Blockholder Short-Term Incentives, Structures, and Governance*

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Abstract

We model blockholder governance as a sequential process, from less hostile private intervention, to confrontational public intervention, and finally exit. When the blockholder faces short-term incentives, the threat of public intervention and exit loses credibility, and management pays little heed to private demands. With two blockholders with heterogeneous incentive horizons, reduction in public intervention by a blockholder with short-term incentives strengthens public intervention by the other with long-term incentives. This ameliorates the free-rider problem and restores the credibility of the threat of public engagement following failed private intervention. Management becomes more responsive to private demands and governance efficacy is improved.

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1 Introduction

It has been widely argued that large shareholders (i.e., blockholders) with long-term incentives who care more about a company's long-term value than its short-term stock price are instrumental to good corporate governance and long-term investment. The argument usually runs like this. Since blockholders with long-term incentives care about a company's long-term performance, they have strong incentives to encourage and monitor management to ensure it delivers long-term value. Therefore, an optimal blockholder structure should consist of *only* blockholders with long-term incentive horizons. This paper shows that although this argument is true with a single blockholder, it may not hold with multiple blockholders. Specifically, we show how a diverse and asymmetric blockholder structure, consisting of blockholders with both long-term and short-term incentives, can help ameliorate the typical free-rider problem associated with multiple blockholders (e.g., Winton (1993), Noe (2002), and Edmans and Manso (2011)),[1] hence enhance governance and foster long-term corporate investment. Like in many other economic settings, the free-rider problem arises with multiple *symmetric* blockholders when each individual blockholder underinvests effort in value-enhancing intervention (e.g., monitoring management) that he will gain benefit of regardless of his own effort. In other words, the corporate value enhancement from the intervention resembles a public good, and each individual blockholder believes that effort contributions by others would compensate for the lack of contribution by himself, so his own effort does not make a *material* difference to the outcome of the intervention. We show that a diverse and asymmetric blockholder structure may make an individual blockholder *pivotal* in whether the intervention is undertaken, thereby attenuating the free-rider problem.

To fix ideas, we start with a base model adapting the framework of Edmans (2009) with one blockholder. The blockholder sells (a fraction of) his block if he discovers that the firm he invested is of low quality (bad firm), while he does not sell if the firm turns out to be of high quality (good firm). The blockholder's trading in the financial market is thus informative about firm quality, which encourages a good firm to pursue valuable long-term investment with less fear of producing unfavorable short-term outcomes and hence being misvalued as

[1] McCahery, Sautner, and Starks (2016) show in their survey that the most important impediment to shareholder activism is the free-rider problem.

a bad firm. This governance mechanism via blockholder trading, also examined in Admati and Pfleiderer (2009) in a different setting,[2] is known as exit or the "Wall Street Rule."

Like Edmans, in this paper we also view the efficacy of blockholder governance as the extent to which the actions taken by the blockholder in a bad firm attenuates the undervaluation of a good firm, thereby overcoming the latter's (undervaluation-induced) corporate myopia. However, we depart from Edmans in two important ways. First, instead of assuming the blockholder as a principal investor trading on his own account (an assumption also made in Admati and Pfleiderer), we model him as a fund manager acting as an agent of other capital providers. This is motivated by the fact that a significant fraction of U.S. publicly traded companies is collectively held by institutional investors who are often times delegated portfolio managers (e.g., mutual funds, hedge funds, and pension funds).[3] Our starting point is that the fund manager may face short-term incentives and care about short-term fund performance, due to the well documented flow-performance relationship (e.g., Chevalier and Ellison (1997, 1999)). To elaborate, suppose the fund manager, after establishing his block in a firm, discovers that the firm is bad. He can sell a fraction of his block at some interim date. If he sells a large fraction, he will hurt the firm's short-term stock price, hence depress the fund's short-term performance relative to other funds, causing a big short-term fund outflow. This discourages fund selling, thereby impairing the governance role of exit. To capture the essence of the point in a simple way, the modeling approach we employ assumes that the fund manager cares about how his "stock-picking" ability is perceived by both current and potential capital providers.[4] A low perception, derived from low interim stock price, usually results in redemptions by current investors, and may also discourage capital inflows from potential investors, which can ultimately jeopardize the fund manager's compensation and even employment. Since selling more a bad firm's stock sends a clearer signal to the

[2]Admati and Pfleiderer focus on the disciplinary effect of the threat of blockholder trading in attenuating managerial underperformance.

[3]Over 70% of all outstanding U.S. corporate equities are controlled by institutional money managers, including pension and retirement funds, mutual funds, and hedge funds (see, for example, the Federal Reserve Flow of Funds data), and many of these institutional investors have at east 5% equity ownership in a single firm (which typically defines a blockholder in the empirical literature); see Gopalan (2009).

[4]McCahery, Sautner, and Starks (2016) find that negative inferences made by clients about their stock-picking skills represent an "important" (or "very important") factor affecting institutional money managers' trading. Section 6.1 considers alternative modeling assumptions about ability.

market that he has invested in a bad firm, a reputation-conscious fund manager trades less aggressively. The trading reduction consequently causes the stock price to be less reflective of firm quality, thereby discouraging a good firm from pursuing long-term investment.

Second, while Edmans only considers exit, in our model the fund manager can also undertake corrective actions (referred to as intervention, monitoring, or voice), either publicly or privately, to improve a bad firm's value. Specifically, we model blockholder governance as a sequential decision process, beginning with private intervention, then public intervention upon failed private intervention, and finally exit. Private intervention, wherein the fund manager privately engages with a bad firm's management (e.g., via private letter) by proposing value-enhancing changes, is less hostile and less costly to both the fund and management.[5] However, the success of such private engagement depends upon costly and unobservable effort put forth by management to implement those changes. By contrast, public intervention, wherein the action of intervention is publicly observable (e.g., making a public shareholder proposal), is more confrontational and entails higher costs for both the fund and management. Thus, blockholder governance in our model follows an escalating sequence from private and less hostile negotiations to public and more confrontational engagement.

We show that career concerns weaken a reputation-conscious fund manager's incentive to engage in public intervention following failed private intervention. The reason is that public intervention unambiguously reveals to the market that the fund has invested in a bad firm – we show that the reputational gain to the fund manager from not publicly intervening *always* outweighs the fund value loss due to the lack of public intervention. As a result, the threat by the reputation-conscious fund manager to escalate his intervention to a more confrontational public stage following failed private intervention loses credibility, which causes the firm's management to be less responsive to the changes proposed by the fund manager at the private intervention stage, making private intervention more likely to fail. Furthermore, trading reduction by the reputation-conscious fund manager at the exit stage drives the bad firm's stock price further above its true value, causing the stock price to be less reflective of the management's effort, which also weakens the management's effort

[5]The survey by McCahery, Sautner, and Starks (2016) documents widespread behind-the-scenes shareholder intervention through private discussion with management.

incentive at the private intervention stage. Thus, with a reputation-conscious fund manager, the bad firm's value is less likely to be improved through intervention (public and private); as a result, the consequence to a good firm from being misvalued as a bad firm, following unfavorable short-term performance due to long-term investment, is more dire. The good firm then pursues less long-term investment, and corporate myopia rises.

In sum, our analysis so far establishes that, with a single blockholder, (reputation-driven) blockholder short-term incentives weaken blockholder governance by leading to a lower success rate of private intervention and fewer incidents of public intervention and exit following failed private intervention.

We then extend the preceding analysis and examine an asymmetric multiple blockholder structure, wherein the block is split between two funds with two fund managers having heterogeneous degrees of career concerns. Our main result is that a reputation-conscious fund manager's weakened public intervention incentive *strengthens* a reputation-unconscious fund manager's incentive to engage in public intervention. The key is that the lack of public intervention by the reputation-conscious fund manager, due to his career concerns, makes the reputation-unconscious fund manager *pivotal* in whether public intervention is undertaken following failed private intervention – knowing that he cannot free-ride on the reputation-conscious fund manager and hence his effort makes a *material* difference to the outcome, the reputation-unconscious fund manager has strong incentive to engage in public intervention. Thus, the reputation-conscious fund manager's career concerns serve as a *credible commitment device* that strengthens public intervention by the reputation-unconscious fund manager, thereby partially overcoming the free-rider problem typically associated with multiple blockholders. In particular, we show that, compared to a symmetric blockholder structure with two reputation-unconscious fund managers, neither of whom suffers (reputation-driven) short-term incentives, public intervention (following failed private intervention) may be more intensive in the aforementioned asymmetric structure.

Furthermore, the amelioration of the free-rider problem at the public intervention stage restores the credibility of the threat that intervention will be escalated to a more confrontational public stage following failed private intervention. Consequently, the firm's management, anticipating the high cost that it will bear upon public intervention, becomes more responsive to changes proposed at the private intervention stage, thereby increasing the success of private intervention. Therefore, the bad firm's value may be more likely to be improved in the asymmetric blockholder structure (compared to the aforementioned symmetric structure), which in turn reduces a good firm's undervaluation-induced investment myopia.

Let us summarize. Our key finding is that while (reputation-driven) blockholder short-term incentives worsen corporate myopia in a single blockholder structure, as is suggested by conventional wisdom, they may enhance blockholder governance (through amelioration of the free-rider problem) and encourage long-term corporate investment in a multiple blockholder structure with a mixture of blockholders with both long-term and short-term incentives.

A noteworthy feature of our model is its emphasis on the threat of (rather than just actual) public intervention as being instrumental to efficient blockholder governance. A credible threat of confrontational public engagement causes management to heed the blockholder's private demands for changes, thereby increasing the success rate of private intervention and leading to fewer incidents of actual costly public intervention.

At a broad level, this paper shows that our understanding of blockholder governance can be further enhanced by considering agency problems at the blockholder level together with firm-level agency problems, given the prevalence of institutional blockholders, many of whom are themselves agents and may face short-term incentives that are inconsistent with long-term value maximization. Our analysis points out that the interaction between the two agency problems should be examined in conjunction with blockholder structures. While blockholder short-term incentives always impair governance and hence induce corporate short-termism in a single blockholder structure, they may help improve governance and promote long-term investment in a diverse multiple blockholder structure.

Although our reputation-based model of blockholder short-term incentives is rather specific, and there certainly are other factors leading to blockholder-level agency problems, our core idea – an individual blockholder's short-term incentives enable a diverse and asymmetric blockholder structure to be effective in ameliorating the free-rider problem by *directly breaking the condition that gives rise to the free-rider problem* – has numerous implications. For example, it may shed light on potential governance roles played by "passive" institutional investors like index funds whose ownership in U.S. public companies becomes growingly large. These funds do not engage in disciplinary trading due to their business models (their trading is non-discretionary); they are also typically non-activists, seldom openly engaging with management. Based on our core idea, such passivity may actually have governance value – the presence of such passive funds in a diverse multiple blockholder structure may strengthen other activists' intervention incentive. We discuss this in detail in Section 6.2.

The rest is organized as follows. Section 2 reviews the related literature. Section 3 develops the base model with a single blockholder, which is then analyzed in Section 4. Section 5 shows how career concerns may ameliorate the free-rider problem and improve governance in a multiple blockholder structure. We discusse model robustness and implications in Section 6, and conclude in Section 7. All proofs are in the Appendix.

2 Related Literature

This paper is related to an extensive literature on blockholder governance. Our review focuses on the theoretical studies that are most relevant to our paper; see Edmans (2014) and Edmans and Holderness (2016) for recent comprehensive surveys of both the theoretical and empirical literature. The majority of studies focus on blockholders undertaking costly actions to initiate value-enhancing changes, labeled as intervention, monitoring or voice. Examples include voting against management, and suggesting corporate policy changes by making public shareholder proposals or via private communication to management.[6] Recent advances in blockholder models start to examine an alternative governance mechanism via the so-called "Wall Street Rule" (also referred to as exit). In Admati and Pfleiderer (2009) and Edmans (2009), a blockholder who is unsatisfied with current management can credibly threat to sell his stake, generating a negative price impact. To the extent that managerial pay is tied to stock prices, the threat of exit disciplines management.[7] While this literature models blockholders as value-maximizing principals and focuses on how factors like ownership

[6]A partial list of the theoretical studies on blockholder voice includes Shleifer and Vishny (1986), Admati, Pfleiderer, and Zechner (1994), Burkart, Gromb, and Panunzi (1997), Bolton and von Thadden (1998), Kahn and Winton (1998), Maug (1998), Noe (2002), and Faure-Grimaud and Gromb (2004). See McCahery, Sautner, and Starks (2016) for a survey about specific channels of voice.

[7]Edmans, Levit, and Reilly (2016) examine exit *and* voice by investors owning blocks in multiple firms.

structure and market liquidity affect voice and exit,[8] we model blockholders as agents facing short-term incentives themselves, and examine how such incentives affect governance.

Assuming symmetric blockholders, Edmans and Manso (2011) examine their optimal number in a multiple blockholder structure by exploring the following tradeoff: while having more blockholders worsens the typical free-rider problem in intervention, it also causes each blockholder to trade more competitively, thereby impounding more information into prices and strengthening exit. Our paper extends their analysis by examining asymmetric blockholders. Fixing their number, we show that a greater asymmetry among blockholders, in terms of the degrees of their (reputation-induced) short-term incentives, can attenuate the free-rider problem and may consequently strengthen blockholder voice.

Most closely related is an interesting recent contribution of Dasgupta and Piacentino (2015), who also model blockholders as fund managers with short-term incentives. They show that a fund manager who cares about others' perception of his stock-picking ability is less likely to engage in disciplinary exit, which in turn weakens his voice. While they show how blockholder short-term incentives *adversely* affect governance in a *single blockholder structure* and their analysis mainly focuses on exit, we focus on voice (and consider both public and private intervention and model them as a sequential decision process) and our central result reveals the *beneficial* role of such short-term incentives in a *multiple blockholder structure* in ameliorating the free-rider problem and enhancing blockholder voice.

In Goldman and Strobl (2013), a blockholder may have to liquidate his shares before the market can fully evaluate firm investment. This creates an incentive for the blockholder to inflate the short-term stock price by refraining from disciplinary exit. Like Dasgupta and Piacentino, their focus is also on the negative effect of blockholder short-term incentives. Levit (2013) models private intervention as informal communication between a blockholder and management as a cheap talk. He shows how exit can facilitate such communication by making it more credible to management, thereby improving private intervention. In Fos and Kahn (2016), the threat of (public) intervention by a large blockholder may discipline

[8] A sizable empirical literature tests those theories on voice and exit. See, for example, Carleton, Nelson, and Weisbach (1998), Parrino, Sias, and Starks (2003), Brav, Jiang, Partnoy, and Thomas (2008), Gopalan (2009), Klein and Zur (2009), Becht, Franks, Mayer, and Rossi (2010), Bharath, Jayaraman, and Nagar (2013), Edmans, Fang, and Zur (2013), and Norli, Ostergaard, and Schindele (2015). Gantchev (2013), in a multi-stage representation of blockholder voice, empirically estimates the costs of voice at each stage.

management and lead to fewer incidents of intervention. This is related to our point that the threat of public intervention improves private intervention, thereby reducing the need for actual public intervention. Their focus is on the optimal governance form (public intervention vs. exit), while ours is on how the credibility of the threat of public intervention can be restored in a multiple blockholder structure inflicted by the free-rider problem.

Our paper is also rooted in the vast theoretical literature on career concerns. The essence of models in this literature is that an agent's proclivity to positively influence others' perception of his ability distorts his actions.[9] A burgeoning literature links institutional investors' career concerns to asset price dynamics. Studies in Scharfstein and Stein (1990), Dasgupta and Prat (2006, 2008), Dasgupta, Prat, and Verardo (2011), and Guerrieri and Kondor (2012) show that institutional investors' career concerns impede information incorporation into asset prices and lead to excessive volatility, creating inefficiencies in financial markets.

3 Base Model: A Single Blockholder

Our base model adapts the framework of Edmans (2009) with the addition of intervention, which is broadly defined and incorporates any value-enhancing activities that the blockholder may undertake, from monitoring the CEO to influencing strategy. Before describing model specifics, we first provide an overview of our model of blockholder governance.

3.1 Model Overview: Intervention as an Escalation Process

Our model tries to capture several important aspects of shareholder governance in reality (see Gantchev (2013), and the survey findings in McCahery, Sautner, and Starks (2016)):

- We consider both public and private intervention. Public intervention, which is publicly observable, encompasses any open (confrontational) contest with management, from making shareholder proposals to launching proxy contests. Besides that, shareholders may also engage in informal and "behind-the-scenes" interactions and negotiations with management about ways to improve firm value (i.e., private intervention).

[9] The literature starts from the seminal work of Holmstrom (1999/1982). For recent applications, see, for example, Boot (1992), Song and Thakor (2006), and Grenadier, Malenko, and Strebulaev (2014).

- Compared to public intervention, private intervention is less hostile and less costly to both shareholders and management, but has a lower success rate.[10]
- Shareholders usually first try to privately engage with management, and take public measures only after private negotiations have failed. That is, the intervention process is, as described by Gantchev (2013), an "escalating sequence from less hostile to more confrontational... from private to more public forms of engagement."
- Intervention typically precedes exit, according to McCahery, Sautner, and Starks (2016).

3.2 Model Specifics

3.2.1 The Economic Environment

An all-equity firm, run by a CEO ("she"), has one share outstanding, of which $\alpha \in (0, 1)$ units are owned by a blockholder and the rest are collectively held by atomistic shareholders. The blockholder is a delegated portfolio (e.g., mutual fund or hedge fund) manager acting on behalf of many small (fund) investors, and henceforth is referred to simply as fund ("he"). All agents are risk neutral, and the risk-free rate is zero. There are three dates, $t \in \{0, 1, 2\}$; date 1 is further divided into three stages. The sequence of events is described below.

Events at $t = 0$**:** The firm can be good (G) or bad (B). Firm value, which will realize at $t = 2$, is $V \in \{X, 0\}$; $V = X > 0$ ($V = 0$) for a good (bad) firm. The common belief at $t = 0$ is that the firm is good with probability (w.p.) φ, and bad w.p. $1 - \varphi$, where φ is a random variable distributed on $[0, 1]$ with density $f(\varphi)$. Denote by $\mathbf{E}(\varphi) = \bar{\varphi}$ and $\mathbf{Var}(\varphi) = \eta^2$ the expected value and the variance of φ, respectively. Nobody knows φ a priori.

The firm's type is then privately revealed to its CEO. A good firm may invest $\upsilon \in [0, 1]$ in intangible assets (e.g., brand recognition, patents, or goodwill) at $t = 0$, which increases its value by $g\upsilon$ at $t = 2$, with $g > 1$ being a constant. This investment opportunity is unavailable to a bad firm. Moreover, although such opportunity exists for a good firm, only its CEO knows it, while others, including the fund, are unaware of its presence.[11]

[10] Based on a large sample of hedge fund activist campaigns, Gantchev (2013) reports that proxy contests have the highest success rate (57.38%), while demand negotiations are successful in only 6.76% of the sample.

[11] This simplifying assumption follows Edmans (2009) for mathematical brevity in solving for the optimal υ. All the model's results sustain if we allow the investment to be anticipated by others. Edmans also shows that his results are qualitatively unchanged if such investment opportunity is publicly known.

There is unobservable heterogeneity in fund ability. Specifically, a smarter fund is more likely to invest in a good firm. Without loss of generality we also designate φ as fund ability, which nobody knows, including the fund himself when he establishes his block in the firm.

Events at $t = 1$**:** Firm type is now also perfectly revealed to the fund. A public signal $s \in \{s_G, s_B\}$ emits, where s_G is a good signal and s_B is a bad signal; s is the market's short-term (imperfect) projection about the firm's long-term prospect. The common prior belief is $\Pr(s = s_G) = \Pr(s = s_B) = \frac{1}{2}$ for a good firm, while $\Pr(s = s_B) = 1$ for a bad firm. Thus, if $s = s_G$, it is commonly known that the firm is good; if $s = s_B$, the market believes that $\Pr(G) = \frac{\bar{\varphi}}{2-\bar{\varphi}}$ and $\Pr(B) = \frac{2(1-\bar{\varphi})}{2-\bar{\varphi}}$.

From a valuation perspective, a good firm should invest $\upsilon = 1$. However, although investment in intangible assets increases the long-term value, it risks lowering the market's short-term assessment. For example, expenditures in intangible investment lower a firm's short-term earnings, but the market may not be able to fully tell if the weak earnings result from low firm quality or desirable long-term investment. Specifically, if $\upsilon \in [0, 1]$ is invested, then for a good firm $\Pr(s = s_G) = \frac{1-\upsilon^2}{2}$ and $\Pr(s = s_B) = \frac{1+\upsilon^2}{2}$. This reflects the aforementioned tension that more long-term investment (larger υ) lowers the market's short-term assessment (lower $\Pr(s = s_G)$).

We now model blockholder governance. Suppose the firm is bad (so $s = s_B$). The fund moves through the following three stages at $t = 1$, as depicted in Figure 1.

1. ***Private intervention*****:** The fund first privately communicates with the CEO about value-enhancing changes. While such communication is costless to the fund, implementing changes requires costly and unobservable CEO effort. There is thus a layer of agency problem between the fund and the CEO. If the CEO exerts effort $\sigma \in [0, 1]$, incurring a personal cost $c(\sigma)$, the bad firm's value improves to X (i.e., successful private intervention) w.p. σ, whereas w.p. $1 - \sigma$ firm value remains 0 (i.e., failed private intervention). We assume $c(\sigma)$ is an increasing and convex function that satisfies the Inada conditions, $c'(0) = 0$ and $c'(1) = \infty$. Upon a successful private intervention, the outcome (i.e., value enhancement) is publicly observable, and the game ends. A failed private intervention is known *only* to the fund and the CEO.

2. ***Public intervention*:** Suppose private intervention failed. The fund may escalate the engagement into public intervention, which is publicly observable and succeeds for sure,[12] improving firm value to X. While private intervention is costless to the fund, public intervention is costly: it costs the fund τ, a random variable uniformly distributed on $[0, 1]$.[13] The fund *privately* observes τ, then decides whether to intervene publicly. Public confrontation is also costly to the CEO: the CEO's utility drops to zero upon public intervention.[14]

3. ***Exit*:** If the fund does not publicly intervene following a failed private intervention, he trades in a financial market with a structure similar to Kyle (1985). The fund may sell a fraction of his block, $\beta \in [0, \alpha]$, which will be endogenously determined. We assume $\beta \leq \alpha$ to preclude short selling. There are also liquidity traders who demand u, a random variable with density $r(u)$, where $r(u) = \lambda e^{-\lambda u}$ if $u > 0$, and $r(u) = 0$ if $u \leq 0$, with $\lambda > 1$. A larger λ means a less liquid market; note $\mathbf{E}(u) = \lambda^{-1}$. The market maker, unaware of the value-enhancement opportunity to a good firm, observes total demand $d = u - \beta$, and sets a competitive stock price, $P = \mathbf{E}(V|s, d)$. Since the fund knows firm type and the outcomes from the intervention stages, his trading allows the market to draw further inferences about the firm.

If the firm is good, the fund does nothing and holds his block until $t = 2$ (i.e., $\beta = 0$).

***Events at* $t = 2$:** The firm's type and its value (including the enhancement, gv, for a good firm) are realized and observed by all. The firm is then liquidated, and agents get paid.

3.2.2 Preferences

The fund has career concerns in the sense that he cares about others' perception of his ability. Fund investors (hereafter, investors) update their beliefs about fund ability using Bayes' rule

[12] Nothing changes qualitatively if public intervention succeeds with some probability less than one.

[13] The variable τ is meant to capture all the costs that the fund bears in engaging in public intervention; examples include costs of monitoring and mounting a contest with management. The uniform distribution assumption for τ is an innocuous assumption that is merely made for mathematical simplicity.

[14] This extreme assumption is meant to capture, in the simplest way for mathematical brevity, the fact that public confrontation with shareholders is very costly to the CEO. Nothing changes as long as the CEO suffers a sufficiently large utility loss upon public intervention by the fund.

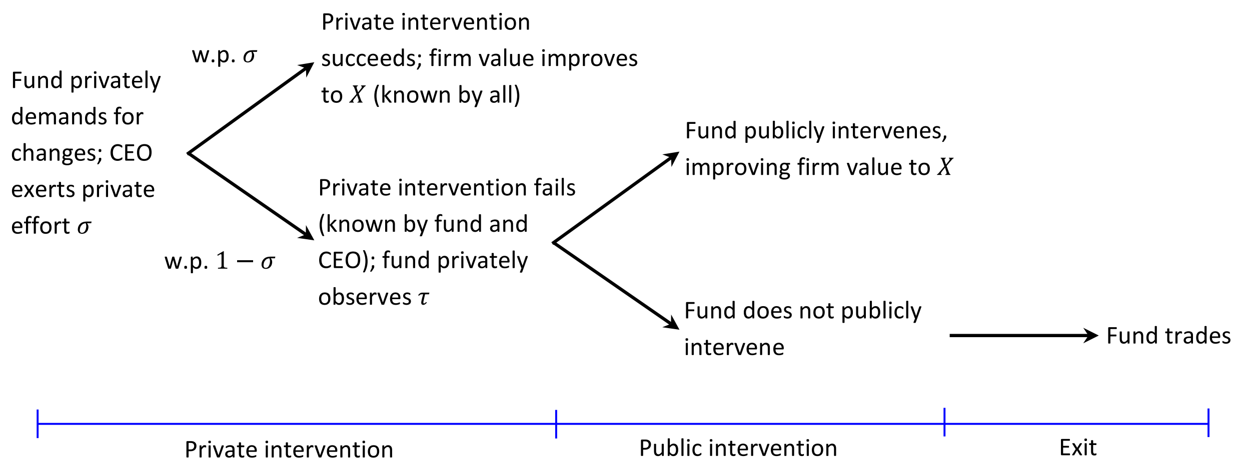

Figure 1. Three stages of blockholder governance (in a bad firm) at $t = 1$

at $t = 1$. The fund's utility, U_f, depends on the investors' assessment of his ability and fund profit:

$$U_f = \pi_f + \kappa_f \mathbf{E}(\varphi|\mathcal{F}_1), \tag{1}$$

where (i) $\mathbf{E}(\varphi|\mathcal{F}_1)$ is the investors' ability assessment at $t = 1$, conditional on their information at that date, $\mathcal{F}_1$, including the signal (s), the stock price (P), and any intervention outcome observable to investors (i.e., a successful private intervention or a public intervention); and (ii) $\kappa_f \geq 0$ is the weight that the fund attaches to career concerns relative to fund profit, $\pi_f = \beta P + (\alpha - \beta)V$. Note βP is the trading profit from the β units sold at $t = 1$, and $(\alpha - \beta)V$ is the $t = 2$ value of unsold units.

The component of the fund's utility that depends on his perceived ability, $\kappa_f \mathbf{E}(\varphi|\mathcal{F}_1)$, is meant to capture all the consequences that this perception impinges on fund utility calculation. In the delegated portfolio management industry, the investors' perception of a money manager's ability affects how the manager's human capital is valued by the market, hence his compensation and possibly the employment decision. A low perception usually results in fund redemption, since investors will chase skilled managers and reallocate their capital. To the extent that fund management fees are often tied to the size of assets under management (AUM), it is transparent that the fund has concerns with how his ability is perceived.[15]

The CEO's utility places weight $\delta \in (0,1)$ on the $t=1$ stock price and $1-\delta$ on the $t=2$ firm value $V + gv \times 1_{\{G\}}$ (where $1_{\{G\}} = 1$ (0) for a good (bad) firm):[16]

$$U_c = \delta P + (1-\delta)(V + gv \times 1_{\{G\}}). \tag{2}$$

4 Analysis of the Base Model

We use backward induction beginning with the exit stage, assuming that the fund did not publicly intervene in a bad firm following a failed private intervention. We then examine public intervention, assuming a failed private intervention. Finally, we determine the success rate of private intervention. We first conduct a benchmark analysis in Section 4.1 with a reputation-unconscious fund (i.e., $\kappa_f = 0$). Section 4.2 then analyzes a reputation-conscious fund (i.e., $\kappa_f > 0$) and examines the effect of fund career concerns on governance.

4.1 Benchmark: Governance without Fund Career Concerns

4.1.1 Exit Stage

The benchmark analysis of exit follows Edmans (2009). We analyze a pure strategy Perfect Bayesian Equilibrium (PBE), and conjecture that the market's equilibrium beliefs are as follows: (i) following a failed private intervention in a bad firm, the fund publicly intervenes if and only if $\tau \leq \tau_*$ (i.e., the cost of public intervention is sufficiently low), and sells β_* absent public intervention; and (ii) the fund abstains from selling with public intervention or a successful private intervention (note that both improve the bad firm's value to X). In equilibrium, the fund's privately optimal choices coincide with the market's beliefs about

[15] Our exogenous specification of fund career concerns can be endogenized by analyzing commonly used "two-and-twenty" compensation contracts in the money management industry with a linear AUM fee and a convex performance fee (carried interest). Dasgupta and Piacentino (2015) show how such compensation practice generates competition for short-term flows among fund managers, which hinges on investors' inferences of the managers' stock-picking ability from interim stock prices.

[16] A good firm's CEO knows the value-enhancement opportunity, so her utility calculation accounts for the enhancement, gv.

those choices (updated using Bayes' rule).[17] Given such beliefs, we first derive the market maker's equilibrium stock pricing function, P, at $t = 1$, and then examine fund trading, β.

***Equilibrium stock pricing*:** If $s = s_G$, the market maker knows that the firm is good, and sets $P = X$. The fund does not trade in this case ($\beta = 0$) with a fully revealing price. The following analysis considers $s = s_B$, wherein firm type is not fully revealed; the notation "$|s_B$" is omitted for brevity. The fund may trade to exploit his information advantage, and the market maker infers the fund's information from total order d. Clearly, the fund only sells a bad firm's stock, whose price is no smaller than the true firm value (which is 0). There are two possibilities.

- If $d = u - \beta \leq 0$, the market maker knows that the fund has sold (since $u > 0$), hence the firm is bad, private intervention has failed (note that the fund will not sell otherwise), and there is no public intervention. Thus, the market maker sets $P = 0$.
- If $d > 0$, the market maker cannot tell apart the following possibilities without visible public intervention: (i) the firm is good (w.p. $\frac{\bar{\varphi}}{2-\bar{\varphi}}$) that needs no intervention; or (ii) the firm is bad (w.p. $\frac{2(1-\bar{\varphi})}{2-\bar{\varphi}}$), private intervention has failed (note that the outcome of a successful private intervention would have been publicly observed) but public intervention is not initiated (w.p. $\Pr(\tau > \tau_*) = 1 - \tau_*$), so the fund sells β_*, but $d = u - \beta_* > 0$ (w.p. $\int_{\beta_*}^{\infty} \lambda e^{-\lambda u} du = e^{-\lambda\beta_*}$). The market maker thus sets[18]

$$P = \Pr(G|d > 0)X = \frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_*)e^{-\lambda\beta_*}}X, \tag{3}$$

[17]The equilibrium definition does not specify any beliefs corresponding to out-of-equilibrium moves. This is because there are no out-of-equilibrium moves.

[18]The market maker's posterior belief in this case is

$$\begin{aligned}\Pr(G|d > 0) &= \frac{\Pr(d > 0|G)\Pr(G)}{\Pr(d > 0|G)\Pr(G) + \Pr(d > 0|B)\Pr(B)} \\ &= \frac{\bar{\varphi}(2-\bar{\varphi})^{-1}}{\bar{\varphi}(2-\bar{\varphi})^{-1} + 2(1-\bar{\varphi})(2-\bar{\varphi})^{-1}(1-\tau_*)e^{-\lambda\beta_*}} \\ &= \frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_*)e^{-\lambda\beta_*}}.\end{aligned}$$

In deriving the posterior, we have used the following facts: (i) with a good firm, $d = u > 0$ for sure, so the event $d > 0$ with no visible public intervention occurs w.p. 1; and (ii) with a bad firm, $d = u - \beta_* > 0$ occurs w.p. $e^{-\lambda\beta_*}$, so the event $d > 0$ with no visible public intervention occurs w.p. $(1-\tau_*)e^{-\lambda\beta_*}$.

which is increasing in β_*. The idea is as follows. With a larger β_*, the probability of having $d > 0$ (upon $s = s_B$) is *ceteris paribus* smaller, so the event $d > 0$ with no visible public intervention implies it is more likely that the fund has *not* sold and hence the firm is good.

Investors do not observe d, but they can infer the market maker's posterior belief from the public signal s and the stock price P. They know that the firm is good w.p. 1 if $s = s_G$, and is good w.p. $\frac{P}{X}$ if $s = s_B$. To ease the exposition, we therefore assume that investors update their beliefs as if they also observe d, and use the term "market" to denote both the market maker and investors.

***Fund exit*:** We now solve for the fund's privately optimal choice of β, which must coincide with the market's belief about it (β_*) in equilibrium. The fund's problem at the exit stage (condition on the firm being bad) is

$$\max_{\{\beta\}} U_f = (\alpha - \beta)(0) + \beta[e^{-\lambda\beta}P + (1 - e^{-\lambda\beta})(0)], \tag{4}$$

where P is given by (3). To interpret (4), note that (i) the fund makes a trading profit, βP, only if $d > 0$ (the bad firm is not fully revealed), which occurs if $u > \beta$, w.p. $\int_\beta^\infty \lambda e^{-\lambda u} du = e^{-\lambda\beta}$; (ii) w.p. $1 - e^{-\lambda\beta}$, the bad firm is perfectly revealed ($d \leq 0$), and trading yields no gain; and (iii) $(\alpha - \beta)(0)$ is the $t = 2$ value of the fund's unsold units.

Proposition 1. *Suppose a reputation-unconscious fund does not engage in public intervention following a failed private intervention in a bad firm. At the exit stage, the fund sells* $\beta_* = \min(\lambda^{-1}, \alpha)$.

Selling more shares increases trading profit *ceteris paribus* but also increases the odds of revealing the bad firm. This tradeoff determines the optimal fund trading. Note that (i) $\beta_* \leq \alpha$, due to the short-sale constraint; and (ii) in a more liquid market, liquidity traders buy more (larger λ^{-1}), which reduces the odds of revealing the bad firm by fund selling, and hence encourages fund trading (larger β_*). Subsequently, we assume $\alpha > \lambda^{-1}$, so $\beta_* = \lambda^{-1}$. This means that the market is not sufficiently liquid, so the fund does not sell its entire stake in a bad firm.[19]

[19] We make this assumption since our focus, unlike Edmans's, is not on how the block size (α) affects exit.

4.1.2 Public Intervention Stage

We now move back to the public intervention stage, assuming that private intervention in a bad firm has failed (which is known only to the fund and the CEO). The fund, after observing the cost τ, decides whether to publicly intervene. With public intervention (which is publicly observable and succeeds for sure), the market sets $P = X$. The fund is indifferent between selling and holding in this case; we assume holding ($\beta = 0$) due to some unmodeled trading costs (e.g., short-term capital gains taxes). If the fund does not engage in public intervention, he privately knows that the bad firm is still worth $V = 0$, and sells $\beta_* = \lambda^{-1}$ at the exit stage (see Proposition 1). The fund publicly intervenes if and only if τ is sufficiently small, so that his continuation utility is higher with public intervention than without.

Proposition 2. *There exists a unique cutoff, $\tau_* \in (0, 1)$, defined by*

$$\tau_* = h(\beta_*, \tau_*) \equiv \left[\alpha - \frac{\beta_* e^{-\lambda\beta_*}\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_*)e^{-\lambda\beta_*}}\right] X, \tag{5}$$

where $\beta_* = \lambda^{-1}$, such that following a failed private intervention in a bad firm, a reputation-unconscious fund publicly intervenes if and only if $\tau \leq \tau_*$.

In equilibrium, the fund's value enhancement from public intervention instead of trading (i.e., exit), $h(\beta_*, \tau_*)$ as defined in (5), offsets the fund's cost of public intervention (τ_*).

4.1.3 Private Intervention Stage

Finally, we examine private intervention. A bad firm's CEO, after being advised by the fund about value-enhancing changes, privately chooses effort σ to maximize her utility:

$$\max_{\{\sigma\}} \ \sigma[\delta X + (1-\delta)X] + (1-\sigma)(1-\tau_*)e^{-\lambda\beta_*}(\delta P) - c(\sigma), \tag{6}$$

where P is given by (3). To understand (6), note that (i) w.p. σ firm value is improved, the outcome of the successful private intervention becomes public, the market sets the $t = 1$ stock price as X, and the CEO's corresponding utility is $\delta X + (1-\delta)X$; (ii) w.p. $1-\sigma$ private intervention fails, in which case the CEO knows that in the subgame of confrontational public intervention, w.p. τ_* the fund publicly intervenes, driving the CEO's utility to zero, and w.p.

$1-\tau_*$ the fund does not engage in public intervention (see Proposition 2); and (iii) absent public intervention the fund sells β_* at the exit stage, in which case total share demand $d>0$ w.p. $e^{-\lambda\beta_*}$, and the corresponding stock price P is given by (3) (the CEO's utility in this case is δP), whereas w.p. $1-e^{-\lambda\beta_*}$, $d\leq 0$ and the stock price is 0 (the CEO's utility in this case is 0). The last term $c(\sigma)$ is the CEO's cost of effort.

It follows directly from (6) that the CEO's equilibrium effort, hence the success rate of private intervention with a reputation-unconscious fund, denoted by σ_*, is given by

$$c'(\sigma_*)=\left[1-\delta\frac{\bar{\varphi}(1-\tau_*)e^{-\lambda\beta_*}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_*)e^{-\lambda\beta_*}}\right]X, \tag{7}$$

where $\beta_*=\lambda^{-1}$ and τ_* is defined by (5). Inada conditions satisfied by $c(\cdot)$ ensure that $\sigma_*\in(0,1)$.

4.2 Governance with Fund Career Concerns

We now examine a reputation-conscious fund ($\kappa_f>0$), who may be tempted to distort his actions in order to positively influence others' perceptions of his ability. The analysis mirrors that in Section 4.1. We first characterize the market's potential assessments of fund ability.

Lemma 1. *The market's posterior belief about the fund's ability is*

$$\mathbf{E}(\varphi|G)=\bar{\varphi}+\frac{\eta^2}{\bar{\varphi}}\in(\bar{\varphi},1), \tag{8}$$

if the firm is revealed to be good, and

$$\mathbf{E}(\varphi|B)=\bar{\varphi}-\frac{\eta^2}{1-\bar{\varphi}}\in(0,\bar{\varphi}), \tag{9}$$

if the firm is revealed to be bad at $t=1$.

4.2.1 Exit Stage

Consider a bad firm (so $s=s_B$). We again analyze a pure strategy PBE, similarly defined as in Section 4.1. Denote by τ_f and β_f the market's equilibrium beliefs about fund strategies, respectively, at the public intervention stage and the exit stage (corresponding to τ_* and β_*, respectively, in the benchmark case). If total share demand $d \leq 0$, the bad firm is fully revealed, and the market believes

$$\mathbf{E}(\varphi|d \leq 0) = \mathbf{E}(\varphi|B) = \bar{\varphi} - \frac{\eta^2}{1-\bar{\varphi}}. \tag{10}$$

If $d > 0$, the market cannot unambiguously tell the firm's type, and its posterior ability inference, given its equilibrium beliefs about fund strategies (τ_f and β_f), is[20]

$$\begin{aligned}\mathbf{E}(\varphi|d > 0) &= \Pr(G|d > 0)\mathbf{E}(\varphi|G) + \Pr(B|d > 0)\mathbf{E}(\varphi|B) \\ &= \frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}\left(\bar{\varphi} + \frac{\eta^2}{\bar{\varphi}}\right) + \frac{2(1-\bar{\varphi})e^{-\lambda\beta_f}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}\left(\bar{\varphi} - \frac{\eta^2}{1-\bar{\varphi}}\right).\end{aligned} \tag{11}$$

With a bad firm, the correct ability assessment should be $\mathbf{E}(\varphi|B)$. However, given the fund's private choice of β, this assessment forms only if $d \leq 0$ (w.p. $1 - e^{-\lambda\beta}$); if $d > 0$ (w.p. $e^{-\lambda\beta}$), the market cannot fully tell the firm's type, and fund ability is overly assessed in (11). Thus, importantly, although the fund's private choice of β cannot influence the market's equilibrium inferences, $\mathbf{E}(\varphi|d \leq 0)$ and $\mathbf{E}(\varphi|d > 0)$,[21] it does affect the relative probabilities of the occurrences of the two reputational outcomes.

The fund chooses β to maximize his expected utility:

$$\max_{\{\beta\}} U_f = \beta e^{-\lambda\beta}\Pr(G|d > 0)X + \kappa_f[(1 - e^{-\lambda\beta})\mathbf{E}(\varphi|d \leq 0) + e^{-\lambda\beta}\mathbf{E}(\varphi|d > 0)], \tag{12}$$

where $\Pr(G|d > 0) = \frac{\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}$. Fund profit, $\beta e^{-\lambda\beta}\Pr(G|d > 0)X$, is similarly calculated as in (4). The second term in (12) is the reputation part of utility, where the state $d \leq 0$ ($d > 0$) occurs w.p. $1 - e^{-\lambda\beta}$ ($e^{-\lambda\beta}$), and the corresponding ability assessment is $\mathbf{E}(\varphi|d \leq 0)$ ($\mathbf{E}(\varphi|d > 0)$).

[20] The posterior $\Pr(G|d > 0)$ in this case with a reputation-conscious fund can be derived in the same way as that for (3), with τ_* and β_* being replaced with τ_f and β_f, respectively.

[21] The two inferences are based on the market's *belief* about the fund's choice of β, which is β_f.

For our subsequent analysis, it is useful to introduce the following notation:

$$\Delta \equiv \frac{\kappa_f[\mathbf{E}(\varphi|G) - \mathbf{E}(\varphi|B)]}{X} = \frac{\kappa_f \eta^2}{\bar{\varphi}(1-\bar{\varphi})X}. \tag{13}$$

The numerator of Δ equals to the weight that the fund attaches to his career concerns relative to fund profit, κ_f, times the wedge between the market's best and worst possible ability assessments, $\mathbf{E}(\varphi|G) - \mathbf{E}(\varphi|B)$. Thus, Δ captures the degree of fund career concerns, with a larger Δ indicating a more reputation-conscious fund with stronger short-term incentives.[22]

Proposition 3. *Suppose a reputation-conscious fund does not publicly intervene in a bad firm following a failed private intervention. At the exit stage, the fund sells* $\beta_f = \max(\lambda^{-1} - \Delta, 0) < \beta_*$.

This proposition is reminiscent of the key finding in Dasgupta and Piacentino (2015). It establishes that a reputation-conscious fund trades less relative to a reputation-unconscious fund ($\beta_f < \beta_*$). To see this, suppose the market believes $\beta_f = \beta_*$, so its posterior ability inferences, $\mathbf{E}(\varphi|d \leq 0)$ and $\mathbf{E}(\varphi|d > 0)$, are based on β_*. Importantly, as noted earlier, the fund's private choice of β only affects the probabilities of the occurrences of the two reputational outcomes but not the outcomes themselves. Since a lower β increases the likelihood of the occurrence of the state $d > 0$ and hence the more favorable outcome, $\mathbf{E}(\varphi|d > 0)$, the fund has a proclivity to privately lower β to positively influence the market's ability assessment. However, a lower β also decreases trading profit. This tradeoff between reputational concerns and trading profit results in a choice of $\beta_f < \beta_*$ by the fund. It turns out that the trading reduction is exactly Δ, which is defined in (13). A fund with sufficiently strong career concerns ($\Delta \geq \lambda^{-1}$) fully gives up trading profit by choosing $\beta = 0$, so as to maximize the probability of the occurrence of the favorable outcome by ensuring $d > 0$.

[22] In Dasgupta and Piacentino (2015), the cross-sectional variation in fund short-term incentives arises from the variation in fund managers' contractual incentives (which hinge on fund size and flow, hence the market's ability assessment; see discussions in footnote 15) relative to their self-investment in their own funds. They show that while the former leads to fund short-term incentives, the latter attenuates such incentives.

4.2.2 Public Intervention Stage

Next, we move back to the public intervention stage. The analysis is similar to that for a reputation-unconscious fund, except now career concerns also affect fund intervention.

Proposition 4. *There exists a unique cutoff, $\tau_f \in (0,1)$, defined by*

$$\tau_f = h(\beta_f, \tau_f) - \frac{e^{-\lambda\beta_f}\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}\Delta X, \tag{14}$$

where $\beta_f = \max(\lambda^{-1} - \Delta, 0)$, such that following a failed private intervention in a bad firm, a reputation-conscious fund publicly intervenes if and only if $\tau \leq \tau_f$. The likelihood of public intervention by a reputation-conscious fund is lower than that by a reputation-unconscious fund ($\tau_f < \tau_*$), and is further decreasing in the degree of fund career concerns ($\frac{\partial \tau_f}{\partial \Delta} < 0$).

In (14), $h(\beta_f, \tau_f)$ is the fund's value enhancement from public intervention compared to trading, similar as $h(\beta_*, \tau_*)$ in (5). The extra term, $\frac{e^{-\lambda\beta_f}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}\Delta X$, is the fund's reputational loss from public intervention instead of trading. Note that (i) public intervention perfectly reveals the bad firm, causing the market's ability assessment to drop to its lowest level, $\mathbf{E}(\varphi|B)$; and (ii) absent public intervention, the fund sells β_f and only reveals the bad firm w.p. $1 - e^{-\lambda\beta_f}$ (when $d \leq 0$). Reputational gain from eschewing public intervention arises when $d > 0$, w.p. $e^{-\lambda\beta_f}$, *and* the market mistakenly perceives the (bad) firm to be good, w.p. $\frac{\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}$. When the two events occur, the fund gains reputation, $\kappa_f[\mathbf{E}(\varphi|G) - \mathbf{E}(\varphi|B)] = \Delta X$.

Proposition 4 establishes that a reputation-conscious fund, despite his larger post-trading stake ($\alpha - \beta_f > \alpha - \beta_*$), engages in less public intervention than a reputation-unconscious fund ($\tau_f < \tau_*$). This is again rooted in the reputation-conscious fund's inclination to positively influence the market's ability assessment through distorted actions – by engaging in less public intervention, hence reducing the odds of revealing the bad firm, the fund's reputational gain outweighs its value loss due to the reduction in public intervention.[23]

[23] We show in the Appendix (Proof of Proposition 4, especially (A5)) that the utility increase from public intervention instead of trading is *always* larger for a reputation-unconscious fund than for a reputation-conscious fund. The idea is as follows. Although a reputation-conscious fund sells Δ less than a reputation-unconscious fund absent public intervention, the reduction in trading profit (due to reduced trading) is *exactly* offset by the fund's gain in reputation from trading Δ less – this is how the reputation-conscious

4.2.3 Private Intervention Stage

Finally, we move back to the private intervention stage. Following an analysis similar to the one in the benchmark case, we show that the CEO's equilibrium effort, hence the success rate of the reputation-conscious fund's private intervention, denoted by σ_f, is given by

$$c'(\sigma_f) = \left[1 - \delta \frac{\bar{\varphi}(1-\tau_f)e^{-\lambda\beta_f}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}\right] X, \tag{15}$$

where $\beta_f = \max(\lambda^{-1} - \Delta, 0)$ and τ_f is defined by (14). Inada conditions satisfied by $c(\cdot)$ ensure that $\sigma_f \in (0,1)$. Comparing σ_f with σ_* (as determined by (7)) leads to:

Proposition 5. *The success rate of private intervention is lower with a reputation-conscious fund than with a reputation-unconscious fund ($\sigma_f < \sigma_*$), and is further decreasing in fund career concerns ($\frac{\partial \sigma_f}{\partial \Delta} < 0$). A CEO whose utility attaches greater weight to the $t = 1$ stock price relative to the $t = 2$ firm value (larger δ) exerts less effort; as a result, the success rate of private intervention decreases ($\frac{\partial \sigma_*}{\partial \delta} < 0$ and $\frac{\partial \sigma_f}{\partial \delta} < 0$), and becomes more sensitive to fund career concerns ($|\frac{\partial \sigma_f}{\partial \Delta}|$ increases).*

The CEO's effort, hence the success rate of private intervention, negatively hinges on her continuation utility in the subgame of public intervention following failed private intervention,[24] which depends on the likelihood of public intervention (CEO utility drops to zero in this case) and fund trading absent public intervention. Propositions 3 and 4 show that a more reputation-conscious fund (larger Δ) (i) is less likely to publicly intervene; and (ii) trades less absent public intervention in order to reduce the odds of revealing the bad firm, which in turn drives the bad firm's stock price further above its true value (which is 0). Consequently, the CEO, whose utility is partially tied to the inflated stock price, makes a windfall gain. Both (i) and (ii) increase the CEO's continuation utility following failed private intervention, thereby lowering her effort incentive.

fund's equilibrium trading is determined. Thus, the reputation-conscious fund's utility from trading can be calculated *as if* the fund also sells λ^{-1}, same as a reputation-unconscious fund. However, the key is that the *expected* stock price at which trading takes place is higher with a reputation-conscious fund, because his trading reduction lowers the odds of revealing the bad firm. This causes the reputation-conscious fund's utility increase from public intervention instead of trading to be smaller than that for a reputation-unconscious fund, making public intervention relatively less desirable for the reputation-conscious fund.

[24] The CEO's continuation utility following successful private intervention is fixed at $\delta X + (1-\delta)X = X$.

Interestingly, at the exit stage the reputation-conscious fund and the CEO have *shared* incentives to mislead the market in its valuation of the firm – the fund's incentive is rooted in his inclination to positively influence the market's perception of his ability through reduced trading, and the CEO's incentive arises from her desire to make windfall gains from inflated stock prices. Furthermore, the two incentive problems interact with each other – trading reduction by the fund causes the stock price to be less reflective of the true firm value (hence CEO effort), fueling the CEO's moral hazard and lowering her effort incentive at the private intervention stage. This problem worsens when the CEO's own incentive horizon becomes shorter, i.e., when her utility attaches greater weight to the short-term stock price relative to the long-term firm value (larger δ).

Two layers of *complementarity* in blockholder governance are thus identified. First, as discussed above, there is complementarity between fund exit and private intervention – when exit becomes less effective, private intervention is also weakened. This complementarity works through, and is strengthened by, the CEO's short-term incentives (δ). Second, public intervention and private intervention also exhibit complementarity – fund short-term incentives reduce the credibility of the fund's threat to escalate his intervention to a confrontational public stage following a failed private intervention, which weakens the CEO's effort incentive, lowering the success rate of fund private intervention.

Proposition 5 highlights the CEO's incentive horizon as an important driver behind the success/failure of shareholder private intervention. Private intervention is less likely to succeed, hence shareholders are more likely to resort to more confrontational public measures, when the CEO has a shorter incentive horizon (larger δ). Moreover, a shorter CEO incentive horizon further worsens the adverse impact of fund short-term incentives on private intervention ($|\frac{\partial \sigma_f}{\partial \Delta}|$ increases with δ).

***Summary*:** So far, we have shown that a reputation-conscious fund reduces public intervention (Proposition 4) and trading (Proposition 3) in order to make the market's perception of his ability more favorable. As a result, *the fund's threat of escalating his intervention following failed private intervention loses credibility*, which causes the CEO to be less responsive to the fund's private demands, making private intervention more likely to fail (Proposition 5).

4.3 Long-Term Investment by a Good Firm

Having analyzed governance in a bad firm, we now examine how that affects a good firm's long-term investment (choice of υ). What impedes a good firm from making long-term investment is the market's inability to fully tell if an interim bad signal is a result of bad firm quality or a good firm pursuing long-term investment. Thus, the better the market can distinguish between good and bad firms, the more long-term investment by a good firm.

The CEO of a good firm chooses υ to maximize her utility:

$$\max_{\{\upsilon\}} U_c = (1-\delta)(X+g\upsilon) + \delta\left[\frac{1-\upsilon^2}{2}X + \frac{1+\upsilon^2}{2}\Pr(G|d>0)X\right], \tag{16}$$

The CEO's utility attaches weight $1-\delta$ on the $t=2$ firm value, $X+g\upsilon$. The second term in (16) captures the CEO's utility derived from the $t=1$ stock price P, with a weighting factor δ. If $s=s_G$ (w.p. $\frac{1-\upsilon^2}{2}$), the market identifies the good firm and sets $P=X$. If $s=s_B$ (w.p. $\frac{1+\upsilon^2}{2}$), the fund, knowing that the firm is good, does nothing throughout the three governance stages; in this case $d>0$ with no visible public intervention, and $P=\Pr(G|d>0)X$, where $\Pr(G|d>0)=\frac{\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_*)e^{-\lambda\beta_*}}$ with a reputation-unconscious fund, and $\Pr(G|d>0)=\frac{\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}$ with a reputation-conscious fund.

Proposition 6. *A good firm makes more long-term investment when facing a less reputation-conscious fund.*

The fund does not intervene in a good firm, nor does he sell its shares. Thus, upon releasing a bad signal (s_B), the only relevant state for the good firm is that total share demand $d>0$ with no visible intervention. We know that a less reputation-conscious fund is more likely to engage in visible public intervention in a bad firm following a failed private intervention (i.e., τ_f is decreasing in Δ; see Proposition 4). We also know that absent public intervention, a less reputation-conscious fund would have sold more aggressively if the firm were bad (i.e., β_f is decreasing in Δ; see Proposition 3). Therefore, larger τ_f and β_f associated with a less reputation-conscious fund allow the market to draw sharper inferences: the event $d>0$ with no visible intervention implies it is more likely that the firm is good. Said differently, stronger governance in a bad firm exerted by a less reputation-conscious fund allows the market to better identify a good firm. Emitting s_B is thus less dire to the good firm's CEO, who then chooses more long-term investment. This is reminiscent of the key finding in Edmans (2009) that active blockholder trading can foster, rather than hinder, long-term investment. Our analysis extends to including blockholder intervention.

5 Multiple Blockholders

We now extend the preceding analysis to examine governance by multiple blockholders. Our main idea can be illustrated in a most parsimonious way with two funds, each owning $\frac{\alpha}{2}$ units of share.[25] Again, consider a bad firm (so $s = s_B$). Private intervention is modeled in the same way as that with one fund: value-enhancing changes are proposed to the CEO (by either or both funds), and the success of private intervention depends on unobservable CEO effort. If private intervention fails, the public intervention stage ensues. Public intervention is costly to both funds; their costs, τ, are uniformly distributed on $[0, 1]$ and independent of each other. The bad firm's value, following a failed private intervention, can be improved from 0 to X as long as *one* fund publicly intervenes.

We examine and compare three blockholder structures:

- A symmetric structure with two reputation-unconscious funds, denoted as UU;
- A symmetric structure with two reputation-conscious funds, denoted as CC; and
- An asymmetric structure with a reputation-unconscious fund and a reputation-conscious fund, denoted as UC.

In each case, the model is again solved backwards from exit, then to public intervention, and finally private intervention.

5.1 UU Structure

Suppose private intervention failed. At the ensuing public intervention stage, we analyze a symmetric pure strategy PBE, and conjecture that the market believes that in equilibrium each reputation-unconscious fund (i) publicly intervenes if and only if $\tau \leq \tau_{**}$; and (ii) sells

[25] Our focus with multiple blockholders, unlike Edmans and Manso (2011), is not on their optimal number.

β_{**} if neither fund publicly intervenes, while abstains from selling as long as *one* fund publicly intervenes. Given such beliefs, the market sets the firm's $t = 1$ stock price as $P = 0$ if total share demand $d \leq 0$, and $P = X$ if $d > 0$ with public intervention being observed. If $d > 0$ without visible intervention, the market weighs the following two possibilities in forming its posterior belief: (i) a good firm that needs no intervention (w.p. $\frac{\bar{\varphi}}{2-\bar{\varphi}}$); or (ii) the firm is bad (w.p. $\frac{2(1-\bar{\varphi})}{2-\bar{\varphi}}$), private intervention has failed but public intervention is not undertaken by either fund (w.p. $(1-\tau_{**})^2$), therefore each fund sells β_{**}, but $d = u - 2\beta_{**} > 0$ (w.p. $e^{-2\lambda\beta_{**}}$). The market thus sets[26]

$$P = \frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_{**})^2 e^{-2\lambda\beta_{**}}} X. \tag{17}$$

It can be easily verified that, same as the single-blockholder case with a reputation-unconscious fund, in this case with two reputation-unconscious funds each fund sells $\beta_{**} = \min(\lambda^{-1}, \alpha/2)$ at the exit stage if neither fund publicly intervenes. We assume $\alpha > 2\lambda^{-1}$ throughout the rest of the analysis, so $\beta_{**} = \lambda^{-1}$.

At the private intervention stage, the problem to the bad firm's CEO is

$$\max_{\{\sigma\}} \; \sigma[\delta X + (1-\delta)X] + (1-\sigma)(1-\tau_{**})^2 e^{-2\lambda\beta_{**}}(\delta P) - c(\sigma), \tag{18}$$

where P is given by (17). The CEO's problem in (18) is similar to that in (6), except that in this case with two funds, the bad firm is not perfectly revealed at the public intervention stage if (i) neither fund publicly intervenes (w.p. $(1-\tau_{**})^2$); and (ii) at the subsequent exit stage demand by liquidity traders exceeds aggregate selling by the two funds (w.p. $e^{-2\lambda\beta_{**}}$).

Proposition 7. *In a UU structure, if private intervention fails in a bad firm, there is a unique cutoff, τ_{**}, defined by*

$$\tau_{**} = (1-\tau_{**})H(\beta_{**}, \tau_{**}) \equiv (1-\tau_{**}) \left[\frac{\alpha}{2} - \frac{\beta_{**} e^{-2\lambda\beta_{**}} \bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_{**})^2 e^{-2\lambda\beta_{**}}} \right] X, \tag{19}$$

[26] The posterior $\Pr(G|d>0) = \frac{\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{**})^2 e^{-2\lambda\beta_{**}}}$ in this case can be derived in the same way as that for (3), with $(1-\tau_*)$ and β_* being replaced with $(1-\tau_{**})^2$ and $2\beta_{**}$, respectively.

such that in a symmetric equilibrium each reputation-unconscious fund publicly intervenes if and only if $\tau \leq \tau_{**}$, and sells $\beta_{**} = \lambda^{-1}$ at the exit stage if neither publicly intervenes. Private intervention succeeds w.p. σ_{**}, given by

$$c'(\sigma_{**}) = \left[1 - \delta \frac{\bar{\varphi}(1-\tau_{**})^2 e^{-2\lambda\beta_{**}}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_{**})^2 e^{-2\lambda\beta_{**}}}\right] X. \tag{20}$$

Note that $H(\beta_{**}, \tau_{**}) \equiv \left[\frac{\alpha}{2} - \frac{\beta_{**} e^{-2\lambda\beta_{**}} \bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{**})^2 e^{-2\lambda\beta_{**}}}\right] X$, as defined in (19), is each fund's value enhancement from public intervention compared to trading. The key difference between (19) and (5), wherein the likelihood of public intervention by a reputation-unconscious fund in the single-blockholder case (τ_*) is determined, stems from the extra term, $1 - \tau_{**}$, on the right-hand side of (19).[27] This captures the standard free-rider problem with multiple blockholders – each fund, knowing that the value enhancement to himself, $H(\beta_{**}, \tau_{**})$, realizes as long as the other fund publicly intervenes, will incur the cost, τ_{**}, to publicly intervene by himself only if the other fund does not publicly intervene (which occurs w.p. $1 - \tau_{**}$ in equilibrium).

5.2 CC Structure

The CC structure with two reputation-conscious funds can be similarly analyzed as the UU structure. The results are summarized by the following proposition:

Proposition 8. *In a CC structure, if private intervention fails in a bad firm, there is a unique cutoff, τ_{ff}, defined by*

$$\tau_{ff} = (1-\tau_{ff}) \left[H(\beta_{ff}, \tau_{ff}) - \frac{e^{-2\lambda\beta_{ff}} \bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_{ff})^2 e^{-2\lambda\beta_{ff}}} \Delta X\right], \tag{21}$$

[27] $H(\beta_{**}, \tau_{**})$ differs from $h(\beta_*, \tau_*)$ in (5) in two aspects. First, each fund now only owns $\frac{\alpha}{2}$ units of share, which *ceteris paribus* lowers the intervention-induced value enhancement for each fund compared to the single-fund case. Second, absent public intervention by either fund, total fund trading is $2\lambda^{-1}$, doubling that with a single fund. This elevated trading increases the odds of revealing the bad firm, reducing each fund's trading profit from exit.

such that in a symmetric equilibrium each reputation-conscious fund publicly intervenes if and only if $\tau \leq \tau_{ff}$*, and sells* $\beta_{ff} = \max(\lambda^{-1} - \Delta, 0)$ *at the exit stage if neither publicly intervenes. Private intervention succeeds w.p.* σ_{ff}*, given by*

$$c'(\sigma_{ff}) = \left[1 - \delta \frac{\bar{\varphi}(1-\tau_{ff})^2 e^{-2\lambda\beta_{ff}}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_{ff})^2 e^{-2\lambda\beta_{ff}}}\right] X. \tag{22}$$

Equation (21) can be similarly understood as (19). The key difference between the two lies in the additional term, $\frac{e^{-2\lambda\beta_{ff}}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{ff})^2 e^{-2\lambda\beta_{ff}}}\Delta X$, in (21), which captures each fund's reputational loss from engaging in public intervention instead of trading.[28]

5.3 UC Structure

We now examine the UC structure with a reputation-unconscious fund and a reputation-conscious fund. We start by analyzing a pure strategy PBE at the public intervention stage (assuming private intervention has failed). Suppose the market's equilibrium beliefs are that the reputation-unconscious (resp. reputation-conscious) fund (i) publicly intervenes if and only if $\tau \leq \tau_{*f}$ (resp. $\tau \leq \tau_{f*}$); and (ii) sells β_{*f} (resp. β_{f*}) if neither fund publicly intervenes, while refrains from selling as long as one fund publicly intervenes.[29]

As in other cases, the market sets the firm's $t = 1$ stock price as $P = 0$ if total share demand $d \leq 0$, and $P = X$ if $d > 0$ with visible public intervention. If $d > 0$ with no visible public intervention, the market weighs the following two possibilities in forming its posterior belief: (i) a good firm requiring no intervention (w.p. $\frac{\bar{\varphi}}{2-\bar{\varphi}}$); or (ii) the firm is bad (w.p. $\frac{2(1-\bar{\varphi})}{2-\bar{\varphi}}$), private intervention has failed but public intervention is not undertaken by either fund (w.p. $(1-\tau_{*f})(1-\tau_{f*})$), so both funds sell, but $d = u - (\beta_{*f} + \beta_{f*}) > 0$ (w.p. $e^{-\lambda(\beta_{*f}+\beta_{f*})}$). Therefore, the market sets

$$P = \frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-\lambda(\beta_{*f}+\beta_{f*})}} X. \tag{23}$$

[28] The intuition for this extra term is same as that for the extra term in (14) compared to (5).

[29] Note the difference in subscripts in different notations: "$*f$" means that the fund in consideration is reputation-unconscious while the other fund is reputation-conscious; "$f*$" represents the opposite case.

At the private intervention stage, the problem to the bad firm's CEO is

$$\max_{\{\sigma\}} \ \sigma[\delta X + (1-\delta)X] + (1-\sigma)(1-\tau_{*f})(1-\tau_{f*})e^{-\lambda(\beta_{*f}+\beta_{f*})}(\delta P) - c(\sigma), \tag{24}$$

where P is given by (23). The problem in (24) is similar as that in (18), except that in this case with an asymmetric structure, following a failure of private intervention the bad firm is not perfectly revealed w.p. $(1-\tau_{*f})(1-\tau_{f*})e^{-\lambda(\beta_{*f}+\beta_{f*})}$. Solving (24) yields the CEO's equilibrium effort, hence the success rate of private intervention with the asymmetric structure (denoted by σ_{asy}):

$$c'(\sigma_{asy}) = \left[1 - \delta \frac{\bar{\varphi}(1-\tau_{*f})(1-\tau_{f*})e^{-\lambda(\beta_{*f}+\beta_{f*})}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-\lambda(\beta_{*f}+\beta_{f*})}}\right] X. \tag{25}$$

It is straightforward to verity that, same as the single-blockholder cases (see Propositions 1 and 3), in a UC structure absent public intervention by either fund following failed private intervention, the reputation-unconscious (resp. reputation-conscious) fund sells $\beta_{*f} = \lambda^{-1}$ (resp. $\beta_{f*} = \max(\lambda^{-1} - \Delta, 0)$). The complexity of the analysis for this case with an asymmetric blockholder structure arises from the possibility that the two funds may engage in public intervention with different probabilities – it is possible that $\tau_{*f} \neq \tau_{f*}$ – and they need to be jointly determined.

Determining τ_{*f} ***and*** τ_{f*}**:** We first prove that, interestingly, in a UC structure wherein the reputation-conscious fund's career concerns are not too strong (specifically, $\Delta \in (0, \lambda^{-1}]$), both the reputation-unconscious and reputation-conscious funds publicly intervene with the *same*, but *lower*, probability relative to that under the UU structure (wherein each reputation-unconscious fund publicly intervenes w.p. τ_{**}; see (19)).

Lemma 2. *When* $\Delta \in (0, \lambda^{-1}]$*, comparing the UC and UU structures we have* $\tau_{*f} = \tau_{f*} < \tau_{**}$.

The intuition is as follows. When $\Delta \in (0, \lambda^{-1}]$, at the exit stage the reputation-conscious fund sells Δ less compared to the reputation-unconscious fund,[30] but the consequent reduction in the reputation-conscious fund's trading profit, relative to that earned by the

[30]Note that $\beta_{*f} - \beta_{f*} = \lambda^{-1} - (\lambda^{-1} - \Delta) = \Delta$ in this case.

reputation-unconscious fund, is *exactly* offset by his gain in reputation from trading Δ less, instead of selling as much as the reputation-unconscious fund.[31] Thus, the reputation-conscious fund's utility from trading can be calculated *as if* he also sells λ^{-1}, same as the reputation-unconscious fund. Since the expected stock price at which trading takes place is the same for the two funds,[32] both derive the same utility from trading, hence will publicly intervene with the same probability ($\tau_{f*} = \tau_{*f}$).[33] Furthermore, compared to the UU structure, in the UC structure the reduction in total fund trading absent public intervention lowers the odds that the bad firm is revealed through trading, which increases each fund's utility from trading, thereby weakening each fund's public intervention incentive ($\tau_{f*} = \tau_{*f} < \tau_{**}$).

Next, we examine the case with $\Delta > \lambda^{-1}$: a UC structure in which the reputation-conscious fund's career concerns are sufficiently strong so that he does not trade ($\beta_{f*} = 0$) at the exit stage.

Proposition 9. *Suppose $\Delta > \lambda^{-1}$. In a UC structure the reputation-conscious fund is less likely to engage in public intervention than the reputation-unconscious fund ($\tau_{f*} < \tau_{*f}$) following a failed private intervention. When the reputation-conscious fund's career concerns become stronger (Δ increases), he publicly intervenes less (τ_{f*} decreases), while the reputation-unconscious fund publicly intervenes more (τ_{*f} increases).*

This is one main result of the paper. Different from the case in which $\Delta \in (0, \lambda^{-1}]$ (see Lemma 2), any increase in Δ beyond λ^{-1} (so $\beta_{f*} = 0$) does *not* further reduce total fund trading at the exit stage in a UC structure – total fund trading stays constant at $\beta_{*f} + \beta_{f*} = \lambda^{-1} + 0 = \lambda^{-1}$ with $\Delta > \lambda^{-1}$. Thus, different from the case in which $\Delta \in (0, \lambda^{-1}]$, with $\Delta > \lambda^{-1}$ the odds that the bad firm may be revealed to the market cannot be lowered further via trading reduction by the reputation-conscious fund, simply because his trading

[31]Total trading by the two funds is also lowered by Δ, which reduces the odds of revealing the bad firm at the exit stage, and consequently improves the market's assessment of the reputation-conscious fund's ability, compared to the (counterfactual) case wherein the reputation-conscious fund were also to sell λ^{-1}.

[32]The expected stock price is $e^{-\lambda(\beta_{*f}+\beta_{f*})}P$, depending on *total* trading by the two funds but not individual trading, where P is given by (23) and $e^{-\lambda(\beta_{*f}+\beta_{f*})}$ is the probability with which total share demand $d > 0$.

[33]The idea here is different from that for the comparison between a reputation-conscious fund and a reputation-unconscious fund in the single-blockholder cases (see footnote 23). There, the reputation-conscious fund and the reputation-unconscious fund are examined in two *separate* cases, and the expected stock prices at which trading takes place (hence trading profits) are different, depending on each fund's *individual* trading in each case.

(which is $\beta_{f*} = 0$) cannot be reduced further. Consequently, as the reputation-conscious fund's career concerns become stronger (Δ increases), he has to resort to more reduction in public intervention (i.e., τ_{f*} decreases) in order to reduce the odds of revealing the bad firm. Anticipating this, the reputation-unconscious fund publicly intervenes more (i.e., τ_{*f} increases) to compensate the reduction in public intervention by the reputation-conscious fund. Interestingly, thus, the reputation-conscious fund's weakened incentive to engage in public intervention, due to his strong career concerns, serves as a *credible commitment device* that strengthens the reputation-unconscious fund's public intervention incentive. That is, fund career concerns may help overcome the free-rider problem typically associated with multiple blockholders at the public intervention stage.

5.4 Comparing the Three Blockholder Structures

Having examined the three blockholder structures separately, we now compare their relative governance efficacy. Below we first summarize, for each structure, the findings on (i) the success rate of private intervention; (ii) the probability that at least one fund publicly intervenes following a failed private intervention; and (iii) aggregate fund trading at the exit stage.

Blockholder structure	(i) Private intervention	(ii) Public intervention	(iii) Exit
UU	σ_{**}	$1-(1-\tau_{**})^2$	$2\lambda^{-1}$
CC	σ_{ff}	$1-(1-\tau_{ff})^2$	$2\max(\lambda^{-1}-\Delta,0)$
UC	σ_{asy}	$1-(1-\tau_{*f})(1-\tau_{f*})$	$\lambda^{-1}+\max(\lambda^{-1}-\Delta,0)$

We first compare the two symmetric blockholder structures, UU and CC.

Lemma 3. *The success rate of private intervention, the probability that at least one fund publicly intervenes following a failed private intervention, and aggregate fund trading at the exit stage absent public intervention are all higher in the UU structure compared to the CC structure.*

This lemma shows that the blockholder structure with two reputation-conscious funds (CC) is strictly dominated by the one with two reputation-unconscious funds (UU) in terms of governance efficacy. The is because fund career concerns in the CC structure weaken exit and public intervention, both of which also lower the CEO's effort incentive at the private intervention stage.

Given that the CC structure is dominated by the UU structure, our next comparison is between the UU structure and the UC structure. We first compare the UU structure with a UC structure in which the reputation-conscious fund's career concerns are not too strong (i.e., the UC structure considered in Lemma 2 with $\Delta \in (0, \lambda^{-1}]$). We note that both fund exit and public intervention are stronger in the UU structure: (i) following a failed private intervention, the probability that at least one fund publicly intervenes in the UU structure, $1-(1-\tau_{**})^2$, is higher than that in the UC structure, $1-(1-\tau_{*f})(1-\tau_{f*})$ (following from Lemma 2); and (ii) aggregate fund trading at the exit stage is $2\beta_{**} = 2\lambda^{-1}$ in the UU structure, also larger than that in the UC structure, $\beta_{*f} + \beta_{f*} = 2\lambda^{-1} - \Delta$. Both (i) and (ii) lower the CEO's effort incentive at the private intervention stage in the UC structure – comparing (25) with (20), it follows immediately that $\sigma_{asy} < \sigma_{**}$. The intuition, similar as that for Proposition 5, is as follows. Compared to the UU structure, in the UC structure the fact (i) reduces the credibility of the funds' threat to take more confrontational public measures following a failed private intervention, and the fact (ii) drives the firm's stock price further above its true value at the exit stage. Both weaken the CEO's effort incentive at the private intervention stage, thereby lowering the success rate of private intervention. The discussions are summarized in the following lemma:

Lemma 4. *A UC structure in which the reputation-conscious fund's career concerns are not sufficiently strong ($\Delta \in (0, \lambda^{-1}]$) is strictly dominated by the UU structure: the success rate of private intervention, the probability that at least one fund publicly intervenes following a failure of private intervention, and aggregate fund trading at the exit stage absent public intervention are all higher in the UU structure.*

Finally, we compare the UU structure with a UC structure in which the reputation-conscious fund's career concerns are sufficiently strong (i.e., the UC structure considered in Proposition 9 with $\Delta > \lambda^{-1}$). The results are summarized as follows.

Proposition 10. *Suppose the reputation-conscious fund's career concerns are sufficiently strong (Δ sufficiently bigger than λ^{-1}). When a fund's block size ($\frac{\alpha}{2}$) is sufficiently large* *and/or financial market liquidity* (λ^{-1}) *is sufficiently low, the UC structure dominates the UU structure in terms of governance efficacy, manifested by* (i) *a higher probability in the UC structure that at least one fund publicly intervenes following a failed private intervention, i.e.,* $1-(1-\tau_{*f})(1-\tau_{f*}) > 1-(1-\tau_{**})^2$*; and* ($ii$) *a higher success rate of private intervention in the UC structure, i.e.,* $\sigma_{asy} > \sigma_{**}$*. Consequently, a good firm makes more long-term investment in the UC structure.*

This is the other main result of the paper, with the following intuition. First, consider public intervention. In the UC structure, as Δ increases further beyond λ^{-1}, although the reputation-conscious fund intervenes less (τ_{f*} decreases), the reputation-unconscious fund intervenes more (τ_{*f} increases), due to the positive externality that the former's (reputation-induced) reduction in public intervention exerts on the latter's intervention incentive (Proposition 9). When the fund's block size ($\frac{\alpha}{2}$) is sufficiently large, such externality will be sufficiently strong, so that the negative effect of the reputation-conscious fund's career concerns in weakening his own public intervention incentive is outweighed by its positive effect in strengthening the reputation-unconscious fund's incentive. Consequently, following a failed private intervention, public intervention (by at least one fund) is more likely to be initiated in the UC structure, i.e., $1-(1-\tau_{*f})(1-\tau_{f*}) > 1-(1-\tau_{**})^2$.

The efficacy of blockholder governance also depends on the success rate of private intervention and fund trading at the exit stage. Consider trading first. In the UU structure, trading is stronger – at the exit stage each reputation-unconscious fund sells λ^{-1} and total trading is $2\lambda^{-1}$, while in the UC structure (with $\Delta > \lambda^{-1}$) total trading is only λ^{-1}, due to the reputation-conscious fund's trading reduction. However, as discussed above, public intervention may be stronger in the UC structure, due to the amelioration of the free-rider problem at the public intervention stage. Thus, it is possible that in the UC structure the strengthened fund public intervention outweighs the the weakened fund exit, causing the UC structure to dominate the UU structure in terms of the overall governance efficacy following a failed private intervention. This dominance occurs when (i) a fund's block size ($\frac{\alpha}{2}$) is sufficiently large; and/or (ii) market liquidity (λ^{-1}) is sufficiently low, which effectively diminishes the comparative disadvantage of the UC structure relative to the UU structure in terms of fund trading.

When blockholder governance becomes stronger following a failed private intervention, the bad firm CEO's effort incentive at the private intervention stage also becomes stronger, thereby increasing the success rate of fund private intervention in the first place. Therefore, under the same two conditions above (i.e., $\frac{\alpha}{2}$ is sufficiently large and/or λ^{-1} is sufficiently small), private intervention is also more likely to succeed in the UC structure.

Finally, when blockholder governance becomes more effective, undervaluation upon releasing an interim bad signal becomes less of a concern for a good firm, which then chooses more long-term investment in the UC structure.

***Remarks*:** This result shows that although we may observe less public intervention in a UC structure, it does not necessarily imply that the presence of the reputation-conscious fund weakens blockholder governance. In fact, quite the contrary may be true: the amelioration of the free-rider problem, precisely due to the presence of the reputation-conscious fund, *strengthens the credibility of the threat of public intervention in the UC structure*, causing the bad firm's CEO to be more responsive to fund demand for changes at the initial private intervention stage. This is not observed on the equilibrium path of play, but nonetheless reduces the need for actual confrontational public intervention and improves the overall governance efficacy.

6 Model Robustness and Implications

6.1 Modeling Choices and Robustness

In our main model, a fund develops his reputation for selecting good firms *ex ante*, i.e., stock-picking skill. While this modeling choice is consistent with the survey finding in McCahery, Sautner, and Starks (2016) (see footnote 4), and can capture the well documented fund flow-performance relationship, there could be multiple dimensions of ability. Therefore, it is natural to ask, at least from a theoretical perspective, how our analysis would be affected if a fund's ability is modeled as his ability to gather private information about firm type *ex post* (i.e., distinguish between good and bad firms) and act upon that information by developing *right* strategies to enhance a bad firm's value. That is, the fund builds his reputation for being able to identify a bad firm *ex post* and turn it around.[34] There are two layers of ability in this alternative modeling assumption, and we consider each in turn. We describe below the main results from the analysis of this alternative model and explain the intuition.[35]

First, suppose, same as in the main model, the fund can unambiguously identify a bad firm ex post at $t = 1$, and his reputation rests in his ability to turn around the bad firm by proposing *right* strategic changes to its CEO. In our main model, changes proposed by the fund at the private intervention stage are assumed to be always right, and the success of private intervention only depends on the CEO's effort to implement those changes. Here, the success also depends on whether the proposed changes are effective to the specific firm.

Suppose the fund privately proposes some changes to the bad firm's CEO, who then exerts (hidden) effort to implement those changes, but firm value fails to improve at this private intervention stage (otherwise, the game ends); the failure is known only to the fund and the CEO as in the main model. The fund, being aware that the failure could be due to his strategies being wrong or shirking by the CEO, decides whether to escalate intervention to a public stage and forcibly implement those changes by himself or simply exit. With public intervention, the bad firm is revealed to the market and the potential reputation cost to the fund arises if his public intervention fails, in which case the market knows unambiguously that the failure must be due to the fund's wrong strategies. In the case of exit, selling more increases the odds of revealing to the market that the fund lacks the ability to turn around a bad firm – the market knows that the fund sells only when private intervention has failed and he is sufficiently pessimistic about the effectiveness of his turnaround strategies. Therefore, fund career concerns in this alternative model also cause him to reduce public intervention and trading following a failed private intervention, thereby jeopardizing the success of private intervention.[36] The results in our main model thus sustain qualitatively.

[34] Some activists may get their reputation from *deliberately* picking bad firms and turning them around. While we do not model this possibility (for example, imagine that high uncertainty may cloud turnaround prospects, so the majority of investors will first try to select good firms and only deal with turnaround issues if they find out later that they have picked a bad firm, rather than "picking a fight" intentionally), we discuss later that it is unlikely to change our main results qualitatively; see footnote 36.

[35] The formal analysis, omitted here for the sake of the paper's length, is available upon request.

[36] We do not expect the results to change qualitatively if we consider activists who deliberately select bad firms (see footnote 34), since they also care about the market's assessment of their turnaround ability.

Second, suppose, different from the main model, the fund receives an informative but imprecise (private) signal about firm type at $t = 1$, and develops his reputation for identifying firm type ex post (i.e., high signal precision). We show that when the market's prior belief about firm type is sufficiently positive, the results in our main model remain qualitatively.

The intuition is as follows. With this alternative ability model, the fund tends to distort his actions to conform with the market's prior belief in order to manipulate the market's perception that he has received a signal with high precision. If the prior is that the firm is likely to be good, then trading and public intervention following a failed private intervention, which are against the prior, will adversely affect the market's ability inferences – the market will place a higher weight that the fund has received a wrong signal when trading and public intervention are detected. Knowing this, the fund will sell less and engage in less public intervention to protect his reputation. Therefore, the results in the main model remain.

If the firm is a priori likely to be bad, then fund trading and intervention are consistent with the market's prior, and career concerns may induce the fund to sell and intervene even when his private signal at $t = 1$ indicates a good firm that does not warrant intervention or exit. In this case, this alternative ability model changes our results on exit and intervention in the main model.[37] However, what remains unaffected is that fund career concerns again adversely affects a good firm's long-term investment, since excessive selling and intervention lowers the market's ability to draw correct inferences about firm type, which again worsens the good firm's misvaluation-induced investment myopia.

6.2 Implications

6.2.1 The Corporate Governance Value of Passivity

Index funds do not engage in active monitoring or disciplinary trading. Such passivity may make one wonder about their corporate governance value. This question becomes increasingly important due to the recent proliferation of index funds whose ownership in

[37] The result that exit could be a sign of high (rather than low) ability in this case echoes the finding in Dow and Gorton (1997) that fund managers may trade excessively because they want to signal that they have information.

U.S. publicly traded companies has been growingly significant.[38] Although index funds' passivity in voice and exit is largely driven by their business strategies, whereas in our model the passivity of a reputation-conscious fund arises from its short-term incentives, the model's core idea may still be applied to shed light on the potential governance value of index funds – in firms owned by both index funds and non-index active institutional blockholders, the former's (credible) passivity may strengthen the latter's activity in performing active monitoring and thus ameliorate the free-rider problem. There is some anecdotal evidence that seems to be consistent with this explanation. According to a report by Reuters, with increasingly many index and exchange-traded funds who are "passive investors which own millions of shares of U.S. companies but rarely say much about how they should be run," activists complain that they *have to conduct deep research on companies by themselves*.[39]

Appel, Gormley, and Keim (2016) find that the increasing presence of index funds strengthens activists' incentive to engage in aggressive and costly interventions (e.g., seeking board representation through proxy fights). They interpret the finding as suggesting that the presence of passive institutional investors mitigates free-rider problems faced by activists by either decreasing the cost or increasing the payoff of intervention. Their hypothesis is that the increased ownership by large passive investors allows activists to easily rally support for their demands through better coordination. An alternative mechanism, as suggested by the core idea of our paper, is that a partial shift from active ownership to passive ownership attenuates the free-rider problem by making the remaining activists pivotal to the success of intervention.

At a broad level, our analysis sheds light on the prevalence of diverse blockholder structures, in which blockholders with various incentive horizons (various Δ in our model) co-exist. Think about mutual funds and hedge funds. To the extents that a fund manager's perceived ability affects fund flow and a mutual fund manager's compensation is relatively more tied to the size of assets under management (and hence fund flow) than a hedge fund manager,[40]

[38] According to Morningstar, as of year end of 2012 about 24% of U.S. institutional assets are owned by index funds.

[39] See "U.S. activist investors gain from index funds' passivity," by *Reuters*, November 20, 2013.

[40] Hedge fund managers typically self-invest more in their own funds than mutual fund managers, which causes them to care relatively more about long-term fund value (and hence have relatively lower Δ in our model); see Dasgupta and Piacentino (2015) for a formal analysis distinguishing between hedge funds and mutual funds along this line.

our analysis suggests that mutual funds tend to have longer stock holding horizons and are less likely to engage with management (both publicly and privately) than hedge funds. This is consistent with casual observations that hedge funds are usually more active in both exit and intervention (regardless of public confrontation or private negotiation). However, our analysis reveals some potential corporate governance value arising from the *co-existence* of mutual funds and hedge funds in a firm's ownership structure, wherein the inactivity of mutual funds can strengthen hedge funds' incentives to undertake corrective actions. That is, a heterogeneous blockholder structure with a mutual fund and a hedge fund can be more valuable (in terms of governance) than a homogeneous structure with two hedge funds.

6.2.2 Private Intervention

The survey by McCahery, Sautner, and Starks (2016) documents widespread behind-the-scenes shareholder engagement with management. Given the importance of both private and public engagement, it is empirically interesting to examine the driving factors behind the shareholders' choice between the two.[41] Our analysis suggests that besides the usual cost consideration, the CEO's incentive horizon (e.g., the weight that the CEO's compensation attaches to short-term stock prices relative to the long-term firm value, with a lower weight corresponding to a longer incentive horizon; for such a measure, see Gopalan, Milbourn, Song, and Thakor (2014)) is also an important determinant. Proposition 5 shows that firms with longer CEO incentive horizons are *ceteris paribus* more likely to experience successful private intervention, so fewer incidents of public intervention may be observed in those firms.

6.2.3 The Dark Side of Investor "Long-Termism"

Long stock holding horizon by institutional investors is widely lauded as instrumental to encouraging firms to pursue long-term goals, while short holding horizon is blamed as a significant contributing factor to corporate myopia. This view, largely mixing investor long-termism with stock holding horizon, is ubiquitous and influences much of the policy debate.[42]

[41] McCahery, Sautner, and Starks (2016) construct a voice index summing the different types of corrective (public and private) actions taken by an institutional investor to measure the voice intensity and examine its determinants. Their measure of voice intensity does not differentiate between private and public engagement.

[42] The 2009 Aspen Institute proposal, architected by renowned investors like Warren Buffett and John Bogle, recommends changes in capital gains tax rules to attract long-term stockholders in order to overcome

In academia, a sizable empirical literature uses fund turnover to gauge whether an institutional investor is long-term or short-term oriented, with those with low turnover (hence long holding horizon) being classified as long-term investors (e.g., Bushee (1998), and Gaspar, Massa, and Matos (2005)). This is grounded on two arguments. First, the fact that an investor holds a stock for a long period, rather than selling it upon short-term fluctuations, is because he cares about the firm's long-term performance. In turn, the investor's long-term view encourages the firm to focus on long-term value creation rather than improving short-term metrics. Second, since the investor maintains a prolonged (usually large) equity stake, he has strong incentive to monitor management to ensure it delivers long-term value.[43]

Our analysis shows that such conventional wisdom should be taken with caution. For an investor who is the sole or dominant blockholder, his long holding horizon should not be viewed synonymously as long-termism, if what drives the long holding horizon is his short-term (reputational) concerns as in our model. Such seemingly long-termism impedes information incorporation into prices and exacerbates corporate myopia. Such an investor, despite his endured and large stake, may not be a dedicated monitor either. Thus, empirical research on investor horizon and policy prescriptions aiming to promote long-termism should adopt a finer approach by heeding investors' *motives* in stock holding as well as *blockholder structure*. This echoes Edmans (2009) who also shows that policies that "create unconditionally long-run shareholders who never sell" may discourage long-term investment. As Edmans and Holderness (2016) point out, "what matters is not short-term or long-term trading, but whether the blockholder trades on short-term or long-term information."

7 Conclusion

We model blokcholder governance as a sequential process, beginning with less hostile private intervention, then more confrontational public intervention, and finally exit. The block-

myopia; see "Overcoming short-termism: A call for a more responsible approach to investment and business management," published by *The Aspen Institute*, September 9, 2009. The EU Commission is consulting on granting "extra voting rights and a bigger slice of dividends" to "loyal" shareholders who are long-term holders of a company's stock, aiming to promote long-termism; see "Brussels aims to reward investor loyalty," published by *Financial Times*, January 23, 2013.

[43]Empirical studies include, among others, Chen, Harford, and Li (2007), Cella, Ellul, and Giannetti (2013), and Derrien, Kecskés, and Thesmar (2013).

holder is a fund manager who may face short-term incentives and care about the market's assessment of his stock-picking ability. Such career concerns cause the fund manager to reduce disciplinary trading and undertake less public interventions following a failed private intervention, in order to positively influence others' perception of his ability. As a result, the threat by the fund manager to escalate his intervention to a more confrontational public stage loses credibility, jeopardizing the success of private intervention. Consequently, the effectiveness of blockholder governance is weakened in a single blockholder structure.

Our main result is that, interestingly, the *very* cause of the ineffectiveness of blockholder governance in a single blockholder structure can help improve governance in an *asymmetric* multiple blockholder structure by ameliorating the free-rider problem associated with multiple blockholders. In an asymmetric structure with a reputation-unconscious fund manager and a reputation-conscious fund manager, the weakened public intervention incentive by the latter makes the former pivotal in whether public intervention is undertaken following a failed private intervention, thereby strengthening the former's public intervention incentive. Consequently, the credibility of the threat that intervention is likely to be escalated to a confrontational public stage (following a failed private intervention) is restored, which increases the success of private intervention, hence the efficacy of blockholder governance.

The paper's central message is that a diverse blockholder structure with heterogeneous blockholder incentive horizons may help improve governance. Quite contrary to conventional wisdom, agency problems at the blockholder level do not necessarily exacerbate, but instead may ameliorate agency problems at the firm level.

Future research could go in various directions. One is to explore the multiple blockholder structure further. While we only model two blockholders in order to deliver our key message in a most direct and parsimonious way, it would be interesting to simultaneously endogenize both the optimal number of blockholders and the degree of asymmetry among them. The other direction is to endogenize the CEO's incentive horizon which we have taken as given, as in most blockholder models. However, it is likely that CEO incentive and blockholder governance are jointly determined. It would be fruitful to examine how the incentive horizon of blockholders and the CEO's pay horizon (i.e., the mix of short-term and long-term pay, as in Gopalan, Milbourn, Song, and Thakor (2014)) interact. Current corporate governance discussions have centered around executive compensation, but perhaps an equally important issue is how to design blockholder structure to complement executive compensation to promote long-term investment.

Appendix

Proof of Proposition 1. The first-order condition for (4) is

$$(1 - \lambda\beta)e^{-\lambda\beta}\frac{\bar{\varphi}}{\bar{\varphi} + 2(1 - \bar{\varphi})(1 - \tau_*)e^{-\lambda\beta_*}}X = 0, \tag{A1}$$

so the fund chooses $\beta = \min(\lambda^{-1}, \alpha)$, given that $\beta \leq \alpha$, which must coincide with β_* in equilibrium. The second-order condition is satisfied, $[-\lambda - \lambda(1 - \lambda\beta)]e^{-\lambda\beta}\frac{\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_*)e^{-\lambda\beta_*}}X < 0$. □

Proof of Proposition 2. If the fund publicly intervenes, he will not sell, and his continuation utility is

$$U_f^{pub} = \alpha X - \tau.$$

If the fund does not publicly intervene, he will sell $\beta_* = \lambda^{-1}$, and his continuation utility is

$$U_f^{no} = \frac{\beta_* e^{-\lambda\beta_*}\bar{\varphi}}{\bar{\varphi} + 2(1 - \bar{\varphi})(1 - \tau_*)e^{-\lambda\beta_*}}X.$$

Public intervention occurs if and only if $U_f^{pub} \geq U_f^{no}$, which yields (5), a fixed-point problem. Since $h(\beta_*, \tau)$ is a continuous and decreasing function of τ, the condition $h(\beta_*, 1) \in (0, 1)$, i.e.,

$$(\alpha - \lambda^{-1}e^{-1})X \in (0, 1), \tag{A2}$$

ensures the existence and uniqueness of an interior solution, $\tau_* \in (0, 1)$, by the Fixed-Point Theorem. Note $(\alpha - \lambda^{-1}e^{-1})X > 0$ is ensured by $\alpha > \lambda^{-1}$, so we only need $(\alpha - \lambda^{-1}e^{-1})X < 1$. If $(\alpha - \lambda^{-1}e^{-1})X \geq 1$, we have $h(\beta_*, \tau) \geq \tau$ for $\forall\tau \in [0, 1]$, so $\tau_* = 1$, i.e., the fund always publicly intervenes as the value enhancement from public intervention instead of trading is too high compared to the cost of public intervention. To knock out this uninteresting boundary case, we assume $(\alpha - \lambda^{-1}e^{-1})X < 1$ throughout. □

Proof of Lemma 1. If the firm is revealed to be good, then

$$f(\varphi|G) = \frac{\varphi f(\varphi)}{\int_0^1 \varphi f(\varphi) d\varphi} = \frac{\varphi f(\varphi)}{\bar{\varphi}}.$$

Substituting this into $\mathbf{E}(\varphi|G) = \int_0^1 \varphi f(\varphi|G) d\varphi$ yields (8). If the firm is revealed to be bad, then

$$f(\varphi|B) = \frac{(1-\varphi)f(\varphi)}{\int_0^1 (1-\varphi)f(\varphi)d\varphi} = \frac{(1-\varphi)f(\varphi)}{1-\bar{\varphi}}.$$

Substituting this into $\mathbf{E}(\varphi|B) = \int_0^1 \varphi f(\varphi|B) d\varphi$ yields (9). Finally, note that $\eta^2 = \mathbf{E}(\varphi^2) - [\mathbf{E}(\varphi)]^2 < \mathbf{E}(\varphi) - [\mathbf{E}(\varphi)]^2 = \bar{\varphi} - \bar{\varphi}^2$, which ensures $\mathbf{E}(\varphi|G) \in (\bar{\varphi}, 1)$ and $\mathbf{E}(\varphi|B) \in (0, \bar{\varphi})$. □

Proof of Proposition 3. To analyze the fund's problem in (12), denote

$$\Lambda(\beta, \beta_f) \equiv \frac{\partial U_f}{\partial \beta} = e^{-\lambda\beta} \frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}} \left[(1-\lambda\beta)X - \frac{\kappa_f \lambda \eta^2}{\bar{\varphi}(1-\bar{\varphi})}\right].$$

It is clear $\Lambda(\lambda^{-1}, \beta_f) < 0$, so we must have $\beta_f < \lambda^{-1}$. If $\lambda\Delta \in (0,1)$, then $\Lambda(0, \beta_f) > 0$. Note

$$\frac{\partial \Lambda(\beta, \beta_f)}{\partial \beta} \propto \left[\frac{\kappa_f \lambda \eta^2}{\bar{\varphi}(1-\bar{\varphi})} - X\right] - (1-\lambda\beta)X < 0,$$

so U_f is a concave function of β, and β_f is given by the first-order condition, $\Lambda(\beta_f, \beta_f) = 0$:

$$(1-\lambda\beta_f)X = \frac{\kappa_f \lambda \eta^2}{\bar{\varphi}(1-\bar{\varphi})} \Rightarrow \beta_f = \lambda^{-1} - \frac{\kappa_f \eta^2}{\bar{\varphi}(1-\bar{\varphi})X} = \lambda^{-1} - \Delta. \tag{A3}$$

If $\lambda\Delta \geq 1$, then $\Lambda(\beta, \beta_f) < 0 \; \forall \beta \in [0, \lambda^{-1})$. In this case, U_f is monotonically decreasing in β over $[0, \lambda^{-1}]$, and hence $\beta_f = 0$. □

Proof of Proposition 4. With public intervention, the fund improves the bad firm's value to X (and hence chooses $\beta = 0$), but also reveals its type. His continuation utility is

$$U_f^{pub} = \alpha X + \kappa_f \mathbf{E}(\varphi|B) - \tau.$$

If the fund does not publicly intervene, he will sell $\beta_f = \max(\lambda^{-1} - \Delta, 0)$ at the exit stage, and his continuation utility is given by (12) with $\beta = \beta_f$. The fund publicly intervenes if and only if $U_f^{pub} \geq U_f^{no}$, which yields

$$\begin{aligned}\tau_f &= [\alpha - \beta_f e^{-\lambda\beta_f} \Pr(G|d>0)]X - e^{-\lambda\beta_f} \Pr(G|d>0)\kappa_f[\mathbf{E}(\varphi|G) - \mathbf{E}(\varphi|B)] \\ &= \left[\alpha - \frac{\beta_f e^{-\lambda\beta_f}\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}\right]X - \frac{e^{-\lambda\beta_f}\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}\Delta X \\ &= h(\beta_f, \tau_f) - \frac{e^{-\lambda\beta_f}\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}\Delta X \\ &\equiv \widehat{h}(\beta_f, \tau_f). \end{aligned} \tag{A4}$$

It is clear $\frac{\partial \widehat{h}(\beta_f, \tau_f)}{\partial \tau_f} < 0$. We consider several cases, depending on the value of Δ. First, suppose $\Delta \geq \lambda^{-1}$, so $\beta_f = 0$. In this case, $\widehat{h}(0,0) = [\alpha - \bar{\varphi}(2-\bar{\varphi})^{-1}\Delta]X$. There are two subcases:

1. If $\Delta \geq \alpha(2-\bar{\varphi})\bar{\varphi}^{-1}$, we have $\widehat{h}(0,0) \leq 0$, and hence $\tau_f = 0$, always smaller than τ_*.
2. If $\Delta \in [\lambda^{-1}, \alpha(2-\bar{\varphi})\bar{\varphi}^{-1})$, we have $\widehat{h}(0,0) > 0$. In this case $\widehat{h}(0,1) = (\alpha - \Delta)X \leq (\alpha - \lambda^{-1})X < (\alpha - \lambda^{-1}e^{-1})X < 1$. This ensure a unique interior solution, $\tau_f \in (0,1)$. To show $\tau_f < \tau_*$ in this case, it is sufficient to show $\widehat{h}(0,\tau) < h(\lambda^{-1}, \tau)$ for $\forall \tau \in [0,1]$. Note:

$$\widehat{h}(0,\tau) - h(\lambda^{-1},\tau) = \left[\lambda^{-1}\frac{\bar{\varphi}}{\bar{\varphi}e + 2(1-\bar{\varphi})(1-\tau)} - \Delta\frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau)}\right]X,$$

   which is clearly negative, since $\Delta \geq \lambda^{-1}$.

Second, suppose $\Delta \in (0, \lambda^{-1})$, so $\beta_f = \lambda^{-1} - \Delta > 0$. In this case, the existence and uniqueness of τ_f can be shown by observing (i) $\frac{\partial \widehat{h}(\beta_f, \tau_f)}{\partial \tau_f} < 0$; and (ii) $\widehat{h}(\beta_f, 1) \in (0,1)$, which requires

$$(\alpha - \beta_f e^{-\lambda\beta_f})X - e^{-\lambda\beta_f}\Delta X = (\alpha - \lambda^{-1}e^{-1+\lambda\Delta})X \in (0,1).$$

Note (i) $(\alpha - \lambda^{-1}e^{-1+\lambda\Delta})X < (\alpha - \lambda^{-1}e^{-1})X < 1$, where the second inequality follows from (A2); and (ii) $(\alpha - \lambda^{-1}e^{-1+\lambda\Delta})X > (\alpha - \lambda^{-1})X > 0$. To prove $\tau_f < \tau_*$ in this case with $\Delta \in (0, \lambda^{-1})$, it is sufficient to show $\widehat{h}(\beta_f, \tau) < h(\beta_*, \tau)$ for $\forall \tau \in [0, 1]$. Substituting $\beta_f = \lambda^{-1} - \Delta$ into $\widehat{h}(\beta_f, \tau)$ yields

$$\begin{aligned}\widehat{h}(\beta_f, \tau) = & \left[\alpha - (\lambda^{-1} - \Delta)e^{-1+\lambda\Delta}\frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau)e^{-1+\lambda\Delta}}\right]X \\ & - e^{-1+\lambda\Delta}\frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau)e^{-1+\lambda\Delta}}\Delta X \\ = & \left[\alpha - \lambda^{-1}e^{-1+\lambda\Delta}\frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau)e^{-1+\lambda\Delta}}\right]X \\ = & \left[\alpha - \lambda^{-1}e^{-1}\frac{\bar{\varphi}}{\bar{\varphi}e^{-\lambda\Delta} + 2(1-\bar{\varphi})(1-\tau)e^{-1}}\right]X \\ < & \left[\alpha - \frac{\lambda^{-1}e^{-1}\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau)e^{-1}}\right]X \\ = & \, h(\beta_*, \tau). \end{aligned} \tag{A5}$$

Finally, the result $\frac{\partial \tau_f}{\partial \Delta} < 0$ directly follows from the fact $\frac{\partial \widehat{h}(\beta_f, \tau)}{\partial \Delta} < 0$. □

Proof of Proposition 5. The result $\sigma_f < \sigma_*$ follows directly by comparing (7) and (15), noting that $(1 - \tau_f)e^{-\lambda\beta_f} > (1 - \tau_*)e^{-\lambda\beta_*}$. The right-hand side of (15) is decreasing in Δ (because it is increasing in β_f and τ_f, both of which are decreasing in Δ), which leads to $\frac{\partial \sigma_f}{\partial \Delta} < 0$. The results $\frac{\partial \sigma_*}{\partial \delta} < 0$ and $\frac{\partial \sigma_f}{\partial \delta} < 0$ follow by noting that the right-hand sides of (7) and (15) are decreasing in δ. Finally,

$$\left|\frac{\partial \sigma_f}{\partial \Delta}\right| = \delta \frac{\frac{\partial \left(\frac{\bar{\varphi}(1-\tau_f)e^{-\lambda\beta_f}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}\right)}{\partial \Delta}}{c''(\sigma_f)},$$

which is increasing in δ (note both the numerator and denominator are positive). □

Proof of Proposition 6. Consider a reputation-unconscious fund. To analyze the CEO's problem in (16), denote

$$\Omega(\upsilon, \beta_*) \equiv \frac{\partial U_c}{\partial \upsilon} = (1 - \delta)g - \delta\upsilon \frac{2(1-\bar{\varphi})e^{-\lambda\beta_*}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_*)e^{-\lambda\beta_*}}X.$$

It is clear U_c is a concave function of υ, since $\frac{\partial\Omega(\upsilon,\beta_*)}{\partial\upsilon} < 0$. Note

$$\Omega(0,\beta_*) = (1-\delta)g > 0,$$
$$\Omega(1,\beta_*) = (1-\delta)g - \delta\frac{2(1-\bar{\varphi})e^{-\lambda\beta_*}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_*)e^{-\lambda\beta_*}}X.$$

Denote the solution to (16) as υ_*. If $\delta \leq \delta_* \equiv g\left[g + \frac{2(1-\bar{\varphi})e^{-\lambda\beta_*}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_*)e^{-\lambda\beta_*}}X\right]^{-1} \in (0,1)$, then $\Omega(1,\beta_*) \geq 0$; this shows $\Omega(\upsilon,\beta_*) > 0\ \forall\upsilon \in [0,1)$ and hence $\upsilon_* = 1$. If $\delta > \delta_*$, then $\Omega(1,\beta_*) < 0$, and hence υ_* is given by the first-order condition, $\Omega(\upsilon_*,\beta_*) = 0$, where $\upsilon_* = \frac{1-\delta}{\delta}\frac{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_*)e^{-1}}{2(1-\bar{\varphi})(1-\tau_*)e^{-1}}\frac{g}{X} \in (0,1)$ is exactly ensured by $\delta > \delta_*$. Thus, a good firm invests

$$\upsilon_* = \min\left(\frac{1-\delta}{\delta}\frac{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_*)e^{-1}}{2(1-\bar{\varphi})(1-\tau_*)e^{-1}}\frac{g}{X}, 1\right). \tag{A6}$$

Similarly, we can show that with a reputation-conscious fund, a good firm invests

$$\upsilon_f = \min\left(\frac{1-\delta}{\delta}\frac{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}{2(1-\bar{\varphi})(1-\tau_f)e^{-\lambda\beta_f}}\frac{g}{X}, 1\right). \tag{A7}$$

It is clear $\upsilon_f < \upsilon_*$, since $\tau_f < \tau_*$ and $\beta_f < \beta_* = \lambda^{-1}$. □

Proof of Proposition 7. If a reputation-unconscious fund publicly intervenes by incurring the cost τ, his block is worth $\frac{\alpha X}{2}$, and his continuation utility is

$$U_f^{pub} = \frac{\alpha X}{2} - \tau.$$

If the fund does not publicly intervene, he knows (i) w.p. τ_{**} the other fund publicly intervenes, in which case neither fund sells and his own block is worth $\frac{\alpha X}{2}$; and (ii) w.p. $1-\tau_{**}$ the other fund does not publicly intervene either, in which case each fund sells $\beta_{**} = \lambda^{-1}$, with a stock price being given by (17) if $d > 0$ (w.p. $e^{-2\lambda\beta_{**}} = e^{-2}$), and 0 if $d \leq 0$ (w.p. $1-e^{-2}$). His continuation utility is

$$U_f^{no} = \tau_{**}\frac{\alpha X}{2} + (1-\tau_{**})\frac{\lambda^{-1}e^{-2}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{**})^2e^{-2}}X.$$

Public intervention occurs if and only if $U_f^{pub} \geq U_f^{no}$, which yields (19). Equation (20) follows directly by solving (18). □

Proof of Proposition 8. If a reputation-conscious fund publicly intervenes, he improves the value of his block to $\frac{\alpha X}{2}$, but also reveals the bad firm's type. His continuation utility is

$$U_f^{pub} = \frac{\alpha X}{2} + \kappa_f \mathbf{E}(\varphi|B) - \tau.$$

If the fund does not publicly intervene, he knows (i) w.p. τ_{ff} the other fund publicly intervenes, in which case neither fund sells and his own block is worth $\frac{\alpha X}{2}$, but the bad firm's type is fully revealed; and (ii) w.p. $1 - \tau_{ff}$ the other fund does not publicly intervene either, in which case each fund sells $\beta_{ff} = \max(\lambda^{-1} - \Delta, 0)$ (this can be easily verified). His continuation utility is

$$U_f^{no} = \tau_{ff}\left[\frac{\alpha X}{2} + \kappa_f \mathbf{E}(\varphi|B)\right] + (1-\tau_{ff})\frac{\beta_{ff} e^{-2\lambda\beta_{ff}}\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_{ff})^2 e^{-2\lambda\beta_{ff}}} X$$
$$+ (1-\tau_{ff})\kappa_f[(1-e^{-2\lambda\beta_{ff}})\mathbf{E}(\varphi|B) + e^{-2\lambda\beta_{ff}}\mathbf{E}(\varphi|d>0)].$$

To understand the last term in the above expression, note when neither fund publicly intervenes:

- the bad firm's type is fully revealed when $d \le 0$, which occurs w.p. $1 - e^{-2\lambda\beta_{ff}}$; and
- when $d > 0$, which occurs w.p. $e^{-2\lambda\beta_{ff}}$, the market's posterior belief is

$$\begin{aligned}\mathbf{E}(\varphi|d>0) =& \Pr(G|d>0)\mathbf{E}(\varphi|G) + \Pr(B|d>0)\mathbf{E}(\varphi|B)\\ =& \frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_{ff})^2 e^{-2\lambda\beta_{ff}}}\mathbf{E}(\varphi|G) + \frac{2(1-\bar{\varphi})(1-\tau_{ff})^2 e^{-2\lambda\beta_{ff}}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_{ff})^2 e^{-2\lambda\beta_{ff}}}\mathbf{E}(\varphi|B).\end{aligned}$$

Public intervention occurs if and only if $U_f^{pub} \ge U_f^{no}$, which yields (21). Equation (22) can be derived in the same way as (20). □

Proof of Lemma 2. For the reputation-unconscious fund, if he publicly intervenes, his continuation utility is

$$U_f^{pub} = \frac{\alpha X}{2} - \tau.$$

If he does not publicly intervene, he knows (i) w.p. τ_{f*} the other fund (who is reputation conscious) publicly intervenes, in which case neither fund sells and his own block is worth $\frac{\alpha X}{2}$; and (ii) w.p.

$1-\tau_{f*}$ the other fund does not intervene either, in which case he sells λ^{-1} and the other fund sells $\max(\lambda^{-1}-\Delta, 0)$. His continuation utility is

$$U_f^{no} = \tau_{f*}\frac{\alpha X}{2} + (1-\tau_{f*})\frac{\lambda^{-1}e^{-1-\max(1-\lambda\Delta,0)}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1-\max(1-\lambda\Delta,0)}}X.$$

The reputation-unconscious fund publicly intervenes if and only if $U_f^{pub} \geq U_f^{no}$, which yields

$$\tau_{*f} = (1-\tau_{f*})\left[\frac{\alpha}{2} - \frac{\lambda^{-1}e^{-1-\max(1-\lambda\Delta,0)}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1-\max(1-\lambda\Delta,0)}}\right]X. \tag{A8}$$

For the reputation-conscious fund, if he publicly intervenes, then the bad firm's type is fully revealed, and his corresponding continuation utility is

$$U_f^{pub} = \frac{\alpha X}{2} + \kappa_f \mathbf{E}(\varphi|B) - \tau.$$

If he does not publicly intervene, he knows (i) w.p. τ_{*f} the other fund (who is reputation unconscious) intervenes, in which case neither fund sells, but the bad firm's type is fully revealed; and (ii) w.p. $1-\tau_{*f}$ the other fund does not intervene either, in which case he sells $\max(\lambda^{-1}-\Delta, 0)$ and the other fund sells λ^{-1}. His continuation utility is

$$\begin{aligned} U_f^{no} = {} & \tau_{*f}\left[\frac{\alpha X}{2} + \kappa_f \mathbf{E}(\varphi|B)\right] + (1-\tau_{*f})\frac{\max(\lambda^{-1}-\Delta,0)e^{-1-\max(1-\lambda\Delta,0)}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1-\max(1-\lambda\Delta,0)}}X \\ & + (1-\tau_{*f})\kappa_f\{[1-e^{-1-\max(1-\lambda\Delta,0)}]\mathbf{E}(\varphi|B) + e^{-1-\max(1-\lambda\Delta,0)}\mathbf{E}(\varphi|d>0)\}. \end{aligned}$$

To understand the last term in the above expression, note when neither fund publicly intervenes: (i) the bad firm's type is fully revealed when $d \leq 0$, w.p. $1-e^{-\lambda(\beta_{*f}+\beta_{f*})} = 1-e^{-1-\max(1-\lambda\Delta,0)}$; and (ii) when $d>0$, w.p. $e^{-1-\max(1-\lambda\Delta,0)}$, the market's posterior belief about the reputation-conscious fund's ability is

$$\begin{aligned} \mathbf{E}(\varphi|d>0) = {} & \Pr(G|d>0)\mathbf{E}(\varphi|G) + \Pr(B|d>0)\mathbf{E}(\varphi|B) \\ = {} & \frac{\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1-\max(1-\lambda\Delta,0)}}\mathbf{E}(\varphi|G) \\ & + \frac{2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1-\max(1-\lambda\Delta,0)}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1-\max(1-\lambda\Delta,0)}}\mathbf{E}(\varphi|B). \end{aligned}$$

The reputation-conscious fund publicly intervenes if and only if $U_f^{pub} \geq U_f^{no}$, which yields

$$\tau_{f*} = (1-\tau_{*f})\left[\frac{\alpha}{2} - \frac{\max(\lambda^{-1}-\Delta,0)e^{-1-\max(1-\lambda\Delta,0)}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1-\max(1-\lambda\Delta,0)}}\right]X$$
$$-(1-\tau_{*f})\frac{e^{-1-\max(1-\lambda\Delta,0)}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1-\max(1-\lambda\Delta,0)}}\Delta X. \tag{A9}$$

When $\Delta \in (0, \lambda^{-1}]$, (A8) and (A9) can be simplified as, respectively,

$$\tau_{*f} = (1-\tau_{f*})\left[\frac{\alpha}{2} - \frac{\lambda^{-1}e^{-2+\lambda\Delta}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-2+\lambda\Delta}}\right]X, \tag{A10}$$
$$\tau_{f*} = (1-\tau_{*f})\left[\frac{\alpha}{2} - \frac{\lambda^{-1}e^{-2+\lambda\Delta}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-2+\lambda\Delta}}\right]X. \tag{A11}$$

From (A10) and (A11), we have $\frac{\tau_{*f}}{1-\tau_{f*}} = \frac{\tau_{f*}}{1-\tau_{*f}} \Rightarrow (\tau_{*f}-\tau_{f*})(1-\tau_{*f}-\tau_{f*}) = 0$. Note $\tau_{*f}+\tau_{f*} < 1$: observe

$$\left[\frac{\alpha}{2} - \frac{\lambda^{-1}e^{-2+\lambda\Delta}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-2+\lambda\Delta}}\right]X < (\alpha-\lambda^{-1}e^{-1})X < 1,$$

where the first inequality is ensured by $\alpha > 2\lambda^{-1}$, and the second inequality follows from (A2). Denote $\tau_{*f} = \tau_{f*} \equiv \widehat{\tau}$. We need to show that $\widehat{\tau}$, given by

$$\widehat{\tau} = (1-\widehat{\tau})\left[\frac{\alpha}{2} - \frac{\lambda^{-1}e^{-2+\lambda\Delta}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\widehat{\tau})^2e^{-2+\lambda\Delta}}\right]X, \tag{A12}$$

is smaller than τ_{**}, given by (19). Suppose $\widehat{\tau} \geq \tau_{**}$, so $(1-\widehat{\tau})^2 \leq (1-\tau_{**})^2$. Then, the right-hand side of (A12) is smaller than the right-hand side of (19), which leads to $\widehat{\tau} < \tau_{**}$, a contradiction. □

Proof of Proposition 9. In this case with $\Delta > \lambda^{-1}$, (A8) and (A9) can be written as, respectively,

$$\tau_{*f} = (1-\tau_{f*})\left[\frac{\alpha}{2} - \frac{\lambda^{-1}e^{-1}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1}}\right]X, \tag{A13}$$
$$\tau_{f*} = (1-\tau_{*f})\left[\frac{\alpha}{2} - \frac{\Delta e^{-1}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1}}\right]X. \tag{A14}$$

Note

$$\frac{\tau_{*f}}{\tau_{f*}} = \frac{1-\tau_{f*}}{1-\tau_{*f}}\frac{\frac{\alpha}{2} - \frac{\lambda^{-1}e^{-1}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1}}}{\frac{\alpha}{2} - \frac{\Delta e^{-1}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1}}} > \frac{1-\tau_{f*}}{1-\tau_{*f}},$$

which yields $(\tau_{*f} - \tau_{f*})(1 - \tau_{*f} - \tau_{f*}) > 0$. Note $\tau_{*f} + \tau_{f*} < 1$,[44] so $\tau_{f*} < \tau_{*f}$. When Δ increases, holding τ_{*f} fixed, the right-hand side of (A14) falls. The solution to the fixed-point problem in (A14), τ_{f*}, falls as well. The decrease in τ_{f*} causes the right-hand side of (A13) to increase, and therefore the solution to the fixed-point problem in (A13), τ_{*f}, also increases. □

Proof of Lemma 3. The proof for $\tau_{ff} < \tau_{**}$ is similar to that for $\tau_f < \tau_*$ with one fund (see the Proof of Proposition 4). Note $\frac{\tau_{ff}}{1-\tau_{ff}} = H(\beta_{ff}, \tau_{ff}) - \frac{e^{-2\lambda\beta_{ff}}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{ff})^2 e^{-2\lambda\beta_{ff}}}\Delta X \equiv \widehat{H}(\beta_{ff}, \tau_{ff})$ and $\frac{\tau_{**}}{1-\tau_{**}} = H(\beta_{**}, \tau_{**})$, so it is sufficient show $\widehat{H}(\beta_{ff}, \tau) < H(\beta_{**}, \tau)$ for $\forall \tau \in [0, 1]$. Consider the case in which $\Delta \in (0, \lambda^{-1})$. Substituting $\beta_{ff} = \lambda^{-1} - \Delta$ into $\widehat{H}(\beta_{ff}, \tau)$ yields

$$
\begin{aligned}
\widehat{H}(\beta_{ff}, \tau) &= \left[\frac{\alpha}{2} - (\lambda^{-1} - \Delta)e^{-2+2\lambda\Delta}\frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau)^2 e^{-2+2\lambda\Delta}}\right] X \\
&\quad - e^{-2+2\lambda\Delta}\frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau)^2 e^{-2+2\lambda\Delta}}\Delta X \\
&= \left[\frac{\alpha}{2} - \lambda^{-1}e^{-2+2\lambda\Delta}\frac{\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau)^2 e^{-2+2\lambda\Delta}}\right] X \\
&= \left[\frac{\alpha}{2} - \lambda^{-1}e^{-2}\frac{\bar{\varphi}}{\bar{\varphi}e^{-2\lambda\Delta} + 2(1-\bar{\varphi})(1-\tau)^2 e^{-2}}\right] X \\
&< \left[\frac{\alpha}{2} - \frac{\lambda^{-1}e^{-2}\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau)^2 e^{-2}}\right] X \\
&= H(\beta_{**}, \tau).
\end{aligned}
$$

The proof for the case with $\Delta \geq \lambda^{-1}$ (so $\beta_{ff} = 0$) is similar as the corresponding proof for $\tau_f < \tau_*$ with $\Delta \geq \lambda^{-1}$, and hence is omitted here (see the Proof of Proposition 4 with one fund). The result $\sigma_{ff} < \sigma_{**}$ follows directly by comparing (20) and (22), noting that $(1 - \tau_{ff})^2 e^{-2\lambda\beta_f^{no}} > (1 - \tau_{**})^2 e^{-2\lambda\beta_*^{no}}$. □

Proof of Lemma 4. We only need to show $\sigma_{**} > \sigma_{asy}$, which directly follows by comparing (20) and (25), noting that $(1 - \tau_{*f})(1 - \tau_{f*})e^{-\lambda(\beta_{*f}+\beta_{f*})} > (1 - \tau_{**})^2 e^{-2\lambda\beta_{**}}$ when $\Delta \in (0, \lambda^{-1}]$. □

Proof of Proposition 10. It is sufficient to examine the case wherein Δ is sufficiently big such that $\tau_{f*} = 0$. In this case,

$$\tau_{*f} = \left[\frac{\alpha}{2} - \frac{\lambda^{-1}e^{-1}\bar{\varphi}}{\bar{\varphi} + 2(1-\bar{\varphi})(1-\tau_{*f})e^{-1}}\right] X. \tag{A15}$$

[44] Following similar arguments as in the Proof of Lemma 2, we can show $\left[\frac{\alpha}{2} - \frac{\lambda^{-1}e^{-1}\bar{\varphi}}{\bar{\varphi}+2(1-\bar{\varphi})(1-\tau_{*f})(1-\tau_{f*})e^{-1}}\right]X < (\alpha - \lambda^{-1}e^{-1})X < 1$, which is what is needed to show $\tau_{*f} + \tau_{f*} < 1$.

Comparing (A15) with (19), wherein τ_{**} is determined, note when $\frac{\alpha}{2}$ is sufficiently large and/or λ^{-1} is sufficiently small, $\tau_{*f} \approx \frac{\tau_{**}}{1-\tau_{**}} > \tau_{**}$. Comparing (20) and (25), we know that establishing the possibility of $\sigma_{asy} > \sigma_{**}$ is equivalent to establishing the possibility of $(1-\tau_{*f})(1-\tau_{f*})e^{-\lambda(\beta_{*f}+\beta_{f*})} < (1-\tau_{**})^2 e^{-2\lambda\beta_{**}}$, i.e., $1-\tau_{*f} < (1-\tau_{**})^2 e^{-1}$. Since $\tau_{*f} \approx \frac{\tau_{**}}{1-\tau_{**}}$, it is thus sufficient to show $1-\frac{\tau_{**}}{1-\tau_{**}} < (1-\tau_{**})^2 e^{-1} \Leftrightarrow J(\tau_{**}) \equiv \tau_{**}^3 - 3\tau_{**}^2 + (3-2e)\tau_{**} + (e-1) < 0$. Note $J(0) = e-1 > 0$, $J(1) = -e < 0$, and $J'(\tau_{**}) < 0$. Thus, there exists a cutoff value of τ_{**}, such that if τ_{**} is bigger than that cutoff, $J(\tau_{**}) < 0$. The result follows by noting that τ_{**} is sufficiently big when $\frac{\alpha}{2}$ is sufficiently big and/or λ^{-1} is sufficiently small. Finally, note $(1-\tau_{*f})(1-\tau_{f*})e^{-\lambda(\beta_{*f}+\beta_{f*})} < (1-\tau_{**})^2 e^{-2\lambda\beta_{**}} \Rightarrow 1-(1-\tau_{*f})(1-\tau_{f*}) > 1-(1-\tau_{**})^2$. □

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