac{1}{\lambda} - \alpha \cdot \frac{V(S_L, Q \geq 0) - V(S_L, Q < 0)}{P(Q \geq 0) - V(S_L, Q \geq 0)}; \alpha\}. \tag{40}$$

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

$$\frac{\partial P(Q \geq 0) - V(S_L, Q \geq 0)}{\partial \gamma} = \frac{q}{q + (1-q)e^{-\tilde{\beta}\lambda}} \Delta_p (D_{LT} - D^2_{ST}(Q \geq 0)) > 0, \tag{41}$$

and

$$\frac{\partial V(Q \geq 0) - V(S_L, Q < 0)}{\partial \gamma} = p_L(D_{LT} - D^2_{ST}(Q \geq 0)) + p_L(D^2_{ST}(Q < 0) - D_{LT}) > 0, \tag{42}$$

and thus

$$\begin{aligned}
\frac{\partial v(\tilde{\beta},\gamma)}{\partial \gamma} &= -\alpha \frac{p_L(D^2_{ST}(Q < 0) - (D^2_{ST}(Q \geq 0))[q\Delta_p(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT})]}{[q\Delta_p(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT})]^2}(1-q)e^{-\tilde{\beta}\lambda} \\
&\quad - \alpha \frac{(D_{LT} - D^2_{ST}(Q \geq 0))q\Delta_p[p_L\gamma(D^2_{ST}(Q < 0) - (D^2_{ST}(Q \geq 0))]}{[q\Delta_p(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT})]^2}(1-q)e^{-\tilde{\beta}\lambda} \\
&= -\alpha \frac{(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT}) - (D_{LT} - D^2_{ST}(Q \geq 0))\gamma}{[q\Delta_p(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT})]^2}(1-q)e^{-\tilde{\beta}\lambda} \\
&= -\alpha \frac{\overline{R} - D_{LT}}{[q\Delta_p(\overline{R} - \gamma D^2_{ST}(Q \geq 0) - (1-\gamma)D_{LT})]^2}(1-q)e^{-\tilde{\beta}\lambda} < 0,
\end{aligned} \tag{43}$$

which completes the proof.

□

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