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Sustainable Investing and Market Governance

Finance Working Paper N° 677/2500
May 2025

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Abstract

This paper examines how sustainable investing affects the governance role of financial markets. We show that stronger pro-social preferences among informed investors can reduce price informativeness about managerial effort to improve financial performance, increasing the cost of incentive provision. Our mechanism gives rise to a positive relationship 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, Q5

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Sustainable Investing and Market Governance*

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May 16, 2025

Abstract

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Keywords: Sustainable investing, corporate governance, market monitoring, ESG, managerial incentives, price informativeness, agency costs, divestment
JEL Classifications: G30, G32, G34, G14, G23, M14, Q56

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1 Introduction

The rise of sustainable investing, which incorporates social and environmental factors into investment decisions, has significantly impacted financial markets.[1] A growing literature examines how sustainable investors' impact on firms' market prices can have real environmental and social consequences by reducing corporate externalities (e.g., Heinkel et al., 2001; Pastor et al., 2021; Pedersen et al., 2021; Gupta et al., 2024). However, this literature has largely overlooked how changes in market prices due to sustainable investing affect the traditional governance role of financial markets (e.g., Holmström and Tirole, 1993).

In this paper, we examine how sustainable investing influences firm governance through its effects on price informativeness and market-based monitoring. Our analysis demonstrates 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, a pro-social informed trader may choose not to invest in a firm with poor environmental or social outcomes, even when observing strong financial performance. This decision reduces informed trading based on firm fundamentals, thereby lowering the informational content of prices. Consequently, it becomes more costly for firms' shareholders to incentivize managers to improve financial performance. If these incentive costs become sufficiently high, shareholders may optimally reduce incentive provision, leading to lower managerial effort and ultimately diminishing firm 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. Our analysis challenges arguments that these components are unrelated and should not be considered jointly in ESG ratings.[2] Specifically, we demonstrate that when an informed trader cares strongly about firm externalities, a positive relationship emerges between ES and G scores. This relationship emerges endogenously because shareholders can more easily incentivize

[1] For instance, Edmans et al. (2024) report that 77% of 509 surveyed active equity portfolio managers say that they 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.

managerial effort to improve firm fundamentals (leading to higher G scores) when the firm is more likely to achieve good environmental and social outcomes (reflected in higher ES scores). Intuitively, lower externalities increase informed trading based on firm fundamentals, leading to more informative stock prices that enhance market-based governance.

Building on this foundational link between firm sustainability and governance, we establish several key insights. Importantly, the market-governance channel of sustainable investing may lead to improvements in real social and environmental outcomes by financially motivated agents. In particular, we show that even purely financially motivated shareholders who do not care about externalities may rationally invest in reducing firm externalities to enhance price informativeness and reduce the cost of providing managerial incentives. Similarly, a purely financially motivated manager may exert costly effort to reduce externalities because this may increase their total financial compensation. Thus, the agency costs of sustainable investing can paradoxically generate positive real effects by incentivizing firms to reduce externalities.

The market-governance channel of sustainable investing in our paper differs from the traditional cost-of-capital channel (e.g., Broccardo et al., 2022). In our framework, sustainable investors affect real outcomes by making incentive provision, rather than capital, more expensive. This implies that sustainable investing can have real effects even when there is no difference in the expected returns of green and brown firms. We further show that sustainable investing can lead to differences in price volatility, rather than in expected returns, of green and brown firms. Finally, we show that financial shareholders may optimally link managerial compensation to ES news even if the manager has no ability to improve the firm's ES performance. In our framework, ES-linked compensation can improve firm governance even if it does not reduce firm externalities.

Our model features an informed investor who may have pro-social preferences trading in a Kyle-type market. She possesses private information about the firm's financial performance and social cost.[3] All agents are risk-neutral. The firm generates both an uncertain financial payoff and an uncertain social cost, capturing negative externalities. In our baseline analysis, we assume these two outcomes are uncorrelated to demonstrate the mechanism most transparently. In an extension

[3] In an extension, we demonstrate a natural complementarity between these two types of private information when the informed investor is pro-social. Specifically, acquiring information about the firm's social cost allows the investor to avoid incurring disutility when trading on private information about the firm's financial performance.

to the baseline model, we show that a positive correlation between the firm's financial payoff and its social cost amplifies our main mechanism, while a negative correlation dampens it.

The firm is initially owned by financial investors who value only financial payoffs. A manager operates the firm and can exert costly effort to increase the firm's financial performance. In the baseline model, we assume that 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 be contingent on the firm's interim stock price.

The informed investor's valuation of firm shares depends on both the financial payoff and social cost, weighted by the intensity of her pro-social preferences. She privately observes both the financial payoff and social cost before trading and can either buy a share or abstain. Market makers set prices based on aggregate order flow, which incorporates noise trader demand, to reflect the preferences of marginal financial investors who only care about financial performance. This setup allows us to examine how pro-social investors affect the information content of stock prices and, consequently, the effectiveness of market-based governance.

We show that as the informed investor's pro-social preferences 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 its financial performance and, thus, about managerial effort toward improving financial performance. The decline in price informativeness about managerial effort increases the agency costs of separating ownership and control, as it becomes more costly to incentivize the manager when stock prices provide noisier signals of effort. If these costs become prohibitively high, shareholders may reduce incentive provision, leading to reduced effort and worse financial performance, highlighting a potentially important real cost of sustainable investing.

Price informativeness about managerial effort crucially depends on the probability of the firm 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. Conversely, when the firm frequently generates a high social cost, the informed investor regularly abstains from trading on financial information, reducing the infor-

mation content of prices and making incentive provisions more costly. This mechanism generates a positive relationship between "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 an extension of the baseline model, we allow the firm's initial financial shareholders to invest in reducing the probability of generating social costs. We find that shareholders may make such investments even if 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 lowering incentive costs. "Doing well by doing good" thus arises endogenously in our framework. Unlike traditional arguments that sustainable practices might enhance financial performance by reducing risks or attracting consumers, our model demonstrates that better environmental and social outcomes can directly improve firm financial performance by enhancing market-based governance.

Our model highlights a novel complementarity between voice and exit in reducing firm externalities. Specifically, in our model, pro-social investors' exit decisions prompt financial investors to exercise voice. This interaction across investor types differs from the existing literature, which focuses on the same investor choosing between voice and exit. This complementarity between exit and voice introduces a new perspective, as academics and practitioners typically view the two as competing investment strategies (e.g., Broccardo et al., 2022).

In a complementary extension, in which the manager can exert costly social effort to improve the firm's social performance, we highlight another channel through which the market-governance channel can have real effects on firm externalities. We show that when the informed investor's pro-social preferences are sufficiently strong, a purely financially motivated manager may exert social effort to increase the intensity of informed trading, which makes it more likely that he is rewarded for his financial effort that improves the firm's fundamentals.

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 of firms 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.

We further explore how public news about firm externalities affects market monitoring in the presence of sustainable investing. We show that when there is public news about the social cost being low, optimal contracts may include bonuses contingent on both prices and news about social costs. Intuitively, the public signal helps the firm interpret the information contained in the stock price, which lowers the cost of compensation. Consequently, managerial compensation tied to social outcomes may be optimal even when controlling shareholders do not care about the firm's social cost and when the manager cannot take actions to reduce externalities. We thus show that ES-linked compensation can improve governance quality, consistent with empirical 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).

We also examine how the precision of the informed investor's private information about the firm's social cost affects price informativeness regarding effort. We find that increased precision can have ambiguous effects. A more precise signal increases the dispersion in the informed investor's posterior beliefs about the firm's social cost. When the firm's expected social cost is high, increased precision reduces informed trading on financial information, decreasing effort informativeness. When the firm's expected social cost is low, the opposite occurs—increased precision encourages informed trading on financial information, increasing effort informativeness.

The remainder of the paper proceeds as follows. We discuss the related literature in Section 2. Section 3 presents the model. Section 4 analyzes the benchmark case with only financial investors. Section 5 examines how pro-social investors affect agency costs and governance. Section

6 explores extensions, including the firm's incentives to reduce the social cost, the role of public news about the social cost, and the precision of the informed investor's private information about the social cost. Section 7 concludes.

2 Related Literature

Our paper contributes to the theoretical literature studying the real impact of pro-social investors on firm decisions (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).[4] A significant part of this literature examines how pro-social 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 pro-social investors can affect firm behavior through market prices beyond the cost-of-capital effect by undermining the traditional governance role of stock markets in disciplining management. We also highlight a complementarity between voice and exit in reducing firm externalities, in contrast to papers that view these as competing investment strategies (e.g., Berk and Van Binsbergen, 2022; Broccardo et al., 2022; Jagannathan et al., 2023; Gupta et al., 2024).

A small number of papers study optimal contracting based on stock prices when investors have pro-social preferences.[5] Chaigneau and Sahuguet (2024) study how a board optimally sets

[4]Legal scholars have also recognized that sustainable investing practices affect the agency problem arising from the separation of ownership and control. For example, Christie (2021) discusses how sustainability concerns shape investor activism.

[5]A number of other papers study optimal contracting without stock price-based incentives (e.g., Baron, 2008; Bonham and Riggs-Cragun, 2022). There are also papers that study the effect of stock prices on 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).

managerial compensation to balance financial and social goals. In their model, the stock price is exogenous, and there are no pro-social investors affecting price informativeness, which is our focus. The tilting strategy of pro-social investors in Edmans et al. (2023) can be interpreted as an incentive mechanism affecting managerial behavior through stock prices. In their framework, pro-social investors affect prices by changing the risk-bearing capacity of the market. In contrast, our framework shows how pro-social investors affect managerial behavior by altering the informativeness of the stock price. A related literature studies firm investment with sustainability concerns in the presence of feedback effects (e.g., Chen and Schneemeier, 2023; Xue, 2023). However, these papers do not study optimal contracting.

Our paper is closely related to Goldstein et al. (2022), who study how informed trading by pro-social investors affects the information contained in prices.[6] We contribute by introducing optimal contracting, which allows us to study how informed trading by pro-social investors affects the traditional governance role of stock markets. Our framework focuses on the real effects, highlighting a novel channel through which sustainable investing affects firm financial performance and externalities.

We also 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, 2009a) by introducing public good provision and pro-social investors. Specifically, we examine how the pro-social preferences of an informed investor influence her trading behavior and the ability of shareholders to discipline managers using compensation contracts based on the stock price.

Our paper contributes to the literature examining multiple, potentially conflicting roles of stock prices (e.g., Bresnahan et al., 1992; Banerjee et al., 2022). Most closely related is Banerjee et al. (2022), who identify a fundamental trade-off between investment efficiency and effort efficiency when stock prices both guide investment decisions and incentivize effort. In a related paper, Strobl (2014) demonstrates that shareholders' concerns about the effectiveness of stock-based compensation can lead to overinvestment as a means to increase price informativeness. In contrast, our mechanism is driven by the interaction between public and private good provision, revealing a

[6] Yang et al. (2023) and Hitzemann et al. (2024) provide evidence consistent with pro-social investing affecting price informativeness.

complementarity between social efficiency and effort efficiency when stock prices reflect both firm financial performance and externalities. Specifically, enhanced social efficiency—achieved through reducing negative externalities—improves effort efficiency by facilitating more informed trading based on financial information.

Our paper also 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 suboptimal short-termism, even when each firm's managerial contract and project choice are individually optimal. In these papers, inefficiencies arise from general equilibrium effects with varying horizons of payoffs. Our mechanism differs as inefficiencies arise in partial equilibrium with identical payoff horizons. The insights, therefore, naturally differ. For example, interpreting the long-horizon projects in Dow et al. (2024) as sustainable choices and long-term investors as more pro-social implies that strengthening sustainable investing by increasing investor horizon would lead to more sustainable long-term investments, which increases efficiency. In contrast, strengthening pro-social preferences in our model leads to weaker governance and a deterioration in firm fundamentals, reducing 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 that is initially owned by financial investors. At the final date $t = 2$, the firm generates a financial payoff for its owners and potentially imposes a negative externality 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 the firm's externality, has private information about the firm's financial payoff and social cost and can acquire a stake in the firm. 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 the final date $t = 2$, where $\eta > 0$. Normalizing

the low social cost to zero simplifies the analysis but is not necessary for our results. In Section 6.4, we introduce noise into the informed investor's information on S, which is isomorphic to a model with a high and a low social cost. The social cost may represent, for instance, the social cost of carbon that captures the economic damages resulting from the firm's carbon emissions (e.g., Bolton and Kacperczyk, 2021, 2023) or the social cost of an opioid epidemic (e.g., Maclean et al., 2020; Case and Deaton, 2021; Florence et al., 2021). Managerial effort exerted 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 given by $p_F \in (0,1)$; 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 is equal to 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 6.1 considers an extension with observable investments that can lower the probability of a high social cost, and Section 6.2 introduces managerial effort to reduce the probability of a high social cost. To most clearly demonstrate how sustainable investing affects the traditional monitoring role of financial markets, we assume that F and S are independent and abstract away from effects that can arise if investors update their expectations about a firm's financial payoff based on its social cost (e.g., Pedersen et al., 2021). In Section 6.5, we introduce an arbitrary correlation between F and S and demonstrate the robustness of our results. Furthermore, to focus on the case where market monitoring is desirable, we assume that exerting financial effort is socially efficient: $N\Delta_F > B_F$.

The firm's shares are traded at $t = 1$ in a discrete Kyle (1985)-type market. Restricting trading to discrete quantities is well-established in applied financial economics when analyzing phenomena beyond price formation, including feedback effects, strategic manipulation, and short-selling constraints (e.g., Goldstein and Guembel, 2008; Edmans et al., 2015; Gao et al., 2025).[7] Noise traders' random demand $z \in \mathbb{N}_0 := \{0,1,\ldots\}$ follows a geometric distribution with density function $(1-\lambda)^z\lambda$, where $\lambda \in (0,1)$.[8] For simplicity, we assume the informed investor learns the

[7] We can generate the main mechanism in our model in a framework with continuous informed trading as in Edmans (2009b), but the setup is much less tractable.

[8] This distribution results in a constant likelihood ratio for larger order flows, simplifying the solution for the equilibrium pricing rule and optimal contract. Note that this specification implies that the expected demand from noise traders is $\frac{1}{\lambda} - 1 > 0$. However, we can shift the support of the distribution so that the demand from noise traders can be non-positive without affecting our results.

realized values of F and S before trading.[9] We introduce noise into the informed investor's private information in Section 6.4. 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). In Appendix C.1, we allow for short-selling (i.e., $x \in \{-1,0,1\}$) and demonstrate the robustness of our results.[10] 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.[11] Specifically, the informed investor exhibits pro-social preferences 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 $t=1$.

We are agnostic about why the informed investor values firms with low externalities more. This may capture investors inherently caring about externalities or concerns about physical or transition risks, which may differ from those of the firms' initial shareholders due to different beliefs or exposure.[12] The informed investor in our framework is most similar to the manager of an active equity fund—someone who has relevant private information and may trade based on information about firm externalities besides firm financial information. There is evidence that investors demand mutual funds with high sustainability ratings (e.g., Hartzmark and Sussman, 2019; Edmans et al., 2024), that many mutual fund managers have private information about firms' sustainability performance with their trades predicting future changes in ESG ratings (Ceccarelli et al., 2024), and that trading on ESG information has increased noise in prices (Cao et al., 2023;

[9] Section 6.6 extends the model to consider the endogenous acquisition of private information about the firm's social cost S, highlighting a natural complementarity between the two types of private information for an informed pro-social investor.

[10] Specifically, we show that the informed investor fully trades on her negative information about the firm's financial payoff, short selling ($x=-1$) upon observing $F=0$. However, her trading intensity upon learning positive information ($F=1$) still decreases with stronger pro-social preferences, increasing the cost of compensating the manager.

[11] While not necessary for any of the results in our paper, requiring that $\gamma \leq 1$ ensures that the total disutility suffered by the informed investor does not exceed the social cost.

[12] Under the former interpretation, the investor can either have deontological warm-glow preferences, inherently valuing firms for being green (e.g., Heinkel et al., 2001; Pastor et al., 2021; Pedersen et al., 2021) or consequentialist broad-impact preferences, leading them to adopt an investment mandate reflecting those preferences (e.g., Gupta et al., 2024). There is growing evidence that moral and ethical considerations influence investors' decision-making in a financial market context (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 on the evidence for pro-social preferences in financial markets. For evidence on pro-social preferences in other non-financial contexts, see List (2009).

Yang et al., 2023). More broadly, many papers highlight the importance of active equity fund managers in influencing 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.[13] Consequently, the firm's stock price at $t = 1$ depends solely on the expected value of the firm's financial payoff F at $t = 2$. In Appendix C.2, we introduce market makers who partially account for the social cost in setting prices and demonstrate the robustness of our results.

The firm's initial controlling shareholders—being financial investors—care only about the firm's financial payoff, F.[14] At $t = 0$, they design the manager's compensation contract, denoted by W, to maximize the firm's expected financial payoff net of compensation costs. The manager is protected by limited liability, so the contract requires $W \geq 0$. To emphasize the monitoring role of the financial market, we assume that the manager's incentive pay can only be contingent on the firm's stock price P at $t = 1$.[15] The manager's outside option is normalized to zero. To simplify the exposition, we follow the literature and assume 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). In Appendix C.3, we show that this assumption is without loss of generality in our framework.[16] Figure 1 summarizes the model's timing.

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

[13] The intuition is that the market makers must break even in expectation and anticipate selling any order imbalance to the marginal investor at $t = 2$, whom we assume to be a financial investor valuing shares at F.

[14] We make this assumption to abstract from the direct impact of sustainable investing through voice by pro-social shareholders, which would matter in our extensions in which the firm can reduce externalities through direct investment (Section 6.1) or managerial effort (Section 6.2). However, in our baseline model, pro-social initial shareholders do not alter our results since they can only maximize expected financial firm value.

[15] Alternatively, we can adjust the information structure so that the stock price contains incremental information about the manager's effort beyond that in F. In this case, we can allow the contract to depend both on the price P and the financial payoff F without qualitatively changing the model's main predictions.

[16] 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.

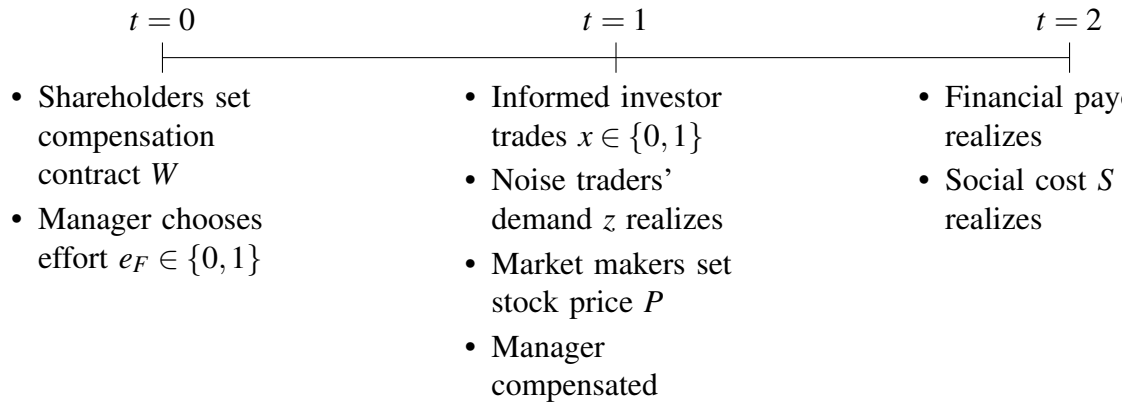


Figure 1: Model Timeline

objects in this benchmark case with a subscript 0. Under purely financial preferences, the informed investor's optimal strategy is straightforward: buy one share if and only if she observes $F = 1$.

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 $P_0(0) = 0$. In contrast, high aggregate order flow ($q > 0$) creates ambiguity—it could result from informed buying based on positive information about F (with probability p_F) or from noise trading (with probability $(1 - p_F)(1 - \lambda)$). 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 the cost of buying a share is $P_0(q > 0) < 1$ due to noise trading.

Anticipating the trading equilibrium at $t = 1$, the firm's 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).[17] For ease

[17]For recent papers considering risk-neutral contracting with a finite number of states, similar to this paper, see,

of exposition, we consider the contracting problem as a function of the order flow rather than the price. As will become clear below, this is without loss of generality. The likelihood ratio as a function of the 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.

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 firm's stock price.[18] Since the maximum likelihood ratio occurs in all states $q > 0$, which corresponds to positive order flow and a high stock price, the manager optimally receives compensation only in these states. Hence, we consider a contract that pays the manager a constant bonus for $q > 0$ and zero otherwise.[19]

The manager's compensation for $q > 0$, denoted by $W_0^*(q > 0)$, is set to make the manager just

e.g., Chaigneau et al. (2019) and Starmans (2023, 2024).

[18] 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 firm's 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 $\frac{\partial\phi_0^*}{\partial\psi_0} > 0$.

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

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 leverages the effort informativeness of the stock price by paying the manager more when the 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 effort.

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. Note that, as is standard in risk-neutral contracting under limited liability, the manager earns rents under an optimal contract. Thus, compensating the manager is costly for shareholders, with the manager's rent and the cost of compensating the manager decreasing in the maximum likelihood ratio—the stock price's effort informativeness.

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 firm's 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 pro-social preferences. Without this assumption, shareholders would never induce effort, making changes in market-monitoring effectiveness irrelevant.

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

5 Agency Cost of Sustainable Investing

This section studies how the informed investor's pro-social preferences affect the governance role of financial markets. We denote equilibrium objects with a subscript γ to highlight their dependence on the intensity of these preferences. The benchmark case with $\gamma = 0$ was analyzed in Section 4.

We first characterize how the informed investor's pro-social preferences affect equilibrium trading, pricing, and incentive costs in Section 5.1. Section 5.2 then examines the relationship between the firm's propensity to generate a high social cost and managerial effort, showing that sustainable investing creates an endogenous link between these outcomes. Finally, Section 5.3 studies how sustainable investing affects expected returns and stock price volatility for firms with different propensities to generate a social cost.

5.1 Equilibrium with Sustainable Investing

The presence of 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. The relative importance of the social cost in her valuation is captured by the parameter γ. Given this valuation, her optimal trading strategy is straightforward in two states: she never submits a buy order when $F = 0$, as the expected market-clearing price would exceed her valuation, and she always buys when observing $F = 1$ and $S = 0$, as her valuation exceeds the expected market-clearing price. What remains to be determined is the informed investor's 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.[20] Figure 2 summarizes the informed investor's trading behavior across all possible states.

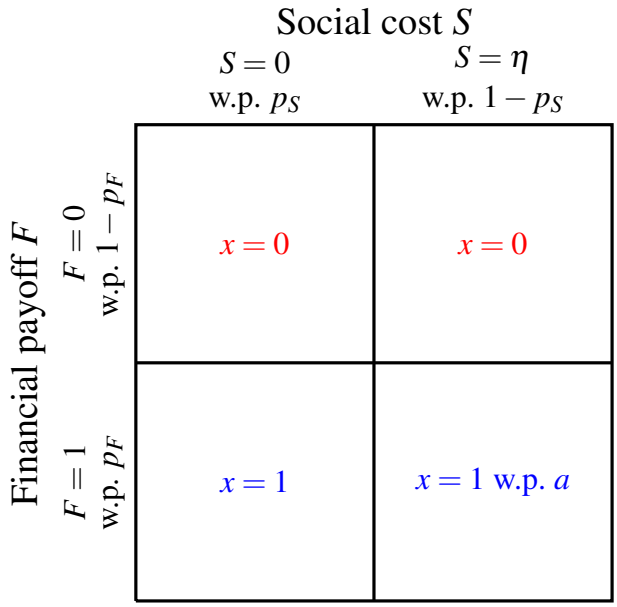


Figure 2: Informed Investor's Trading Strategy. This figure illustrates the informed investor's equilibrium trading behavior conditional on observing different combinations of the financial payoff (F) and social cost (S). The variable $a \in [0,1]$ denotes the probability that the informed investor submits a buy order 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 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 high social cost ($F = 1$ and $S = \eta$), where*

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

[20] For intermediate intensities of the informed investor's pro-social preferences, 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 a profitable deviation. Specifically, if the informed investor abruptly shifts from buying to abstaining as her pro-social preferences strengthen, the price would drop discontinuously. However, since her disutility is continuous in her pro-social preferences, this would make buying optimal—a contradiction resolved only through a mixed strategy that allows for a smooth transition in trading behavior and market prices.

The thresholds for pro-social preferences 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 the aggregate order flow $q = x + z$ at $t = 1$ is

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

The informed investor's trading strategy can be characterized by two key quantities. 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, accounting for both social cost realizations. Recall that in our baseline model, the probability of a low social cost (p_S) is exogenous and the manager can only influence the probability of a high financial payoff.[21] Figure 3 illustrates how the quantities a^* and τ_γ^* vary with the informed investor's pro-social preferences. For weak pro-social preferences ($\gamma \leq \underline{\gamma}$), the social cost does not deter trading ($a^* = 1$), resulting in maximal informed trading ($\tau_\gamma^* = 1$). As pro-social preferences strengthen ($\gamma \in (\underline{\gamma}, \bar{\gamma})$), the informed investor becomes less willing to buy with a high social cost, and a^* declines linearly to zero. However, τ_γ^* declines more gradually since the informed investor still buys when observing a low social cost. For strong pro-social preferences ($\gamma \geq \bar{\gamma}$), the informed investor never buys with a high social cost ($a^* = 0$), and informed trading occurs only with a low social cost ($\tau_\gamma^* = p_S$).

The equilibrium prices reflect how the informed investor's trading strategy varies with her pro-social preferences, shown in Figure 4. For weak pro-social preferences ($\gamma \leq \underline{\gamma}$), prices match the benchmark case: zero for low order flow and a constant positive value, which is less than 1, for high order flow. As pro-social preferences strengthen ($\gamma \in (\underline{\gamma}, \bar{\gamma})$), prices become less responsive to order flow—the price for high order flow decreases while the price for low order flow increases—reflecting reduced informativeness about financial payoffs. Specifically, when $\tau_\gamma^* < 1$, an order flow of $q = 0$ no longer provides a definitive signal of a low financial payoff. Similarly, a positive order flow ($q > 0$) no longer provides as strong a signal of a high financial payoff.

[21] Section 6.1 considers an extension with observable investments that lower the probability of a high social cost, and Section 6.2 introduces managerial effort to reduce the probability of a high social cost.

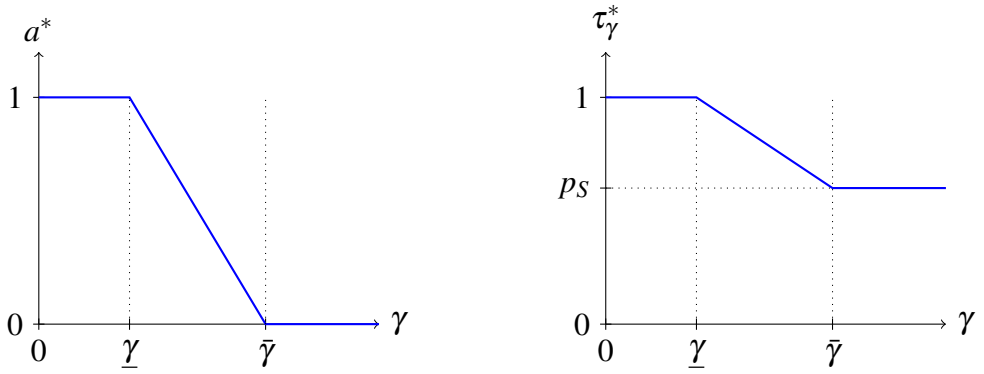


Figure 3: Equilibrium Trading Strategies. This figure shows how the informed investor's trading strategy varies with her pro-social preferences (γ). The left panel plots the probability of buying with a high social cost (a^*). For $\gamma \leq \underline{\gamma}$, the informed investor always buys ($a^* = 1$). For $\gamma \in (\underline{\gamma}, \bar{\gamma})$, a^* decreases linearly. For $\gamma \geq \bar{\gamma}$, the informed investor never buys with a high social cost ($a^* = 0$). The right panel plots the overall probability of informed buying given a high financial payoff (τ^*_γ). For $\gamma \leq \underline{\gamma}$, the informed investor always buys ($\tau^*_\gamma = 1$). For $\gamma \in (\underline{\gamma}, \bar{\gamma})$, τ^*_γ declines more gradually than a^* due to the possibility of a low social cost. For $\gamma \geq \bar{\gamma}$, informed buying occurs only with a low social cost ($\tau^*_\gamma = p_S$).

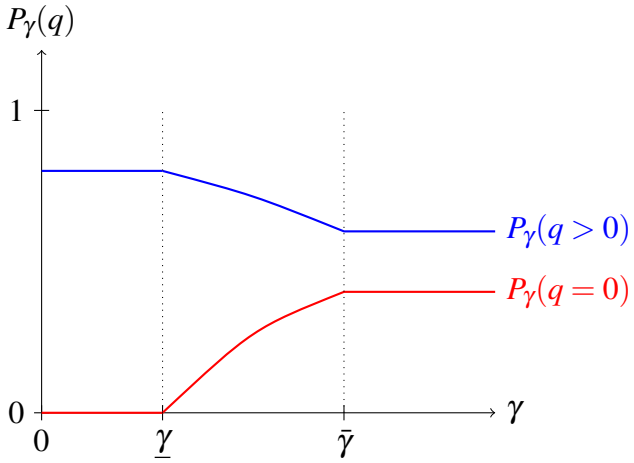


Figure 4: Equilibrium Prices. This figure shows how equilibrium prices vary with the informed investor's pro-social preferences (γ). The blue line represents the price when aggregate order flow is positive ($q > 0$), and the red line represents the price when order flow is zero ($q = 0$). Prices become less responsive to order flow as pro-social preferences strengthen, reflecting reduced informed trading on financial information.

The informed investor's pro-social preferences affect the informativeness of prices about managerial effort through their impact on the likelihood ratio.

Lemma 2. *The likelihood ratio is given by*

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

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^*).[22]

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

Figure 5 illustrates how the maximum likelihood ratio varies with pro-social preferences. For $\gamma \leq \underline{\gamma}$, effort informativeness matches the benchmark case. As pro-social preferences strengthen beyond $\underline{\gamma}$, effort informativeness declines because the informed investor trades less aggressively on financial information.

Given this decline in effort informativeness, the manager's optimal compensation contract also changes with pro-social preferences. The manager's compensation for positive order flow, $W_\gamma(q > 0)$, must make her indifferent between exerting effort and shirking.

[22] Using the notation from Footnote 18, we have $\psi_\gamma = \frac{(1-\lambda+\lambda\tau_\gamma^*)}{1-\lambda}$ where $\tau_\gamma^* = p_S + (1-p_S)a^*$ captures the equilibrium amount of informed trading when $F = 1$. The effort informativeness (ϕ_γ^*) can also be expressed in terms of financial payoff informativeness (ψ_γ): $\phi_\gamma^* = \frac{p_F\psi_\gamma+(1-p_F)}{(p_F-\Delta_F)\psi_\gamma+(1-p_F+\Delta_F)}$.

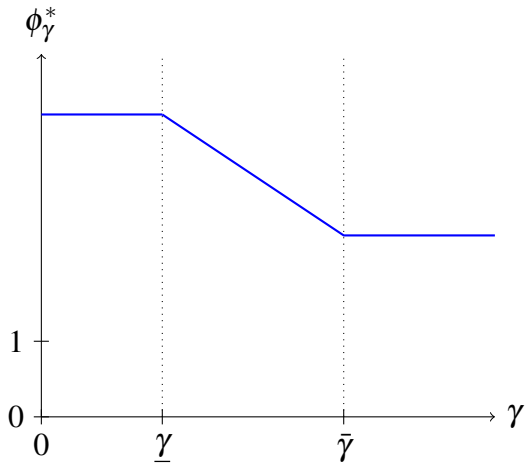


Figure 5: Maximum Likelihood Ratio. This figure shows how the maximum likelihood ratio ϕ^*_γ varies with pro-social preferences. The ratio remains constant at its benchmark level for $\gamma \leq \underline{\gamma}$. For stronger preferences, it decreases as the informed investor trades less aggressively on financial information, reducing price informativeness about managerial effort.

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 with $\tau^*_\gamma = 1$.

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

$$C_\gamma = \frac{1}{1 - \frac{1}{\phi^*_\gamma}} B_F, \tag{3}$$

where ϕ^*_γ captures the effort informativeness of prices when the intensity of the informed investor's pro-social preferences is γ. As the informed investor's pro-social preferences strengthen, her trading strategy is increasingly affected by her private information about 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.

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 pro-social*

preferences (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.

Figure 6 illustrates how incentive costs (C_γ) vary with the informed investor's pro-social preferences (γ). For weak pro-social preferences ($\gamma \leq \underline{\gamma}$), costs match the benchmark case. As pro-social preferences strengthen ($\gamma > \underline{\gamma}$), costs rise because the informed investor trades less aggressively on financial information. When these costs exceed the expected gain from effort ($N\Delta_F$), which occurs for $\gamma > \gamma_e$, shareholders optimally abandon managerial incentives. This reduction in effort represents a real efficiency loss from sustainable investing—the agency cost of sustainable investing.

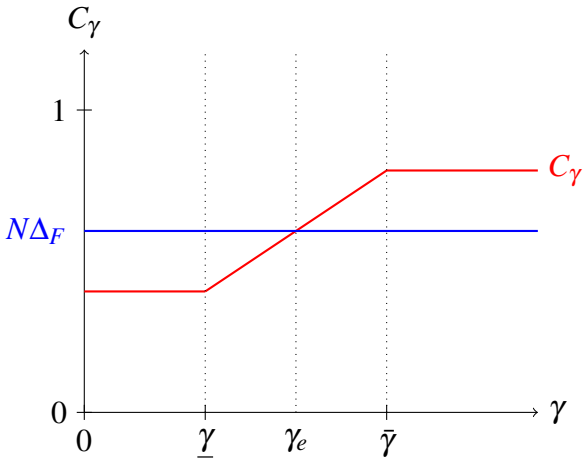


Figure 6: Cost of Incentive Provision. This figure plots the expected cost of providing incentives (C_γ) as a function of pro-social preferences (γ). For weak preferences ($\gamma \leq \underline{\gamma}$), costs equal the benchmark level. As pro-social preferences strengthen, costs increase because informed trading becomes less informative about firm fundamentals. When costs exceed the expected benefit from effort ($N\Delta_F$), shareholders optimally forgo incentive provision. The threshold γ_e represents the level of pro-social preferences above which managerial effort is no longer induced.

In our framework, sustainable investing influences corporate governance by altering the information content of stock prices, thereby affecting the cost-effectiveness of market-based incentive schemes. This mechanism differs fundamentally from traditional cost-of-capital explanations for how sustainable investing affects firm behavior. For instance, Edmans et al. (2023) study a model featuring a market with limited risk-bearing capacity. The exit of sustainable investors due to the firm's negative externalities reduces the market's limited risk-bearing capacity and increases the

firm's cost of capital. As a result, the firm invests less, resulting in poorer financial performance. In contrast, our model features a rational risk-neutral market, which implies that all firms have the same cost of capital. However, the exit of the informed investor due to the firm's negative externalities reduces the effort informativeness of market outcomes and increases the firm's cost of providing incentives. As a result, the firm is less likely to incentivize managerial effort, reducing the firm's expected financial payoff.

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

Our model features two distinct dimensions of what may be captured by ESG ratings in practice. The endogenous probability of a high financial payoff, which depends on managerial effort, $p_F - \Delta_F$ or p_F, can be interpreted as a measure of governance quality—the "G" component of ESG. The exogenous probability of a low social cost, p_S, can be interpreted as a measure of environmental and social quality—the "ES" components of ESG. While the different dimensions of ESG are often viewed as unrelated,[23] our analysis reveals that sustainable investing creates an endogenous link between them through its effect on market monitoring.

The relationship between ES and G, as implied by our model, emerges through the informed investor's trading behavior. To understand this relationship, we first study the effect of p_S on 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 strictly increases in p_S for $p_S \geq \hat{p}_S$. For $\gamma \geq \bar{\gamma}(0)$, $\tau_\gamma^* = p_S$ for all p_S.*

Lemma 3 characterizes how informed trading varies with ES quality, captured by p_S. When pro-social preferences are weak ($\gamma \leq \underline{\gamma}$), informed trading is constant and maximal as the social cost never deters trading. For moderate preferences ($\gamma \in (\underline{\gamma}, \bar{\gamma}(0))$), the relationship between informed trading and p_S depends on whether p_S is below or above a threshold $\hat{p}_S$. As illustrated in Figure 7, below this threshold, there are two forces that exactly offset, resulting in constant informed trading.

[23] 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.

First, a higher p_S makes the state $(F = 1, S = 0)$ more likely, increasing informed trading through this extensive margin. Second, this increase in the extensive margin also raises the market-clearing price for high order flow, making it less likely that the informed investor buys a share in the state $(F = 1, S = \eta)$, that is, she chooses a lower a^*, decreasing informed trading through an 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. However, once p_S reaches $\hat{p}_S$, the informed investor switches to never buying when the social cost is high $(a^* = 0)$. Beyond this point, only the extensive margin operates, and informed trading increases linearly with p_S. For strong preferences $(\gamma \geq \bar{\gamma}(0))$, the informed investor never buys when the social cost is high, so informed trading simply equals p_S.

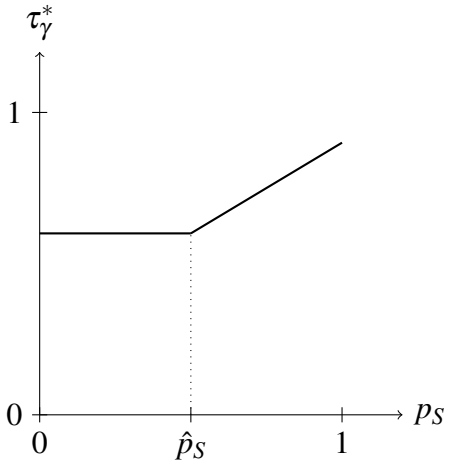


Figure 7: Equilibrium Informed Trading and p_S. This figure shows how equilibrium informed trading (τ^*_γ) varies with p_S for fixed pro-social preferences satisfying $\gamma > \underline{\gamma}$ and $\gamma < \bar{\gamma}(0)$. When p_S is low and $\gamma < \bar{\gamma}$, the informed investor follows a mixed strategy, and the intensive and extensive margin effects of higher p_S exactly offset, keeping τ^*_γ constant. Once p_S reaches the threshold $\hat{p}_S$ where $\gamma = \bar{\gamma}(\hat{p}_S)$, the informed investor switches to never buying with a high social cost $(a^* = 0)$. Beyond this point, further increases in p_S raise τ^*_γ through the extensive margin effect alone.

The probability of a high social cost p_S affects how informative stock prices are about managerial effort, which in turn influences governance quality. The strength of this relationship depends critically on the informed investor's pro-social preferences. We first characterize how effort informativeness of prices varies with p_S.

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.

The relationship between p_S and effort informativeness depends critically on the strength of the informed investor's pro-social preferences. For weak pro-social preferences ($\gamma \leq \underline{\gamma}$), the social cost does not affect trading decisions. In this case, the informed investor ignores her private information about the firm's social cost, making effort informativeness independent of p_S. For moderate pro-social preferences ($\gamma \in (\underline{\gamma}, \bar{\gamma})$), 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—the extensive margin effect of a more likely low social cost and the intensive margin effect of reduced trading with a high social cost—resulting in constant informed trading. For strong pro-social preferences ($\gamma \geq \bar{\gamma}$), the informed investor never buys when observing a high social cost ($a^* = 0$). While changes in the market-clearing price cannot affect this intensive margin, a higher p_S still increases informed trading through the extensive margin by making the state $(F = 1, S = 0)$ more likely. Consequently, effort informativeness increases with p_S in this region.

The preceding analysis describes local changes in p_S holding $\bar{\gamma}$ fixed. However, p_S also affects the threshold $\bar{\gamma}$ itself. Starting from $\gamma < \bar{\gamma}$, an increase in p_S lowers a^* because of the intensive margin effect. Consequently, it lowers $\bar{\gamma}$ because, at some point, the informed investor switches to never buying when the social cost is high ($a^* = 0$). When this occurs, the intensive margin can no longer adjust to offset the extensive margin effect of a higher p_S on informed trading. Consequently, effort informativeness begins to increase with p_S. This non-local effect is captured by the fact that $\bar{\gamma}$ is decreasing in 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. The improvement in p_S has two effects: it shifts the threshold of pro-social preferences from $\bar{\gamma}$ to $\bar{\gamma}'$ and reduces incentive costs when $\gamma \geq \bar{\gamma}'$. When these costs fall below $N\Delta_F$, shareholders optimally provide managerial incentives, which can be interpreted as generating better governance outcomes for firms with higher ES quality. These effects on effort informativeness generate an endogenous relationship between ES and G quality. When pro-social preferences are weak, effort informativeness and, thus, incentive costs stay constant, resulting in governance quality that is

independent of p_S. However, for sufficiently strong pro-social preferences, effort informativeness increases with p_S. A high p_S leads to more informative prices and lower incentive costs, while a low p_S results in less informative prices and higher incentive costs. 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 6.1, 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.

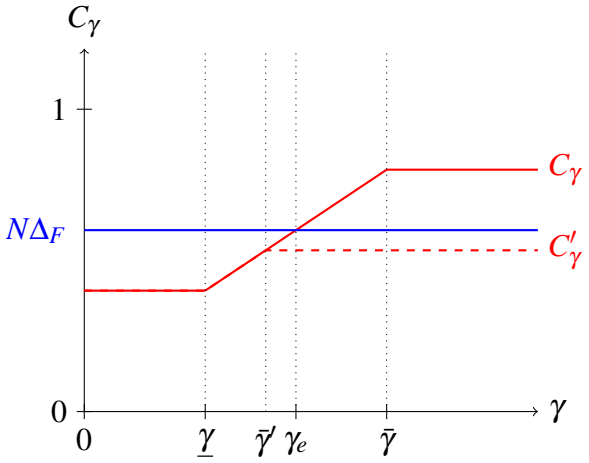


Figure 8: Effect of p_S on Incentive Costs. This figure shows how incentive costs vary with pro-social preferences (γ) for different levels of p_S. The solid red line shows the baseline incentive cost C_γ for an initial p_S. The dashed red line shows incentive costs C'_γ after an increase to $p'_S > p_S$. 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 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), and differences in price volatility, which has received relatively less attention. We show that while expected returns do not vary with p_S, differences in average realized returns and price volatility arise naturally through the effects of sustainable investing on informed trading.

In our model, the risk-neutral market makers, who care only about financial payoffs, 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, measured by $\mathbb{E}[F - P_\gamma(q)] = 0$,

implying no greenium. Importantly, this absence of a greenium does not imply that sustainable investing is not influencing financial markets, asset prices, and firm decisions. As shown in Section 5.2, pro-social preferences significantly affect equilibrium trading outcomes and firm policies.

However, the realization of the social cost influences the informed investor's trading strategy and generates return differences. Define the average realized returns conditional on the social cost as:

$$R_{S=0} = \mathbb{E}[F - P_\gamma(q)|S = 0],$$

and

$$R_{S=\eta} = \mathbb{E}[F - P_\gamma(q)|S = \eta],$$

which can be interpreted as the average realized returns of green and brown firms when firms are classified as such based on the realized social cost.[24]

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 $\tau_\gamma^* < 1$.*

Intuitively, 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 news into prices, leading to undervaluation at $t = 1$ and higher average realized returns. Because market makers set prices to reflect expected financial payoffs, we have $p_S R_{S=0} + (1 - p_S)R_{S=\eta} = 0$, implying that higher average realized returns for high-social-cost firms and lower average realized returns for low-social-cost firms.

The impact of firms' social costs on returns thus depends critically on how they are measured empirically. When firms are classified by what can be interpreted as ex-ante ES quality (p_S), such as supply chain monitoring policies, 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 may help explain the mixed empirical evidence on the existence of a greenium, generated in part by the challenge of empirically distinguishing between expected and realized returns (e.g., Pastor et al., 2022; Eskildsen et al., 2024).

[24]Note that, to simplify the analysis, we consider Dollar returns as it generates a simple linear relationship between expected and average realized returns: $p_S R_{S=0} + (1 - p_S)R_{S=\eta} = 0$.

Beyond returns, our framework generates predictions about price volatility. The variance of the firm's stock price at $t = 1$ is:

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

Proposition 5. *For $\gamma \in (\underline{\gamma}, \bar{\gamma}(0))$, the firm's stock price volatility at $t = 1$, $\text{Var}[P_\gamma]$, 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 pro-social preferences ($\gamma \in (\underline{\gamma}, \bar{\gamma}(0))$) and low p_S ($p_S < \hat{p}_S$), volatility remains constant because informed trading is unchanged due to 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 pro-social preferences ($\gamma \geq \bar{\gamma}(0)$), 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 (volatility) through their effect on informed trading intensity, even when they do not affect first moments (expected returns).

6 Extensions and Robustness

We explore several extensions to our baseline model. These extensions demonstrate the robustness of our core mechanism while yielding additional insights about the effect of sustainable investing on market-based governance. Section 6.1 examines the firm's incentives to invest in reducing the probability of a high social cost. Section 6.2 introduces the manager's ability to reduce the probability of a high social cost through effort. Section 6.3 analyzes how public news about the social cost affects market monitoring. Section 6.4 studies how the precision of the informed investor's signal about the social cost influences governance outcomes. Section 6.5 extends our model by allowing the financial payoff and social cost to be correlated. Section 6.6 endogenizes the strategic investor's information acquisition.

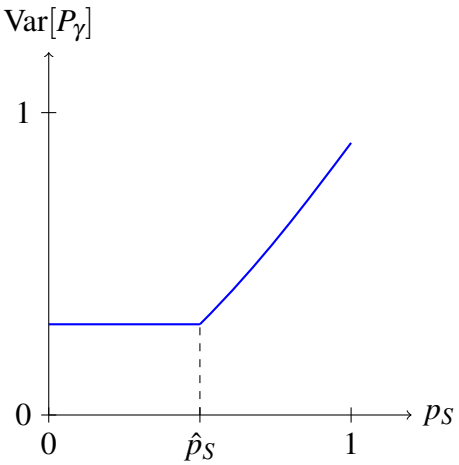


Figure 9: Price Volatility and p_S. This figure shows how price volatility (Var$[P_\gamma]$) varies with p_S for fixed pro-social preferences $\gamma \in (\underline{\gamma}, \bar{\gamma}(0))$, where $\bar{\gamma}(0)$ is defined in Lemma 3. For $p_S < \hat{p}_S$, price volatility remains constant as the equilibrium level of informed trading (τ_γ^*) is unchanged due to offsetting extensive and intensive margin effects. For $p_S \geq \hat{p}_S$, price volatility increases with p_S as informed trading rises through the extensive margin effect alone. The threshold $\hat{p}_S$, implicitly defined by $\gamma = \bar{\gamma}(\hat{p}_S)$, is characterized in Lemma 3.

6.1 Investment in Reducing Social Cost

This section analyzes how the informed investor's pro-social preferences affect the firm's investment in reducing its social cost. Specifically, we extend the model by assuming that at $t = 0$, the firm's initial controlling shareholders can make an investment at cost $c > 0$ that increases 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 6. *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).*[25]

Proposition 3 implies that effort informativeness improves along with the firm's probability of a low social cost only when the informed investor has sufficiently strong pro-social preferences. When $\gamma < \hat{\gamma}$, the effort informativeness of the firm's stock price does not increase with p_S. As a result, the investment in reducing the firm's social cost does not change the cost of providing incentives. In contrast, when the informed investor has sufficiently strong pro-social preferences ($\gamma > \hat{\gamma}$), a higher p_S increases the effort informativeness, which decreases the cost of providing incentives.

[25]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 $\gamma > \hat{\gamma}$.

Corollary 5. *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 intrinsically value reductions in the social cost. Instead, they make investments in reducing the firm's social cost only if doing so lowers the cost of providing incentives for the manager, that is, when the informed investor has sufficiently strong pro-social preferences ($\gamma > \hat{\gamma}$). In this case, the firm's controlling shareholders find it optimal to invest in reducing its social cost if the cost of doing so does not exceed the benefit of improved market monitoring.

Note that the investment in reducing the social cost can have consequences for the quality of the firm's governance, represented by e_F in our model. Specifically, if the compensation costs are too high in the absence of the investment, then the reduction in the social cost—i.e., an improvement in the firm's ES quality—can enhance governance quality by encouraging shareholders to switch from not inducing effort to inducing effort. This relationship reveals an important economic insight: higher environmental and social performance can lead to greater firm value even when shareholders care only about financial returns. "Doing well by doing good" arises endogenously in our framework through this market governance channel. Unlike traditional arguments that sustainable practices might enhance financial performance by reducing risks or attracting consumers, our model demonstrates that better environmental and social outcomes can directly improve firm financial performance by enhancing market-based governance.

Proposition 6 reveals a novel complementarity between "voice" and "exit" as mechanisms for reducing the firm's negative externalities. Specifically, 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 that arises across sustainable and financial investors offers a novel perspective, as these investment strategies are typically viewed as competing approaches (e.g., Broccardo et al., 2022).

This analysis also highlights an interesting dual role for carbon taxation. A social planner who implements a carbon tax can generate an improvement in both social and financial efficiency. Since shareholders only maximize firm financial value net of the manager's compensation, they

may forgo paying the cost to reduce the social cost and incentivize managerial effort even if it is financially efficient. In this case, a carbon tax can induce the shareholders to pay this cost, increasing both financial and social efficiency.

6.2 Managerial Social Effort

In the baseline model, the manager can only exert effort to influence the firm's financial payoff. In Section 6.1, we consider an investment in reducing the firm's social cost determined by initial shareholders. In this extension, we 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. Specifically, when the manager exerts social effort ($e_S = 1$), the probability that the firm's 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^* may not change in response to 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 our attention on when the informed investor has sufficiently strong pro-social preferences (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 provision—financial and social. The less severe the moral hazard problem associated with social effort, the more likely that sustainable investing will motivate the manager to reduce the firm's social cost—despite the manager's indifference to its externalities.

Proposition 7. *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 pro-social preferences 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 aggregate 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.

It is worth noting that Proposition 7 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 pro-social preferences can induce inefficient social effort, echoing concerns that sustainable investing can result in wasteful activities.

Proposition 8. *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 only motivated to induce social effort if doing so enhances the price informativeness about the manager's financial effort, thereby allowing them to reduce the manager's compensation by reducing the agency rent necessary to incentivize financial effort. However, 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 therefore more costly to incentivize than financial effort. As a result, any agency rent reduction achieved through the increase in price informativeness about financial effort is ultimately outweighed by the additional agency rent required to incentivize social effort.

6.3 Public News about Social Cost

In this section, we examine how public news about the firm's social cost interacts with market monitoring. Specifically, we assume that there is a public signal $\sigma \in \{L, H\}$ about the firm's realized social cost after trading occurs at $t = 1$.[26] For instance, the signal may correspond to ES news and incidents (e.g., Krüger, 2015; Glossner, 2021; Derrien et al., 2022). The signal has

[26]The assumption that the signal arrives after trading simplifies our analysis. If the signal arrives before trading, market outcomes at $t = 1$ would reflect the information contained in the signal. However, a managerial contract that conditions on both market outcomes and the signal remains optimal. In fact, the structure of the optimal incentive contract is identical to the case when the public signal realizes after trading occurs.

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] This information structure implies that observing $\sigma = L$ indicates a higher probability that the firm generates a low social cost, while $\sigma = H$ signals a lower probability of a low social cost. Specifically, we have

$$\underline{p}_S := \Pr(S = 0|\sigma = H) < p_S < Pr(S = 0|\sigma = L) =: \bar{p}_S.$$

An increase in ρ corresponds to a more precise signal.

This public signal helps the firm interpret the information contained in market outcomes at $t = 1$.[28] We now consider the optimal contract that can condition the manager's pay on both the order flow q and the signal σ.

Proposition 9. *When the informed investor's pro-social preferences are sufficiently strong ($\gamma > \underline{\gamma}$), an optimal incentive-compatible contract is given by*

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

where a^* is given by Proposition 2.

When the informed investor's pro-social preferences 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. As a result, when the public signal indicates that the firm's social cost is high, the firm infers that the aggregate order flow is more likely driven by liquidity trades rather than that of the informed investor. In the extreme case where the public signal perfectly reveals the firm's high social cost ($S = \eta$) and the informed investor has very

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

strong pro-social preferences (i.e., $\gamma > \bar{\gamma}$), the firm infers that the resulting aggregate order flow is uninformative about the manager's effort. In contrast, when the public signal indicates that the firm's social cost is low, the firm infers that the aggregate order flow is more likely to reflect information about the firm's financial payoff. A low order flow ($q = 0$) is more indicative of a low financial payoff ($F = 0$). A high order flow ($q > 0$) is more indicative of a high financial payoff ($F = 1$). Consequently, the optimal contract pays the manager only when the order flow is high and the signal indicates a low social cost, which corresponds to the state with the maximum likelihood ratio.

Proposition 9 implies that the presence of compensation tied to positive 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 features pay contingent on the firm's social cost being low without intending to reduce the firm's social cost. In fact, in our baseline specification, the firm's p_S is exogenous.

Corollary 6. *When the informed investor's pro-social preferences 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 6 establishes a link between ES-linked compensation, governance quality captured by e_F, and firm value. Specifically, ES-linked compensation can improve governance quality and firm value by reducing compensation costs to induce the manager to exert effort to improve the expected financial payoff of the firm.

These implications may help reconcile some conflicting evidence in the empirical literature about the effectiveness of optimal contracting in reducing firms' negative externalities (e.g., Bebchuk and Tallarita, 2022; Cohen et al., 2023). Consistent with our predictions, several papers find 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).

6.4 Precision of Private Information

In our baseline model, the informed investor perfectly observes the firm's social cost S. In this section, we relax this assumption and examine how the precision of the informed investor's private information affects the trading equilibrium. Specifically, we assume that the informed investor receives a potentially noisy private signal about the firm's social cost prior to trading at $t = 1$. The private signal $\xi \in \{L, H\}$ satisfies

$$\mathbb{E}[S|\xi = L] < (1 - p_S)\eta = \mathbb{E}[S],$$

$$\mathbb{E}[S|\xi = H] > (1 - p_S)\eta = \mathbb{E}[S],$$

$\frac{\partial \mathbb{E}[S|\xi=L]}{\partial \varepsilon} > 0$, $\frac{\partial \mathbb{E}[S|\xi=H]}{\partial \varepsilon} < 0$, where $\varepsilon \in (0,1)$ captures the amount of noise in the informed investor's private signal.[29] The expected social cost conditional on $\xi = H$ decreases with ε, while the expected social cost conditional on $\xi = L$ increases with ε. Thus, a less noisy signal leads to more dispersed conditional expectations.

To analyze the equilibrium in this setting, we need to extend the strategy space relative to the baseline model. The reason is that when $\mathbb{E}[S|\xi = L] > 0$, the informed investor may not buy with certainty upon observing a high financial payoff and a low signal ($F = 1$ and $\xi = L$), unlike in the baseline model where observing $S = 0$ and $F = 1$ always leads to buying. Specifically, 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, that is,* $a_H^* \in (0,1) \Rightarrow a_L^* = 1$ *and* $a_L^* \in (0,1) \Rightarrow a_H^* = 0$.

The informed investor values each share of the firm at $F - \gamma S$. A higher expected social cost reduces the informed investor's valuation. If the informed investor 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 in that state. Since the expected social cost is strictly lower when $\xi = L$, the investor's expected

[29] For instance, we can set $\Pr(\xi = L|S = 0) = 1 - \frac{1}{2}\varepsilon$ and $\Pr(\xi = L|S = \eta) = \frac{1}{2}\varepsilon$, where the parameter $\varepsilon \in (0,1)$ captures the amount of noise in the informed investor's private signal. The baseline model corresponds to $\varepsilon \to 0$, where the signal perfectly reveals the firm's social cost. An increase in ε implies a noisier private signal. When $\varepsilon \to 1$, the signal is pure noise.

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 choose $a_L^* = 1$. Similarly, if she follows a 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 10. *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. Consider the case where $a_H^* \in (0,1)$, meaning 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. This lower expected social cost makes buying more attractive to the informed investor when she learns that $F = 1$ and $\xi = H$, increasing a_H^*. This increase in informed trading based on financial information ultimately enhances effort informativeness. Conversely, 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 the informed investor leans that $F = 1$ and $\xi = L$. The decrease in informed trading worsens effort informativeness. Lemma 4 ensures that only one of these effects operates in any given equilibrium due to the corner solution in trading strategies. As such, improved ES information can have an ambiguous effect on price informativeness and firm governance and depends crucially on the informed investor's existing trading strategy.

6.5 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. In this section, we examine how the correlation between the firm's financial payoff and its social cost affects the impact of sustainable investing on market governance. Specifically, we allow the conditional probabilities of the firm's social cost being high—$\Pr(S = 0|F = 1)$ and $\Pr(S = 0|F = 0)$—to differ from the unconditional probability p_S. The firm's

financial payoff and social cost are negatively correlated when $\Pr(S=0|F=1) > p_S$ and positively correlated when $\Pr(S=0|F=1) < p_S$.[30] 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 emissions. A negative correlation may occur if an accident in the production process results in both lower sales and emissions. The baseline model in which the firm's financial payoff and social cost are uncorrelated corresponds to $\Pr(S=0|F=1) = \Pr(S=0|F=0) = p_S$.

Proposition 11. *If the firm generates a high social cost alongside a high financial payoff with some positive probability (i.e.,* $1 - \Pr(S=0|F=1) > 0$*), then an increase in the intensity of the informed investor's pro-social preferences (*γ*) weakly decreases the effort informativeness of the firm's stock price (*ϕ^*_γ*), strictly so for some* γ*.*

Proposition 11 demonstrates the robustness of the results in our baseline analysis. When the informed investor's pro-social preferences 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, pro-social preferences 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. In this case, the informed investor's pro-social preferences exert a stronger influence on her overall trading strategy, amplifying the negative impact of sustainable investing on market governance. Conversely, a negative correlation (i.e., $\Pr(S=0|F=1) > p_S$) decreases the probability that both the firm's financial payoff and the social cost are high, 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 directly influences social outcomes, introducing an additional channel through which

[30] 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 $\Pr(S=0|F=0) < p_S$.

sustainable investing affects real outcomes. With positive correlation (i.e., $\Pr(S=0|F=1) < p_S$), managerial shirking simultaneously reduces the probability of a high financial payoff and the probability of high social cost, creating a trade-off between financial performance and sustainability. For example, lower effort leads to lower sales, with a lower production level leading to lower emissions. Conversely, with negative correlation (i.e., $\Pr(S=0|F=1) > p_S$), inducing managerial effort improves financial performance while reducing the social cost, aligning financial and social objectives. Depending on its direction, the agency costs of sustainable investing may either amplify or mitigate the externalities generated by the firm.

6.6 Information Acquisition

In our baseline model, the informed investor was endowed with information on both F and S. In this section, we consider the informed investor's incentives to acquire information about S. Specifically, we assume that 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 this information allows her to avoid the disutility associated with the social cost when trading on F.

Consider first the case without information acquisition. While there are trading gains based on her private information about F if she trades as characterized in Proposition 1, buying one share if and only if she learns that $F=1$, the investor only informed about F incurs the expected disutility from the social cost $\gamma\mathbb{E}[S] = \gamma(1-p_S)\eta$ when buying a share. Specifically, the ex-ante expected utility of the informed investor when not acquiring information on S but trading on F is given by

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

where the equilibrium price is determined in Proposition 1.[31]

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

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

[31] Notice that 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.

where the equilibrium price is determined in Proposition 2. The advantage of 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 $S = \eta$.

Proposition 12. *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 pro-social, 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.

7 Conclusion

This paper identifies a novel mechanism through which sustainable investing affects firm behavior and performance. When informed investors care about firm externalities, they may choose not to trade on their private information about financial performance, reducing price informativeness for governance purposes and making it costlier 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 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.

References

Admati, Anat R., and Paul Pfleiderer, 2009, The "Wall Street Walk" and Shareholder Activism: Exit as a Form of Voice, *Review of Financial Studies* 22, 2645–2685.

Al-Shaer, Habiba, and Mahbub Zaman, 2019, CEO Compensation and Sustainability Reporting Assurance: Evidence from the UK, *Journal of Business Ethics* 158, 233–252.

Allen, Franklin, Adelina Barbalau, and Federica Zeni, 2023, Reducing Carbon using Regulatory and Financial Market Tools, Working Paper.

Baker, Malcolm, Mark L. Egan, and Suproteem K. Sarkar, 2022, How Do Investors Value ESG?, Working Paper.

Banerjee, Snehal, Jesse Davis, and Naveen Gondhi, 2022, Incentivizing Effort and Informing Investment: The Dual Role of Stock Prices, Working Paper.

Barbalau, Adelina, and Federica Zeni, 2022, The Optimal Design of Green Securities, Working Paper.

Baron, David P., 2008, Managerial Contracting and Corporate Social Responsibility, *Journal of Public Economics* 92, 268–288.

Bauer, Rob, Tobias Ruof, and Paul Smeets, 2021, Get Real! Individuals Prefer More Sustainable Investments, *Review of Financial Studies* 34, 3976–4043.

Bebchuk, Lucian A., and Roberto Tallarita, 2022, The perils and questionable promise of esg-based compensation, *J. Corp. L.* 48, 37.

Berk, Jonathan, and Jules H. Van Binsbergen, 2022, The Impact of Impact Investing, Working Paper.

Bolton, Patrick, and Marcin Kacperczyk, 2021, Do Investors Care about Carbon Risk?, *Journal of Financial Economics* 142, 517–549.

Bolton, Patrick, and Marcin Kacperczyk, 2023, Global Pricing of Carbon-Transition Risk, *Journal of Finance* 78, 3677–3754.

Bonham, Jonathan, and Amoray Riggs-Cragun, 2022, Managerial Contracting And Corporate Social Responsibilitymotivating ESG Activitiesf Through Contracts, Taxes And Disclosure Regulation, Working Paper.

Bonnefon, Jean-Francois, Augustin Landier, Parinitha Sastry, and David Thesmar, 2023, The Moral Preferences of Investors: Experimental Evidence, Working Paper.

Bresnahan, Timothy F., Paul Milgrom, and Jonathan Paul, 1992, The Real Output of the Stock Exchange, in *Output measurement in the service sectors*, 195–216 (University of Chicago Press).

Broccardo, Eleonora, Oliver D. Hart, and Luigi Zingales, 2022, Exit versus Voice, *Journal of Political Economy* 130, 3101–3145.

Bucourt, Noémie, and Nicolas Inostroza, 2023, ESG Investing and Managerial Incentives, Working Paper.

Cao, Jie, Sheridan Titman, Xintong Zhan, and Weiming Zhang, 2023, ESG Preference, Institutional Trading, and Stock Return Patterns, *Journal of Financial and Quantitative Analysis* 58, 1843–1877.

Case, Anne, and Angus Deaton, 2021, *Deaths of Despair and the Future of Capitalism* (Princeton University Press, Princeton, NJ).

Ceccarelli, Marco, Richard B. Evans, Simon Glossner, Mikael Homanen, and Ellie Luu, 2024, ESG Skill of Mutual Fund Managers, Working Paper.

Chaigneau, Pierre, Alex Edmans, and Daniel Gottlieb, 2019, The Informativeness Principle Without the First-Order Approach, *Games and Economic Behavior* 113, 743–755.

Chaigneau, Pierre, and Nicolas Sahuguet, 2024, Executive Compensation With Social and Environmental Performance, Working Paper.

Chen, Alvin, and Michael D. Wittry, 2025, Production and Externalities: The Role of Corporate Governance, Working Paper.

Chen, Hui, and Jan Schneemeier, 2023, Responsible Investors and Stock Market Feedback, Working Paper.

Chowdhry, Bhagwan, Shaun William Davies, and Brian Waters, 2019, Investing for Impact, *Review of Financial Studies* 32, 864–904.

Christie, Anna, 2021, The Agency Costs of Sustainable Capitalism, *UC Davis Law Review* 55, 875–954.

Cohen, Shira, Igor Kadach, Gaizka Ormazabal, and Stefan Reichelstein, 2023, Executive Compensation Tied to EST Performance: International Evidence, *Journal of Accounting Research* 61, 805–853.

Davies, Shaun William, and Edward Dickersin Van Wesep, 2018, The Unintended Consequences of Divestment, *Journal of Financial Economics* 128, 558–575.

De Angelis, Tiziano, Peter Tankov, and Olivier David Zerbib, 2023, Climate Impact Investing, *Management Science* 69, 7669–7692.

Derrien, François, Philipp Krueger, Augustin Landier, and Tianhao Yao, 2022, ESG News, Future Cash Flows, and Firm Value, Working Paper.

Döttling, Robin, Doron Levit, Nadya Malenko, and Magdalena Rola-Janicka, 2024, Voting on Public Goods: Citizens vs. Shareholders, Working Paper.

Dou, Winston Wei, Leonid Kogan, and Wei Wu, 2023, Common Fund Flows: Flow Hedging and Factor Pricing, Working Paper.

Dow, James, Itay Goldstein, and Alexander Guembel, 2017, Incentives for Information Production in Markets Where Prices Affect Real Investment, *Journal of the European Economic Association* 15, 877–909.

Dow, James, and Gary Gorton, 1997, Stock Market Efficiency and Economic Efficiency: Is There a Connection?, *Journal of Finance* 52, 1087–1129.

Dow, James, Jungsuk Han, and Francesco Sangiorgi, 2024, The Short-termism Trap: Catering To Informed Investors With Limited Horizons, *Journal of Financial Economics* 159, 103884.

Döttling, Robin, and Magdalena Rola-Janicka, 2023, Too Levered for Pigou: Carbon Pricing, Financial Constraints, and Leverage Regulation, Working Paper.

Edmans, Alex, 2009a, Blockholder Trading, Market Efficiency, and Managerial Myopia, *Journal of Finance* 64, 2481–2513.

Edmans, Alex, 2009b, Blockholder Trading, Market Efficiency, and Managerial Myopia, *Journal of Finance* 64, 2481–2513.

Edmans, Alex, Xavier Gabaix, and Augustin Landier, 2009, A Multiplicative Model of Optimal CEO Incentives in Market Equilibrium, *Review of Financial Studies* 22, 4881–4917.

Edmans, Alex, Itay Goldstein, and Wei Jiang, 2015, Feedback Effects, Asymmetric Trading, and the Limits to Arbitrage, *American Economic Review* 105, 3766–3797.

Edmans, Alex, Tom Gosling, and Dirk Jenter, 2024, Sustainable Investing: Evidence From the Field, Working Paper.

Edmans, Alex, Doron Levit, and Jan Schneemeier, 2023, Socially Responsible Divestment, Working Paper.

Eskildsen, Marc, Markus Ibert, Theis Ingerslev Jensen, and Lasse Heje Pedersen, 2024, In Search of the True Greenium, Working Paper.

Florence, Curtis, Feijun Luo, and Ketra Rice, 2021, The Economic Burden of Opioid Use Disorder and Fatal Opioid Overdose in the United States, 2017, *Drug and Alcohol Dependence* 218, 108350.

Gao, Pingyang, Xu Jiang, and Jinzhi Lu, 2025, Manipulation, panic runs, and the short selling ban, *Journal of Economic Theory* 223, 105939.

Geelen, Thomas, Jakub Hajda, and Jan Starmans, 2023, Sustainable Organizations, Working Paper.

Giglio, Stefano, Matteo Maggiori, Johannes Stroebel, Zhenhao Tan, Stephen Utkus, and Xiao Xu, 2023, Four Facts about ESG Beliefs and Investor Portfolios, Working Paper.

Glossner, Simon, 2021, Repeat Offenders: ESG Incident Recidivism and Investor Underreaction, Working Paper.

Goldstein, Itay, and Alexander Guembel, 2008, Manipulation and the Allocational Role of Prices, *Review of Economic Studies* 75, 133–164.

Goldstein, Itay, Alexandr Kopytov, Lin Shen, and Haotian Xiang, 2022, On ESG Investing: Heterogeneous Preferences, Information, and Asset Prices, Working Paper.

Gollier, Christian, and Sébastien Pouget, 2022, Investment Strategies and Corporate Behaviour with Socially Responsible Investors: A Theory of Active Ownership, *Economica* 89, 997–1023.

Green, Daniel, and Benjamin N. Roth, 2021, The Allocation of Socially Responsible Capital, Working Paper.

Gryglewicz, Sebastian, Simon Mayer, and Erwan Morellec, 2024, Investor Activism and the Green Transition, Working Paper.

Gupta, Deeksha, Alexandr Kopytov, and Jan Starmans, 2024, The Pace of Change: Socially Responsible Investing in Private Markets, Working Paper.

Hart, Oliver D., and Luigi Zingales, 2017, Companies Should Maximize Shareholder Welfare Not Market Value, *Journal of Law, Finance, and Accounting* 2, 247–274.

Hartzmark, Samuel M., and Abigail B. Sussman, 2019, Do Investors Value Sustainability? A Natural Experiment Examining Ranking and Fund Flows, *Journal of Finance* 74, 2789–2837.

Heeb, Florian, Julian F. Kölbel, Falko Paetzold, and Stefan Zeisberger, 2023, Do Investors Care About Impact?, *Review of Financial Studies* 36, 1737–1787.

Heinkel, Robert, Alan Kraus, and Josef Zechner, 2001, The Effect of Green Investment on Corporate Behavior, *Journal of Financial and Quantitative Analysis* 36, 431–449.

Hitzemann, Steffen, Alaia An Qin, Stanislav Sokolinski, and Andrea Tamoni, 2024, Does Sustainable Investing Dull Stock Reactions to Cash Flow News?, Working Paper.

Holmström, Bengt, and Jean Tirole, 1993, Market Liquidity and Performance Monitoring, *Journal of Political Economy* 101, 678–709.

Homroy, Swarnodeep, Taylan Mavruk, and Van Diem Nguyen, 2023, ESG-Linked Compensation, CEO Skills, and Shareholder Welfare, *Review of Corporate Finance Studies* 12, 939–985.

Hong, Bryan, Zhichuan Li, and Dylan Minor, 2016, Corporate Governance and Executive Compensation for Corporate Social Responsibility, *Journal of Business Ethics* 136, 199–213.

Huang, Shiyang, and Alexandr Kopytov, 2022, Sustainable Finance under Regulation, Working Paper.

Humphrey, Jacquelyn, Shimon Kogan, Jacob Sagi, and Laura Starks, 2021, The Asymmetry in Responsible Investing Preferences, Working Paper.

Ikram, Atif, Zhichuan Frank Li, and Dylan Minor, 2023, CSR-Contingent Executive Compensation Contracts, *Journal of Banking & Finance* 151, 105655.

Innes, Robert D., 1990, Limited Liability and Incentive Contracting with Ex-Ante Action Choices, *Journal of Economic Theory* 52, 45–67.

Jagannathan, Ravi, Soohun Kim, Robert McDonald, and Shixiang Xia, 2023, Environmental Activism, Endogenous Risk, and Stock Prices, Working Paper.

Jin, Dunhong, and Thomas H. Noe, 2023, Making Sure Your Vote Does not Count: ESG Activism, Pseudo-Green Shareholders, and Insincere Proxy Voting, Working Paper.

Kräussl, Roman, Tobi Oladiran, and Denitsa Stefanova, 2023, A Review on ESG Investing: Investors' Expectations, Beliefs and Perceptions, *Journal of Economic Surveys,* forthcoming.

Krüger, Philipp, 2015, Corporate Goodness and Shareholder Wealth, *Journal of Financial Economics* 115, 304–329.

Kyle, Albert S, 1985, Continuous Auctions and Insider Trading, *Econometrica: Journal of the Econometric Society* 1315–1335.

Landier, Augustin, and Stefano Lovo, 2023, ESG Investing: How to Optimize Impact?, Working Paper.

Levit, Doron, Nadya Malenko, and Ernst G. Maug, 2023, Trading and Shareholder Democracy, *Journal of Finance,* forthcoming.

List, John A., 2009, Social Preferences: Some Thoughts from the Field, *Annual Review of Economics* 1, 563–579.

Maclean, Johanna Catherine, Justine Mallatt, Christopher J. Ruhm, and Kosali Simon, 2020, Economic Studies on the Opioid Crisis: A Review, Working Paper.

Malenko, Andrey, and Nadya Malenko, 2023, Voting Choice, Working Paper.

Matsusaka, John G., and Chong Shu, 2021, A Theory of Proxy Advice when Investors Have Social Goals, Working Paper.

Maug, Ernst, 1998, Large Shareholders As Monitors: Is There A Trade-off Between Liquidity And Control?, *Journal of Finance* 53, 65–98.

Moisson, Paul-Henri, 2022, Ethics and Impact Investment, Working Paper.

Morgan, John, and Justin Tumlinson, 2019, Corporate Provision of Public Goods, *Management Science* 65, 4489–4504.

Oehmke, Martin, and Marcus M. Opp, 2023, A Theory of Socially Responsible Investment, *Review of Economic Studies,* forthcoming.

Pastor, Lubos, Robert F. Stambaugh, and Lucian A. Taylor, 2021, Sustainable Investing in Equilibrium, *Journal of Financial Economics* 142, 550–571.

Pastor, Lubos, Robert F. Stambaugh, and Lucian A. Taylor, 2022, Dissecting Green Returns, *Journal of Financial Economics* 146, 403–424.

Pedersen, Lasse Heje, Shaun Fitzgibbons, and Lukasz Pomorski, 2021, Responsible Investing: The ESG-Efficient Frontier, *Journal of Financial Economics* 142, 572–597.

Peng, Lin, and Ailsa Röell, 2014, Managerial Incentives and Stock Price Manipulation, *Journal of Finance* 69, 487–526.

Piccolo, Alessio, 2022, The Earnings Game, Working Paper.

Piccolo, Alessio, Jan Schneemeier, and Michele Bisceglia, 2023, Externalities of Responsible Investments, Working Paper.

Riedl, Arno, and Paul Smeets, 2017, Why Do Investors Hold Socially Responsible Mutual Funds?, *Journal of Finance* 72, 2505–2550.

Roth, Benjamin N., 2021, Impact Investing: A Theory of Financing Social Enterprises, Working Paper.

Savov, Alexi, 2014, The Price of Skill: Performance Evaluation by Households, *Journal of Financial Economics* 112, 213–231.

Starmans, Jan, 2023, Technological Determinants of Financial Constraints, *Management Science* 69, 3003–3024.

Starmans, Jan, 2024, Contracting and Search With Heterogeneous Principals and Agents, *Journal of Economic Theory* 217, 105761.

Strobl, Günter, 2014, Stock-Based Managerial Compensation, Price Informativeness, and the Incentive to Overinvest, *Journal of Corporate Finance* 29, 594–606.

Xue, Hao, 2023, ESG Disclosure, Market Forces, and Investment Efficiency, Working Paper.

Yang, Yong George, Xintong Zhan, Weiming Elaine Zhang, and Yaojia Zoe Zhang, 2023, Socially Responsible Investors and Stock Price Informativeness, Working Paper.

Zhang, Ye, 2021, Impact Investing and Venture Capital Industry: Experimental Evidence, Working Paper.

Zhang, Ye, 2022, Startups' Strategies for Green Funding Adoption, Working Paper.

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

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

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

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

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

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

and

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

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

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

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:

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

Taking the derivative of $\mathrm{Var}[P]$ 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. 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 5. 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 7. 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 8. 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

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

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 Proposition 9. 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 6. 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 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 10. 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

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

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.[32]

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	$p_Fp_\xi(1-a_L)$	$x=0$	$q\in\mathbb{N}_0$	$\lambda(1-\lambda)^q$
1	L	$p_Fp_\xi a_L$	$x=1$	$q\in\mathbb{N}_+$	$\lambda(1-\lambda)^{q-1}$

Table 2: Distribution of Equilibrium Aggregate Order Flow

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

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

[32]Note that in the example provided in Footnote 29, we have $p_\xi=p_S$.

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 11. For algebraic convenience, let $\Pr(S = 0|F = 1) = p_{S,1}$ and $\Pr(S = 0|F = 0) = p_{S,0}$. 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 pro-social preferences 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 pro-social preferences 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 12. 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 $\gamma \geq \hat{\gamma}$. ■

C Additional Robustness

This section contains additional results to provide 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 ability of the investor 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 pro-social preferences of the informed investor lead to less informed trading on financial information, thus reducing price informativeness for governance purposes.

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

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

The thresholds for pro-social preferences 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 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	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 3: Distribution of Equilibrium Aggregate Order Flow

In this case, Bayesian updating implies

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

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

and

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

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 short sell one share 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 Pro-social Market Makers

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 pro-social investors. Specifically, we assume that the market makers put a weight $\theta \in (0,1)$ on pro-social investors such that $P_\gamma(q) = \mathbb{E}[F - \theta\gamma S|q]$. Intuitively, θ may capture the share of pro-social investors in the economy who have pro-social preferences 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 pro-social 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 pro-social preferences 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 high social cost ($F = 1$ and $S = \eta$),*

where

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

The thresholds for pro-social preferences 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

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

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

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

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.[33] 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

[33] 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 $\bar{\theta}$.

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

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

Second, consider an equilibrium with $a = 0$, which requires[34]

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

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*

[34] 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 from the firm's financial payoff ex post, 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 how sustainable investing affects market-based governance remain valid under this alternative specification.

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