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Sustainable Investing and Market Governance

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August 2025

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Abstract

This paper examines how sustainable investing affects the governance role of financial markets. We show that stronger concerns about social costs among informed investors can reduce price informativeness about managerial effort to improve financial performance, increasing the cost of incentive provision. Our mechanism induces an inherent link between firms' environmental and social ("ES" of ESG) and governance ("G" of ESG) outcomes. We show that the agency cost of sustainable investing can incentivize financially motivated shareholders to reduce externalities to enhance price informativeness for governance purposes. We establish further insights into how sustainable investing affects asset prices and managerial compensation contracts.

Keywords: Sustainable investing, corporate governance, market monitoring, ESG, managerial incentives, price informativeness, agency costs

JEL Classifications: G30, G32, G34, G14, G23, M14, Q56

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Sustainable Investing and Market Governance*

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1 Introduction

Sustainable investing, which incorporates social and environmental factors into investment decisions, has had a significant impact on financial markets.[1] While a growing literature examines how sustainable investing can reduce corporate externalities, it has largely overlooked how sustainable investing affects the traditional governance role of financial markets (e.g., Holmström and Tirole, 1993).

This paper examines how sustainable investing influences firm governance through its effects on price informativeness and market-based monitoring. We demonstrate that sustainable investing can weaken the governance role of financial markets by reducing the sensitivity of stock prices to information about firm fundamentals, particularly when firm externalities are significant. Specifically, an informed trader with social concerns may avoid investing in firms with poor environmental or social outcomes despite observing strong financial performance. This behavior reduces informed trading based on fundamentals, lowering the informational content of prices. Consequently, it becomes more costly for shareholders to incentivize managers to improve financial performance. If these costs become sufficiently high, shareholders may reduce incentive provision, leading to lower managerial effort and diminished financial performance. Thus, sustainable investing can increase the agency costs associated with the separation of ownership and control.

This novel market-governance channel of sustainable investing establishes an inherent link between firms' environmental and social (the "ES" of ESG) and governance (the "G" of ESG) outcomes. Specifically, we demonstrate that when informed traders strongly care about firm externalities, a positive relationship emerges between ES and G scores. This relationship arises endogenously because shareholders can more easily incentivize managerial effort to improve fundamentals (higher G scores) when firms are more likely to achieve good environmental and social outcomes (higher ES scores). Intuitively, lower negative externalities increase informed trading based on firm fundamentals, leading to more informative stock prices that enhance market-based governance. Our analysis thus challenges arguments that these components are unrelated and should not be jointly considered in ESG ratings.[2]

Building on this foundational link between firm sustainability and governance, we establish

[1] Edmans et al. (2024) report that 77% of 509 active equity portfolio managers incorporate ES performance into stock selection.

[2] See, for example, "Is it time to separate 'E' from 'S' and 'G?,'" Financial Times, 14 March 2022, and "It's Time to Unbundle ESG," Harvard Business Review, 20 September 2024.

several key insights. Importantly, the market-governance channel of sustainable investing may lead to social and environmental improvements by financially motivated agents. We show that even purely financially motivated shareholders may rationally invest in reducing firm externalities to enhance price informativeness and reduce managerial incentive costs. Similarly, a purely financially motivated manager may exert costly effort to reduce externalities in order to increase her financial compensation. Thus, the agency costs of sustainable investing can paradoxically generate positive real effects by incentivizing firms to reduce negative externalities.

The market-governance channel of sustainable investing differs from the traditional cost-of-capital channel (e.g., Heinkel et al., 2001). In our framework, sustainable investors affect real outcomes by making incentive provision, rather than capital, more expensive. This mechanism implies that sustainable investing can have real effects even without differences in the expected returns between green and brown firms. We further show that sustainable investing can lead to differences in price volatility between green and brown firms, rather than in expected returns. In addition, we demonstrate that financial shareholders may optimally link managerial compensation to ES news even when managers cannot improve ES performance. In our framework, ES-linked compensation can improve firm governance even without reducing externalities. Finally, we show that when firms generate social benefits rather than costs, the relationship between "ES" and "G" can become negative, and shareholders may reduce social benefits.

Our model features an informed investor who may care about the firm's social cost and trades in a Kyle-type market. The firm generates both an uncertain financial payoff and an uncertain social cost, capturing negative externalities. The firm is initially owned by investors who value only financial payoffs. A manager operates the firm and can exert costly effort to increase its financial performance. In the baseline model, the probability of the firm generating negative externalities is exogenous. The initial shareholders design the manager's compensation contract to maximize the firm's expected financial payoff net of compensation costs. The manager's pay can only depend on the firm's interim stock price and is subject to limited liability. All parties are risk-neutral.

The informed investor's valuation of firm shares depends on both the financial payoff and social cost, weighted by her social concerns. She privately observes both the financial payoff and social cost before trading and can either buy a share or abstain from doing so. Market makers set prices based on aggregate order flow, which includes noise trader demand, to reflect the firm's expected financial payoff. This setup enables us to examine how investors' social concerns affect the information content of stock prices and, consequently, market-based governance.

We show that as the informed investor's social concerns intensify, she becomes less likely to acquire a share when observing high financial performance but a high social cost. This reduction in informed trading makes the firm's stock price less informative about financial performance and, thus, about managerial effort. Declining price informativeness increases the agency costs of separating ownership and control, as incentivizing the manager becomes more costly when the stock price provides a noisier signal of effort. If these costs become prohibitively high, shareholders may reduce incentive provision, leading to reduced effort and worse financial performance, highlighting an important real cost of sustainable investing.

Price informativeness about managerial effort crucially depends on the firm's probability of generating a high social cost. When the firm never generates a social cost, the informed investor always trades based on financial information, resulting in highly informative prices that enable low-cost managerial incentives. When the firm frequently generates a high social cost, the informed investor regularly abstains from trading on financial information, reducing the information content of prices and making incentive provision more costly. This mechanism generates a positive relationship between the "ES" and "G" of ESG: firms with high ES quality—reflected in low probabilities of negative externalities—are more likely to maintain good governance practices—reflected in high probabilities of strong financial performance through managerial effort.

In a first extension to our baseline model, we explore how public news about firm externalities affects market monitoring. When there is additional public news about the social cost, optimal contracts may include bonuses contingent on both prices and news about the social cost. Intuitively, the public signal helps the firm interpret the information contained in the stock price, lowering the cost of managerial incentive provision. Consequently, managerial compensation tied to social outcomes may be optimal even when controlling shareholders do not care about social costs and when managers cannot reduce externalities. We show that ES-linked compensation can enhance governance quality, consistent with evidence that ES-linked pay is more prevalent in firms with strong governance structures (e.g., Hong et al., 2016; Al-Shaer and Zaman, 2019; Homroy et al., 2023; Ikram et al., 2023).

In another extension, we allow the firm's initial financial shareholders to invest in reducing the probability of generating social costs and show that they may make such investments even though they do not intrinsically value these outcomes. A lower probability of a high social cost increases informed trading on financial information, making prices more informative about financial performance and reducing incentive costs. "Doing well by doing good" thus arises endogenously through a market-based governance channel.

Our model highlights a novel complementarity between exit and voice in reducing firm externalities. The exit of sustainable investors prompts financial investors to exercise voice. This interaction across investor types differs from the existing literature, which focuses on the same investor choosing between exit and voice, typically viewing them as competing investment strategies (e.g., Broccardo et al., 2022).

In a complementary extension where the manager can exert costly social effort to improve the firm's social performance, we highlight another channel through which our market-governance mechanism affects firm externalities. When the informed investor's social concerns are sufficiently strong, a purely financially motivated manager may exert social effort to increase informed trading intensity, increasing the likelihood of being rewarded for her financial effort. The multi-tasking literature typically emphasizes a tension in providing incentives for multiple tasks, where incentivizing one task weakens the incentives for others (e.g., Holmström and Milgrom, 1991). Our results highlight a novel complementarity based on information spillovers, where incentivizing one task enhances the informativeness of signals about another.

Our framework highlights that sustainable investing can affect market prices and have real effects even without generating a "greenium." In our model, market makers rationally set prices to reflect only expected financial payoffs given public information. Consequently, firms with different ex-ante propensities to generate a high social cost have identical expected returns, even though the informed investor's trading behavior is affected by externalities. Thus, the absence of a greenium does not necessarily imply that sustainable investing fails to impact financial markets, firm performance, and externalities.

Beyond return levels, our model predicts that stock price volatility can vary with ex-ante propensities to generate a high social cost even when expected returns remain constant. Prices become more informative and, thus, more volatile for firms with higher probabilities of good social outcomes as they attract more informed trading. This implies that the effects of sustainable investing may manifest in higher moments of return distributions even when expected returns remain unchanged.

Our baseline model emphasizes social costs, as this case is particularly pertinent. For example, in the case of environmental externalities, there is scientific consensus that aggregate emissions are too high (e.g., IPCC, 2021). In an extension, we demonstrate that our mechanism also applies to social benefits. Here, the informed investor may buy a share in the firm due to its social benefits despite a low financial performance, thereby weakening market-based governance. Together, our analysis shows that any externality—negative or positive—adds noise to prices and increases the cost of inducing managerial financial effort. As such, market-based governance is most effective when the firm does not generate any externalities. The extension adds nuance to some of our key insights: the relationship between ES and G turns negative, and shareholders now have incentives to decrease social benefits.

The extension to social benefits also generates several interesting implications. For example, a net-zero carbon commitment generally dominates a carbon-negative one from a financial perspective, as the latter weakens market-based governance. In addition, negative screening strategies—excluding firms with the highest social costs—are preferable to positive screening strategies that favor firms with the highest social benefits. The former incentivizes firms to decrease negative externalities, while the latter incentivizes them to decrease positive ones.

We additionally show that our results are robust to several alternative model specifications: different correlation structures between financial and social outcomes, noisy signals for the informed investor, endogenous information acquisition, different market structures (e.g., competitive informed traders, short-selling, market makers considering social costs), and alternative compensation arrangements. These analyses confirm that our core mechanism—the market governance channel of sustainable investing—operates across various institutional and economic contexts.

The remainder of the paper proceeds as follows. Section 2 discusses related literature. Section 3 presents the model. Section 4 analyzes the benchmark case with only financial investors. Section 5 examines how investors with social concerns affect agency costs and governance. Section 6 explores extensions and robustness. Section 7 discusses additional implications. Section 8 concludes.

2 Related Literature

Our paper contributes to the theoretical literature studying the real impact of sustainable investors on firms (e.g., Heinkel et al., 2001; Hart and Zingales, 2017; Davies and Van Wesep, 2018;

Chowdhry et al., 2019; Morgan and Tumlinson, 2019; Green and Roth, 2021; Matsusaka and Shu, 2021; Pastor et al., 2021; Roth, 2021; Barbalau and Zeni, 2022; Broccardo et al., 2022; Gollier and Pouget, 2022; Huang and Kopytov, 2022; Moisson, 2022; Allen et al., 2023; De Angelis et al., 2023; Döttling and Rola-Janicka, 2023; Edmans et al., 2023; Geelen et al., 2023; Jagannathan et al., 2023; Jin and Noe, 2023; Landier and Lovo, 2023; Levit et al., 2023; Oehmke and Opp, 2023; Piccolo et al., 2023; Malenko and Malenko, 2023; Döttling et al., 2024; Gupta et al., 2024; Gryglewicz et al., 2024; Chen and Wittry, 2025).[3] Much of this literature examines how sustainable investors affect firm behavior through their impact on firms' cost of capital (e.g., Heinkel et al., 2001; Pastor et al., 2021; Pedersen et al., 2021; Berk and Van Binsbergen, 2022). Our paper demonstrates that sustainable investors can influence firm behavior through market prices, extending beyond the cost-of-capital effect, by undermining the governance role of financial markets. We also highlight a complementarity between exit and voice in reducing firm externalities, contrasting with papers viewing them as competing strategies (e.g., Broccardo et al., 2022; Jagannathan et al., 2023; Gupta et al., 2024).

Few studies examine optimal contracting based on stock prices when investors have social concerns.[4] Chaigneau and Sahuguet (2024) study how boards set managerial compensation that balances financial and social goals. In their model, the stock price is exogenous, without sustainable investors affecting price informativeness. The tilting strategy of sustainable investors in Edmans et al. (2023) can be interpreted as an incentive mechanism affecting managerial behavior through stock prices. In their framework, sustainable investors affect prices by changing market risk-bearing capacity. Our framework shows how sustainable investors can influence managerial behavior by affecting stock price informativeness. A related literature studies firm investment with sustainability concerns and feedback effects (e.g., Chen and Schneemeier, 2023; Xue, 2023) but does not examine optimal contracting.

Our paper closely relates to Goldstein et al. (2022), who study how informed trading by sustainable investors affects the information contained in prices. We contribute by introducing optimal contracting, allowing us to study how informed trading by sustainable investors affects the traditional governance role of markets. Our framework focuses on real effects, highlighting a novel

[3]Legal scholars have recognized that sustainable investing practices affect agency problems arising from the separation of ownership and control (e.g., Christie, 2021).

[4]Other papers study optimal contracting without stock price-based incentives (e.g., Baron, 2008; Bonham and Riggs-Cragun, 2022) or managers' investment in public goods in the absence of agency problems in which managers maximize shareholder value (e.g., Pastor et al., 2021; Bucourt and Inostroza, 2023).

channel through which sustainable investing affects firm financial performance and externalities.

We also build on and contribute to the literature studying how markets discipline management (e.g., Holmström and Tirole, 1993; Dow and Gorton, 1997; Maug, 1998; Admati and Pfleiderer, 2009; Edmans, 2009) by introducing public good provision and sustainable investors. We examine how the social concerns of informed investors influence trading behavior and shareholders' ability to discipline managers using stock-based compensation.

Our paper contributes to the literature examining how multiple components of firm value reflected in stock prices can undermine their effectiveness in incentivizing managerial effort (e.g., Gjesdal, 1981; Paul, 1992; Bresnahan et al., 1992). Most recently, Banerjee et al. (2022) identify a fundamental trade-off between investment efficiency and effort efficiency when stock prices both guide investment decisions and incentivize effort (see also Strobl (2014) for a similar tension). In contrast, our mechanism reveals a complementarity between social efficiency and effort efficiency when social concerns constrain informed investor trading behavior. Specifically, enhanced social efficiency—through reduced negative externalities—improves effort efficiency by facilitating more informed trading based on financial information.

Our paper relates to the literature studying the real effects of informed trading with multiple dimensions of firm investment decisions. For example, Piccolo (2022) show that coordination problems in information production can lead to multiple equilibria. Dow et al. (2024) show that competition for informed trading results in excessive short-termism, even when firms' managerial contracts and project choices are individually optimal. In these papers, inefficiencies arise from general equilibrium effects with varying payoff horizons. Our mechanism differs as inefficiencies arise in partial equilibrium with identical payoff horizons, generating naturally different insights. Interpreting long-horizon projects and long-term investors in Dow et al. (2024) as sustainable implies that strengthening sustainable investing by increasing investor horizons would increase efficiency through more sustainable long-term investments. In contrast, strengthening social concerns in our model leads to weaker governance, which in turn reduces efficiency.

3 Model

There are three dates, $t \in \{0,1,2\}$, without time-discounting, and all agents are risk-neutral. We consider a firm initially owned by financial investors. At $t = 2$, the firm generates a financial payoff for its owners and potentially imposes negative externalities on society. At $t = 0$, the firm's manager can increase the probability of a high financial payoff by exerting effort, and the initial shareholders can design an incentive contract to induce the manager's effort based on the firm's stock price. At $t = 1$, an informed investor, who may care about externalities and has private information about the firm's financial payoff and social cost, can acquire a stake in the firm.[5] The firm's shares are traded in a discrete Kyle (1985)-type market.

The firm, financed entirely by equity with N shares outstanding, generates a financial payoff per share $F \in \{0,1\}$ and a total social cost $S \in \{0,\eta\}$ at $t = 2$, where $\eta > 0$. The social cost S captures negative externalities, such as the environmental damages from a manufacturing firm's carbon emissions (e.g., Bolton and Kacperczyk, 2021, 2023) or the adverse social effects of an opioid epidemic resulting from a pharmaceutical firm's marketing practices (e.g., Maclean et al., 2020; Case and Deaton, 2021; Florence et al., 2021). Normalizing the low social cost to zero simplifies the analysis but is not necessary for our results. Section 6.5 introduces noise into the informed investor's information on S, generating a model isomorphic to one with high and low social costs. Section 6.4 demonstrates that the market-governance channel of sustainable investing also emerges when firms generate social benefits rather than costs.

Managerial effort at $t = 0$, $e_F \in \{0,1\}$, influences the probability of achieving the high financial payoff ($F = 1$). With effort ($e_F = 1$), this probability is $p_F \in (0,1)$; without effort ($e_F = 0$), it decreases to $p_F - \Delta_F$, where $0 < \Delta_F < p_F$. In the latter case, the manager enjoys a private benefit $B_F > 0$. The social cost S equals 0 with probability $p_S \in (0,1)$ and η with probability $1 - p_S$. In our baseline model, the probability p_S is exogenous. Section 6.2 considers observable investments that lower the probability of a high social cost, and Section 6.3 introduces managerial effort to reduce this probability.

To most clearly demonstrate how sustainable investing affects the traditional governance role of financial markets, we assume that F and S are independent and abstract from effects that arise if investors update their expectations about financial payoffs based on social costs (e.g., Pedersen et al., 2021). Section 6.6 allows for arbitrary correlation between F and S, demonstrating the robustness of our results, and showing that a positive correlation—social costs tend to be high when financial payoffs are high—amplifies our mechanism while a negative correlation dampens it. To focus on cases where market monitoring is relevant, we assume that exerting financial effort

[5] We explore the implications of our results for investor sorting in Section 7.

is socially efficient: $N\Delta_F > B_F$.

At $t = 1$, shares are traded in a discrete Kyle (1985)-type market.[6] Restricting trading to discrete quantities is well-established in the applied financial economics literature when analyzing phenomena beyond price formation (e.g., Goldstein and Guembel, 2008; Edmans et al., 2015; Gao et al., 2025).[7] Noise traders' random demand $z \in \mathbb{N}_0 := \{0, 1, \dots\}$ follows a geometric distribution with density $(1-\lambda)^z\lambda$, where $\lambda \in (0,1)$.[8,9] For simplicity, we assume the informed investor learns the realized values of F and S before trading.[10] Section 6.5 introduces noise to the informed investor's private information. Trading frictions limit the informed investor to submitting an order $x \in \{0,1\}$. For instance, the informed investor may have convex opportunity costs to deploy capital or face short-selling restrictions (e.g., Edmans et al., 2015; Dow et al., 2017). Appendix C.1 shows that our results continue to hold when we allow for short-selling (i.e., $x \in \{-1, 0, 1\}$).[11]

Our key departure from a standard Kyle (1985)-type framework is that the informed investor cares about the firm's social cost with intensity $\gamma \in [0,1]$ and is informed about both the financial payoff F and the social cost S.[12] Specifically, the informed investor's concern about the social cost is characterized by the gross utility function $x(F - \gamma S)$, where $x \in \{0,1\}$ indicates share ownership. The investor's net utility is then $x(F - \gamma S - \mathbb{E}[P])$, where $\mathbb{E}[P]$ is the expected market price at $t = 1$.

The informed investor's concern about the social cost has various interpretations. For example, the valuation may capture investors' preferences, regulatory constraints, or concerns about physical

[6] We adopt the discrete Kyle-type framework because it provides a transparent and analytically tractable environment for studying the effects of sustainable investing on price informativeness and optimal contracting, independent of cost-of-capital effects. However, our core mechanism—that social concerns can reduce informed trading on financial information, thereby increasing agency costs—does not rely on this specific market microstructure. For instance, Appendix C.4 derives our main result with competitive informed traders.

[7] While we can generate our main mechanism with continuous informed trading as in Edmans (2009), the discrete setup is essential for analyzing the rich set of extensions—including endogenous investment in reducing externalities, managerial social effort, and public ESG news—that generate our key insights about the link between sustainable investing and market governance.

[8] This approach to modeling noise trade is similar to that of Edmans (2009), who uses the exponential distribution—the continuous counterpart of the geometric distribution. Parlasca and Voss (2023) also employ the geometric distribution in an extension of their analysis of voting and trading. The geometric distribution yields constant likelihood ratios for positive order flows, simplifying the equilibrium pricing rule and optimal contract, and making the model tractable. However, the economic mechanism does not rely on this assumption.

[9] Note that this assumption implies that the expected noise trader demand is $\frac{1}{\lambda} - 1 > 0$. However, we can shift the support of the distribution so that z can be negative without affecting our results.

[10] Section 6.7 extends the model to endogenous private information, highlighting a natural complementarity between the two types of private information.

[11] We show that the informed investor fully trades on negative information about the financial payoff, short selling ($x = -1$) upon observing $F = 0$. However, her trading intensity upon learning positive information ($F = 1$) still decreases with stronger social concerns, increasing managerial incentive costs.

[12] While not necessary for any results, requiring $\gamma \leq 1$ ensures that the total disutility does not exceed the social cost.

or transition risks that diverge from those of initial shareholders due to different beliefs or existing exposure.[13] The informed investor in our framework resembles an active equity fund manager—someone with relevant private information whose trades based on the firm's financial payoffs are constrained by concerns about its externalities. The utility function can be interpreted more broadly as reflecting an active equity fund's investment mandate that incorporates sustainability considerations into investment decisions. This interpretation aligns with evidence on sustainable investing practices. Edmans et al. (2024) report that 77% of active equity portfolio managers incorporate ES performance into stock selection. Studies also show that investors demand mutual funds with high sustainability ratings (e.g., Hartzmark and Sussman, 2019; Edmans et al., 2024), many mutual fund managers have private information about firms' sustainability performance with trades predicting future ESG ratings changes (Ceccarelli et al., 2024; Cremers et al., 2024), and trading on ESG information has increased noise in prices (Cao et al., 2023; Yang et al., 2023). More broadly, many papers highlight the influence of active equity fund managers on stock prices (e.g., Savov, 2014; Dou et al., 2023).

The market makers' equilibrium pricing rule reflects the preferences of the marginal financial investor, who is indifferent to the firm's social cost.[14] Specifically, the market makers set the firm's stock price at $t = 1$ to capture the firm's expected financial payoff given the observable order flow. Appendix C.2 introduces market makers who partially account for the social cost in pricing and demonstrates the robustness of our results, showing that this can weaken our mechanism by making the informed investor trade more aggressively when social costs are present, as prices are now lower, reflecting the social cost.

The firm's initial controlling shareholders, being financial investors, care only about the financial payoff F.[15] At $t = 0$, they design the manager's compensation contract, W, to maximize the

[13] If driven by preferences, the investor may have deontological warm-glow preferences, inherently valuing green firms (e.g., Heinkel et al., 2001; Pastor et al., 2021; Pedersen et al., 2021) or consequentialist broad-impact preferences, leading to investment mandates reflecting those preferences (Gupta et al., 2024). We explore the implications of these interpretations in Section 7. Growing evidence suggests that moral and ethical considerations influence investors' decision-making in financial markets (e.g., Riedl and Smeets, 2017; Bauer et al., 2021; Humphrey et al., 2021; Zhang, 2021; Baker et al., 2022; Zhang, 2022; Bonnefon et al., 2023; Giglio et al., 2023; Heeb et al., 2023). See Kräussl et al. (2023) for a survey.

[14] Intuitively, market makers must break even in expectation and anticipate selling any order imbalance to marginal investors at $t = 2$, whom we assume are financial investors valuing shares at F.

[15] We make this assumption to abstract from the direct impact of shareholders with social concerns through voice. In our baseline model, initial shareholders with social concerns would not alter the results because they can only influence expected financial payoffs through optimal contracting. Similarly, a manager with social concerns would not change our baseline results because the manager's effort only affects financial performance. The extensions in Sections 6.2 and 6.3 endogenize the firm's social performance, allowing for an examination of how sustainable investing affects

firm's expected financial payoff net of compensation costs. The manager is protected by limited liability, requiring $W \geq 0$. To emphasize the governance role of the financial market, we assume that the manager's incentive pay can only depend on the firm's stock price P at $t = 1$.[16] The manager's outside option is normalized to zero. To simplify the exposition, we follow the literature assuming that the firm's initial shareholders pay the manager's compensation (e.g., Holmström and Tirole, 1993; Admati and Pfleiderer, 2009; Edmans et al., 2009; Peng and Röell, 2014). Appendix C.3 shows that this assumption is without loss of generality in our framework.[17] Figure 1 summarizes the model's timing.

$t = 0$

- Shareholders set compensation contract W
- Manager chooses effort $e_F \in \{0,1\}$

$t = 1$

- Informed investor trades $x \in \{0,1\}$
- Noise traders' demand z realizes
- Market makers set stock price P
- Manager compensated

$t = 2$

- Financial payoff F realizes
- Social cost S realizes

Figure 1: Model Timeline

4 Benchmark with Only Financial Investors

We first establish a benchmark case where the informed investor does not care about the firm's social cost (i.e., $\gamma = 0$). When the informed investor disregards the social cost, our framework reduces to a standard market-monitoring model à la Holmström and Tirole (1993). We denote equilibrium objects in this benchmark case with the subscript 0. The optimal trading strategy of an informed financial investor is straightforward: buy one share if and only if she observes $F = 1$.

the direct voice channel. In these instances, the social concerns of initial shareholders and the manager would make social investment and social effort more likely.

[16]Alternatively, we can adjust the information structure such that the stock price contains incremental information about the manager's effort beyond F. Then we can allow the contract to depend both on the price P and the financial payoff F without qualitatively changing our main insights.

[17]If the manager were paid from firm profits, the stock price would reflect the net-of-wages financial payoff, but it does not affect the informed investor's optimal trading strategy.

Proposition 1. *Assume that the manager exerts effort ($e_F = 1$). Then, there exists a unique equilibrium in which the informed investor buys one share of the firm's stock ($x = 1$) if and only if she learns that its financial payoff is high ($F = 1$). In this equilibrium, the pricing rule as a function of the aggregate order flow $q = x + z$ at $t = 1$ is given by*

$$P_0(q) = \begin{cases} 0, & \text{if } q = 0, \\ \frac{p_F}{p_F + (1-p_F)(1-\lambda)}, & \text{if } q > 0. \end{cases}$$

The equilibrium pricing rule reflects how trading reveals information. When aggregate order flow is low ($q = 0$), it reveals the absence of informed buying and, therefore, a low financial payoff ($F = 0$), resulting in $P_0(0) = 0$. A high aggregate order flow ($q > 0$) creates some ambiguity—it could result from informed buying based on positive information about F (with probability p_F) or from noise trading (with probability $(1 - p_F)(1 - \lambda)$).[18] The pricing rule captures this uncertainty. In equilibrium, the informed investor generates positive expected trading profits: when $F = 1$, each share's true value is 1, but buying a share costs $P_0(q > 0) < 1$ due to noise trading.

Anticipating the trading equilibrium at $t = 1$, the initial shareholders design the manager's compensation contract W at $t = 0$. As is standard in risk-neutral contracting under limited liability, the optimal contract is determined by the likelihood ratio (e.g., Innes, 1990).[19] For ease of exposition, we consider the contracting problem as a function of order flow rather than price. As will become clear, this is without loss of generality. The likelihood ratio as a function of order flow is defined as

$$\phi_0(k) = \frac{\Pr(q = k | e_F = 1)}{\Pr(q = k | e_F = 0)}, \ k \in \mathbb{N}_0.$$

The likelihood ratio $\phi_0(k)$ measures how informative the order flow $q = k$ is about the manager's effort. As is standard, it is optimal to compensate the manager in states where the likelihood ratio takes its maximum, as these states are most informative about effort.

[18]Recall that our assumption of a geometric noise trader distribution generates a constant likelihood ratio for all positive order flows, also implying a constant price for all positive order flows.

[19]For recent papers considering risk-neutral contracting with finite states, see Chaigneau et al. (2019) and Starmans (2023, 2024).

Lemma 1. *The likelihood ratio function is given by*

$$\phi_0(k) = \begin{cases} \frac{1-p_F}{1-p_F+\Delta_F}, & \text{if } k = 0, \\ \frac{p_F\lambda+(1-\lambda)}{(p_F-\Delta_F)\lambda+(1-\lambda)}, & \text{if } k > 0. \end{cases}$$

The likelihood ratio takes its maximum in states with $q > 0$ and equals

$$\phi_0^* = \max_{k\in\mathbb{N}} \phi_0(k) = \frac{p_F\lambda + (1-\lambda)}{(p_F - \Delta_F)\lambda + (1-\lambda)}.$$

We refer to the maximum likelihood ratio ϕ_0^* as the *effort informativeness* of the stock price.[20] Since the maximum likelihood ratio occurs in all states $q > 0$, corresponding to positive order flow and a high stock price, the manager optimally receives compensation only in these states. Hence, we consider a contract paying the manager a constant bonus for $q > 0$ and zero otherwise.[21]

The manager's compensation for $q > 0$, denoted by $W_0^*(q > 0)$, is set to make the manager just indifferent between exerting effort and shirking:

$$\Pr(q > 0|e_F = 1)W_0^*(q > 0) = \Pr(q > 0|e_F = 0)W_0^*(q > 0) + B_F.$$

Corollary 1. *An optimal contract is given by*

$$W_0^*(q) = \begin{cases} 0, & \text{if } q = 0, \\ \frac{B_F}{\Delta_F\lambda}, & \text{if } q > 0. \end{cases}$$

The optimal contract in Corollary 1 leverages the effort informativeness of the stock price by paying the manager more when aggregate order flow—or, equivalently, the stock price—is high. A higher order flow indicates a higher likelihood of a high financial payoff, which the manager can influence through her effort.

[20]There is a positive link between the stock price's effort informativeness and its financial informativeness ψ_0, defined as the sensitivity of the order flow to the financial payoff: $\psi_0 = \frac{Pr(q>0|F=1)}{Pr(q>0|F=0)} = \frac{1}{1-\lambda}$. In particular, effort informativeness (ϕ_0^*) can be expressed as a strictly increasing function of financial informativeness (ψ_0): $\phi_0^* = \frac{p_F\psi_0+(1-p_F)}{(p_F-\Delta_F)\psi_0+(1-p_F+\Delta_F)}$ and $\frac{\partial\phi_0^*}{\partial\psi_0} > 0$.

[21]Since the likelihood ratio is constant for $q > 0$, there also exist optimal contracts compensating the manager for a subset of positive order flow states. Importantly, all optimal contracts generate the same cost for shareholders.

The expected cost to shareholders of providing managerial incentives is

$$\Pr(q>0|e_F=1)W_0^*(q>0)=\frac{1-(1-p_F)\lambda}{\Delta_F\lambda}B_F=\frac{1}{1-\frac{1}{\phi_0^*}}B_F.$$

A higher private benefit from shirking, B_F, increases incentive costs by making the agency problem more severe. Higher effort informativeness, ϕ_0^*, reduces incentive costs. Specifically, a higher p_F reduces ϕ_0^* by making a high financial payoff more likely regardless of effort, while an increase in Δ_F raises ϕ_0^* by amplifying the manager's impact on financial payoffs. A higher λ increases ϕ_0^* by reducing noise trading. As is standard in risk-neutral contracting under limited liability, the manager earns rents under an optimal contract. Thus, incentivizing the manager is costly for shareholders, with the incentivization cost decreasing as the maximum likelihood ratio—the stock price's effort informativeness—increases.

The firm's initial controlling shareholders find it optimal to induce managerial effort if and only if

$$N\Delta_F\geq\frac{1}{1-\frac{1}{\phi_0^*}}B_F,\tag{1}$$

where the left-hand side represents the increase in the expected financial payoff from managerial effort, and the right-hand side captures the cost of providing incentives. For the remainder of our analysis, we assume the parameters satisfy condition (1), ensuring that controlling shareholders prefer to induce managerial effort when the informed trader has no social concerns.

Assumption 1. *Condition* (1) *is satisfied.*

Without this assumption, shareholders would never induce effort, making changes in market-monitoring effectiveness irrelevant.

5 Agency Cost of Sustainable Investing

This section studies how the informed investor's social concerns affect the governance role of financial markets. We denote equilibrium objects with the subscript γ to highlight their dependence on the informed investor's social concerns. Section 5.1 characterizes how social concerns affect equilibrium trading, pricing, and incentive costs. Section 5.2 examines the relationship between the firm's propensity to generate a high social cost and managerial effort. Section 5.3 studies how sustainable investing affects expected returns and price volatility.

5.1 Equilibrium with Sustainable Investing

Noise trading ensures that the expected market-clearing price remains strictly between 0 and 1. The informed investor values the firm's shares at $F - \gamma S$, reflecting both the financial payoff and the social cost. Her optimal trading strategy is straightforward in two states: she never buys when $F = 0$, as the expected market-clearing price exceeds her valuation, and always buys when observing $F = 1$ and $S = 0$, as her valuation exceeds the expected market-clearing price. What remains to be determined is her behavior upon observing $F = 1$ and $S = \eta$. We denote by $a \in [0, 1]$ the probability that she submits a buy order in this state.[22] Figure 2 summarizes the informed investor's trading behavior.

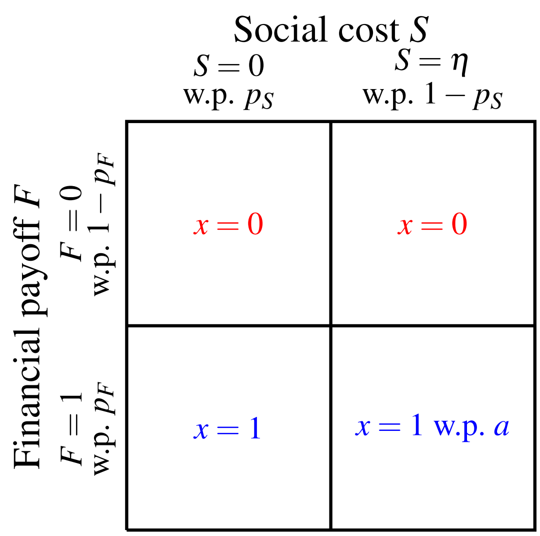

Figure 2: Informed Investor's Trading Strategy. This figure illustrates the informed investor's equilibrium trading behavior conditional on observing the financial payoff (F) and social cost (S). Variable $a \in [0, 1]$ denotes the probability of buying upon observing $F = 1$ and $S = \eta$.

Proposition 2. *Assume that the manager exerts effort ($e_F = 1$). Then there exists a unique equilibrium in which the informed investor: (i) buys one share ($x = 1$) upon observing a high financial*

[22] For intermediate social concerns, the trading equilibrium involves a mixed strategy ($a \in (0, 1)$) because a pure strategy with an abrupt shift from always buying to never buying would create a price discontinuity that allows for profitable deviations. Specifically, if the informed investor abruptly shifts from buying to abstaining as her social concerns strengthen, the price would drop discontinuously. However, since her disutility is continuous in the intensity of her social concerns, this would make buying optimal—a contradiction resolved only through a mixed strategy that allows for a continuous transition in trading behavior and market prices.

payoff and a low social cost ($F=1$ and $S=0$), (ii) abstains from buying ($x=0$) upon observing a low financial payoff ($F=0$), (iii) buys a share with probability a^* upon observing a high financial payoff and a high social cost ($F=1$ and $S=\eta$), where

$$a^* = \begin{cases} 1, & \text{if } \gamma \leq \underline{\gamma}, \\ \frac{(1-p_F)(1-\lambda)-\gamma\eta(1-(1-p_F p_S)\lambda)}{\gamma\eta p_F \lambda(1-p_S)}, & \text{if } \gamma \in (\underline{\gamma}, \bar{\gamma}), \\ 0, & \text{if } \gamma \geq \bar{\gamma}. \end{cases}$$

The thresholds are given by

$$\underline{\gamma} = \frac{(1-p_F)(1-\lambda)}{\eta(1-(1-p_F)\lambda)} < \frac{(1-p_F)(1-\lambda)}{\eta(1-(1-p_F p_S)\lambda)} = \bar{\gamma}.$$

The equilibrium pricing rule as a function of aggregate order flow $q = x+z$ at $t=1$ is

$$P_\gamma(q) = \begin{cases} \frac{p_F(1-p_S)(1-a^*)}{p_F(1-p_S)(1-a^*)+(1-p_F)}, & \text{if } q=0, \\ \frac{p_F(1-\lambda(1-p_S)(1-a^*))}{p_F(1-\lambda(1-p_S)(1-a^*))+(1-p_F)(1-\lambda)}, & \text{if } q>0. \end{cases}$$

The equilibrium level of informed trading, $\tau^*_\gamma = p_S + (1-p_S)a^*$, captures the overall probability of buying given a high financial payoff. Figure 3 shows how a^* and τ^*_γ vary with the informed investor's social concerns. For weak social concerns ($\gamma \leq \underline{\gamma}$), the social cost does not deter trading ($a^*=1$), resulting in maximal informed trading ($\tau^*_\gamma = 1$). As social concerns strengthen ($\gamma \in (\underline{\gamma}, \bar{\gamma})$), the informed investor becomes less willing to buy with a high social cost, and a^* declines to zero. However, τ^*_γ declines more gradually since she still buys when observing a low social cost. For strong social concerns ($\gamma \geq \bar{\gamma}$), she never buys with a high social cost ($a^*=0$), and informed trading occurs only with a low social cost ($\tau^*_\gamma = p_S$).

Equilibrium prices reflect how the informed investor's trading strategy varies with the intensity of her social concerns, shown in Figure 4. For weak social concerns ($\gamma \leq \underline{\gamma}$), prices match the benchmark case. As social concerns strengthen ($\gamma \in (\underline{\gamma}, \bar{\gamma})$), prices gradually become less responsive to order flow, reflecting the reduced informativeness about financial payoffs.

The informed investor's social concerns affect the likelihood ratios of market outcomes.

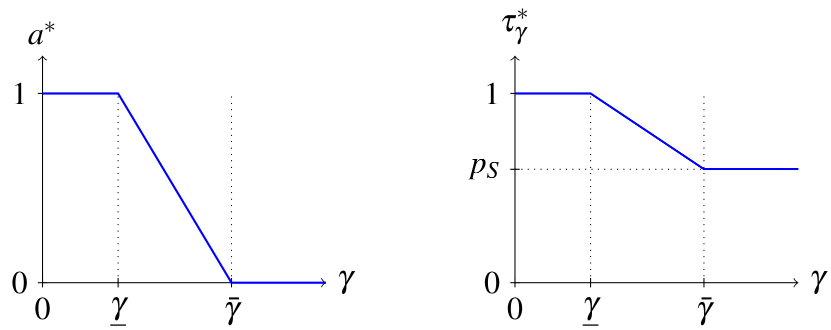

Figure 3: Equilibrium Trading Strategy. This figure shows how the informed investor's trading strategy varies with the intensity of her social concerns (γ). The left panel plots the probability of buying when both the financial payoff and the social cost are high (a^*). The right panel plots the overall probability of informed buying given a high financial payoff (τ^*_γ).

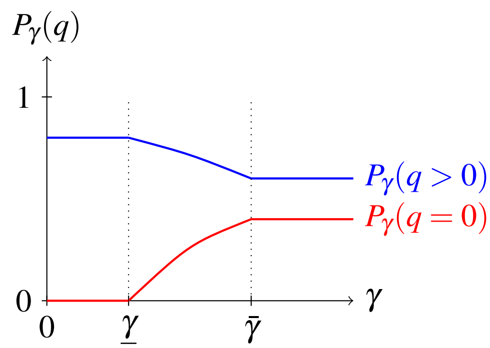

Figure 4: Equilibrium Prices. This figure shows how equilibrium prices vary with the intensity of the informed investor's social concerns (γ). The blue line represents the price when aggregate order flow is high ($q > 0$), and the red line represents the price when order flow is low ($q = 0$).

Lemma 2. *The likelihood ratio is*

$$\phi_\gamma(k) = \begin{cases} \frac{1-a^* p_F - p_F p_S(1-a^*)}{1-(a^*+p_S(1-a^*))(p_F-\Delta_F)}, & \text{if } k = 0, \\ \frac{p_F(1-\lambda(1-p_S)(1-a^*))+(1-p_F)(1-\lambda)}{(p_F-\Delta_F)(1-\lambda(1-p_S)(1-a^*))+(1-p_F+\Delta_F)(1-\lambda)}, & \text{if } k > 0. \end{cases}$$

The maximum likelihood ratio occurs in states with positive order flow and equals

$$\phi^*_\gamma = \max_{k\in\mathbb{N}} \phi_\gamma(k) = \frac{p_F(1-\lambda(1-p_S)(1-a^*)) + (1-p_F)(1-\lambda)}{(p_F-\Delta_F)(1-\lambda(1-p_S)(1-a^*)) + (1-p_F+\Delta_F)(1-\lambda)}.$$

As in the benchmark case, the state achieving the maximum likelihood ratio is not unique. Writing

ϕ_γ^* in terms of the equilibrium level of informed trading $\tau_\gamma^* = p_S + (1-p_S)a^*$ yields

$$\phi_\gamma^* = \frac{\lambda p_F \tau_\gamma^* + (1-\lambda)}{\lambda (p_F - \Delta_F)\tau_\gamma^* + (1-\lambda)}.$$

This expression highlights the direct relationship between effort informativeness (ϕ_γ^*) and informed trading intensity (τ_γ^*).[23]

Corollary 2. *The effort informativeness of the firm's stock price decreases with the intensity of the informed investor's social concerns,* $\frac{\partial \phi_\gamma^*}{\partial \gamma} \leq 0$*, strictly so when* $\gamma \in (\underline{\gamma}, \bar{\gamma})$.

Figure 5 illustrates how the maximum likelihood ratio varies with the informed investor's social concerns. For $\gamma \leq \underline{\gamma}$, effort informativeness matches the benchmark case. As social concerns strengthen beyond $\underline{\gamma}$, effort informativeness declines because the informed investor trades less aggressively on financial information, consistent with empirical evidence (Goldstein et al., 2022; Yang et al., 2023; Hitzemann et al., 2024).

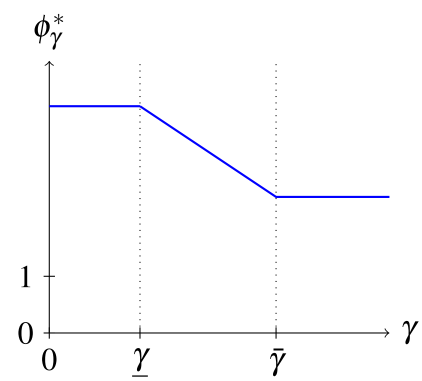

Figure 5: Maximum Likelihood Ratio. This figure shows how the maximum likelihood ratio ϕ_γ^* varies with the informed investor's social concerns.

Given this decline in effort informativeness, the manager's optimal compensation changes with the intensity of social concerns.

[23]Using the notation from Footnote 20, we have $\psi_\gamma = \frac{1-\lambda+\lambda\tau_\gamma^*}{1-\lambda}$ where $\tau_\gamma^* = p_S + (1-p_S)a^*$ captures equilibrium informed trading when $F=1$. Effort informativeness (ϕ_γ^*) can also be expressed in terms of financial payoff informativeness (ψ_γ): $\phi_\gamma^* = \frac{p_F \psi_\gamma + (1-p_F)}{(p_F - \Delta_F)\psi_\gamma + (1-p_F+\Delta_F)}$.

Corollary 3. *An optimal incentive-compatible contract is given by*

$$W_\gamma^*(q) = \begin{cases} 0, & \text{if } q = 0, \\ \frac{B_F}{\Delta_F \lambda \tau_\gamma^*}, & \text{if } q > 0. \end{cases} \tag{2}$$

As γ increases and τ_γ^* decreases, the required bonus payment rises because effort becomes harder to infer from prices. When $\gamma = 0$, we recover the benchmark contract.

The expected cost of providing incentives under an optimal incentive-compatible contract is

$$C_\gamma = \frac{1}{1 - \frac{1}{\phi_\gamma^*}} B_F. \tag{3}$$

As the informed investor's social concerns intensify, her trading strategy is increasingly determined by the firm's social cost rather than its financial payoff. This shift makes governance through market monitoring less effective, increasing the cost of incentivizing managerial effort. Thus, our framework generates a novel testable prediction: sustainable investing increases the cost of providing managerial incentives.

Corollary 4. *Sustainable investing can increase the cost of providing managerial incentives (C_γ). When $\gamma \in (\underline{\gamma}, \bar{\gamma})$, this cost strictly increases in the intensity of the informed investor's social concerns (γ). If $C_{\bar{\gamma}} > N\Delta_F$, then there exists a threshold $\gamma_e \in (\underline{\gamma}, \bar{\gamma})$ such that the firm's controlling shareholders optimally choose not to induce managerial effort whenever $\gamma > \gamma_e$, despite effort provision being socially efficient and induced in the absence of social concerns ($\gamma = 0$).*

Figure 6 shows how incentive costs (C_γ) vary with the informed investor's social concerns (γ). For weak social concerns ($\gamma \leq \underline{\gamma}$), costs match the benchmark. As social concerns intensify ($\gamma > \underline{\gamma}$), costs increase because the informed investor trades less aggressively on financial information. When these costs exceed the expected gain from effort ($N\Delta_F$), which occurs when $\gamma > \gamma_e$, shareholders optimally forgo incentive provision. The resulting effort reduction represents a real efficiency loss from sustainable investing—the agency cost of sustainable investing.

Our framework shows how sustainable investing impacts corporate governance by altering the information content of stock prices, thereby affecting the cost-effectiveness of market-based incentive schemes. This mechanism differs from traditional cost-of-capital explanations for how sustainable investing affects firm behavior. For instance, Edmans et al. (2023) study markets with

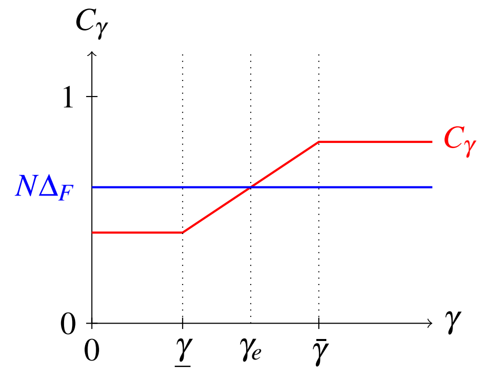

Figure 6: Cost of Incentive Provision. This figure plots the expected cost of providing incentives (C_γ) as a function of the intensity of the investor's social concerns (γ). The threshold γ_e represents the level of social concerns above which managerial effort is no longer induced.

limited risk-bearing capacity, where the exit of sustainable investors reduces the market's limited risk-bearing capacity and increases the firm's cost of capital. In contrast, our model features a risk-neutral market, where all firms have the same cost of capital. However, less informed trading due to negative externalities reduces the effort informativeness of market outcomes and increases the firm's cost of providing incentives. Consequently, the firm is less likely to incentivize managerial effort, reducing the firm's expected financial payoff.

Our mechanism provides a formal theoretical foundation for concerns that sustainability objectives can distract from core business objectives and undermine corporate governance (e.g., Bebchuk and Tallarita, 2020). However, as Sections 6.2 and 6.3 show, this negative governance effect can have a positive real effect by inducing firms to mitigate negative externalities.

5.2 Sustainable Investing and "ES" and "G" Performance

Our model encompasses two distinct dimensions of ESG ratings. The endogenous probability of a high financial payoff, which depends on managerial effort, $p_F - \Delta_F$ or p_F, can be interpreted as governance quality—the "G" component of ESG. The exogenous probability of a low social cost, p_S, can be interpreted as environmental and social quality—the "ES" components of ESG. While these dimensions of ESG are often viewed as unrelated,[24] our analysis reveals that sustainable investing creates an endogenous link between them through its effect on market monitoring.

The relationship between ES and G emerges endogenously through the informed investor's

[24] See, for example, "Is it time to separate 'E' from 'S' and 'G?,'' Financial Times, 14 March 2022, and "It's Time to Unbundle ESG," Harvard Business Review, 20 September 2024.

trading behavior. To better understand this relationship, we first study how p_S affects the equilibrium level of informed trading (τ_γ^*).

Lemma 3. *For $\gamma \leq \underline{\gamma}$, the equilibrium level of informed trading is $\tau_\gamma^* = 1$ for all p_S. For $\gamma \in (\underline{\gamma}, \bar{\gamma}(0))$, where $\bar{\gamma}(0) := \lim_{p_S \to 0} \bar{\gamma}$, there exists a unique threshold $\hat{p}_S \in (0,1)$ such that τ_γ^* is constant in p_S for $p_S < \hat{p}_S$ and increasing in p_S for $p_S \geq \hat{p}_S$. For $\gamma \geq \bar{\gamma}(0)$, $\tau_\gamma^* = p_S$ for all p_S.*

When social concerns are weak ($\gamma \leq \underline{\gamma}$), informed trading is constant and maximal as the social cost never deters trading. When social concerns are moderate ($\gamma \in (\underline{\gamma}, \bar{\gamma}(0))$), how informed trading responds to changes in p_S depends on whether p_S is below a threshold $\hat{p}_S$. As illustrated in Figure 7, below this threshold, two opposing forces exactly offset. First, a higher p_S makes the state ($F = 1, S = 0$) more likely, increasing informed trading (τ_γ^*) through the extensive margin. Second, this increase through the extensive margin raises the market-clearing price for high order flows. The higher price makes it less likely that the informed investor buys a share in the state ($F = 1, S = \eta$) and decreases informed trading through the intensive margin. The informed investor's indifference condition implies that these two opposing forces are exactly offset in our model, leaving the equilibrium level of informed trading unchanged. Once p_S reaches $\hat{p}_S$, the informed investor never buys when the social cost is high ($a^* = 0$). Beyond this point, only the extensive margin operates, and informed trading increases linearly with p_S. When social concerns are strong ($\gamma \geq \bar{\gamma}(0)$), the informed investor never buys when the social cost is high, so informed trading equals p_S.

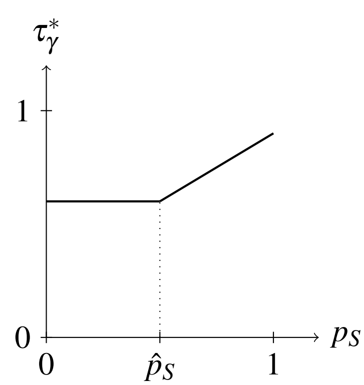

Figure 7: Equilibrium Informed Trading and p_S. This figure shows how equilibrium informed trading (τ_γ^*) varies with p_S for a fixed intensity of social concerns satisfying $\gamma > \underline{\gamma}$ and $\gamma < \bar{\gamma}(0)$.

The probability of a high social cost, p_S, affects how informative stock prices are about managerial effort, thereby influencing governance quality. The strength of this relationship depends on the intensity of the informed investor's social concerns.

Proposition 3. *When $\gamma \leq \underline{\gamma}$, the effort informativeness of the firm's stock price is independent of p_S. When $\gamma \in (\underline{\gamma}, \bar{\gamma}(0))$, effort informativeness is constant in p_S for $p_S < \hat{p}_S$ and strictly increases in p_S for $p_S \geq \hat{p}_S$. When $\gamma \geq \bar{\gamma}(0)$, effort informativeness strictly increases in p_S.*

For weak social concerns ($\gamma \leq \underline{\gamma}$), the social cost does not affect trading decisions, making effort informativeness independent of p_S. For moderate social concerns ($\gamma \in (\underline{\gamma}, \bar{\gamma})$), the informed investor follows a mixed strategy requiring indifference between buying and not buying. In this region, changes in p_S have the two offsetting effects discussed earlier, resulting in constant informed trading. For strong social concerns ($\gamma \geq \bar{\gamma}$), the informed investor never buys when observing a high social cost ($a^* = 0$). A higher p_S increases informed trading through the extensive margin by making the state $(F = 1, S = 0)$ more likely, so effort informativeness increases with p_S.

Figure 8 illustrates the effect of a discrete increase from p_S to p'_S. The red solid line shows incentive costs C_γ under the initial p_S, while the red dashed line shows costs C'_γ under the higher p'_S. When these costs fall below $N\Delta_F$, shareholders optimally provide managerial incentives, generating better governance outcomes for firms with higher ES quality. This mechanism induces a positive relationship between ES and G outcomes, even though the firm's initial shareholders care only about financial payoffs. In Section 6.2, we show that this relationship can induce financial shareholders to invest in improving the firm's social outcomes to capitalize on more effective market monitoring.

While there is extensive debate about the correlation of ESG scores across ratings providers (e.g., Berg et al., 2022), less attention has been paid to the correlation between the different ESG components within a ratings provider, suggesting an important avenue for future empirical research. Section 7 discusses further implications for defining and measuring governance.

In our baseline model featuring social costs, the equilibrium ES-G relationship is positive—firms with lower social costs generate lower agency costs. Our baseline model emphasizes social costs, as this case is particularly pertinent. For example, in the case of environmental externalities, there is scientific consensus that aggregate emissions are too high (e.g., IPCC, 2021). Notably, this relationship reverses when the firm generates a social benefit; firms with higher social benefits incur higher agency costs, which we study formally in Section 6.4. This contrast provides important nuance to our results, demonstrating that the relationship between sustainability and governance depends critically on whether firms generate positive or negative externalities.

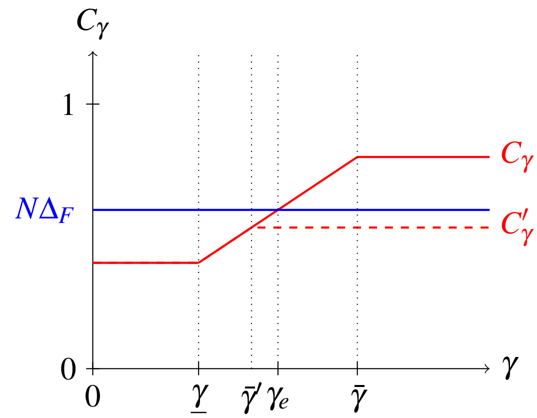

Figure 8: Effect of p_S on Incentive Costs. This figure shows how incentive costs vary with the intensity of social concerns (γ) for different levels of p_S. The solid red line represents the baseline incentive costs, C_γ, for an initial p_S. The dashed red line represents the incentive costs C'_γ after an increase to $p'_S > p_S$. A higher p_S shifts the threshold $\bar{\gamma}$ leftward to $\bar{\gamma}'$ and reduces incentive costs for $\gamma \geq \bar{\gamma}'$. The horizontal blue line represents the gain from managerial effort ($N\Delta_F$), below which shareholders optimally provide incentives.

5.3 Expected Returns, Price Volatility, and the Greenium

Our analysis provides insights into the differences in expected and average realized returns among firms with different social costs, a central focus in the sustainable finance literature (e.g., Pastor et al., 2022), as well as differences in price volatility, which has received less attention. In our model, while expected returns do not vary with p_S, differences in average realized returns and price volatility arise through the effects of sustainable investing on informed trading.

In our model, risk-neutral market makers set prices at $t = 1$ to reflect expected financial payoffs at $t = 2$. Consequently, firms with different propensities to generate a low social cost (p_S) have identical expected returns, $\mathbb{E}[F - P_\gamma(q)] = 0$, implying no greenium. Importantly, this absence of a greenium does not imply that sustainable investing cannot influence financial markets, asset prices, and firm decisions.

While expected returns are equal across firms, they differ across realizations of the social cost. The difference is driven by the effect of social costs on the informed investor's trading strategy. Define average realized returns conditional on the social cost as $R_{S=0} = \mathbb{E}[F - P_\gamma(q)|S = 0]$ and $R_{S=\eta} = \mathbb{E}[F - P_\gamma(q)|S = \eta]$, interpretable as the average realized returns of green and brown firms classified based on the realized social cost.[25]

[25]We consider dollar returns as it generates a simple linear relationship between expected and average realized returns: $p_S R_{S=0} + (1 - p_S) R_{S=\eta} = 0$.

Proposition 4. *A firm with a high social cost ($S = \eta$) has higher average realized returns than one with a low social cost ($S = 0$): $R_{S=\eta} \geq R_{S=0}$, strictly so when $\tau_\gamma^* < 1$.*

When $\tau_\gamma^* < 1$, the informed investor sometimes foregoes buying a share of a firm with a high financial payoff ($F = 1$) but a high social cost ($S = \eta$). This reduces the incorporation of positive financial information into prices, leading to an undervaluation at $t = 1$ and higher average realized returns. Because market makers set prices to reflect expected financial payoffs, we have $p_S R_{S=0} + (1 - p_S) R_{S=\eta} = 0$—higher average realized returns for high-social-cost firms imply lower average realized returns for low-social-cost firms.

The impact of firms' social costs on returns thus depends critically on empirical measurement. When firms are classified by what can be interpreted as ex-ante ES quality (p_S), such as supply chain monitoring policies or climate change transition plans, no return differences emerge. However, when classified by ex-post performance (S), such as ES news and incidents, firms with better performance earn lower returns. This distinction provides a novel information-based explanation for the divergence between expected and realized returns in the presence of sustainable investing. It may help explain the mixed empirical evidence on the existence of a greenium, stemming partly from the empirical challenge of distinguishing between expected and realized returns (e.g., Pastor et al., 2022; Eskildsen et al., 2024).

Beyond returns, our framework generates predictions about price volatility. The stock price variance at $t = 1$ is

$$\mathrm{Var}[P_\gamma] = (1 - p_F \tau_\gamma^*)\lambda \left(P_\gamma(q = 0) - p_F\right)^2 + \left(1 - (1 - p_F \tau_\gamma^*)\lambda\right)\left(P_\gamma(q > 0) - p_F\right)^2.$$

Proposition 5. *For $\gamma \in (\underline{\gamma}, \bar{\gamma}(0))$, the firm's stock price volatility at $t = 1$, $\mathrm{Var}[P_\gamma]$, is constant in p_S for $p_S < \hat{p}_S$ and strictly increases in p_S for $p_S \geq \hat{p}_S$, where $\hat{p}_S$ is defined in Lemma 3. For $\gamma \geq \bar{\gamma}(0)$, stock price volatility strictly increases in p_S for all p_S.*

Figure 9 illustrates how price volatility varies with p_S. The relationship mirrors the pattern in informed trading characterized in Lemma 3. For moderate social concerns ($\gamma \in (\underline{\gamma}, \bar{\gamma}(0))$) and low ES quality ($p_S < \hat{p}_S$), volatility remains constant because informed trading is unchanged due to the offsetting extensive and intensive margin effects. Once p_S exceeds $\hat{p}_S$, informed trading increases with p_S through the extensive margin effect alone, leading to higher price volatility as prices become more responsive to financial information. For strong social concerns ($\gamma \geq \bar{\gamma}(0)$), informed trading and thus price volatility increase with p_S for all p_S. This relationship implies that empirical measures of ES quality may significantly impact second moments through their effect on informed trading intensity, even if they do not affect first moments.

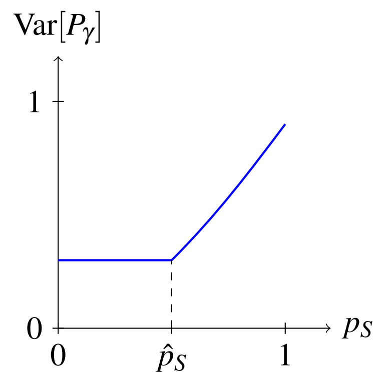

Figure 9: Price Volatility and p_S. This figure shows how price volatility (Var[P_γ]) varies with p_S for a fixed intensity of social concerns $\gamma \in (\underline{\gamma}, \bar{\gamma}(0))$, where $\bar{\gamma}(0)$ is defined in Lemma 3. The threshold $\hat{p}_S$, implicitly defined by $\gamma = \bar{\gamma}(\hat{p}_S)$, is characterized in Lemma 3.

6 Extensions and Robustness

We explore several extensions that demonstrate the robustness of our core mechanism while yielding additional insights. Section 6.1 analyzes how public news about the social cost affects market monitoring. Section 6.2 examines firm incentives to reduce the probability of a high social cost. Section 6.3 introduces managerial effort to reduce the probability of a high social cost. Section 6.4 studies a social benefit rather than a cost. Section 6.5 studies the precision of the informed investor's signal about the social cost. Section 6.6 allows the financial payoff and social cost to be correlated. Section 6.7 endogenizes information acquisition.

6.1 Public News about the Social Cost

In this section, we examine how public news about the firm's social cost interacts with market monitoring. Assume that there is a public signal $\sigma \in \{L, H\}$ about the realized social cost after trading occurs at $t = 1$.[26] For instance, the signal may correspond to ES news and incidents (e.g.,

[26]The assumption that the signal arrives after trading simplifies our analysis. If the signal arrives before trading, market outcomes would reflect the information contained in the signal. However, a managerial contract conditioning on both market outcomes and the signal remains optimal. In fact, the structure of the optimal incentive contract

Krüger, 2015; Glossner, 2021; Derrien et al., 2022). The signal has precision $\rho \in (0,1)$, such that $\Pr(\sigma = L|S=0) > \Pr(\sigma = L|S=\eta)$, $\frac{\partial \Pr(\sigma=L|S=0)}{\partial \rho} > 0$, and $\frac{\partial Pr(\sigma=L|S=\eta)}{\partial \rho} < 0$.[27] An increase in ρ corresponds to a more precise signal. This information structure implies $\underline{p}_S := \Pr(S=0|\sigma=H) < p_S < Pr(S=0|\sigma=L) =: \bar{p}_S$.

This public signal helps the firm interpret the information contained in market outcomes and we allow for contracts conditioning on both the order flow q and signal σ.[28]

Proposition 6. *When the informed investor's social concerns are sufficiently strong ($\gamma > \underline{\gamma}$), an optimal incentive-compatible contract is*

$$W^*_\gamma(q,\sigma) = \begin{cases} 0, & \textit{if } q = 0 \textit{ or } \sigma = H, \\ \frac{B_F}{\Pr(\sigma=L)\Delta_F \lambda(\bar{p}_S + (1-\bar{p}_S)a^*)}, & \textit{if } q > 0 \textit{ and } \sigma = L, \end{cases}$$

where a^* is given by Proposition 2.

When the informed investor's social concerns are sufficiently strong, Proposition 2 implies that the informed investor is less likely to trade on her private information about the firm's financial payoff when its social cost is high. When the public signal indicates that the social cost is high, the firm infers that the aggregate order flow is more likely driven by liquidity trades rather than the informed investor's trade. When the public signal indicates that the social cost is low, the firm infers that the aggregate order flow is more likely to reflect the informed investor's information about the firm's financial payoff. Consequently, the optimal contract pays the manager only when the order flow is high and the signal indicates a low social cost.

Proposition 6 implies that the presence of compensation tied to news about the firm's social cost need not indicate that its controlling shareholders intrinsically value reductions in its social cost. Moreover, the firm's controlling shareholders may offer an optimal contract that pays the manager more when the firm's social cost is low, even when the manager cannot affect the social cost. In fact, in our baseline specification, the probability that the firm generates a high social cost (p_S) is exogenous.

remains unchanged in this case.

[27] For instance, $\Pr(\sigma = L|S=0) = \Pr(\sigma = H|S=\eta) = 1 - \frac{1}{2}(1-\rho)$, and $\Pr(\sigma = L|S=\eta) = \Pr(\sigma = H|S=0) = \frac{1}{2}(1-\rho)$.

[28] If the signal arrives before trading at $t=1$, then it also helps market participants update their beliefs about p_S to either $\underline{p}_S$ or $\bar{p}_S$. In this case, the market equilibrium follows Proposition 2, with $p_S = \underline{p}_S$ given a negative signal ($\sigma = H$) and with $p_S = \bar{p}_S$ given a positive signal ($\sigma = L$).

Corollary 5. *When the informed investor's social concerns are sufficiently strong, $\gamma > \bar{\gamma}(0)$, where the threshold $\bar{\gamma}(0)$ is defined in Lemma 3, then introducing the signal σ to the compensation contract lowers the compensation cost and can enhance governance quality by encouraging shareholders to switch from not inducing effort to inducing effort.*

Corollary 5 establishes that ES-linked compensation can improve governance quality and firm value by reducing compensation costs to induce the manager to improve the firm's expected financial payoff.

The existing literature on ES-linked compensation focuses on whether it improves future ES performance (e.g., Maas, 2018; Flammer et al., 2019; Hazarica et al., 2022; Cohen et al., 2023; Homroy et al., 2023; Ikram et al., 2023; Michaely et al., 2024) and finds mixed evidence. These studies adopt the conventional premise that ES-linked compensation aims to enhance ES performance. Our framework offers a fundamentally different rationale: instead of improving ES outcomes, ES-linked compensation enables financially motivated shareholders to extract more information about managerial effort from market outcomes, thereby improving governance. This governance explanation aligns with recent evidence (Gantchev et al., 2025) and is consistent with findings that ES-linked pay is more prevalent in firms with strong governance structures (Hong et al., 2016; Al-Shaer and Zaman, 2019; Homroy et al., 2023; Ikram et al., 2023).

Our analysis also has implications for the extensive literature on ES-related disclosure (e.g., Dhaliwal et al., 2011; Cheng et al., 2014; Matsumura et al., 2014; Grewal et al., 2019; Krueger et al., 2020; Christensen et al., 2021; Gupta and Starmans, 2023) by revealing a novel benefit of ES information—it can improve corporate governance by enhancing the effectiveness of market-based compensation schemes. In particular, our channel works by improving information used in contracting rather than affecting price setting by changing the market's information set.

6.2 Investment in Reducing the Social Cost

This section analyzes an extension where the firm can invest to reduce its social cost. At $t = 0$, the firm's initial controlling shareholders can pay a cost $c > 0$ to increase the probability that its social cost is low ($S = 0$) from p_S to $p_S + \Delta_S$, where $0 < \Delta_S < 1 - p_S$.

Proposition 7. *There exists a threshold $\hat{\gamma} > \underline{\gamma}$ such that when $\gamma > \hat{\gamma}$, the investment into reducing the firm's social cost lowers the cost of providing incentives (C_γ).*

Proposition 3 implies that effort informativeness improves with the probability of a low social cost only when social concerns are sufficiently strong.[29]

Corollary 6. *If $\gamma > \hat{\gamma}$ and inducing managerial effort is optimal for the firm's initial shareholders if they invest in reducing the social cost, then there exists a cost threshold $\bar{c} > 0$ such that they invest in reducing the firm's social cost when $c \leq \bar{c}$.*

The firm's initial controlling shareholders—being financial investors—do not inherently value reductions in the social cost. They find it optimal to invest in reducing its social cost if and only if the cost of doing so does not exceed the resulting benefit of improved market monitoring—a lower cost of managerial incentive provision.

Investment in reducing the social cost can improve firm governance, represented by e_F in our model. When compensation costs are prohibitively high without the investment, an improvement in the firm's ES-quality—reducing the social cost—can enhance governance quality by encouraging shareholders to switch from not inducing to inducing effort. In this way, "doing well by doing good" arises endogenously through our market governance channel. Beyond traditional arguments that sustainable business practices enhance financial performance by reducing risks or increasing revenues, our model demonstrates that better environmental and social outcomes can also improve firm financial performance by enhancing market-based governance. We discuss the welfare implications of sustainable investing further in Section 7.

Proposition 7 reveals a novel complementarity between exit and voice in reducing firm externalities.[30] When the informed investor can exit firms with a high social cost, it can motivate financial shareholders to exercise their voice to reduce their firm's social cost. This complementarity between exit and voice offers a new perspective, as these strategies are typically viewed as competing approaches (e.g., Broccardo et al., 2022).

[29] Note that for effort informativeness to reduce incentive costs, we require $p_S + \Delta_S > \hat{p}_S$, where $\hat{p}_S$ is defined in Lemma 3, which is equivalent to $\gamma > \hat{\gamma}$.

[30] While we interpret the informed investor's decision not to buy despite observing good financial performance as "exit," our model does not explicitly feature divestment. Importantly, the same market monitoring mechanism would operate with explicit divestment—an informed investor holding shares may sell, despite observing strong financial performance, if the firm generates a high social cost. More broadly, our mechanism requires only that informed sustainable investors deviate from purely financial trading. The general insight regarding the market governance channel of sustainable investing, therefore, applies whether firms generate social benefits or costs, and whether the informed investor buys or sells.

6.3 Managerial Social Effort

In the baseline model, the manager can only exert effort to influence the firm's financial payoff. We now study the effect of sustainable investing when the manager can exert social effort $e_S \in \{0,1\}$ to reduce the firm's social cost.[31] When the manager exerts social effort ($e_S = 1$), the probability that the social cost is low ($S = 0$) increases from p_S to $p_S + \Delta_S$, where $0 < \Delta_S < 1 - p_S$. Additionally, we introduce the private benefit B_S when the manager does not exert social effort.

Recall from Lemma 3 that when $\gamma < \bar{\gamma}(0)$, the informed investor's equilibrium trading intensity τ_γ^* does not change with small perturbations in the probability of a high social cost (i.e., $\Delta_S < \hat{p}_S - p_S$, where $\hat{p}_S$ is defined in Lemma 3). In this case, neither the manager nor the firm's controlling shareholders would be motivated to reduce the firm's social cost. Hence, we focus on when social concerns are sufficiently strong (i.e., $\gamma \geq \bar{\gamma}(0)$).

When the manager can exert social effort to reduce the firm's social cost, the effect of sustainable investing on firm externalities depends on the relative severity of the moral hazard problems plaguing the different types of effort—financial and social.

Proposition 8. *When $\gamma \geq \bar{\gamma}(0)$ and $\frac{p_F}{\Delta_F} B_F \geq \frac{p_S}{\Delta_S} B_S$, any contract that induces the manager to exert financial effort ($e_F = 1$) also induces the manager to exert social effort ($e_S = 1$).*

Any incentive-compatible contract must pay the manager more when the aggregate order flow is high at $t = 1$ ($q > 0$) than when it is low ($q = 0$). When the informed investor's social concerns are sufficiently strong ($\gamma \geq \bar{\gamma}(0)$), the manager's social effort strictly increases her expected compensation. Intuitively, a lower probability of a high social cost leads to more informed buying based on a high financial payoff ($F = 1$), increasing the probability of a high order flow. The condition $\frac{p_F}{\Delta_F} B_F \geq \frac{p_S}{\Delta_S} B_S$ implies that it is less costly to induce social effort than financial effort. Put differently, the manager's social effort is more effective at increasing the probability of a high order flow than the manager's financial effort. Hence, the manager is willing to reduce the firm's social cost alongside increasing its financial payoff.

Proposition 8 does not require that social effort is efficient (i.e., $B_S \leq \Delta_S \eta$), only that social effort is less costly to incentivize than financial effort. Consequently, the informed investor's social concerns can lead to inefficient social effort, echoing concerns that sustainable investing can result

[31] Introducing a manager with social concerns who intrinsically values reducing externalities would not fundamentally alter our results. Such a manager would make it easier for shareholders to induce social effort, but the core mechanism would remain unchanged.

in wasteful activities.

Proposition 9. *When $\gamma \geq \bar{\gamma}(0)$ and $\frac{p_F}{\Delta_F} B_F < \frac{p_S}{\Delta_S} B_S$, the optimal contract does not induce the manager to exert social effort ($e_S = 1$).*

The firm's controlling shareholders are indifferent to its social cost. They are motivated to induce social effort only if doing so enhances price informativeness about the manager's financial effort, allowing them to reduce the manager's compensation by reducing the agency rent necessary to incentivize financial effort. When $\frac{p_F}{\Delta_F} B_F < \frac{p_S}{\Delta_S} B_S$, social effort is associated with a higher agency rent and is more costly to incentivize than financial effort. Any agency rent reduction achieved through increased price informativeness about financial effort is outweighed by the additional agency rent required to incentivize social effort.

Our analysis contributes to the multitasking literature, which examines optimal incentive design when agents allocate effort across multiple tasks (e.g., Holmström and Milgrom, 1991). Classic multitasking models typically feature trade-offs between tasks, where incentivizing one activity crowds out effort on others. Our framework reveals a novel mechanism: financial and social effort can be complements rather than substitutes when sustainable investing affects price informativeness. This complementarity arises because social effort enhances the informativeness of prices about financial effort, making both types of effort mutually reinforcing in optimal contracts, highlighting how market-mediated feedback effects can fundamentally alter the multitasking problem.

6.4 Social Benefit

Our baseline model emphasizes negative, rather than positive, externalities that firms generate, which are arguably more empirically relevant. For example, in the context of environmental externalities, there is scientific consensus that aggregate greenhouse emissions are excessive (IPCC, 2021). We demonstrate that the market governance channel of sustainable investing also emerges when firms generate positive externalities in the form of a social benefit $S \in \{0, -\eta\}$, where S equals $-\eta$ with probability p_S. A social benefit also reduces the effort informativeness of the stock price, as the informed investor may buy a share due to the utility gain from the social benefit even when the financial payoff is low, thereby weakening market-based governance.

As in the baseline model, the presence of noise trading ensures that the expected market-clearing price remains strictly between 0 and 1. Given this valuation, the informed investor's optimal trading strategy is straightforward in two states: she buys when $F = 1$, as her valuation always exceeds the expected market-clearing price, and abstains when observing $F = 0$ and $S = 0$, as the expected market-clearing price exceeds her valuation. What remains to be determined is the informed investor's behavior upon observing $F = 0$ and $S = -\eta$. To simplify the analysis, we assume that γ is sufficiently high such that the investor always buys a share in this state.[32]

Proposition 10. *Assume that the manager exerts effort ($e_F = 1$) and that $\gamma \geq \bar{\bar{\gamma}}$ (defined in the proof). Then there exists a unique equilibrium in which the informed investor: (i) buys one share ($x = 1$) upon observing a high financial payoff ($F = 1$) and upon observing a low financial payoff and a high social benefit ($F = 0$ and $S = -\eta$), and (ii) abstains from buying ($x = 0$) upon observing a low financial payoff and no social benefit ($F = 0$ and $S = 0$). The equilibrium pricing rule as a function of the aggregate order flow $q = x + z$ at $t = 1$ is*

$$P_\gamma(q) = \begin{cases} 0, & \textit{if } q = 0, \\ \frac{p_F}{p_F + (p_S + (1-p_S)(1-\lambda))(1-p_F)}, & \textit{if } q > 0. \end{cases}$$

Corollary 7. *Assume that the manager exerts effort ($e_F = 1$) and that $\gamma \geq \bar{\bar{\gamma}}$, then the equilibrium effort informativeness of the firm's stock price is*

$$\phi_{SB}^* = \frac{1 - \lambda(1-p_F)(1-p_S)}{1 - \lambda(1-p_F+\Delta_F)(1-p_S)},$$

which strictly decreases in p_S.

Proposition 10 and Corollary 7 show that sustainable investing introduces additional noise into prices with positive externalities. Following the arguments in Section 5.2, a negative relationship emerges between ES quality (p_S) and governance (e_F) when externalities are positive. Specifically, compared to a baseline case where $p_S = 0$ and $e_F = 1$, increasing p_S in the equilibrium described by Proposition 10 decreases effort informativeness and raises the cost of providing incentives, potentially leading shareholders to abandon inducing managerial effort ($e_F = 0$). Furthermore, as argued in Section 6.2, the initial shareholders now have an incentive to reduce positive externalities to discourage the informed investor from buying when the financial payoff is low, thereby restoring the effort informativeness of the stock price. These findings provide important nuance to our baseline results, demonstrating that the relationship between sustainability and governance

[32] The analysis can be extended to the full range of $\gamma \geq 0$ without changing the qualitative insights of this section.

depends critically on whether firms generate positive or negative externalities. We discuss the contrasting welfare implications of sustainable investing in the presence of negative versus positive externalities further in Section 7.

Our analysis has stark implications for carbon reduction commitments. Any externality—positive or negative—adds noise to prices and increases managerial incentive costs. Minimizing externalities maximizes firm financial value even when externalities are positive. Our analysis suggests that when maximizing firm financial value, net-zero carbon commitments generally dominate carbon-negative ones, as the latter can compromise firm governance despite its social benefits.

6.5 Precision of Private Information

In our baseline model, the informed investor perfectly observes the firm's social cost S. We now examine how the precision of the informed investor's private information affects equilibrium. Specifically, we assume that the informed investor receives a noisy private signal about the social cost prior to trading at $t=1$. The private signal $\xi \in \{L,H\}$ satisfies $\mathbb{E}[S|\xi=L] < (1-p_S)\eta = \mathbb{E}[S]$, $\mathbb{E}[S|\xi=H] > (1-p_S)\eta = \mathbb{E}[S]$, $\frac{\partial \mathbb{E}[S|\xi=L]}{\partial \varepsilon} > 0$, and $\frac{\partial \mathbb{E}[S|\xi=H]}{\partial \varepsilon} < 0$, where $\varepsilon \in (0,1)$ captures the noise in the informed investor's private signal.[33] The expected social cost conditional on $\xi=H$ decreases with ε, while the expected social cost conditional on $\xi=L$ increases with ε. A less noisy signal leads to more dispersed conditional expectations.

Let (a_L, a_H) denote the probabilities with which the informed investor buys a share upon observing $F=1$ and signals $\xi=L$ and $\xi=H$, respectively.

Lemma 4. *The informed investor's equilibrium trading strategy must feature at least one corner solution:* $a_H^* \in (0,1) \Rightarrow a_L^* = 1$ *and* $a_L^* \in (0,1) \Rightarrow a_H^* = 0$.

The informed investor values each firm's share at $F-\gamma S$. A higher expected social cost reduces the informed investor's valuation. If she follows a mixed strategy when $F=1$ and $\xi=H$ (i.e., $a_H^* \in (0,1)$), she must be indifferent between buying and not buying. Since the expected social cost is strictly lower when $\xi=L$, the investor's expected utility from buying must be strictly higher than not buying in this state, breaking any potential indifference. Given this higher utility, she must strictly prefer buying and therefore chooses $a_L^*=1$. Similarly, suppose she follows a

[33]For instance, $\Pr(\xi=L|S=0) = 1-\frac{1}{2}\varepsilon$ and $\Pr(\xi=L|S=\eta) = \frac{1}{2}\varepsilon$. The baseline model corresponds to $\varepsilon \to 0$. An increase in ε implies a noisier private signal. When $\varepsilon \to 1$, the signal is pure noise.

mixed strategy when the expected social cost is low ($a_L^* \in (0,1)$). Indifference in this state implies she must strictly prefer not buying when the expected social cost is high, requiring $a_H^* = 0$.

Proposition 11. *When $a_H^* \in (0,1)$, an increase in the noise in the informed investor's signal about the firm's social cost increases effort informativeness. When $a_L^* \in (0,1)$, an increase in the noise decreases effort informativeness.*

A noisier signal decreases the dispersion in the informed investor's posterior beliefs about the firm's social cost, leading to different effects depending on the initial equilibrium. When $a_H^* \in (0,1)$, the informed investor is initially indifferent between buying and not buying when observing a high social cost signal. As the signal becomes noisier, the conditional expectation of the social cost given a high signal decreases, making buying more attractive when learning that $F = 1$ and $\xi = H$, thereby increasing a_H^* and enhancing effort informativeness. When $a_L^* \in (0,1)$, additional noise in the signal raises the conditional expectation of the social cost given a low signal, discouraging informed trading when learning that $F = 1$ and $\xi = L$, decreasing informed trading, and worsening effort informativeness. As such, improved ES private information can have an ambiguous effect on price informativeness and firm governance, depending on the informed investor's existing trading strategy.

In the classic Holmström and Tirole (1993) setting with only financial investors, more precise private information about financial payoffs increases effort informativeness and reduces agency costs. Our analysis highlights that this monotonicity result fundamentally breaks down for non-financial information when investors have social concerns. Increasing the precision of ES information can either enhance or reduce effort informativeness, depending on how it affects the informed investor's trading behavior regarding financial information. This non-monotonic relationship implies that as informed investors' technology to process ES information improves, agency costs can either rise or fall, suggesting that technological advances in ESG analytics may not universally benefit corporate governance.

6.6 Correlated Financial Payoff and Social Cost

For clarity of exposition, the baseline model assumes that the firm's financial payoff (F) and social cost (S) are uncorrelated. We now examine how the correlation between them affects the impact of sustainable investing on market governance. We allow the conditional probabilities of the firm's social cost being low—$\Pr(S=0|F=1)$ and $\Pr(S=0|F=0)$—to differ from the unconditional probability p_S. The baseline model corresponds to $\Pr(S=0|F=1)=\Pr(S=0|F=0)=p_S$. The financial payoff and social cost are negatively correlated when $\Pr(S=0|F=1)>p_S$ and positively correlated when $\Pr(S=0|F=1)<p_S$.[34] For example, a positive correlation can capture situations where a high financial payoff occurs due to increased sales, with a higher production level leading to greater carbon emissions. A negative correlation can describe scenarios such as a factory accident that lowers production and releases toxic pollutants.

Proposition 12. *If the firm generates a high social cost alongside a high financial payoff with a positive probability (i.e., $1-\Pr(S=0|F=1)>0$), then an increase in the intensity of the informed investor's social concerns (γ) weakly decreases the effort informativeness of the firm's stock price (ϕ^*_γ), strictly so for some γ.*

When the informed investor's social concerns are sufficiently strong (i.e., $\gamma \geq \bar{\gamma}(0)$, where the threshold is defined in Lemma 3), her optimal strategy is to abstain from trading whenever she learns that the firm's social cost is high ($S=\eta$). As long as there is a positive probability that the social cost is high when the financial payoff is high, social concerns weaken informed trading based on the financial payoff.

A positive correlation between the firm's financial payoff and its social cost (i.e., $\Pr(S=0|F=1)<p_S$) increases the likelihood that the informed investor observes a high social cost alongside a high financial payoff, amplifying the negative impact of sustainable investing on market governance. Conversely, a negative correlation (i.e., $\Pr(S=0|F=1)>p_S$) decreases this probability, diminishing the effect of sustainable investing on market governance. Therefore, sustainable investing has a more significant impact on market governance when firms tend to generate a high social cost when their financial payoff is high.

When the financial payoff and social cost are correlated, managerial effort to improve financial performance has a direct influence on social outcomes, introducing an additional channel through which sustainable investing affects real outcomes. With positive correlation, managerial shirking simultaneously reduces the probability of a high financial payoff and the probability of a high social cost, creating a trade-off between financial performance and sustainability. With negative correlation, inducing managerial effort improves financial performance while reducing the social

[34] Note that $p_S=\Pr(S=0)=\Pr(F=1)\Pr(S=0|F=1)+\Pr(F=0)\Pr(S=0|F=0)$, such that $\Pr(S=0|F=1)>p_S$ implies $\Pr(S=0|F=0)<p_S$.

cost, aligning financial and social objectives.

The analysis has important implications for understanding industry heterogeneity in the effects of sustainable investing. Market monitoring declines more in industries with a positive correlation between financial performance and social costs. Paradoxically, this decline may create stronger incentives for firms in those industries to reduce their negative externalities. This insight suggests that sustainable investing strategies should be tailored to industry-specific correlation structures.

6.7 Information Acquisition

In our baseline model, the informed investor is endowed with information on both F and S. We now consider the informed investor's incentives to acquire information about S. Specifically, the investor privately observes F but must pay a cost $\kappa_S > 0$ to observe S. The central insight is that the investor may acquire information on the social cost because doing so allows her to avoid the disutility associated with the social cost when trading on her private financial information.

Without information on S, the informed investor can profit by trading on her private information about F, but incurs disutility due to the firm's expected social cost, $\gamma\mathbb{E}[S] = \gamma(1-p_S)\eta$. The ex-ante expected utility of trading on F without acquiring information on S is

$$p_F(1-P_0(q>0)-\gamma(1-p_S)\eta), \tag{4}$$

where the equilibrium price is given in Proposition 1.[35]

If the investor acquires information on S, then she trades according to Proposition 2, and her ex-ante expected utility is

$$p_F p_S(1-P_\gamma(q>0)) + p_F(1-p_S)a^*(1-P_\gamma(q>0)-\gamma\eta) - \kappa_S,$$

where the equilibrium price is given in Proposition 2. The advantage of having information on S is that the informed trader can make her trading decision contingent on F and S, trading aggressively on her private information about F when $S = 0$ and potentially muting her trading intensity when $S = \eta$.

[35] This utility can be negative, implying that the investor may prefer not to trade on her private information on F given that she cannot prevent the disutility from the social cost.

Proposition 13. *Assume that the informed investor's utility, when not acquiring information* (4)*, is positive for all* $\gamma \leq \bar{\gamma}$*, where* $\bar{\gamma}$ *is defined in Proposition 2. Then, if the cost of information acquisition* κ_S *is sufficiently low, there exists a threshold* $\hat{\gamma} > \underline{\gamma}$ *such that the informed investor acquires the signal* S *if and only if* $\gamma \geq \hat{\gamma}$.

When the informed investor is sufficiently concerned about the firm's social cost, trading on F becomes less valuable due to the disutility from the firm's social cost. Information about S allows the informed investor to avoid that disutility, making private information about F more valuable. As long as the cost of acquiring information about S is not too high, the informed investor finds it optimal to do so. This complementarity between these two types of private information naturally gives rise to the information structure in our baseline model.

This result highlights a novel information complementarity driven by investor preferences rather than synergies in information production (e.g., Grossman and Stiglitz, 1980; Verrecchia, 1982; Admati and Pfleiderer, 1986; Van Nieuwerburgh and Veldkamp, 2010). When investors have multidimensional preferences, ES information allows them to better utilize their financial information; acquiring the former increases the marginal benefit of the latter, contrasting with settings where different types of financial information are strategic substitutes.

While information acquisition is privately optimal for investors with sufficiently strong social concerns, its social value is ambiguous. ES information acquisition can reduce the price informativeness of managerial effort, potentially harming market-based governance mechanisms. However, the resulting changes in trading behavior can incentivize shareholders to reduce firm externalities through our market governance channel. This tension suggests that the social value of ES information production may differ substantially from its private value, with implications for the optimal regulation of ES-related information and disclosure.

7 Discussion

We discuss several broader implications of our analysis that extend beyond our formal model but follow naturally from our theoretical insights.

Consequentialist Preferences: We model the informed investor's share valuation as $F - \gamma S$, which has a natural interpretation as "warm glow" or deontological preferences. However, our mechanism also provides a foundation for consequentialist investment strategies—avoiding firms with high social costs, despite strong financial performance, creates incentives for firms to reduce externalities. Through our market governance channel, if the consequentialist investor can commit to abstaining from trading on positive financial information, this raises the cost of providing managerial incentives, encouraging shareholders to invest in externality reduction. This strategic consideration suggests that our trading patterns and real effects could emerge even among investors who do not experience direct disutility from holding shares in firms with poor ES performance, broadening our mechanism's scope beyond deontological sustainability preferences.

Welfare Implications of Sustainable Investing: In our framework, the welfare implications depend critically on whether the firm can effectively reduce its social costs. When it cannot, as in our baseline model, sustainable investing lowers welfare because it worsens financial performance by weakening governance without reducing the firm's social costs. When the firm can effectively reduce negative externalities, sustainable investing can increase welfare by incentivizing the firm to reduce its social costs. However, as Section 6.4 demonstrates, the same mechanism may also incentivize the firm to reduce positive externalities. As such, a consequentialist pro-social investor would only want to adopt an investment mandate with screening if firms generate negative externalities, not positive ones, and the firm can take actions to reduce them. Our results suggest that negative screening mandates, excluding firms with the highest social costs, are preferable to positive screening mandates, favoring firms with the highest social benefits.

Investor Specialization and Sorting: Our framework generates implications for how informed investors with social concerns sort across firms with different ES profiles. For example, because informed investors with social concerns face reduced trading opportunities and experience disutility when firms generate high social costs, they may prefer learning about firms with better ES characteristics. This natural sorting results in informed investors with social concerns concentrating in "green" firms while avoiding "brown" firms with poor ES profiles. Such sorting can amplify our identified governance effects: high-social-cost firms face both reduced informed trading from existing sustainable investors and less overall participation by informed sustainable investors. Conversely, firms with strong ES performance benefit from both more intensive informed trading and greater participation by informed investors with social concerns. Given the scarcity of informed capital, this sorting mechanism suggests that the governance divide between green and brown firms may be larger than our baseline analysis implies, incorporating both the intensive margin (how much sustainable investors trade) and the extensive margin (whether they invest at all) of sustainable investor participation.

This sorting pattern would change significantly if we interpret our model through the lens of a consequentialist investor adopting such a mandate, as discussed above. Rather than simply avoiding firms with poor ES performance, a consequentialist investor would strategically target firms where their trading behavior can generate the strongest incentives for externality reduction. This means focusing on firms with high potential for social cost reduction (large Δ_S) and where the governance costs of sustainable investing create the most powerful incentives for shareholders to invest in reducing social costs. Such firms might initially have poor ES profiles but a strong capacity to reduce negative externalities, making them optimal targets for consequentialist sustainable investors.

Defining and Measuring Governance: Our model defines governance in a classical sense: whether managers are incentivized to maximize firm financial value. Under this narrow definition, when the firm generates negative externalities, as in our baseline model, ES and G have a positive relationship. Conversely, if the firm generates positive externalities, as in Section 6.4, ES and G have a negative relationship.

Shareholders and rating agencies increasingly view governance through a broader lens, including incentives for desirable social outcomes. Under this expanded definition, in the case of negative externalities, providing incentives to lower social costs directly enhances governance and improves market-based monitoring, reinforcing the positive ES-G relationship. Conversely, in the case of positive externalities, providing incentives to increase social benefits directly enhances governance, but worsens market-based monitoring, thereby dampening the negative ES-G relationship.

In practice, ESG ratings providers differ significantly in their measurement of governance (e.g., Berg et al., 2022). For example, Refinitiv considers the firm's "CSR Strategy" inside its governance pillar alongside classical financial outcomes (LSEG, 2024). Moody's focuses on the firm's financial strategy, leaving environmental and social oversight to the separate E and S profiles (Moody's Investors Service, 2021). Our theoretical results suggest that providers who incorporate environmental and social components into governance measures should report a stronger positive—or weaker negative—ES and G correlation than those measuring governance primarily based on financial components.

Substitutability of Financial Capital: A natural question is whether the decreased trading intensity of informed sustainable investors can be offset by increased trading activity of informed financial investors. This concern relates to the broader debate about the substitutability between green and brown capital (e.g., Berk and Van Binsbergen, 2022). Importantly, our channel operates through informed capital. The acquisition and processing of private information require specialized skills, resources, and institutional capabilities that are not uniformly distributed across investors, likely making informed capital scarce and concentrated (e.g., Kacperczyk et al., 2014), and thereby increasing the relevance of our mechanism.

Carbon Taxation: Our analysis of the social cost reduction in Section 6.2 also highlights an interesting dual role for carbon taxation. A social planner implementing a carbon tax can achieve improvements in both social and financial efficiency. When shareholders maximize the firm's financial payoff net of managerial compensation, they may forgo both reducing the social cost and incentivizing managerial effort even when doing so is efficient from a financial perspective due to agency rents. In this case, a carbon tax can induce the shareholders to pay this rent, increasing both financial and social efficiency.

8 Conclusion

This paper identifies a novel mechanism through which sustainable investing affects firm behavior and performance: the market-governance channel of sustainable investing. When informed investors care about firm externalities, they may choose not to trade on their private information about financial performance, thereby reducing price informativeness for governance purposes and making it more costly to incentivize managers. This reduction in market-based governance can lead to lower managerial effort and worse financial performance, highlighting an important "agency cost of sustainable investing." However, this same mechanism can paradoxically generate positive real effects. Because firms generating negative externalities face higher agency costs, purely financially motivated shareholders have incentives to reduce externalities to enhance price informativeness for governance purposes. This channel creates an endogenous link between firms' environmental and social performance and the effectiveness of market-based governance, revealing a previously unexplored connection between the "ES" and "G" components of ESG.

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A Proofs: Baseline Model

Proof of Proposition 1. Consider an equilibrium in which the manager exerts effort ($e_F = 1$) and the informed investor buys one share of the firm's stock ($x = 1$) if and only if she learns that $F = 1$. In such an equilibrium, the order flow $q = x + z$ has the distribution $(1-\lambda)^q\lambda$ with support $q \in \mathbb{N}_0$ when $F = 0$, and $(1-\lambda)^{q-1}\lambda$ with support $q \in \mathbb{N}$ when $F = 1$.

The price conditional on order flow q is given by $P_0(q) = \Pr(F = 1|q)$. We have $\Pr(F = 1|q = 0) = 0$ and, for $q > 0$, we have

$$\begin{aligned}\Pr(F = 1|q > 0) &= \frac{\Pr(q > 0|F = 1)\Pr(F = 1)}{\Pr(q > 0|F = 1)\Pr(F = 1) + \Pr(q > 0|F = 0)\Pr(F = 0)} \\ &= \frac{p_F}{p_F + (1-p_F)(1-\lambda)}.\end{aligned}$$

We next confirm that the informed investor prefers to buy one share when she learns that $F = 1$. If she deviates to abstaining from buying, then her utility is equal to 0. When she indeed buys one share ($x = 1$), then $q > 0$ with probability one and the price is given by $P_0(q > 0) = \frac{p_F}{p_F+(1-p_F)(1-\lambda)} < 1$ since $p_F < 1$ and $\lambda < 1$, and thus

$$F - P_0(q > 0) = 1 - \frac{p_F}{p_F + (1-p_F)(1-\lambda)} > 0.$$

Finally, the informed investor prefers to abstain from buying when she learns that $F = 0$. If she indeed abstains from buying, then her utility is equal to 0. If she deviates to buying, then $q > 0$ and the price is given by $P_0(q > 0) = \frac{p_F}{p_F+(1-p_F)(1-\lambda)} > 0$ since $p_F > 0$. Thus, she does not deviate since

$$F - P_0(q) = -\frac{p_F}{p_F + (1-p_F)(1-\lambda)} < 0.$$

In particular, the equilibrium is unique because the expected market-clearing price at $t = 1$ must be strictly greater than zero and less than one, implying that the informed investor strictly prefers to buy upon observing $F = 1$ and to abstain when $F = 0$. ■

Proof of Lemma 1. If the manager exerts effort, then the order flow distribution is given by

$$\Pr(q = k|e_F = 1) = \begin{cases} (1-p_F)\lambda, & \text{if } k = 0, \\ (1-\lambda)^{k-1}\lambda\left(p_F + (1-p_F)(1-\lambda)\right), & \text{if } k > 0. \end{cases}$$

If the manager does not exert effort, then the order flow distribution is given by

$$\Pr(q=k|e_F=0)=\begin{cases}(1-p_F+\Delta_F)\lambda, & \text{if } k=0,\\ (1-\lambda)^{k-1}\lambda\left(p_F-\Delta_F+(1-p_F+\Delta_F)(1-\lambda)\right), & \text{if } k>0.\end{cases}$$

Thus, we get

$$\phi_0(0)=\frac{(1-p_F)\lambda}{(1-p_F+\Delta_F)\lambda}=\frac{1-p_F}{1-p_F+\Delta_F}<1,$$

and for $k>0$, we get

$$\begin{aligned}\phi_0(k)&=\frac{(1-\lambda)^{k-1}\lambda\left(p_F+(1-p_F)(1-\lambda)\right)}{(1-\lambda)^{k-1}\lambda\left(p_F-\Delta_F+(1-p_F+\Delta_F)(1-\lambda)\right)}\\&=\frac{p_F+(1-p_F)(1-\lambda)}{p_F-\Delta_F+(1-p_F+\Delta_F)(1-\lambda)}\\&=\frac{p_F\lambda+(1-\lambda)}{(p_F-\Delta_F)\lambda+(1-\lambda)},\end{aligned}$$

which completes the proof. ■

Proof of Corollary 1. This result follows immediately from solving

$$\Pr(q>0|e_F=1)W_0^*(q>0)=\Pr(q>0|e_F=0)W_0^*(q>0)+B_F$$

for $W_0^*(q>0)$ using

$$\Pr(q>0|e_F=1)=1-(1-p_F)\lambda$$

and

$$\Pr(q>0|e_F=0)=1-(1-p_F+\Delta_F)\lambda$$

from the proof of Lemma 1. ■

Proof of Proposition 2. Consider an equilibrium in which the manager exerts effort ($e_F=1$). Table 1 shows the distribution of the aggregate order flow in different states of the world.

F	S	$\Pr(F,S)$	Informed Trade x	Order Flow q	$\Pr(q)$
0	η	$(1-p_F)(1-p_S)$	$x=0$	$q\in\mathbb{N}_0$	$(1-\lambda)^q\lambda$
0	0	$(1-p_F)p_S$	$x=0$	$q\in\mathbb{N}_0$	$(1-\lambda)^q\lambda$
1	η	$p_F(1-p_S)(1-a)$	$x=0$	$q\in\mathbb{N}_0$	$(1-\lambda)^q\lambda$
1	η	$p_F(1-p_S)a$	$x=1$	$q\in\mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$
1	0	$p_F p_S$	$x=1$	$q\in\mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$

Table 1: Distribution of Equilibrium Aggregate Order Flow

In this case, Bayesian updating implies

$$\begin{aligned}\Pr(F=1|q=0) &= \frac{\Pr(q=0|F=1)\Pr(F=1)}{\Pr(q=0|F=1)\Pr(F=1)+\Pr(q=0|F=0)\Pr(F=0)}\\ &= \frac{(1-p_S)(1-a)\lambda p_F}{(1-p_S)(1-a)\lambda p_F+\lambda(1-p_F)}\\ &= \frac{p_F(1-p_S)(1-a)}{p_F(1-p_S)(1-a)+(1-p_F)},\end{aligned}$$

and

$$\begin{aligned}\Pr(F=1|q>0) &= \frac{\Pr(q>0|F=1)\Pr(F=1)}{\Pr(q>0|F=1)\Pr(F=1)+\Pr(q>0|F=0)\Pr(F=0)}\\ &= \frac{(p_S+(1-p_S)a+(1-p_S)(1-a)(1-\lambda))p_F}{(p_S+(1-p_S)a+(1-p_S)(1-a)(1-\lambda))p_F+(1-\lambda)(1-p_F)}\\ &= \frac{p_F(1-\lambda(1-p_S)(1-a))}{p_F(1-\lambda(1-p_S)(1-a))+(1-p_F)(1-\lambda)}.\end{aligned}$$

Hence, the market makers' pricing rule is given by

$$P_\gamma(q)=\begin{cases}\frac{p_F(1-p_S)(1-a)}{p_F(1-p_S)(1-a)+(1-p_F)}, & \text{if } q=0,\\ \frac{p_F(1-\lambda(1-p_S)(1-a))}{p_F(1-\lambda(1-p_S)(1-a))+(1-p_F)(1-\lambda)}, & \text{if } q>0.\end{cases}$$

We next solve for the informed investor's optimal trading strategy. To begin with, note that it is straightforward to confirm that the informed investor prefers to buy one share when she learns that $F=1$ and $S=0$ and to abstain from buying when she learns that $F=0$. What remains to be determined is the optimal trading strategy when $F=1$ and $S=\eta$. First, consider an equilibrium with $a=1$, which requires

$$1-P_\gamma(q>0)\big|_{a=1}-\gamma\eta\geq 0 \Leftrightarrow \gamma\leq\frac{1}{\eta}\left(1-P_\gamma(q>0)\big|_{a=1}\right)=\frac{(1-p_F)(1-\lambda)}{\eta(1-(1-p_F)\lambda)}=:\underline{\gamma}.$$

Second, consider an equilibrium with $a = 0$, which requires

$$1 - P_\gamma(q>0)\big|_{a=0} - \gamma\eta \le 0 \Leftrightarrow \gamma \ge \frac{1}{\eta}\left(1 - P_\gamma(q>0)\big|_{a=0}\right) = \frac{(1-p_F)(1-\lambda)}{\eta(1-(1-p_F p_S)\lambda)} =: \bar{\gamma}.$$

Note that $\underline{\gamma} < \bar{\gamma}$ since $p_S < 1$.

Second, consider an equilibrium with $a \in (0,1)$, which requires

$$1 - P_\gamma(q>0) - \gamma\eta = 0 \Leftrightarrow a^* = \frac{(1-p_F)(1-\lambda) - \gamma\eta(1-(1-p_F p_S)\lambda)}{\gamma\eta p_F \lambda(1-p_S)}.$$

We have that $a^* \in (0,1) \Leftrightarrow \gamma \in (\underline{\gamma}, \bar{\gamma})$ with $a^* = 1$ if $\gamma = \underline{\gamma}$ and $a^* = 0$ if $\gamma = \bar{\gamma}$. Moreover, a^* is a strictly decreasing function of γ on $[\underline{\gamma}, \bar{\gamma}]$. Hence, the informed investor's optimal trading strategy is a continuous decreasing function of γ for $\gamma \in [0,1]$. In particular, the equilibrium is unique. ■

Proof of Lemma 2. Let $\tau_\gamma^* = p_S + (1-p_S)a^*$ be the equilibrium level of informed trading. If the manager exerts effort, then the order flow distribution is given by

$$\Pr(q=k|e_F=1) = \begin{cases} \left[(1-p_F) + p_F(1-\tau_\gamma^*)\right]\lambda, & \text{if } k=0, \\ \left[p_F\tau_\gamma^* + \left(1-p_F+p_F(1-\tau_\gamma^*)\right)(1-\lambda)\right](1-\lambda)^{k-1}\lambda, & \text{if } k>0. \end{cases}$$

If the manager does not exert effort, then the order flow distribution is given by

$$\Pr(q=k|e_F=0) = \begin{cases} \left[(1-p_F+\Delta_F) + (p_F-\Delta_F)(1-\tau_\gamma^*)\right]\lambda, & \text{if } k=0, \\ \left[(p_F-\Delta_F)\tau_\gamma^* + \left(1-p_F+\Delta_F+(p_F-\Delta_F)(1-\tau_\gamma^*)\right)(1-\lambda)\right](1-\lambda)^{k-1}\lambda, & \text{if } k>0. \end{cases}$$

Thus we get

$$\phi_\gamma(0) = \frac{1-p_F+p_F(1-\tau_\gamma^*)}{1-p_F+\Delta_F+(p_F-\Delta_F)(1-\tau_\gamma^*)} < 1,$$

and for $k>0$, we get

$$\phi_\gamma(k) = \frac{p_F\tau_\gamma^* + \left(1-p_F+p_F(1-\tau_\gamma^*)\right)(1-\lambda)}{(p_F-\Delta_F)\tau_\gamma^* + \left(1-p_F+\Delta_F+(p_F-\Delta_F)(1-\tau_\gamma^*)\right)(1-\lambda)} > 1.$$

Substituting in $\tau_\gamma^* = p_S + (1-p_S)a^*$ into the expressions above completes the proof. ■

Proof of Corollary 2. The maximum likelihood ratio increases in a^* for $a^* \in (0,1)$:

$$\frac{\partial \phi_\gamma^*}{\partial a^*} = \frac{\Delta_F(1-p_S)\lambda(1-\lambda)}{(1-\lambda+(p_S+(1-p_S)a^*)(p_F-\Delta_F)\lambda)^2} > 0.$$

Moreover, a^* decreases in γ for $\gamma \in (\underline{\gamma}, \bar{\gamma})$:

$$\frac{\partial a^*}{\partial \gamma} = -\frac{(1-\lambda)(1-p_F)}{\eta\gamma^2\lambda p_F(1-p_S)} < 0.$$

Hence, the maximum likelihood ratio weakly decreases in γ, strictly so when $\gamma \in (\underline{\gamma}, \bar{\gamma})$. ■

Proof of Corollary 3. This result follows immediately from solving

$$\Pr(q>0|e_F=1)W_0^*(q>0) = \Pr(q>0|e_F=0)W_0^*(q>0) + B_F$$

for $W_0^*(q>0)$ using

$$\Pr(q>0|e_F=1) = 1-\left[(1-p_F)+p_F(1-\tau_\gamma^*)\right]\lambda$$

and

$$\Pr(q>0|e_F=0) = 1-\left[(1-p_F+\Delta_F)+(p_F-\Delta_F)(1-\tau_\gamma^*)\right]\lambda$$

from the proof of Lemma 2. ■

Proof of Corollary 4. This result follows immediately from Assumption 1, which can be written as $C_{\underline{\gamma}} < N\Delta_F$, and the fact that C_γ is strictly increasing for $\gamma \in (\underline{\gamma}, \bar{\gamma})$. ■

Proof of Lemma 3. As shown in Proposition 2, when $\gamma \leq \underline{\gamma}$, the informed investor always buys upon observing $F=1$ regardless of S (i.e., $a^*=1$). In this case, we therefore have $\tau_\gamma^* = p_S + (1-p_S)a^* = 1$ for all p_S.

Define $\bar{\gamma}(0) := \lim_{p_S\to 0}\bar{\gamma}$ and $\bar{\gamma}(1) := \lim_{p_S\to 1}\bar{\gamma}$. We have

$$\bar{\gamma}(0) = \frac{1}{\eta}(1-p_F)$$

and

$$\bar{\gamma}(1) = \frac{(1-p_F)(1-\lambda)}{\eta(p_F\lambda+(1-\lambda))} = \frac{(1-p_F)(1-\lambda)}{\eta(p_F+(1-p_F)(1-\lambda))} = \underline{\gamma}.$$

Furthermore, $\bar{\gamma}$ is strictly decreasing in p_S:

$$\frac{\partial \bar{\gamma}}{\partial p_S} = -\frac{1}{\eta}\frac{p_F(1-p_F)\lambda(1-\lambda)}{(1-\lambda+p_F p_S\lambda)^2} < 0.$$

The intermediate value theorem implies that if $\gamma \in (\underline{\gamma}, \bar{\gamma}(0))$, then there exists a unique $\hat{p}_S \in (0,1)$ such that $\gamma = \bar{\gamma}(\hat{p}_S)$. Solving for $\hat{p}_S$ yields

$$\hat{p}_S = \frac{\big((1-p_F)-\gamma\eta\big)(1-\lambda)}{\gamma\eta p_F\lambda}.$$

For $p_S < \hat{p}_S$, we have $\gamma < \bar{\gamma}(p_S)$, so the informed investor follows a mixed strategy $a^* \in (0,1)$. Equilibrium informed trading is given by $\tau_\gamma^* = p_S + (1-p_S)a^*$, where a^* adjusts to maintain indifference. Specifically, we have

$$\begin{aligned} a^* &= \frac{(1-p_F)(1-\lambda)-\gamma\eta(1-(1-p_F p_S)\lambda)}{\gamma\eta p_F\lambda(1-p_S)} \\ &= \frac{(1-\gamma\eta)(1-p_F)(1-\lambda)}{\gamma\eta p_F\lambda(1-p_S)} - \frac{p_S}{\lambda(1-p_S)} - \frac{1-\lambda}{\lambda}, \end{aligned}$$

which implies that

$$\frac{\partial a^*}{\partial p_S} = \frac{(1-\gamma\eta)(1-p_F)(1-\lambda)}{\gamma\eta p_F\lambda(1-p_S)^2} - \frac{1}{\lambda(1-p_S)^2}.$$

Taking the derivative of τ_γ^* with respect to p_S yields

$$\begin{aligned} \frac{\partial \tau_\gamma^*}{\partial p_S} &= 1 - a^* + (1-p_S)\frac{\partial a^*}{\partial p_S} \\ &= \underbrace{\frac{1}{\lambda(1-p_S)} - \frac{(1-\gamma\eta)(1-p_F)(1-\lambda)}{\gamma\eta p_F\lambda(1-p_S)}}_{=1-a^*} + \underbrace{\left(\frac{(1-\gamma\eta)(1-p_F)(1-\lambda)}{\gamma\eta p_F\lambda(1-p_S)} - \frac{1}{\lambda(1-p_S)}\right)}_{=(1-p_S)\frac{\partial a^*}{\partial p_S}} \\ &= 0. \end{aligned}$$

For $p_S > \hat{p}_S$, we have $\gamma > \bar{\gamma}(p_S)$, so $a^* = 0$ and thus $\tau_\gamma^* = p_S$, which strictly increases in p_S with slope 1. For $\gamma \geq \bar{\gamma}(0)$, we have $\gamma \geq \bar{\gamma}(p_S)$ for all p_S, so $a^* = 0$ and thus $\tau_\gamma^* = p_S$ for all p_S. ■

Proof of Proposition 3. Recall that

$$\phi_\gamma^* = \frac{\lambda p_F \tau_\gamma^* + (1-\lambda)}{\lambda(p_F - \Delta_F)\tau_\gamma^* + (1-\lambda)},$$

which strictly increases in τ_γ^*:

$$\frac{\partial \phi_\gamma^*}{\partial \tau_\gamma^*} = \frac{\lambda(1-\lambda)\Delta_F}{(\lambda(p_F - \Delta_F)\tau_\gamma^* + (1-\lambda))^2} > 0.$$

Applying Lemma 3 completes the proof. ■

Proof of Proposition 4. Proposition 2 implies that

$$R_{S=0} = \underbrace{p_F}_{=\mathbb{E}[F]} - \underbrace{\left((1-p_F)\lambda\left(\frac{p_F(1-\tau_\gamma^*)}{1-p_F\tau_\gamma^*}\right) + \big(1-(1-p_F)\lambda\big)\left(\frac{p_F(1-\lambda+\lambda\tau_\gamma^*)}{1-\lambda+p_F\lambda\tau_\gamma^*}\right)\right)}_{=\mathbb{E}[P_\gamma(q)|S=0]}$$
$$= -p_F^2(1-p_F)\lambda\left(\frac{\tau_\gamma^*(1-\tau_\gamma^*)}{(1-\lambda+p_F\lambda\tau_\gamma^*)(1-p_F\tau_\gamma^*)}\right).$$

Thus, $R_{S=0} \leq 0$, strictly so when $\tau_\gamma^* < 1$.

Further, we have

$$R_{S=\eta} = \underbrace{p_F}_{=\mathbb{E}[F]} - \underbrace{\left((1-p_F a^*)\lambda\left(\frac{p_F(1-\tau_\gamma^*)}{1-p_F\tau_\gamma^*}\right) + \big(1-(1-p_F a^*)\lambda\big)\left(\frac{p_F(1-\lambda+\lambda\tau_\gamma^*)}{1-\lambda+p_F\lambda\tau_\gamma^*}\right)\right)}_{=\mathbb{E}[P_\gamma(q)|S=\eta]}$$
$$= p_F^2(1-p_F)\lambda\left(\frac{\tau_\gamma^* p_S(1-a^*)}{(1-\lambda+p_F\lambda\tau_\gamma^*)(1-p_F\tau_\gamma^*)}\right).$$

Thus, $R_{S=\eta} \geq 0$, strictly so when $\tau_\gamma^* < 1 \Leftrightarrow a^* < 1$. ■

Proof of Proposition 5. Let $\mathrm{Var}[P_\gamma]$ be the variance of the firm's stock price at $t = 1$ as a function of the equilibrium level of informed trading:

$$\begin{aligned}\mathrm{Var}[P_\gamma] &= \left(1-p_F+p_F(1-\tau_\gamma^*)\right)\lambda\left(\frac{1-\tau_\gamma^*}{1-p_F\tau_\gamma^*}p_F-p_F\right)^2\\&\quad+\left(\left(1-p_F+p_F(1-\tau_\gamma^*)\right)(1-\lambda)+p_F\tau^*\right)\left(\frac{1-\lambda+\lambda\tau_\gamma^*}{1-\lambda+p_F\lambda\tau_\gamma^*}p_F-p_F\right)^2\\&= p_F^2(1-p_F)^2\lambda\left(\frac{\tau_\gamma^{*2}}{1-p_F\tau_\gamma^*}+\lambda\frac{\tau_\gamma^{*2}}{1-\lambda+p_F\lambda\tau_\gamma^*}\right).\end{aligned}$$

Taking the derivative of Var[P] with respect to τ_γ^* yields

$$\frac{\partial\,\mathrm{Var}[P_\gamma]}{\partial\tau_\gamma^*}=p_F^2(1-p_F)^2\lambda\left(\frac{\tau_\gamma^*(2-\tau_\gamma^*p_F)}{(1-p_F\tau_\gamma^*)^2}+\lambda\frac{2\tau_\gamma^*(1-\lambda)+\tau_\gamma^{*2}p_F\lambda}{(1-\lambda+p_F\lambda\tau_\gamma^*)^2}\right)>0.$$

Applying Lemma 3 completes the proof. ■

B Proofs: Extensions and Robustness

Proof of Proposition 6. Under the assumption that the manager exerts effort ($e_F=1$) so that $\Pr(F=1)=p_F$, the equilibrium market outcomes at $t=1$ do not depend on the realization of σ, which arrives after trading. The informed investor's equilibrium trading strategy is given by a^* as defined in Proposition 2. Let $\phi_\gamma^*(\sigma=L)$ correspond to the likelihood ratio for $(q>0,\sigma=L)$, which is given by

$$\frac{p_F(1-\bar{p}_S)(1-a^*)(1-\lambda)+p_F(1-\bar{p}_S)a^*+p_F\bar{p}_S+(1-p_F)(1-\lambda)}{(p_F-\Delta_F)(1-\bar{p}_S)(1-a^*)(1-\lambda)+(p_F-\Delta_F)(1-\bar{p}_S)a^*+(p_F-\Delta_F)\bar{p}_S+(1-p_F+\Delta_F)(1-\lambda)},$$

and can be rewritten as

$$\frac{\lambda p_F\tau_\gamma^*(\bar{p}_S)+(1-\lambda)}{\lambda(p_F-\Delta_F)\tau_\gamma^*(\bar{p}_S)+(1-\lambda)},$$

where $\tau_\gamma^*(\bar{p}_S):=\bar{p}_S+(1-\bar{p}_S)a^*$.

Similarly, the likelihood ratio for $(q>0,\sigma=H)$ can be expressed as

$$\phi_\gamma^*(\sigma=H)=\frac{\lambda p_F\tau_\gamma^*(\underline{p}_S)+(1-\lambda)}{\lambda(p_F-\Delta_F)\tau_\gamma^*(\underline{p}_S)+(1-\lambda)},$$

where $\tau^*_\gamma(\underline{p}_S) = \underline{p}_S + (1-\underline{p}_S)a^*$.

Note that $\phi^*_\gamma(\sigma = L) \geq \phi^*_\gamma(\sigma = H)$, with a strict inequality when $a^* < 1$. Thus, an optimal contract pays the manager a bonus $W^*_\gamma(q > 0, \sigma = L)$ in the state $(q > 0, \sigma = L)$, binding the manager's incentive-compatibility constraint:

$$\Pr(q > 0, \sigma = L | e_F = 1) W^*_\gamma(q > 0, \sigma = L) = \Pr(q > 0, \sigma = L | e_F = 0) W^*_\gamma(q > 0) + B_F,$$

which can be rewritten as

$$\begin{aligned} W^*_\gamma(q > 0, \sigma = L) &= \frac{B_F}{\Pr(q > 0, \sigma = L | e_F = 1) - \Pr(q > 0, \sigma = L | e_F = 0)} \\ &= \frac{B_F}{\Pr(\sigma = L)(\Pr(q > 0 | e_F = 1, p_S = \bar{p}_S) - \Pr(q > 0 | e_F = 0, p_S = \bar{p}_S))} \\ &= \frac{B_F}{\Pr(\sigma = L)\Delta_F \lambda \tau^*_\gamma(\bar{p}_S)}. \end{aligned}$$

There are two cases to consider: $\gamma > \underline{\gamma}$ and $\gamma \leq \underline{\gamma}$. In the first case, $a^* < 1$, implying that the maximum likelihood ratio corresponds uniquely to $(q > 0, \sigma = L)$. The optimal contract only pays the manager when $\sigma = L$ and $q > 0$. In the second case, $a^* = 1$, implying that the maximum likelihood ratio is achieved in either state $(q > 0, \sigma = L)$ or $(q > 0, \sigma = H)$. In this case, the contract identified by the proposition remains optimal but generates the same cost as the one identified in the baseline model. ■

Proof of Corollary 5. In the baseline model, the expected cost of providing incentives under an optimal contract is given by (3), and the initial shareholders induce effort if and only if $N\Delta_F \geq C_\gamma$. We can rewrite

$$C_\gamma = \frac{B_F}{\frac{\Delta_F \lambda \tau^*_\gamma(p_S)}{\lambda p_F \tau^*(p_S) + (1-\lambda)}}.$$

The expected cost of providing incentives under an optimal contract that conditions on the signal σ is

$$\begin{aligned}
C_\gamma^\sigma &:= \Pr(q>0,\sigma=L|e_F=1)W_\gamma^*(q>0,\sigma=L) \\
&= \Pr(q>0,\sigma=L|e_F=1)\frac{B_F}{\Pr(\sigma=L)\Delta_F\lambda\tau_\gamma^*(\bar{p}_S)} \\
&= \Pr(q>0|e_F=1)\frac{B_F}{\Delta_F\lambda\tau_\gamma^*(\bar{p}_S)} \\
&= \frac{B_F}{\frac{\Delta_F\lambda\tau_\gamma^*(\bar{p}_S)}{\lambda p_F\tau^*(p_S)+(1-\lambda)}},
\end{aligned}$$

since

$$\Pr(q>0|e_F=1)=\lambda p_F\tau^*(p_S)+(1-\lambda)$$

follows directly from the proof of Proposition 2. Since $\tau_\gamma^*(\bar{p}_S)=\bar{p}_S>p_S=\tau_\gamma^*(p_S)$ by Lemma 3 and $\bar{p}_S>p_S$, we have $C_\gamma^\sigma<C_\gamma$. In particular, when $N\Delta_F<C_\gamma$ and $N\Delta_F\geq C_\gamma^\sigma$, then he signal enhances governance quality by encouraging shareholders to switch from not inducing effort to inducing effort. ■

Proof of Proposition 7. Recall that the effort informativeness of the firm's stock price is

$$\phi_\gamma^*=\frac{\lambda p_F\tau_\gamma^*+(1-\lambda)}{\lambda(p_F-\Delta_F)\tau_\gamma^*+(1-\lambda)},$$

and the cost of incentivizing effort under the optimal incentive-compatible contract is

$$C_\gamma=\frac{B_F}{1-\frac{1}{\phi_\gamma^*}}.$$

Let $\phi_\gamma^*(p_S+\Delta_S)$ and $\phi_\gamma^*(p_S)$ be the effort informativeness of the firm's stock price with and without the investment in reducing the firm's social cost, respectively.

Proposition 3 implies that when $\gamma\leq\hat{\gamma}$, where $\hat{\gamma}$ is the threshold $\bar{\gamma}$ when we replace p_S with $p_S+\Delta_S$, $\phi_\gamma^*(p_S+\Delta_S)=\phi_\gamma^*(p_S)$. When $\gamma>\hat{\gamma}$, Proposition 3 implies that $\phi_\gamma^*(p_S+\Delta_S)>\phi_\gamma^*(p_S)$. ■

Proof of Corollary 6. There are two cases. First, consider the case in which the firm's initial controlling shareholders induce effort both under p_S and $p_S+\Delta_S$. The firm's initial controlling shareholders optimally invest in improving p_S if and only if

$$\underbrace{Np_F - c - \frac{B_F}{1-\frac{1}{\phi^*_\gamma(p_S+\Delta_S)}}}_{\text{Expected payoff with investment}} \geq \underbrace{Np_F - \frac{B_F}{1-\frac{1}{\phi^*_\gamma(p_S)}}}_{\text{Expected payoff without investment}},$$

which can be rewritten as

$$c \leq \frac{B_F(\phi^*_\gamma(p_S+\Delta_S)-\phi^*_\gamma(p_S))}{(\phi^*_\gamma(p_S+\Delta_S)-1)(\phi^*_\gamma(p_S)-1)} =: \bar{c}.$$

Proposition 3 implies that when $\gamma \leq \hat{\gamma}$, where $\hat{\gamma}$ is the threshold $\bar{\gamma}$ when we replace p_S with $p_S+\Delta_S$, $\phi^*_\gamma(p_S+\Delta_S) = \phi^*_\gamma(p_S)$. Hence, when $\gamma \leq \hat{\gamma}$, the firm's controlling shareholders do not pay c to increase p_S. When $\gamma > \hat{\gamma}$, Proposition 3 implies that $\phi^*_\gamma(p_S+\Delta_S) > \phi^*_\gamma(p_S)$. Since $\phi^*_\gamma > 1$, we get $\bar{c} > 0$.

Second, consider the case in which the firm's initial controlling shareholders induce effort only under $p_S+\Delta_S$. The firm's initial controlling shareholders optimally invest in improving p_S if and only if

$$\underbrace{Np_F - c - \frac{B_F}{1-\frac{1}{\phi^*_\gamma(p_S+\Delta_S)}}}_{\text{Expected payoff with investment}} \geq \underbrace{N(p_F-\Delta_F)}_{\text{Expected payoff without investment}},$$

which can be rewritten as

$$c \leq N\Delta_F - \frac{B_F}{1-\frac{1}{\phi^*_\gamma(p_S+\Delta_S)}} =: \bar{c}.$$

Since we assumed that inducing effort is optimal under $p_S+\Delta_S$, we have $\bar{c} > 0$. ■

Proof of Proposition 8. For algebraic convenience, let the manager's pay be w_0 and w_1 when the aggregate order flow at $t=1$ is $q=0$ and $q>0$, respectively. Suppose, for contradiction, that $\gamma \geq \bar{\gamma}(0)$, $\frac{p_F}{\Delta_F}B_F \geq \frac{p_S}{\Delta_S}B_S$, and there exists a contract (w_0, w_1) that induces the manager to exert financial effort ($e_F = 1$) but not social effort ($e_S = 0$). Recall from Lemma 3 that when $\gamma \geq \bar{\gamma}(0)$, the informed investor's equilibrium trading strategy is given by $a^* = 0$ regardless of the probability that the firm generates a high social cost.

In this case, the manager's incentive compatibility constraint for financial effort is

$$\lambda\Delta_F p_S(w_1 - w_0) \geq B_F. \tag{5}$$

Because this contract does not induce the manager to exert social effort, the manager's incentive compatibility constraint for social effort is violated:

$$\lambda p_F \Delta_S (w_1 - w_0) < B_S. \tag{6}$$

Together, (5) and (6) imply that

$$\frac{B_S}{p_F \Delta_S} > \lambda (w_1 - w_0) \geq \frac{B_F}{p_S \Delta_F},$$

which contradicts the assumption that $\frac{B_S}{p_F \Delta_S} \leq \frac{B_F}{p_S \Delta_F}$. ■

Proof of Proposition 9. There are two types of contracts to consider. The first type induces the manager to exert financial effort but not social effort. The second type induces her to exert both types of effort. For algebraic convenience, let the manager's pay be w_0 and w_1 when the aggregate order flow at $t = 1$ is $q = 0$ and $q > 0$, respectively.

Suppose the manager exerts no social effort ($e_S = 0$), then her incentive compatibility constraint for financial effort is given by

$$\lambda \Delta_F p_S (w_1 - w_0) \geq B_F. \tag{7}$$

The likelihood ratio associated with $q = 0$ is strictly less than 1. Hence, the maximal punishment principle implies that the lowest-cost incentive-compatible contract pays nothing when $q = 0$ (i.e., $w_0 = 0$). Standard arguments imply that the lowest-cost incentive-compatible contract that does not induce social effort binds the incentive compatibility constraint (7): $w_1^* = \frac{B_F}{\lambda \Delta_F p_S}$. Note that the assumption that $\frac{p_F}{\Delta_F} B_F < \frac{p_S}{\Delta_S} B_S$ implies that this contract does not induce the manager to exert social effort:

$$\underbrace{[p_F(p_S + \Delta_S) + (1 - p_F(p_S + \Delta_S))(1 - \lambda)] \frac{B_F}{\lambda p_S \Delta_F}}_{\text{Payoff when } e_F = 1 \text{ and } e_S = 1} < \underbrace{[p_F p_S + (1 - p_F p_S)(1 - \lambda)] \frac{B_F}{\lambda p_S \Delta_F} + B_S}_{\text{Payoff when } e_F = 1 \text{ and } e_S = 0},$$

which is equivalent to

$$\frac{p_F}{\Delta_F} B_F < \frac{p_S}{\Delta_S} B_S,$$

and satisfied by assumption. Further, the manager does not find it profitable to deviate to exerting only social effort instead of only financial effort:

$$\underbrace{[(p_F-\Delta_F)(p_S+\Delta_S)+(1-(p_F-\Delta_F)(p_S+\Delta_S))(1-\lambda)]\frac{B_F}{\lambda p_S \Delta_F}+B_F}_{\text{Payoff when } e_F=0 \text{ and } e_S=1} <$$

$$\underbrace{[p_F p_S+(1-p_F p_S)(1-\lambda)]\frac{B_F}{\lambda p_S \Delta_F}+B_S}_{\text{Payoff when } e_F=1 \text{ and } e_S=0}$$

which is equivalent to

$$\frac{p_F-\Delta_F}{\Delta_F}B_F < \frac{p_S}{\Delta_S}B_S,$$

and implied by our assumption $\frac{p_F}{\Delta_F}B_F < \frac{p_S}{\Delta_S}B_S$.

In this case, the firm's expected managerial compensation cost is

$$C_{S,0} = [p_F p_S + (1-p_F p_S)(1-\lambda)]\,\frac{B_F}{\lambda \Delta_F p_S}.$$

Suppose the manager exerts social effort ($e_S = 1$), then her incentive compatibility constraint for financial effort is given by

$$\lambda \Delta_F (p_S+\Delta_S)(w_1-w_0) \geq B_F. \tag{8}$$

Suppose the manager exerts financial effort ($e_F = 1$), then her incentive compatibility constraint for social effort is given by

$$\lambda \Delta_S p_F (w_1-w_0) \geq B_S. \tag{9}$$

Finally, the manager prefers exerting both types of effort over exerting no effort if and only if

$$\lambda(\Delta_S p_F + \Delta_F p_S)(w_1-w_0) \geq B_S + B_F. \tag{10}$$

Clearly, (10) is satisfied whenever (8) and (9) are satisfied. Because the likelihood ratio for both types of effort is strictly less than 1 when $q = 0$, the maximal punishment principle implies that the lowest-cost incentive-compatible contract pays the manager nothing when $q = 0$. Since $\frac{p_F}{\Delta_F}B_F < \frac{p_S}{\Delta_S}B_S$, the lowest-cost incentive compatible contract that induces both types of effort binds constraint (9): $w_1^* = \frac{B_S}{\lambda p_F \Delta_S}$. In this case, the firm's expected managerial compensation cost is

$$\begin{aligned} C_{S,1} &= [p_F(p_S+\Delta_S)+(1-p_F(p_S+\Delta_S))(1-\lambda)]\frac{B_S}{\lambda p_F \Delta_S} \\ &= \underbrace{[p_F p_S+(1-p_F p_S)(1-\lambda)]\frac{B_S}{\lambda p_F \Delta_S}}_{>C_{S,0}} + \underbrace{\lambda p_F \Delta_S \frac{B_S}{\lambda p_F \Delta_S}}_{>0} > C_{S,0}. \end{aligned}$$

The firm's majority shareholders do not care about its social cost, and both types of contracts induce financial effort ($e_F = 1$). Hence, they strictly prefer not to induce social effort because $C_{S,1} > C_{S,0}$. ■

Proof of Lemma 4. Suppose for contradiction that there exists an equilibrium in which both components of the informed investor's trading strategy are interior: $a_H^* \in (0,1)$ and $a_L^* \in (0,1)$. Let $P_\gamma(q>0)$ be the equilibrium market-clearing price when $q>0$, respectively. Because $a_H^* \in (0,1)$, the informed investor must be indifferent between buying and not buying upon observing $F=1$ and $\xi = H$, which implies that $1-P_\gamma(q>0)-\gamma\mathbb{E}[S|\xi=H]=0$. However, since $\mathbb{E}[S|\xi=L] < \mathbb{E}[S|\xi=H]$, it must be that $1-P_\gamma(q>0)-\gamma\mathbb{E}[S|\xi=L]>0$, which implies that the informed investor strictly prefers to buy upon observing $F=1$ and $\xi=L$, a contradiction. Finally, since $1-P_\gamma(q>0)-\gamma\mathbb{E}[S|\xi=L] > 1-P_\gamma(q>0)-\gamma\mathbb{E}[S|\xi=H]$, implies that $a_H^* \in (0,1) \Rightarrow a_L^*=1$ or $a_L^* \in (0,1) \Rightarrow a_H^* = 0$. ■

Proof of Proposition 11. In the first case ($a_H^* \in (0,1)$), the market equilibrium is characterized by Proposition 2, replacing the high and low social cost, $S=0$ and $S=\eta$ with $\mathbb{E}[S|\xi=L]$ and $\mathbb{E}[S|\xi=H]$, respectively. In particular, the informed investor's trading strategy upon observing $F=1$ and $\xi=H$ is

$$a_H^* = \frac{(1-p_F)(1-\lambda)-\gamma\mathbb{E}[S|\xi=H](1-(1-p_F p_S)\lambda)}{\gamma\mathbb{E}[S|\xi=H]p_F\lambda(1-p_S)},$$

which implies that the equilibrium level of informed trading is

$$\tau_H^* = p_\xi + (1-p_\xi)a_H^* = \frac{(1-\lambda)\big((1-p_F)-\gamma\mathbb{E}[S|\xi=H]\big)}{\gamma p_F \lambda \mathbb{E}[S|\xi=H]}.$$

Note that τ_H^* is decreasing in $\mathbb{E}[S|\xi=H]$. A reduction in the noisiness of the informed investor's signal, maintaining $a_H^* \in (0,1)$ (i.e., a small increase in ε), increases $\mathbb{E}[S|\xi=H]$ and, in turn, lowers a_H^*. This reduction in informed trading reduces effort informativeness.

In the second case ($a_L^* \in (0,1)$), we have $a_H^* = 0$ by Lemma 4. The remainder of the proof follows the logic of Proposition 2. Define $p_\xi := \Pr(\xi = L)$. Table 2 shows the distribution of the aggregate order flow in different states of the world.[36]

F	ξ	$\Pr(F,S)$	Informed Trade x	Order Flow q	$\Pr(q)$
0	H	$(1-p_F)(1-p_\xi)$	$x=0$	$q \in \mathbb{N}_0$	$\lambda(1-\lambda)^q$
0	L	$(1-p_F)p_\xi$	$x=0$	$q \in \mathbb{N}_0$	$\lambda(1-\lambda)^q$
1	H	$p_F(1-p_\xi)$	$x=0$	$q \in \mathbb{N}_0$	$\lambda(1-\lambda)^q$
1	L	$p_F p_\xi(1-a_L)$	$x=0$	$q \in \mathbb{N}_0$	$\lambda(1-\lambda)^q$
1	L	$p_F p_\xi a_L$	$x=1$	$q \in \mathbb{N}_+$	$\lambda(1-\lambda)^{q-1}$

Table 2: Distribution of Equilibrium Aggregate Order Flow

Bayesian updating for F implies that the market makers' pricing rule is given by

$$P_\gamma(q>0) = \frac{p_F(1-\lambda+\lambda p_\xi a_L)}{p_F(1-\lambda+\lambda p_\xi a_L)+(1-p_F)(1-\lambda)}.$$

By assumption, $a_L \in (0,1)$, which means that the informed investor must be indifferent between buying one share and buying none upon observing that $F=1$ and $\xi = L$:

$$1 - \frac{p_F(1-\lambda+\lambda p_\xi a_L)}{p_F(1-\lambda+\lambda p_\xi a_L)+(1-p_F)(1-\lambda)} - \gamma\mathbb{E}[S|\xi = L] = 0. \tag{11}$$

Rearranging (11) yields

$$a_L^* = \frac{(1-\lambda)(1-p_F-\gamma\mathbb{E}[S|\xi=L])}{\gamma\mathbb{E}[S|\xi=L]\lambda p_F p_\xi},$$

which implies that the equilibrium level of informed trading is

$$\tau_L^* = p_\xi a_L^* = \frac{(1-\lambda)(1-p_F-\gamma\mathbb{E}[S|\xi=L])}{\gamma\mathbb{E}[S|\xi=L]\lambda p_F}.$$

Note that τ_L^* is decreasing in $\mathbb{E}[S|\xi = L]$. A less noisy signal corresponds to a lower $\mathbb{E}[S|\xi = L]$. Hence, a less noisy signal corresponds to more informed trading and improved effort informativeness. ■

Proof of Proposition 12. For algebraic convenience, let $\Pr(S=0|F=1) = p_{S,1}$ and $\Pr(S=0|F=$

[36]Note that in the example provided in Footnote 33, we have $p_\xi = p_S$.

$0) = p_{S,0}$. The underlying logic of Proposition 2 is that the firm's high social cost discourages the informed investor from acquiring the firm's shares even when its financial payoff is high. The proof of Proposition 2 only depends on the conditional probability $\Pr(S = \eta | F = 1)$ because the informed investor abstains from trading when the firm's financial payoff is low ($F = 0$), regardless of its social cost. Suppose $1 - p_{S,1} > 0$. Thus, we can simply replace p_S with $p_{S,1}$ in the proof of Proposition 2. As a result, when the manager exerts financial effort ($e_F = 1$), the unique trading equilibrium is characterized by the pricing rule

$$P_\gamma(q) = \begin{cases} \frac{p_F(1-p_{S,1})(1-a^*)}{p_F(1-p_{S,1})(1-a^*)+(1-p_F)}, & \text{if } q = 0, \\ \frac{p_F(1-\lambda(1-p_{S,1})(1-a^*))}{p_F(1-\lambda(1-p_{S,1})(1-a^*))+(1-p_F)(1-\lambda)}, & \text{if } q > 0, \end{cases}$$

and the informed investor (i) buys one share ($x = 1$) upon observing a high financial payoff and a low social cost ($F = 1$ and $S = 0$), (ii) abstains from buying ($x = 0$) upon observing a low financial payoff ($F = 0$), (iii) buys a share with probability a^* upon observing a high financial payoff and a high social cost ($F = 1$ and $S = \eta$), where

$$a^* = \begin{cases} 1, & \text{if } \gamma \leq \underline{\gamma}, \\ \frac{(1-p_F)(1-\lambda)-\gamma\eta(1-(1-p_F p_{S,1})\lambda)}{\gamma\eta p_F \lambda(1-p_{S,1})}, & \text{if } \gamma \in (\underline{\gamma}, \bar{\gamma}), \\ 0, & \text{if } \gamma \geq \bar{\gamma}. \end{cases}$$

The thresholds for the intensity of social concerns are given by

$$\underline{\gamma} = \frac{(1-p_F)(1-\lambda)}{\eta(1-(1-p_F)\lambda)} < \frac{(1-p_F)(1-\lambda)}{\eta(1-(1-p_F p_{S,1})\lambda)} = \bar{\gamma}.$$

Then, as in the baseline model, an increase in the intensity of the informed investor's social concerns reduces her equilibrium informed trading intensity, $\tau^*_\gamma = p_{S,1} + (1-p_{S,1})a^*$, which decreases the effort informativeness of the firm's stock price. ■

Proof of Proposition 13. Define

$$U_0(\gamma) := p_F(1 - P_0(q > 0) - \gamma(1-p_S)\eta),$$

and

$$U_\gamma(\gamma) := p_F p_S \underbrace{(1 - P_\gamma(q > 0))}_{\text{Increases in } \gamma \text{ for } \gamma \in (\underline{\gamma}, \bar{\gamma})} + p_F(1 - p_S)a^* \underbrace{(1 - P_\gamma(q > 0) - \gamma\eta)}_{= 0 \text{ when } \gamma \in (\underline{\gamma}, \bar{\gamma})}.$$

Note that the two utility functions have the following properties. First, $U_0(\gamma) = U_\gamma(\gamma)$ for $\gamma \leq \underline{\gamma}$. Second, the function $U_\gamma(\gamma)$ is continuous, strictly decreasing for $\gamma \leq \underline{\gamma}$, strictly increasing for $\gamma \in [\underline{\gamma}, \bar{\gamma}]$, and constant for $\gamma \geq \bar{\gamma}$. These results imply that for κ_S sufficienlty low, we have $U_\gamma(\gamma) - \kappa_S \geq U_0(\gamma)$, whenever $\gamma \geq \hat{\gamma}$. ■

Proof of Proposition 10. Consider an equilibrium in which the manager exerts effort ($e_F = 1$) and γ is sufficiently high such that the informed investor buys a share in the state $F = 0$ and $S = -\eta$. Table 3 shows the distribution of the aggregate order flow in different states of the world.

F	S	$\Pr(F,S)$	Informed Trade x	Order Flow q	$\Pr(q)$
0	0	$(1-p_F)(1-p_S)$	$x=0$	$q \in \mathbb{N}_0$	$(1-\lambda)^q\lambda$
0	$-\eta$	$(1-p_F)p_S$	$x=1$	$q \in \mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$
1	0	$p_F(1-p_S)$	$x=1$	$q \in \mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$
1	$-\eta$	$p_F p_S$	$x=1$	$q \in \mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$

Table 3: Distribution of Equilibrium Aggregate Order Flow

In this case, Bayesian updating implies

$$\Pr(F = 1|q = 0) = \frac{\Pr(q = 0|F = 1)\Pr(F = 1)}{\Pr(q = 0|F = 1)\Pr(F = 1) + \Pr(q = 0|F = 0)\Pr(F = 0)} = 0,$$

and

$$\begin{aligned}\Pr(F = 1|q > 0) &= \frac{\Pr(q > 0|F = 1)\Pr(F = 1)}{\Pr(q > 0|F = 1)\Pr(F = 1) + \Pr(q > 0|F = 0)\Pr(F = 0)} \\ &= \frac{p_F}{p_F + (p_S + (1-p_S)(1-\lambda))(1-p_F)}\end{aligned}$$

Hence, the market makers' pricing rule is given by

$$P_\gamma(q) = \begin{cases} 0, & \text{if } q = 0, \\ \frac{p_F}{p_F + (p_S + (1-p_S)(1-\lambda))(1-p_F)}, & \text{if } q > 0. \end{cases}$$

We next solve for the informed investor's optimal trading strategy. To begin with, note that it is straightforward to confirm that the informed investor prefers to buy one share when she learns that $F=1$ and to abstain from buying when she learns that $F=0$ and $S=0$. What remains to be determined is the optimal trading strategy when $F=0$ and $S=-\eta$. To generate an equilibrium in which $x=1$ in this state, we require

$$0-P_{\gamma}(q>0)+\gamma\eta \geq 0 \Leftrightarrow \gamma \geq \frac{1}{\eta}P_{\gamma}(q>0)=\frac{1}{\eta}\frac{p_F}{p_F+(p_S+(1-p_S)(1-\lambda))(1-p_F)},$$

which has the upper bound

$$\frac{1}{\eta}\frac{p_F}{1-\lambda(1-p_F)}=:\bar{\bar{\gamma}}.$$

In particular, the equilibrium is unique. ■

Proof of Corollary 7. When the manager exerts effort ($e_F=1$) and $\gamma \geq \bar{\bar{\gamma}}$, Proposition 10 implies that the informed investor buys a share when $F=1$ or when $S=-\eta$ and abstains otherwise. This equilibrium trading behavior implies that the maximum likelihood ratio, which is associated with a high order flow ($q \geq 1$), is

$$\begin{aligned}\phi^*_{SB} &= \frac{\overbrace{p_F+(1-p_F)p_S+(1-p_F)(1-p_S)(1-\lambda)}^{\text{Probability of } q\geq 1 \text{ when } e_F=1}}{\underbrace{p_F-\Delta_F+(1-p_F+\Delta_F)p_S+(1-p_F+\Delta_F)(1-p_S)(1-\lambda)}_{\text{Probability of } q\geq 1 \text{ when } e_F=0}}\\ &= \frac{p_F+(1-p_F)(1-\lambda(1-p_S))}{p_F-\Delta_F+(1-p_F+\Delta_F)(1-\lambda(1-p_S))}=\frac{1-\lambda(1-p_F)(1-p_S)}{1-\lambda(1-p_F+\Delta_F)(1-p_S)}.\end{aligned}$$

Taking the derivative of ϕ^*_{SB} with respect to p_S yields

$$\frac{\partial \phi^*_{SB}}{\partial p_S}=-\frac{\lambda\Delta_F}{[1-\lambda(1-p_F+\Delta_F)(1-p_S)]^2}<0,$$

which completes the proof. ■

C Additional Robustness

This section contains additional results to demonstrate the robustness of our results.

C.1 Short Selling

In the baseline model, the informed investor derives gross utility $F - \gamma S$ when owning a share of the firm's equity ($x = 1$), and 0 otherwise. In this section, we introduce the investor's ability to short-sell a stock. Specifically, the informed investor submits an order $x \in \{-1, 0, 1\}$. The net utility of short-selling a stock is given by $-(F - \mathbb{E}[P_\gamma]) = \mathbb{E}[P_\gamma] - F$, where $\mathbb{E}[P_\gamma]$ is the expected market-clearing price.

Due to the presence of noise trading, the expected market-clearing price is strictly between 0 and 1. This implies that, when $F = 1$ and $S = 0$, the informed investor's valuation is 1, but the expected market-clearing price is strictly less than 1. The investor thus buys one share (i.e., $x = 1$) in this state. When $F = 0$, the informed investor knows that the value of the firm at $t = 2$ is 0. Hence, short-selling yields a positive expected price at $t = 1$, and it costs nothing to cover the short at $t = 2$. The informed investor, therefore, short-sells a share (i.e., $x = -1$) when she learns that $F = 0$. It therefore remains to consider the investor's strategy when $F = 1$ and $S = \eta$. In this case, the informed investor knows that the cost of covering a short is 1 at $t = 2$. However, the expected market-clearing price is strictly less than 1. Hence, the investor has no incentive to short-sell the stock. As a result, we consider a mixed strategy in which the investor buys a share with probability $a \in [0, 1]$ and abstains otherwise when $F = 1$ and $S = \eta$, as in the baseline model.

The following proposition demonstrates that the equilibrium in our baseline model remains qualitatively robust when the informed trader can short the stock. In particular, as in our baseline model, stronger social concerns of the informed investor lead to less informed trading on financial information, thus reducing price informativeness for governance purposes. Furthermore, since short selling effectively leads to a more informative order flow, the negative impact of sustainable investing on market monitoring is weakened. This effect is isomorphic to adding an additional informed investor who only cares about F.

Proposition C.1. *Assume that the manager exerts effort ($e_F = 1$). Then there exists a unique equilibrium in which the informed investor: (i) buys one share ($x = 1$) upon observing a high financial payoff and a low social cost ($F = 1$ and $S = 0$), (ii) short-sells one share ($x = -1$) upon observing a low financial payoff ($F = 0$), (iii) buys a share with probability a^* and abstains* *otherwise upon observing a high financial payoff and a high social cost ($F = 1$ and $S = \eta$), where*

$$a^* = \begin{cases} 1, & \text{if } \gamma \le \underline{\gamma}, \\ \frac{(1-p_F)(1-\lambda)^2 - \gamma\eta(1-(1-p_F p_S)\lambda - (1-p_F)\lambda(1-\lambda))}{\gamma\eta p_F \lambda(1-p_S)}, & \text{if } \gamma \in (\underline{\gamma}, \bar{\gamma}), \\ 0, & \text{if } \gamma \ge \bar{\gamma}. \end{cases}$$

The thresholds for the intensity of social concerns are given by

$$\underline{\gamma} = \frac{(1-p_F)(1-\lambda)^2}{\eta(p_F + (1-p_F)(1-\lambda)^2)} < \frac{(1-p_F)(1-\lambda)^2}{\eta(p_F(1-(1-p_S)\lambda) + (1-p_F)(1-\lambda)^2)} = \bar{\gamma}.$$

The equilibrium pricing rule as a function of the aggregate order flow $q = x + z$ at $t = 1$ is

$$P_\gamma(q) = \begin{cases} 0, & \text{if } q = -1, \\ \frac{p_F(1-p_S)(1-a)}{p_F(1-p_S)(1-a) + (1-\lambda)(1-p_F)}, & \text{if } q = 0, \\ \frac{p_F(1-\lambda(1-p_S)(1-a))}{p_F(1-\lambda(1-p_S)(1-a)) + (1-p_F)(1-\lambda)^2}, & \text{if } q > 0. \end{cases}$$

Proof. Consider an equilibrium in which the manager exerts effort ($e_F = 1$). Table 4 shows the distribution of the aggregate order flow in different states of the world.

F	S	$\Pr(F,S)$	Informed Trade x	Order Flow q	$\Pr(q)$
0	η	$(1-p_F)(1-p_S)$	$x = -1$	$q \in \mathbb{N}_0 \cup \{-1\}$	$(1-\lambda)^{q+1}\lambda$
0	0	$(1-p_F)p_S$	$x = -1$	$q \in \mathbb{N}_0 \cup \{-1\}$	$(1-\lambda)^{q+1}\lambda$
1	η	$p_F(1-p_S)(1-a)$	$x = 0$	$q \in \mathbb{N}_0$	$(1-\lambda)^q\lambda$
1	η	$p_F(1-p_S)a$	$x = 1$	$q \in \mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$
1	0	$p_F p_S$	$x = 1$	$q \in \mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$

Table 4: Distribution of Equilibrium Aggregate Order Flow

In this case, Bayesian updating implies

$$\Pr(F = 1 | q = -1) = \frac{\Pr(q = -1 | F = 1)\Pr(F = 1)}{\Pr(q = -1 | F = 1)\Pr(F = 1) + \Pr(q = -1 | F = 0)\Pr(F = 0)} = 0,$$

$$\Pr(F=1|q=0) = \frac{\Pr(q=0|F=1)\Pr(F=1)}{\Pr(q=0|F=1)\Pr(F=1)+\Pr(q=0|F=0)\Pr(F=0)}$$
$$= \frac{(1-p_S)(1-a)\lambda p_F}{(1-p_S)(1-a)\lambda p_F+\lambda(1-\lambda)(1-p_F)}$$
$$= \frac{p_F(1-p_S)(1-a)}{p_F(1-p_S)(1-a)+(1-\lambda)(1-p_F)},$$

and

$$\Pr(F=1|q>0) = \frac{\Pr(q>0|F=1)\Pr(F=1)}{\Pr(q>0|F=1)\Pr(F=1)+\Pr(q>0|F=0)\Pr(F=0)}$$
$$= \frac{(p_S+(1-p_S)a+(1-p_S)(1-a)(1-\lambda))p_F}{(p_S+(1-p_S)a+(1-p_S)(1-a)(1-\lambda))p_F+(1-\lambda)^2(1-p_F)}$$
$$= \frac{p_F(1-\lambda(1-p_S)(1-a))}{p_F(1-\lambda(1-p_S)(1-a))+(1-p_F)(1-\lambda)^2}.$$

Hence, the market makers' pricing rule is given by

$$P_\gamma(q) = \begin{cases} 0, & \text{if } q=-1, \\ \frac{p_F(1-p_S)(1-a)}{p_F(1-p_S)(1-a)+(1-\lambda)(1-p_F)}, & \text{if } q=0, \\ \frac{p_F(1-\lambda(1-p_S)(1-a))}{p_F(1-\lambda(1-p_S)(1-a))+(1-p_F)(1-\lambda)^2}, & \text{if } q>0. \end{cases}$$

We next solve for the informed investor's optimal trading strategy. To begin with, note that it is straightforward to confirm that the informed investor prefers to buy one share when she learns that $F=1$ and $S=0$ and to sell one share short when she learns that $F=0$. What remains to be determined is the optimal trading strategy when $F=1$ and $S=\eta$. First, consider an equilibrium with $a=1$, which requires

$$1-P_\gamma(q>0)\big|_{a=1}-\gamma\eta \geq 0 \Leftrightarrow \gamma \leq \frac{1}{\eta}\left(1-P_\gamma(q>0)\big|_{a=1}\right) = \frac{(1-p_F)(1-\lambda)^2}{\eta(p_F+(1-p_F)(1-\lambda)^2)} =: \underline{\gamma}.$$

Second, consider an equilibrium with $a=0$, which requires

$$1-P_\gamma(q>0)\big|_{a=0}-\gamma\eta \leq 0 \Leftrightarrow \gamma \geq \frac{1}{\eta}\left(1-P_\gamma(q>0)\big|_{a=0}\right) = \frac{(1-p_F)(1-\lambda)^2}{\eta(p_F(1-(1-p_S)\lambda)+(1-p_F)(1-\lambda)^2)} =: \bar{\gamma}.$$

Note that $\underline{\gamma} < \bar{\gamma}$ since $p_S < 1$.

Second, consider an equilibrium with $a \in (0,1)$, which requires

$$1 - P_\gamma(q > 0) - \gamma\eta = 0 \Leftrightarrow a^* = \frac{(1-p_F)(1-\lambda)^2 - \gamma\eta\,(1-(1-p_F p_S)\lambda - (1-p_F)\lambda(1-\lambda))}{\gamma\eta\, p_F \lambda (1-p_S)}.$$

We have that $a^* \in (0,1) \Leftrightarrow \gamma \in (\underline{\gamma}, \bar{\gamma})$ with $a^* = 1$ if $\gamma = \underline{\gamma}$ and $a^* = 0$ if $\gamma = \bar{\gamma}$. Moreover, a^* is a strictly decreasing function of γ on $[\underline{\gamma}, \bar{\gamma}]$. Hence, the informed investor's optimal trading strategy is a continuous decreasing function of γ for $\gamma \in [0,1]$. In particular, the equilibrium is unique. ■

C.2 Market Makers who Consider Social Costs

In the baseline model, we assumed that the market makers' equilibrium pricing rule reflects the preferences of the marginal financial investor, imposing that the firm's stock price at $t = 1$ depends solely on the expected value of the firm's financial payoff F at $t = 2$: $P_\gamma(q) = \mathbb{E}[F|q]$. In this section, we consider an equilibrium pricing rule that reflects the preferences of the average investor in the economy, which may include sustainable investors. Specifically, we assume that the market makers assign a weight $\theta \in (0,1)$ to sustainable investors, such that $P_\gamma(q) = \mathbb{E}[F - \theta\gamma S|q]$. Intuitively, θ may capture the share of sustainable investors in the economy who have social concerns γ, and $1-\theta$ the share of financial investors who do not care about the firm's social cost. This implies that the market makers expect to sell any shares they own to a sustainable investor with probability θ and to a financial investor with probability $1-\theta$.

The following proposition demonstrates that the equilibrium in our baseline model remains robust when market makers incorporate the social cost into pricing, provided that θ is sufficiently small. In particular, as in our baseline model, stronger social concerns of the informed investor lead to less informed trading on financial information, thus reducing price informativeness for governance purposes.

Proposition C.2. *Assume that the manager exerts effort ($e_F = 1$) and that $\theta < \bar{\theta}$ (defined in the proof). Then there exists a unique equilibrium in which the informed investor: (i) buys one share ($x = 1$) upon observing a high financial payoff and a low social cost ($F = 1$ and $S = 0$), (ii) abstains from buying ($x = 0$) upon observing a low financial payoff ($F = 0$), (iii) buys a share with probability a^* upon observing a high financial payoff and a high social cost ($F = 1$ and $S = \eta$),* *where*

$$a^* = \begin{cases} 1, & \text{if } \gamma \le \underline{\gamma}, \\ \frac{(1-p_F)(1-\lambda)-\gamma\eta(1-(1-p_S)\theta(1-\lambda)-(1-p_F p_S)\lambda)}{\gamma\eta p_F\lambda(1-p_S)(1-\theta)}, & \text{if } \gamma \in (\underline{\gamma},\bar{\gamma}), \\ 0, & \text{if } \gamma \ge \bar{\gamma}. \end{cases}$$

The thresholds for the intensity of social concerns are given by

$$\underline{\gamma} = \frac{(1-p_F)(1-\lambda)}{\eta(1-\theta(1-p_S))(1-(1-p_F)\lambda)} < \frac{(1-p_F)(1-\lambda)}{\eta(1-(1-p_S)\theta(1-\lambda)-(1-p_F p_S)\lambda)} = \bar{\gamma}.$$

The equilibrium pricing rule as a function of the aggregate order flow $q = x+z$ at $t = 1$ is

$$P_\gamma(q) = \begin{cases} \frac{p_F(1-p_S)(1-a^*)}{p_F(1-p_S)(1-a^*)+(1-p_F)} - \theta\gamma\frac{(1-p_F a^*)(1-p_S)}{(1-p_F a^*)(1-p_S)+(1-p_F)p_S}\eta, & \text{if } q = 0, \\ \frac{p_F(1-\lambda(1-p_S)(1-a^*))}{p_F(1-\lambda(1-p_S)(1-a^*))+(1-p_F)(1-\lambda)} - \theta\gamma\frac{((1-p_F a)(1-\lambda)+p_F a^*)(1-p_S)}{((1-p_F a^*)(1-\lambda)+p_F a^*)(1-p_S)+(1-\lambda(1-p_F))p_S}\eta, & \text{if } q > 0. \end{cases}$$

Proof. Consider an equilibrium in which the manager exerts effort ($e_F = 1$). Table 1 in the proof of Proposition 2 shows the distribution of the aggregate order flow in different states of the world.

As shown in the proof of Proposition 2, we have

$$\Pr(F=1|q=0) = \frac{p_F(1-p_S)(1-a)}{p_F(1-p_S)(1-a)+(1-p_F)},$$

and

$$\Pr(F=1|q>0) = \frac{p_F(1-\lambda(1-p_S)(1-a))}{p_F(1-\lambda(1-p_S)(1-a))+(1-p_F)(1-\lambda)}.$$

In addition, Bayesian updating implies

$$\begin{aligned} \Pr(S=\eta|q=0) &= \frac{\Pr(q=0|S=\eta)\Pr(S=\eta)}{\Pr(q=0|S=\eta)\Pr(S=\eta)+\Pr(q=0|S=0)\Pr(S=0)} \\ &= \frac{((1-p_F)\lambda+p_F(1-a)\lambda)(1-p_S)}{((1-p_F)\lambda+p_F(1-a)\lambda)(1-p_S)+((1-p_F)\lambda)p_S} \\ &= \frac{(1-p_F a)(1-p_S)}{(1-p_F a)(1-p_S)+(1-p_F)p_S}, \end{aligned}$$

and

$$\Pr(S=\eta|q>0) = \frac{\Pr(q>0|S=\eta)\Pr(S=\eta)}{\Pr(q>0|S=\eta)\Pr(S=\eta)+\Pr(q>0|S=0)\Pr(S=0)}$$
$$= \frac{((1-p_F)(1-\lambda)+p_F(1-a)(1-\lambda)+p_Fa)(1-p_S)}{((1-p_F)(1-\lambda)+p_F(1-a)(1-\lambda)+p_Fa)(1-p_S)+((1-p_F)(1-\lambda)+p_F)p_S}$$

$$= \frac{((1-p_Fa)(1-\lambda)+p_Fa)(1-p_S)}{((1-p_Fa)(1-\lambda)+p_Fa)(1-p_S)+(1-\lambda(1-p_F))p_S}.$$

Hence, the market makers' pricing rule is given by

$$P_\gamma(q=0) = \frac{p_F(1-p_S)(1-a)}{p_F(1-p_S)(1-a)+(1-p_F)} - \theta\gamma\frac{(1-p_Fa)(1-p_S)}{(1-p_Fa)(1-p_S)+(1-p_F)p_S}\eta,$$

and

$$P_\gamma(q>0) = \frac{p_F(1-\lambda(1-p_S)(1-a))}{p_F(1-\lambda(1-p_S)(1-a))+(1-p_F)(1-\lambda)} - \theta\gamma\frac{((1-p_Fa)(1-\lambda)+p_Fa)(1-p_S)}{((1-p_Fa)(1-\lambda)+p_Fa)(1-p_S)+(1-\lambda(1-p_F))p_S}\eta.$$

Note that we have
$$\frac{\partial P_\gamma(q>0)}{\partial\theta} < 0$$

and
$$P_\gamma(q>0) > 0 \Leftrightarrow \theta < \frac{p_F(1-(1-a)\lambda(1-p_S))}{\gamma\eta(1-p_S)(1-\lambda(1-ap_F))} =: \hat{\theta}(a).$$

Note that $\hat{\theta}(a)$ is monotonic in a.[37] Thus, for

$$\theta < \bar{\theta} := \min\left\{\hat{\theta}(0), \hat{\theta}(1)\right\},$$

we have $P_\gamma(q>0) > 0$ for all a.

We next solve for the informed investor's optimal trading strategy. To begin with, note that it is straightforward to confirm that the informed investor prefers to buy one share when she learns that $F=1$ and $S=0$ and to abstain from buying when she learns that $F=0$. What remains to be

[37]Note that $\hat{\theta}(a)$ additionally depends on γ and we consider comparative statics with respect to γ below. To ensure positive prices for all values of γ, we can additionally impose a maximum γ and use the upper bound to determine $\bar{\theta}$.

determined is the optimal trading strategy when $F = 1$ and $S = \eta$. First, consider an equilibrium with $a = 1$, which requires

$$1 - P_\gamma(q > 0)\big|_{a=1} - \gamma\eta \geq 0 \Leftrightarrow \gamma \leq \frac{(1-p_F)(1-\lambda)}{\eta(1-\theta(1-p_S))(1-(1-p_F)\lambda)} =: \underline{\gamma}.$$

Second, consider an equilibrium with $a = 0$, which requires[38]

$$1 - P_\gamma(q > 0)\big|_{a=0} - \gamma\eta \leq 0 \Leftrightarrow \gamma \geq \frac{(1-p_F)(1-\lambda)}{\eta(1-(1-p_S)\theta(1-\lambda)-(1-p_F p_S)\lambda)} =: \bar{\gamma}.$$

Note that $\underline{\gamma} < \bar{\gamma}$ since $p_S < 1$ and $\theta < 1$.

Second, consider an equilibrium with $a \in (0,1)$, which requires

$$1 - P_\gamma(q > 0) - \gamma\eta = 0 \Leftrightarrow a^* = \frac{(1-p_F)(1-\lambda) - \gamma\eta(1-(1-p_S)\theta(1-\lambda)-(1-p_F p_S)\lambda)}{\gamma\eta p_F \lambda(1-p_S)(1-\theta)}.$$

We have that $a^* \in (0,1) \Leftrightarrow \gamma \in (\underline{\gamma}, \bar{\gamma})$ with $a^* = 1$ if $\gamma = \underline{\gamma}$ and $a^* = 0$ if $\gamma = \bar{\gamma}$. Moreover, a^* is a strictly decreasing function of γ on $[\underline{\gamma}, \bar{\gamma}]$. Hence, the informed investor's optimal trading strategy is a continuous decreasing function of γ for $\gamma \in [0,1]$. In particular, the equilibrium is unique. ■

C.3 Compensation Paid by Firm

In this section, we explore an alternative model specification where the firm, rather than the initial shareholders, pays the manager's compensation. This adjustment addresses a potential concern that our main results might be sensitive to the assumption about who bears the cost of managerial incentives. Proposition C.3 demonstrates that our findings remain robust when compensation is paid directly from firm profits.

Proposition C.3. *Assume that the manager exerts effort ($e_F = 1$). Then there exists a unique equilibrium in which the informed investor's trading strategy is identical to the one described in Proposition 2. The equilibrium pricing rule as a function of the aggregate order flow $q = x + z$ at*

[38] Note that for $1 - P_\gamma(q > 0)\big|_{a=0} - \gamma\eta$ to be decreasing in γ, we need that θ is sufficiently small. If the threshold $\bar{\theta}$ does not generate this property, we additionally impose a lower threshold to ensure this property.

$t = 1$ is

$$\tilde{P}_\gamma(q) = P_\gamma(q) - \mathbb{1}_{\{q>0\}} \frac{B_F}{\Delta_F \lambda \tau_\gamma^*} = \begin{cases} \frac{p_F(1-p_S)(1-a^*)}{p_F(1-p_S)(1-a^*)+(1-p_F)}, & \text{if } q = 0, \\ \frac{p_F(1-\lambda(1-p_S)(1-a^*))}{p_F(1-\lambda(1-p_S)(1-a^*))+(1-p_F)(1-\lambda)} - \frac{B_F}{\Delta_F \lambda \tau_\gamma^*}, & \text{if } q > 0, \end{cases}$$

where $P_\gamma(q)$ denotes the price from Proposition 2.

Proof. Consider an equilibrium in which the manager exerts effort ($e_F = 1$). Recall the equilibrium as outlined in Table 1 from the proof of Proposition 2. Following the proof of Proposition 2, Bayesian updating implies the same expressions for $\Pr(F = 1|q = 0)$ and $\Pr(F = 1|q > 0)$.

Anticipating that an optimal contract will pay the manager $W_\gamma^*(q) > 0$ when $q > 0$ and zero otherwise, the market makers' pricing rule is given by $\tilde{P}_\gamma(q) = P_\gamma(q) - \mathbb{1}_{\{q>0\}} W_\gamma^*(q > 0)$, where $P_\gamma(q)$ denotes the price gross of compensation from Proposition 2.

We next solve for the informed investor's optimal trading strategy. Consider first the state $F = 1$ and $S = 0$. The investor prefers to buy a share if $1 - W_\gamma^*(q > 0) - \tilde{P}_\gamma(q > 0) \geq 0 \Leftrightarrow P_\gamma(q > 0) < 1$, which clearly holds. Consider next the state $F = 0$. The investor prefers to abstain from buying a share if $0 - W_\gamma^*(q > 0) - \tilde{P}_\gamma(q > 0) < 0 \Leftrightarrow \tilde{P}_\gamma(q > 0) > 0$, which again clearly holds.

What remains to be determined is the optimal trading strategy when $F = 1$ and $S = \eta$. Note that the investors expected utility from buying a share is $1 - W_\gamma^*(q > 0) - \tilde{P}_\gamma(q > 0) - \gamma\eta = 1 - P_\gamma(q > 0) - \gamma\eta$. As a result, the derivation of the trading behavior is identical to that derived in the proof of Proposition 2.

Further, using the optimal contract from equation (2) for $q > 0$: $W_\gamma^*(q > 0) = \frac{B_F}{\Delta_F \lambda \tau_\gamma^*}$, the pricing formula follows. ■

When the manager is compensated ex post from the firm's financial payoff, the stock price reflects the net-of-wages financial payoff. Since the manager's compensation is known at the time of trading, market makers fully incorporate this cost into the price. Importantly, this adjustment to the pricing mechanism does not affect the informed investor's trading behavior. Consequently, all our results regarding the impact of sustainable investing on market-based governance remain valid under this alternative specification.

C.4 Competitive Informed Trading

In this section, we demonstrate the robustness of our mechanism to assumptions about the market microstructure. Specifically, we consider a market microstructure with competitive informed trading as in Dow et al. (2017). Instead of the single informed investor in the main specification, we now assume a unit mass of informed investors, each possessing private information about the firm's financial performance (F) and social cost (S). Each informed investor, indexed by $i \in [0,1]$, can submit an order $x_i \in [0,1]$ based on their private information about F and S. As in the main specification, each investor's gross utility of holding a share is $F - \gamma S$. To accommodate continuous trading, we assume that noise trader demand follows an exponential distribution: $z \sim \text{Exp}(\lambda)$ with $\lambda > 0$. All other model features remain unchanged from our main specification.

In the benchmark with purely financial investors ($\gamma = 0$), each informed investor trades the maximum size possible upon learning favorable information about the firm's financial payoff (i.e., $F = 1$) and abstains from trading otherwise: $x_i^* = 1$ if and only if $F = 1$. The equilibrium pricing rule is given by

$$P_0(q) = \begin{cases} 0, & q < 1, \\ \frac{p_F}{p_F + (1-p_F)e^{-\lambda}}, & q \geq 1, \end{cases}$$

where $q = x + z$ is the aggregate order flow and $x = \int_i x_i di$ is total informed trading. The effort informativeness of the firm's stock price is

$$\phi_0^* = \frac{p_F + (1-p_F)e^{-\lambda}}{(p_F - \Delta_F) + (1 - p_F + \Delta_F)e^{-\lambda}}.$$

However, as the social concerns of informed investors strengthen, the aggregate level of informed trading declines and market governance weakens. The following proposition characterizes the trading equilibrium at $t = 1$ when $\gamma > 0$.

Proposition C.4. *Assume that the manager exerts effort ($e_F = 1$). Then there exists an equilibrium in which: (i) all informed investors buy one share ($x_i^* = 1$) upon observing a high financial payoff and a low social cost ($F = 1$ and $S = 0$), (ii) all informed investors abstain from buying ($x_i^* = 0$) upon observing a low financial payoff ($F = 0$), and (iii) a fraction a^* of informed investors buy a share upon observing a high financial payoff and a high social cost ($F = 1$ and $S = \eta$) while the* *remaining abstain, where*

$$a^* = \begin{cases} 1, & \text{if } \gamma \le \underline{\gamma}, \\ 0, & \text{if } \gamma \ge \bar{\gamma}. \end{cases}$$

and is defined implicitly by

$$\gamma\eta = \frac{(1-e^{-\lambda(1-a^*)})p_F(1-p_F)e^{-\lambda(1-a^*)}}{p_F(1-p_F)e^{-\lambda(1-a^*)}+(1-p_F)e^{-\lambda}} + \frac{e^{-\lambda(1-a^*)}(1-p_F)e^{-\lambda}}{p_F(p_S+(1-p_S)e^{-\lambda(1-a^*)})+(1-p_F)e^{-\lambda}}$$

when $\gamma \in (\underline{\gamma}, \bar{\gamma})$. Moreover, informed trading (a^*) strictly declines in γ over this range. The thresholds for the intensity of social concerns are given by

$$\underline{\gamma} = \frac{1}{\eta}\left(\frac{(1-p_F)e^{-\lambda}}{p_F+(1-p_F)e^{-\lambda}}\right)$$

and

$$\bar{\gamma} = \frac{1}{\eta}\left(\frac{\left(1-e^{-\lambda}\right)(1-p_F)e^{-\lambda}}{p_F(1-p_S)e^{-\lambda}+(1-p_F)e^{-\lambda}} + \frac{\left(e^{-\lambda}\right)(1-p_F)e^{-\lambda}}{p_F(p_S+(1-p_S)e^{-\lambda})+(1-p_F)e^{-\lambda}}\right),$$

with $\underline{\gamma} < \bar{\gamma}$. The equilibrium pricing rule is

$$P_\gamma(q) = \begin{cases} 0, & \text{if } q < a^*, \\ \frac{p_F(\tau_\gamma^*-p_S)}{p_F(\tau_\gamma^*-p_S)+(1-p_F)e^{-\lambda}}, & \text{if } q \in [a^*, 1), \\ \frac{p_F\tau_\gamma^*}{p_F\tau_\gamma^*+(1-p_F)e^{-\lambda}}, & \text{if } q \ge 1, \end{cases}$$

where $\tau_\gamma^* = p_S + (1-p_S)e^{-\lambda(1-a^*)}$ is the equilibrium informed trading intensity.

Proof of Proposition C.4. Consider an equilibrium in which the manager exerts effort ($e_F = 1$) and a fraction a of informed investors buy a share upon observing a high financial payoff and a high social cost ($F = 1$ and $S = \eta$). Table 5 shows the distribution of the aggregate order flow in different states of the world when informed traders follow the trading strategies described in the proposition.

F	S	$\Pr(F,S)$	Informed Trade x	Order Flow q	$\Pr(q)$
0	η	$(1-p_F)(1-p_S)$	$x=0$	$q \geq 0$	$\lambda e^{-\lambda q}$
0	0	$(1-p_F)p_S$	$x=0$	$q \geq 0$	$\lambda e^{-\lambda q}$
1	η	$p_F(1-p_S)$	$x=a$	$q \geq a$	$\lambda e^{-\lambda(q-a)}$
1	0	$p_F p_S$	$x=1$	$q \geq 1$	$\lambda e^{-\lambda(q-1)}$

Table 5: Distribution of Equilibrium Aggregate Order Flow

In this case, Bayesian updating implies

$$\Pr(F=1|q<a)=0,$$

$$\Pr(F=1|q\in[a,1))=\frac{p_F(\tau_\gamma-p_S)}{p_F(\tau_\gamma-p_S)+(1-p_F)e^{-\lambda}},$$

and

$$\Pr(F=1|q\geq 1)=\frac{p_F\tau_\gamma}{p_F\tau_\gamma+(1-p_F)e^{-\lambda}},$$

where

$$\tau_\gamma=p_S+(1-p_S)e^{-\lambda(1-a)}.$$

Hence, the market makers' pricing rule is given by

$$P_\gamma(q)=\begin{cases}0, & \text{if } q<a,\\ \frac{p_F(\tau_\gamma-p_S)}{p_F(\tau_\gamma-p_S)+(1-p_F)e^{-\lambda}}, & \text{if } q\in[a,1),\\ \frac{p_F\tau_\gamma}{p_F\tau_\gamma+(1-p_F)e^{-\lambda}}, & \text{if } q\geq 1.\end{cases}$$

We next determine the optimal trading strategy for informed investors. To begin with, note that it is straightforward to confirm that all informed investors prefer to buy one share when they learn that $F=1$ and $S=0$ and to abstain from buying when they learn that $F=0$. What remains to be determined is the optimal trading strategy when $F=1$ and $S=\eta$. First, consider an equilibrium with $a=1$, which requires

$$1-P_\gamma(q\geq 1)\big|_{a=1}-\gamma\eta>0\Leftrightarrow\gamma\leq\frac{1}{\eta}\left(1-P_\gamma(q\geq 1)\big|_{a=1}\right)=\frac{1}{\eta}\frac{(1-p_F)e^{-\lambda}}{p_F+(1-p_F)e^{-\lambda}}=:\underline{\gamma}.$$

Similarly, an equilibrium with $a = 0$ requires that

$$\begin{aligned}
\gamma \geq & \frac{1}{\eta}\left(1-(1-e^{-\lambda})P_\gamma(q\in[0,1))\big|_{a=0} - e^{-\lambda}P_\gamma(q\geq 1)\big|_{a=0}\right) \\
= & \frac{1}{\eta}\left(\frac{\left(1-e^{-\lambda}\right)(1-p_F)e^{-\lambda}}{p_F(1-p_S)e^{-\lambda}+(1-p_F)e^{-\lambda}} + \frac{\left(e^{-\lambda}\right)(1-p_F)e^{-\lambda}}{p_F(p_S+(1-p_S)e^{-\lambda})+(1-p_F)e^{-\lambda}}\right) =: \bar{\gamma}.
\end{aligned}$$

Note that $\underline{\gamma} < \bar{\gamma}$ since

$$\eta\bar{\gamma} = \left(1-e^{-\lambda}\right)\underbrace{\frac{(1-p_F)e^{-\lambda}}{p_F+(1-p_F)e^{-\lambda}-p_F(1-(1-p_S)e^{-\lambda})}}_{>\eta\underline{\gamma}} + e^{-\lambda}\underbrace{\frac{(1-p_F)e^{-\lambda}}{p_F+(1-p_F)e^{-\lambda}-p_F(1-p_S)(1-e^{-\lambda})}}_{>\eta\underline{\gamma}}.$$

Second, consider an equilibrium with $a \in (0,1)$, which requires each informed investor to be indifferent between acquiring more shares and not

$$\begin{aligned}
1-\mathbb{E}[P_\gamma|a\in(0,1)]-\gamma\eta = & \ 0, \\
1-\left(1-e^{-\lambda(1-a)}\right)P_\gamma(q\in[a,1))\big|_{a\in(0,1)} - \left(e^{-\lambda(1-a)}\right)P_\gamma(q\geq 1)\big|_{a\in(0,1)} - \gamma\eta = & \ 0.
\end{aligned} \tag{12}$$

Note that the *LHS* of (12) strictly decreases in a because

$$\lambda e^{-\lambda(1-a)}(P_\gamma(q\in[a,1))\big|_{a\in(0,1)} - P_\gamma(q\geq 1)\big|_{a\in(0,1)}) < 0,$$

$$\frac{\partial P_\gamma(q\in[0,1))\big|_{a\in(0,1)}}{\partial a} = \frac{\partial P_\gamma(q\in[0,1))\big|_{a\in(0,1)}}{\partial\tau}\frac{\partial\tau}{\partial a} > 0,$$

and

$$\frac{\partial P_\gamma(q\geq 1)\big|_{a\in(0,1)}}{\partial a} = \frac{\partial P_\gamma(q\geq 1)\big|_{a\in(0,1)}}{\partial\tau}\frac{\partial\tau}{da} > 0.$$

Moreover, $\gamma\in(\underline{\gamma},\bar{\gamma})$ implies that the *LHS* of (12) is strictly positive when $a = 0$ and strictly negative when $a = 1$. Hence, the intermediate value theorem implies that there is a unique $a^* \in (0,1)$ such that (12) holds with equality.

Evaluating the *LHS* of (12) at $a = 0$ and $a = 1$ yields the thresholds $\bar{\gamma}$ and $\underline{\gamma}$, respectively.

Moreover, differentiating (12) with respect to γ yields

$$\underbrace{\frac{\partial LHS}{\partial a^*}}_{<0}\frac{\partial a^*}{\partial \gamma} - \eta = 0,$$

implying that $\frac{da^*}{d\gamma} < 0$. Hence, the total amount of informed trading (a^*) when $F = 1$ and $s = \eta$ is a continuous decreasing function of γ for $\gamma \in [0,1]$ as in the main specification of the model. ■

Proposition C.4 implies that effort informativeness in equilibrium is given by

$$\phi^*_\gamma = \frac{p_F \tau^*_\gamma + (1-p_F)e^{-\lambda}}{(p_F - \Delta_F)\tau^*_\gamma + (1 - p_F + \Delta_F)e^{-\lambda}},$$

which strictly increases in τ^*_γ, and, hence, increases in a^*. Recall that τ^*_γ decreases with γ, which implies that effort informativeness decreases as γ increases.

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