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Sustainable Investing and Market Governance

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Abstract

This paper examines how sustainable investing affects the governance role of financial markets. We show that stronger concerns about externalities among informed investors can reduce price informativeness about managerial effort to improve financial performance, increasing the cost of incentive provision. This mechanism creates an inherent link between firms' environmental and social (ES) and governance quality. We show that the agency costs of sustainable investing can have real effects on ES outcomes when firms can affect their externalities.

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

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

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Sustainable Investing and Market Governance*

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December 2, 2025

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This paper examines how sustainable investing affects the governance role of financial markets. We show that stronger concerns about externalities among informed investors can reduce price informativeness about managerial effort to improve financial performance, increasing the cost of incentive provision. This mechanism creates an inherent link between firms' environmental and social (ES) and governance quality. We show that the agency costs of sustainable investing can have real effects on ES outcomes when firms can affect their externalities.

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1 Introduction

Sustainable investing, which incorporates environmental and social (ES) factors into investment decisions, has had a significant impact on financial markets. While a growing literature examines how sustainable investing can reduce corporate externalities, this literature has largely overlooked its impact on the traditional governance role of financial markets (e.g., Holmström and Tirole, 1993). This paper examines how sustainable investing influences firm governance through its effects on price informativeness and market monitoring.

We demonstrate that sustainable investing can weaken the governance role of financial markets by reducing the sensitivity of stock prices to firm fundamentals. An informed investor with social concerns may deviate from trading purely on financial information when firms generate significant externalities—whether positive or negative. When a firm imposes negative externalities, such as carbon emissions or labor violations, the informed investor may abstain from buying despite observing strong financial performance—a pattern consistent with negative screening strategies that exclude firms with poor ES performance. Conversely, when a firm generates positive externalities, such as carbon sequestration or workforce training programs, the informed investor may buy despite observing weak financial performance—a pattern consistent with positive screening strategies that favor firms with strong ES performance. In both cases, this behavior reduces informed trading based on financial fundamentals, lowering the informational content of prices. Consequently, it becomes more costly for shareholders to incentivize managers to improve financial performance. When these costs become sufficiently high, shareholders reduce incentive provision, leading to lower managerial effort and diminished financial performance. Sustainable investing can thus increase the agency costs associated with the separation of ownership and control.

This novel market-governance channel of sustainable investing creates an inherent link between firms' ES and governance quality when informed investors care sufficiently about firm externalities. Importantly, the direction of this relationship depends on whether the firm generates positive or negative externalities. We show that firms imposing negative externalities exhibit a positive relationship between ES and governance quality: lower negative externalities facilitate more informed trading on financial fundamentals, yielding more informative prices and better market governance. In contrast, firms generating positive externalities exhibit a negative relationship between ES and governance quality: higher positive externalities distort informed trading away from financial fundamentals, yielding less informative prices and weaker market governance.

Building on this foundational link between firm sustainability and governance, we establish several key insights. The market-governance channel of sustainable investing may lead to environmental and social improvements by purely financially motivated agents. We show that even shareholders who only care about financial payoffs may invest in reducing firms' negative externalities to enhance price informativeness and lower managerial incentive costs. Similarly, a purely financially motivated manager may exert costly effort to reduce negative externalities to increase her compensation. The agency costs of sustainable investing can thus paradoxically generate positive real effects by incentivizing firms to reduce negative externalities. However, the same mechanism may also incentivize shareholders to reduce positive externalities, thereby causing social harm. Our analysis, therefore, highlights a crucial asymmetry in how different types of sustainable investment strategies, such as positive versus negative screening, affect ES outcomes.

The market-governance channel of sustainable investing differs fundamentally from the traditional cost-of-capital channel (e.g., Heinkel et al., 2001). In our framework, sustainable investors affect real outcomes by making incentive provision, rather than capital, more expensive. This mechanism implies that sustainable investing can have real effects even without generating differences in expected returns between green and brown firms. We further show that sustainable investing can lead to differences in price volatility between firms with different ES qualities. Volatility increases with ES quality for negative externalities, reflecting more informed trading, but decreases for positive externalities. In addition, we demonstrate that financial shareholders may optimally link managerial compensation to ES news even when managers cannot affect ES performance. In our framework, ES-linked compensation can improve firm governance even without changing externalities.

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

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

We show that as the informed investor's social concerns intensify, the firm's externality—whether positive or negative—increasingly affects her trading decisions. With negative externalities, she becomes less likely to buy a share when observing high financial performance but a high negative externality. With positive externalities, she becomes more likely to buy a share when observing low financial performance but a high positive externality. In both cases, the informed investor's trading becomes less responsive to financial information, making the firm's stock price less informative about financial performance and, thus, about managerial effort. This decline in price informativeness increases agency costs, as incentivizing the manager becomes more costly when the stock price provides a noisier signal of effort. When these costs become sufficiently high, shareholders reduce incentive provision, leading to lower managerial effort and worse financial performance—highlighting an important real cost of sustainable investing.

Price informativeness about managerial effort crucially depends on the probability that the firm generates a high externality. When the firm never generates an externality, the informed investor trades solely on financial information, leading to highly informative prices that enable low-cost managerial incentives. When the firm generates a high externality more frequently, the informed investor deviates from trading on financial information more often, reducing the information content of prices and making incentive provision more costly. This mechanism generates a relationship between firms' ES and governance quality. For firms imposing negative externalities, high ES quality—reflected in low probabilities of negative externalities—associates with stronger governance—reflected in high managerial effort. For firms generating positive externalities, the relationship reverses: high ES quality—reflected in high probabilities of positive externalities—associates with weaker governance.

We explore several extensions of our baseline model. In one extension, we explore how public news about firm externalities affects market monitoring. When there is additional public news about the externality, optimal contracts may include bonuses contingent on both prices and news

about the externality. The public signal helps the firm interpret the information contained in the stock price, lowering the cost of managerial incentive provision. Consequently, managerial compensation tied to ES news may be optimal even when controlling shareholders do not care about the externality and when managers cannot affect externalities. We show that ES-linked compensation can enhance governance quality, consistent with evidence that ES-linked pay is more prevalent in firms with strong governance structures (e.g., Hong et al., 2016; Al-Shaer and Zaman, 2019; Homroy et al., 2023; Ikram et al., 2023).

In another extension, we allow the firm's initial financial shareholders to invest in reducing the probability of generating an externality. When the firm imposes negative externalities, shareholders may invest in improving ES quality even though they do not intrinsically value these outcomes. A lower probability of a high negative externality increases informed trading on financial information, making prices more informative about financial performance and reducing incentive costs. "Doing well by doing good" thus arises endogenously through a market governance channel. However, when the firm generates positive externalities, the same mechanism perversely incentivizes shareholders to reduce positive externalities to improve market monitoring. This governance advantage of low externalities—positive or negative—makes net-zero a natural focal point for corporate sustainability commitments, as shareholders prefer to reduce both negative and positive externalities. Our model therefore provides a market-governance rationale for net-zero commitments as opposed to carbon-negative ones.

Our model highlights a novel complementarity between exit and voice in reducing negative externalities. The exit of sustainable investors from firms with high negative externalities prompts financial investors to exercise voice by investing in externality reduction. This interaction across investor types differs from the existing literature, which focuses on the same investor choosing between exit and voice, typically viewing them as competing 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 ES performance—reducing negative externalities or increasing positive externalities—we highlight another channel through which our market-governance mechanism affects firm externalities. When the informed investor's social concerns are sufficiently strong, a purely financially motivated manager may exert social effort to increase the informed investor's trading intensity, thereby raising her expected compensation through higher order flow that leads to higher prices.

In the case of negative externalities, social effort reduces the cost of incentivizing financial effort, contrasting with the multitasking literature, which typically emphasizes a tension in incentivizing multiple tasks (e.g., Holmström and Milgrom, 1991). Our results highlight a novel complementarity based on information spillovers, where incentivizing one task enhances the informativeness of signals about another.

Our framework demonstrates that sustainable investing can affect market prices and real outcomes 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 externalities 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 varies with ex-ante propensities to generate externalities even when expected returns remain constant. For firms imposing negative externalities, prices become more informative through more informed trading and thus more volatile as the probability of good ES outcomes increases. Conversely, for firms generating positive externalities, prices become less informative and less volatile as the probability of good ES outcomes increases. Hence, the effects of sustainable investing may manifest in higher moments of return distributions even when expected returns remain unchanged.

The quantitative importance of our mechanism depends critically on the prevalence of sustainable investing among active, information-producing investors. In an extension, we show that the cost of providing managerial incentives increases with the fraction of informed investors who have social concerns. As assets under management in active sustainable investing strategies grow over time, our framework predicts that the governance effects we identify should become more pronounced, leading to several empirical predictions. Specifically, our model predicts stronger correlations between firms' ES and governance quality, decreased stock price volatility, reduced use of stock-based compensation, higher compensation levels, greater pay-for-performance sensitivity when incentives are provided, and a greater prevalence of ES-linked compensation.

We additionally show that our results are robust to several alternative model specifications: different correlation structures between financial outcomes and externalities, noisy signals for the informed investor, endogenous information acquisition, different market structures (e.g., competitive

informed investors, short-selling, market makers considering externalities), and alternative compensation arrangements. These analyses confirm that our core mechanism—the market governance channel of sustainable investing—operates across various institutional and economic contexts.

The remainder of the paper proceeds as follows. Section 2 discusses related literature. Section 3 presents the model. Section 4 analyzes the benchmark case with only financial investors. Section 5 examines how investors with social concerns affect agency costs and governance. Section 6 explores extensions and robustness. Section 7 synthesizes the empirical implications of our framework and discusses broader implications that extend beyond our formal analysis. Section 8 concludes.

2 Related Literature

Our paper contributes to the theoretical literature studying the real impact of sustainable investors on firms (e.g., Heinkel et al., 2001; Hart and Zingales, 2017; Davies and Van Wesep, 2018; Chowdhry et al., 2019; Morgan and Tumlinson, 2019; 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; Malenko and Malenko, 2023; Piccolo et al., 2023; Döttling et al., 2024; Gryglewicz et al., 2024; Levit et al., 2024; Oehmke and Opp, 2024; Chen and Wittry, 2025; Green and Roth, 2025; Gupta et al., 2025).[1] Much of this literature examines how sustainable investors affect firm behavior through their impact on firms' cost of capital (e.g., Heinkel et al., 2001; Pastor et al., 2021; Pedersen et al., 2021; Berk and Van Binsbergen, 2025). Our paper demonstrates that sustainable investors can influence firm behavior through market prices, extending beyond the cost-of-capital effect, by undermining the governance role of financial markets. We also highlight a complementarity between exit and voice in reducing firm externalities, contrasting with papers viewing them as competing strategies (e.g., Broccardo et al., 2022; Jagannathan et al., 2023; Gupta et al., 2025).

Several papers explore connections between environmental and social concerns and corporate governance. One strand examines how governance mechanisms can be leveraged to achieve ES

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

objectives through shareholder voting (e.g., Jin and Noe, 2023) and engagement (e.g., Hart and Zingales, 2017; Broccardo et al., 2022; Gollier and Pouget, 2022). Another strand analyzes how ES considerations affect governance quality through various channels: shifts in shareholder composition (e.g., Davies and Van Wesep, 2018; Morgan and Tumlinson, 2019; Matsusaka and Shu, 2021; Jin and Noe, 2023; Piccolo et al., 2023; Gryglewicz et al., 2024; Levit et al., 2024), adoption of investment mandates (e.g., Oehmke and Opp, 2024; Gupta et al., 2025), evolution of voting mechanisms (e.g., Malenko and Malenko, 2023; Döttling et al., 2024), and changes in firms' legal and organizational forms (e.g., Chowdhry et al., 2019; Geelen et al., 2023). Our paper contributes to this second strand by identifying a novel market-governance channel operating through price informativeness. Sustainable investors' trading behavior reduces the information content of stock prices about managerial effort, thereby weakening market governance.

Some studies examine optimal contracting based on stock prices when investors have social concerns.[2] Chaigneau and Sahuguet (2025) study how boards set managerial compensation to balance financial and social goals. In their model, the stock price is exogenous, without sustainable investors affecting price informativeness. While the tilting strategy of sustainable investors in Edmans et al. (2023) can be interpreted as an incentive mechanism affecting managerial behavior through stock prices, sustainable investors in their framework influence prices by changing the market's risk-bearing capacity. In contrast, we show how sustainable investors can influence managerial behavior by affecting the market's informativeness. A related literature studies firm investment with sustainability concerns and feedback effects (e.g., Chen and Schneemeier, 2023; Xue, 2023) but does not examine optimal contracting.

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

We also build on and contribute to the literature studying how markets discipline management (e.g., Holmström and Tirole, 1993; Dow and Gorton, 1997; Maug, 1998; Admati and Pfleiderer, 2009; Edmans, 2009) by introducing public good provision and sustainable investors. We examine

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

how the social concerns of informed investors influence trading behavior and weaken shareholders' ability to discipline managers using stock-based compensation.

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

Our paper relates to the literature studying the real effects of informed trading with multiple dimensions of firm investment decisions. For example, Piccolo (2022) show that coordination problems in information production can lead to multiple equilibria. Dow et al. (2024) show that competition for informed trading results in excessive short-termism, even when firms' managerial contracts and project choices are individually optimal. In these papers, inefficiencies arise from general equilibrium effects with varying payoff horizons. Our mechanism differs as inefficiencies arise in partial equilibrium with identical payoff horizons, generating different insights. Interpreting long-horizon projects and long-term investors in Dow et al. (2024) as sustainable implies that strengthening sustainable investing by increasing investor horizons would increase efficiency through more sustainable long-term investments. In contrast, strengthening social concerns in our model leads to weaker governance, thereby 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 initially owned by financial investors. At $t = 2$, the firm generates a financial payoff for its owners and potentially imposes an 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 and has private information

about its financial payoff and externality, 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 an externality $E \in \{0,\eta\}$ at $t=2$, where $\eta < 0$ captures negative externalities such as the environmental damages from a manufacturing firm's carbon emissions (e.g., Bolton and Kacperczyk, 2021, 2023) or the adverse social effects of an opioid epidemic resulting from a pharmaceutical firm's marketing practices (e.g., Maclean et al., 2020; Case and Deaton, 2021; Florence et al., 2021), and $\eta > 0$ captures positive externalities such as carbon capture and sequestration initiatives (e.g., Fuss et al., 2018; Minx et al., 2018) or workforce training programs that enhance regional human capital and productivity (e.g., Acemoglu and Pischke, 2001; Moretti, 2004). The binary specification for the firm's externality simplifies the analysis but is not necessary for our main results.[3]

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

To most clearly demonstrate how sustainable investing affects the traditional governance role of financial markets, we assume that F and E are independent and abstract from effects that arise if investors update their expectations about financial payoffs based on the externality (e.g., Pedersen et al., 2021). Section 6.5 allows for arbitrary correlation between F and E, demonstrating the robustness of our results, and showing that correlation between the financial payoff and externality can amplify or dampen our mechanism. To focus on cases where market monitoring is relevant, we assume that exerting financial effort is socially efficient: $N\Delta_F > B_F$.

At $t=1$, shares are traded in a discrete Kyle (1985)-type market.[4] Restricting trading to

[3] Section 6.4 introduces noise into the informed investor's information on E, generating a model isomorphic to one with high and low (non-zero) externalities. Appendix C.2 extends the model to allow for a continuous distribution of E. Our mechanism only requires that, with a positive probability, the externality is large enough to influence the informed investor's trading strategy.

[4] We adopt the discrete Kyle-type framework because it provides a transparent and analytically tractable environment for studying the effects of sustainable investing on price informativeness and optimal contracting, independent of cost-of-capital effects. However, our core mechanism—that social concerns can reduce informed trading on financial

discrete quantities is well-established in the applied financial economics literature when analyzing phenomena beyond price formation (e.g., Goldstein and Guembel, 2008; Edmans et al., 2015; Gao et al., 2025).[5] Noise traders' random demand $z \in \mathbb{N}_0 := \{0, 1, \ldots\}$ follows a geometric distribution with density $(1-\lambda)^z\lambda$, where $\lambda \in (0,1)$.[6] For simplicity, we assume the informed investor learns the realized values of F and E before trading.[7] Section 6.4 introduces noise to the informed investor's private information. Trading frictions limit the informed investor to submitting an order $x \in \{0,1\}$. For instance, the informed investor may have convex opportunity costs to deploy capital or face short-selling restrictions (e.g., Edmans et al., 2015; Dow et al., 2017). Appendix C.3 shows that our results continue to hold when we allow for short-selling (i.e., $x \in \{-1,0,1\}$).

Our key departure from a standard Kyle (1985)-type framework is that the informed investor may have social concerns. Specifically, the informed investor cares about the firm's externality with intensity $\gamma \geq 0$ and is informed about both the financial payoff F and the externality E. The informed investor's concern about the externality is characterized by the gross utility function $x(F+\gamma E)$, where $x \in \{0,1\}$ indicates share ownership. Thus, the investor's utility from share ownership decreases with a negative externality ($E = \eta < 0$) and increases with a positive externality ($E = \eta > 0$). The investor's net utility is given by $x(F+\gamma E - \mathbb{E}[P])$, where $\mathbb{E}[P]$ is the expected market price at $t = 1$.

The informed investor's social concerns regarding the externality can be interpreted in several ways. For example, investors may have deontological warm-glow preferences, inherently valuing green firms (e.g., Heinkel et al., 2001; Pastor et al., 2021; Pedersen et al., 2021) or consequentialist broad-impact preferences, leading to investment mandates reflecting those preferences (Gupta et al., 2025). Growing evidence suggests that moral and ethical considerations influence investors' decision-making in financial markets (e.g., Riedl and Smeets, 2017; Bauer et al., 2021; Humphrey et al., 2021; Zhang, 2021; Baker et al., 2022; Zhang, 2022; Heeb et al., 2023; Bonnefon et al.,

information, thereby increasing agency costs—does not rely on this specific market microstructure. To illustrate this, Appendix C.6 derives our main result with competitive informed investors.

[5] While we can generate our main mechanism with continuous informed trading as in Edmans (2009), the discrete setup is essential for analyzing the rich set of extensions—including endogenous investment in reducing the externality, managerial social effort, and public ES news.

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

[7] Appendix C.1 extends the model to endogenous private information, highlighting a natural complementarity between the two types of private information.

2025; Giglio et al., 2025).[8] The social concerns may also capture regulatory constraints or heterogeneous views on physical or transition risks. We explore the implications of these interpretations in Section 7.

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

The market makers' equilibrium pricing rule reflects the preferences of the marginal financial investor, who is indifferent to the firm's externality.[9] Specifically, the market makers set the firm's stock price at $t = 1$ to capture the firm's expected financial payoff given the observable order flow. Appendix C.4 introduces market makers who partially account for the externality in pricing and demonstrates the robustness of our results.

The firm's initial controlling shareholders, being financial investors, care only about the financial payoff F.[10] At $t = 0$, they design the manager's compensation contract, W, to maximize the firm's expected financial payoff net of compensation costs. The manager is protected by limited liability, requiring $W \geq 0$. To emphasize the governance role of the financial market, we assume that the manager's incentive pay can only depend on the firm's stock price P at $t = 1$. The manager's outside option is normalized to zero. To simplify the exposition, we follow the literature assuming

[8] See Kräussl et al. (2024) for a recent survey.

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

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

that the firm's initial shareholders pay the manager's compensation (e.g., Holmström and Tirole, 1993; Admati and Pfleiderer, 2009; Edmans et al., 2009a; Peng and Röell, 2014). Appendix C.5 shows that this assumption is without loss of generality in our framework. Figure 1 summarizes the model's timing.

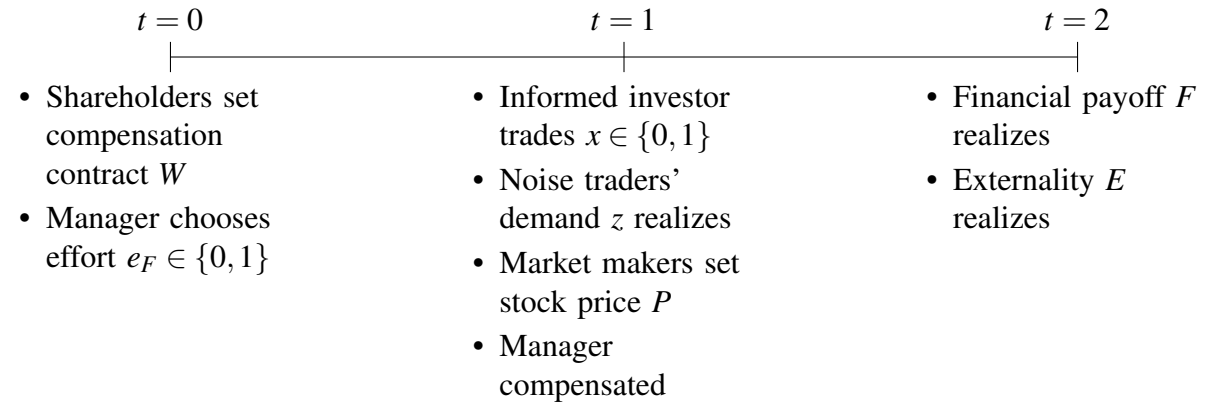


Figure 1: Model Timeline

4 Benchmark with Only Financial Investors

We first establish a benchmark case where the informed investor does not care about the firm's externality (i.e., $\gamma = 0$), reducing our framework to a standard market-monitoring model (e.g., Holmström and Tirole, 1993; Admati and Pfleiderer, 2009; Edmans, 2009). We denote equilibrium objects in this benchmark case with the subscript 0. The optimal trading strategy of an informed financial investor is straightforward: buy one share if and only if she observes $F = 1$.

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

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

The equilibrium pricing rule reflects how trading reveals information. When aggregate order flow is low ($q = 0$), it reveals the absence of informed buying and, therefore, a low financial payoff

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

At $t = 0$, the firm's initial shareholders design the manager's compensation contract W, anticipating the trading equilibrium at $t = 1$. As is standard in risk-neutral contracting under limited liability, the optimal contract is determined by the likelihood ratio (e.g., Innes, 1990).[11] For ease of exposition, we consider the contracting problem as a function of order flow rather than price. As will become clear, this is without loss of generality. The likelihood ratio as a function of order flow is defined as

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

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

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

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

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

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

We refer to the maximum likelihood ratio ϕ_0^* as the *effort informativeness* of the stock price. Since the maximum likelihood ratio occurs in all states $q > 0$, corresponding to positive order flow and a high stock price, the manager optimally receives compensation only in these states. Hence, we consider a contract paying the manager a constant bonus for $q > 0$ and zero otherwise.[12]

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

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

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

indifferent between exerting effort and shirking:

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

Corollary 1. *An optimal contract is given by*

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

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

The expected cost to shareholders of providing managerial incentives is

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

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

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

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

where the left-hand side represents the increase in the expected financial payoff from managerial effort, and the right-hand side captures the cost of providing incentives. For the remainder of our analysis, we assume the parameters satisfy condition (1), ensuring that controlling shareholders

prefer to induce managerial effort when the informed trader has no social concerns.

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

Without this assumption, shareholders would never induce effort, making changes in the effectiveness of market monitoring due to sustainable investing irrelevant.

5 Agency Cost of Sustainable Investing

This section studies how sustainable investing shapes the governance role of financial markets. Section 5.1 characterizes the equilibrium effects of sustainable investing on trading, pricing, and optimal contracting. We establish the core market-governance channel of sustainable investing in our framework: social concerns distort informed trading, reduce the informativeness of prices, and increase the cost of incentivizing managerial effort. Crucially, this mechanism operates whether the firm generates a positive or negative externality. Section 5.2 shows how this market-governance channel creates an endogenous relationship between a firm's ES and governance quality. This relationship is positive for a firm that imposes a negative externality but negative for one that generates a positive externality. Section 5.3 explores the implications for expected returns and price volatility.

5.1 Equilibrium

We begin with the case of negative externalities ($\eta < 0$) to establish the core intuition of the market-governance channel of sustainable investing before examining how it extends to positive externalities ($\eta > 0$). Throughout our analysis, we denote equilibrium objects with the subscript γ to emphasize their dependence on the informed investor's social concerns.

5.1.1 Negative Externality

Consider the case where the firm may generate a negative externality $E \in \{0, \eta\}$ with $\eta < 0$. Noise trading ensures that the expected market-clearing price remains strictly between 0 and 1. The informed investor values the firm's shares at $F + \gamma E$, reflecting both the financial payoff and the externality. Her optimal trading strategy is straightforward in three states: she never buys when

the financial payoff is low regardless of the externality ($F = 0$ and $E = 0$ or η), as the expected market-clearing price exceeds her valuation, and always buys when the financial payoff is high and the externality is low ($F = 1$ and $E = 0$), as her valuation exceeds the expected market-clearing price.

What remains to be determined is her trading behavior upon observing a high financial payoff and a high externality ($F = 1$ and $E = \eta$). When the informed investor observes $F = 1$ and $E = \eta$, she faces a trade-off: buying a share yields a financial gain but generates a disutility from the negative externality. We denote by $a \in [0,1]$ the probability that she submits a buy order in this state.[13] Figure 2 summarizes the informed investor's trading behavior.

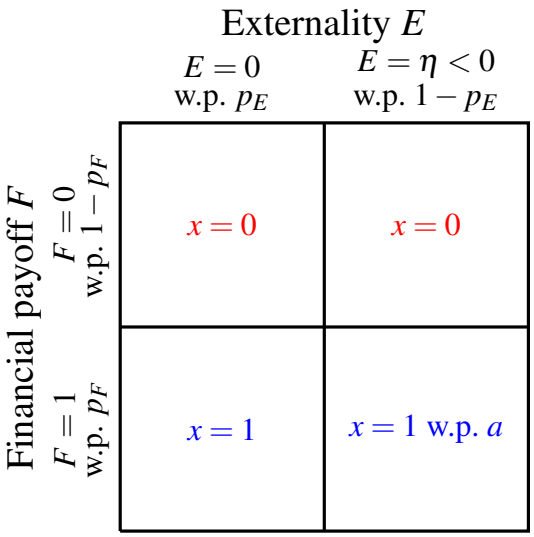


Figure 2: Informed Investor's Trading Strategy with a Negative Externality. This figure illustrates the informed investor's equilibrium trading behavior conditional on observing the financial payoff (F) and externality (E) realizations. Variable $a \in [0,1]$ denotes the probability of buying upon observing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

Lemma 2. *Assume the manager exerts effort ($e_F = 1$). There exist thresholds $\underline{\gamma}$ and $\bar{\gamma}$ with $\underline{\gamma} < \bar{\gamma}$ such that the following unique equilibrium obtains:*

(*i*) *Trading: The informed investor buys one share ($x = 1$) upon observing $F = 1$ and $E = 0$, and abstains ($x = 0$) upon observing $F = 0$. Upon observing $F = 1$ and $E = \eta$, she buys*

[13] For intermediate social concerns, a pure-strategy equilibrium ($a^* = 0$ or $a^* = 1$) does not exist because of negative feedback: less informed trading (lower a) decreases the equilibrium price for high order flow, making informed trading more attractive. If the equilibrium were to shift discontinuously from always buying ($a^* = 1$) to never buying ($a^* = 0$), the corresponding discrete price drop would make buying a profitable deviation. Because the investor's valuation changes continuously with γ, the only equilibrium involves a mixed strategy ($a^* \in (0,1)$) that ensures a continuous transition in trading behavior and market prices.

with probability a^*, where: $a^* = 1$ if $\gamma \leq \underline{\gamma}$; a^* strictly decreases from 1 to 0 as γ increases in the interval $(\underline{\gamma}, \bar{\gamma})$; and $a^* = 0$ if $\gamma \geq \bar{\gamma}$.

(*ii*) *Prices: The equilibrium price as a function of aggregate order flow $q = x + z$ satisfies $P_\gamma(0) < P_\gamma(q)$ for all $q > 0$. Moreover, $P_\gamma(0)$ weakly increases in γ while $P_\gamma(q > 0)$ weakly decreases in γ, with both relationships strict for $\gamma \in (\underline{\gamma}, \bar{\gamma})$.*

Lemma 2 implies that the equilibrium level of informed trading, defined as the probability with which the informed investor buys conditional on observing a high financial payoff ($\tau_\gamma^* = p_E + (1 - p_E)a^*$), weakly decreases in γ. Figure 3 shows how a^* and τ_γ^* vary with the informed investor's social concerns. For weak social concerns ($\gamma \leq \underline{\gamma}$), the negative externality does not deter trading ($a^* = 1$), resulting in maximal informed trading ($\tau_\gamma^* = 1$). As social concerns strengthen ($\gamma \in (\underline{\gamma}, \bar{\gamma})$), the informed investor becomes less willing to buy with a high externality, and a^* declines to zero. However, τ_γ^* declines more gradually since she still buys when observing a low externality. For strong social concerns ($\gamma \geq \bar{\gamma}$), she never buys with a high externality ($a^* = 0$), and informed trading occurs only with a low externality ($\tau_\gamma^* = p_E$).

This trading behavior captures negative screening strategies, which exclude firms with high negative externalities. Negative screening strategies remain the predominant approach in sustainable investing practice (e.g., US SIF, 2024).

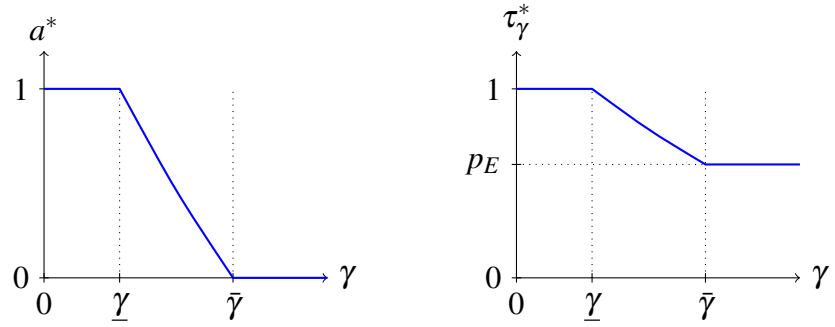


Figure 3: Equilibrium Trading Strategy. This figure shows how the informed investor's trading strategy varies with the intensity of her social concerns (γ). The left panel plots the probability of buying when both the financial payoff and the externality are high (a^*). The right panel plots the overall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

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

responsive to order flow, reflecting the reduced informativeness about financial payoffs.

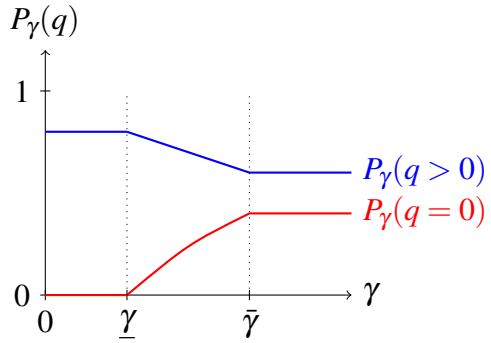


Figure 4: Equilibrium Prices. This figure shows how equilibrium prices vary with the intensity of the informed investor's social concerns (γ). The blue line represents the price when aggregate order flow is high ($q > 0$), and the red line represents the price when order flow is low ($q = 0$).

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

Lemma 3. *The maximum likelihood ratio occurs in states with positive order flow ($q > 0$) and equals*

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

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

Proposition 2. *When the informed investor's social concerns are sufficiently strong, the effort informativeness of the firm's stock price is lower relative to the benchmark without social concerns ($\gamma = 0$): $\phi_\gamma^* < \phi_0^*$.*

Figure 5 illustrates the result in Proposition 2 by showing how the maximum likelihood ratio varies with the informed investor's social concerns. For $\gamma \leq \underline{\gamma}$, effort informativeness matches the benchmark case. As social concerns strengthen beyond $\underline{\gamma}$, effort informativeness declines because the informed investor trades less aggressively on financial information, consistent with empirical evidence (Goldstein et al., 2022; Yang et al., 2023; Hitzemann et al., 2024).

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

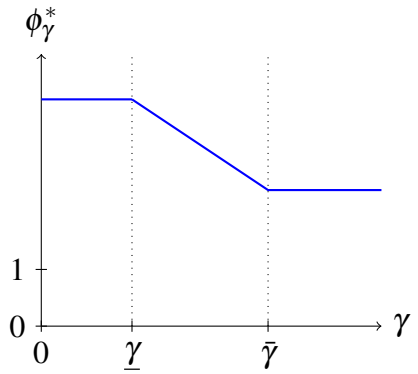


Figure 5: Maximum Likelihood Ratio. This figure shows how the maximum likelihood ratio ϕ^*_γ varies with the informed investor's social concerns.

Lemma 4. *An optimal incentive-compatible contract is given by*

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

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

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

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

As the informed investor's social concerns intensify, her trading strategy is increasingly determined by the firm's externality rather than its financial payoff. This shift makes governance through market monitoring less effective.

Corollary 2. *When the informed investor's social concerns are sufficiently strong, the cost of providing managerial incentives is higher relative to the benchmark without social concerns ($\gamma = 0$): $C_\gamma > C_0$. When the cost of providing managerial incentives exceeds the benefit ($C_\gamma > N\Delta_F$), the initial shareholders do not induce the manager to exert effort.*

Figure 6 illustrates the relationship between incentive costs and the informed investor's social concerns. For weak social concerns ($\gamma \leq \underline{\gamma}$), incentive costs match the benchmark. As social concerns strengthen, incentive costs increase relative to the benchmark because the informed in-

vestor trades less aggressively in response to financial information. Moreover, if $C_\gamma > N\Delta_F$ when $\gamma > \bar{\gamma}$, then sufficiently strong social concerns make inducing managerial effort unprofitable for the firm's controlling shareholders. In this case, they optimally forgo incentive provision, even though managerial effort is socially efficient and would be induced absent the informed investor's social concerns ($\gamma = 0$). The resulting effort reduction represents a real efficiency loss from sustainable investing—the agency cost of sustainable investing.

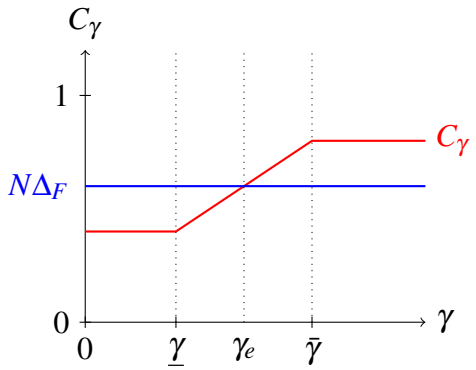


Figure 6: Cost of Incentive Provision. This figure plots the expected cost of providing incentives (C_γ) as a function of the intensity of the investor's social concerns (γ). The threshold γ_e represents the level of social concerns above which managerial effort is no longer induced.

5.1.2 Positive Externality

We now turn to the case where the firm generates a positive externality $E \in \{0, \eta\}$ with $\eta > 0$. We show that our framework's core mechanism—sustainable investing weakens market governance—also operates in this case. While a positive externality induces different trading patterns than a negative externality, these patterns similarly reduce informed trading on financial information, yielding the same governance implications. Specifically, whereas in the case of negative externalities, the informed investor sometimes abstains from buying when the financial payoff is high, with a positive externality, she may buy a share when the financial payoff is low. For brevity, we highlight the key departures from and parallels with the negative externality analysis.

As before, noise trading ensures that the expected market-clearing price remains strictly between 0 and 1. As a result, the informed investor's trading strategy is straightforward in three states: she buys when the financial payoff is high, regardless of the externality ($F = 1$ and $E = 0$ or $E = \eta$), as her valuation exceeds the expected market-clearing price, and never buys when both the financial payoff and the externality are low ($F = 0$ and $E = 0$).

The key strategic decision occurs when observing a low financial payoff and a high externality ($F = 0$ and $E = \eta$). When the informed investor observes $F = 0$ and $E = \eta$, she faces a trade-off: buying a share results in a financial loss but generates positive utility from the positive externality. For weak social concerns, trading losses dominate, making abstaining the optimal choice. For strong social concerns, the utility gain dominates, making buying the optimal choice.[14]

This trading behavior captures positive screening strategies, which include firms with high positive externalities. Positive screening strategies, while less prevalent than negative screening, represent a growing segment of sustainable investing practice (e.g., US SIF, 2024).

This trading distortion—buying a share despite a low financial payoff when there is a positive externality—reduces effort informativeness and increases incentive costs.

Proposition 3. *When the informed investor's social concerns are sufficiently strong, the cost of providing managerial incentives is higher relative to the benchmark without social concerns ($\gamma = 0$). When the cost of providing managerial incentives exceeds the benefit ($C_\gamma > N\Delta_F$), the initial shareholders do not induce the manager to exert effort.*

The incentive cost implications parallel those of the negative externality case. For weak social concerns, incentive costs match the benchmark. For sufficiently strong social concerns, costs rise because the informed investor's trading becomes less responsive to financial payoffs—she buys despite a low financial payoff when the externality is high. When these increased costs exceed the expected gain from managerial effort ($C_\gamma > N\Delta_F$), shareholders optimally forgo incentive provision, resulting in a lower expected financial payoff—the agency cost of sustainable investing.

Our analysis across positive and negative externalities yields several empirical implications. As the social concerns of informed investors intensify, we should observe a lower prevalence of stock-based compensation across firms, as the cost of providing managerial incentives becomes prohibitively high for some. Among firms that continue using stock-based compensation to provide incentives, both the pay-performance sensitivity and the expected compensation level should increase—the bonus payment $W_\gamma^*(q > 0)$ rises with γ and the expected compensation levels required for incentive compatibility C_γ increase with γ. The empirical literature studying managerial

[14]The equilibrium structure differs from the case with negative externalities. While negative feedback in the negative externality case necessitates mixed strategies for intermediate γ (see Footnote 13), positive feedback in the case of positive externalities—higher buying intensity when $F = 0$ and $E = \eta$ lowers the equilibrium price, which further encourages buying—supports pure-strategy equilibria for all γ. When multiple equilibria exist, we select the more informative one. Our results hold regardless of this selection. See the proof of Proposition 3 for details.

incentives has developed proxies for such compensation costs—including a higher delta in executive compensation contracts (e.g., Edmans et al., 2009b), greater total CEO pay (e.g., Gabaix and Landier, 2008), and increased reliance on equity-based incentives (e.g., Hall and Liebman, 1998)—that can be employed to test these predictions.

While the core mechanism—that sustainable investing weakens market governance—operates regardless of whether the firm generates a positive or negative externality, the sign of the externality determines how ES quality affects governance and asset prices. Sections 5.2 and 5.3 demonstrate that better ES quality enhances governance and increases price volatility for firms generating a negative externality, but deteriorates governance and reduces price volatility for firms generating a positive externality.

Note that increasing γ is equivalent to increasing $|\eta|$ in the model because the distortion in trading behavior depends on the informed investor's effective social concern when the externality realizes: $\gamma|\eta|$. Hence, firms with small externalities (low $|\eta|$) have better market monitoring than firms with large externalities (high $|\eta|$).

The preceding analysis establishes how sustainable investing affects equilibrium trading, pricing, and optimal contracting. All subsequent analysis incorporates the full equilibrium response, including shareholders' optimal adjustment of managerial compensation to changes in price informativeness. In particular, when we examine the relationship between ES and governance quality (Section 5.2) and asset pricing implications (Section 5.3), we account for both the direct effect of sustainable investing on the informed investor's trading behavior and the indirect effect through shareholders' optimal contracting response.

Note that when contracts cannot adjust—as in settings where contracts are sticky and changes in sustainable investing are unanticipated—effort provision may decline because the existing contract fails to respond to the deterioration in the effort informativeness of prices caused by stronger social concerns. This highlights an important implication: compensation contracts must adapt to evolving ES concerns in financial markets (Pastor et al., 2022) to maintain managerial incentives.

5.2 Sustainable Investing and the ES and Governance Relationship

Having established that sustainable investing weakens market governance in both the positive and negative externality cases, we now examine the resulting equilibrium relationship between ES and

governance quality. This relationship emerges endogenously as shareholders adjust managerial compensation in response to changes in price informativeness.

Our model captures governance quality through the endogenous probability of a high financial payoff ($p_F - \Delta_F$ or p_F), which depends on managerial effort, and ES quality through p_E, the exogenous probability of a low externality. Note that a higher p_E implies better ES quality when the firm imposes a negative externality, but worse ES quality when the firm generates a positive externality.

Proposition 4. *When the informed investor's social concerns are sufficiently strong, effort informativeness (ϕ_γ^*) increases with p_E. The resulting relationship between ES and governance quality is positive when the firm imposes a negative externality ($\eta < 0$) and negative when it generates a positive externality ($\eta > 0$).*

The intuition follows directly from the trading patterns established in Section 5.1. When social concerns are sufficiently strong, the realization of a high externality—positive or negative—distorts the informed investor's trading strategy, making it less responsive to her private information about financial payoffs and reducing the effort informativeness of prices. The higher the probability that the externality realizes, the greater the reduction in effort informativeness. While this analysis focuses on the externality's frequency ($1 - p_E$), as discussed in Section 5, its magnitude ($|\eta|$) plays a conceptually similar role—firms with large externalities (high $|\eta|$) have worse market monitoring.

When the firm imposes a negative externality, the realization of a high externality ($E = \eta < 0$) discourages the informed investor from buying despite positive financial information. The distortion weakens as the firm becomes less likely to generate a negative externality (higher p_E). Consequently, firms with better ES quality—those generating a lower expected negative externality—preserve greater price informativeness and enjoy stronger market governance. This yields a positive relationship between ES and governance quality.

When the firm generates a positive externality, the realization of a high externality ($E = \eta > 0$) encourages the informed investor to buy a share despite negative financial information. The distortion strengthens as the firm becomes more likely to generate a positive externality (lower p_E). Consequently, firms with better ES quality—those generating a higher expected positive externality—suffer reduced price informativeness and weaker market governance. This yields a negative relationship between ES and governance quality.

This analysis reveals an important asymmetry: while sustainable investing consistently reduces price informativeness, its impact on the relationship between ES and governance quality depends critically on the nature of the externality. Firms that impose negative externalities (such as carbon emissions) see governance improve with better ES quality, while firms that generate positive externalities (such as workforce training programs) see governance deteriorate with better ES quality.

Our mechanism suggests that negative screening strategies—excluding firms with the highest negative externalities—induce a positive relationship between ES and governance quality, while positive screening strategies—seeking firms with the highest positive externalities—induce a negative relationship between ES and governance quality. This asymmetry implies that the governance implications of sustainable investing strategies depend fundamentally on whether they screen based on avoiding harm or contributing to solutions, with positive screening strategies creating governance costs precisely for firms that create the most social value.

5.3 Expected Returns, Price Volatility, and the Greenium

Our analysis provides insights into expected returns and price volatility among firms with different ES qualities. While the greenium—return differentials between high and low ES firms—has been a central focus in the sustainable finance literature (e.g., Heinkel et al., 2001; Pedersen et al., 2021; Pastor et al., 2022), price volatility effects have received less attention. We show that in our framework, ES quality affects price volatility through informed trading, even when expected returns remain unchanged.

In our model, risk-neutral market makers set prices at $t = 1$ to reflect expected financial payoffs at $t = 2$. Consequently, firms with different ES qualities have identical expected returns, $\mathbb{E}[F - P_\gamma(q)] = 0$, implying no greenium. Importantly, as our paper demonstrates, this absence of a greenium does not mean that sustainable investing cannot affect financial markets, asset prices, and firm decisions. We discuss implications for realized returns in Appendix C.7.

While expected returns are invariant to ES quality, price volatility is not. Sustainable investing affects volatility through its impact on informed trading.

Proposition 5. *When the informed investor's social concerns are sufficiently strong, the firm's stock price volatility increases with p_E. The resulting relationship between ES quality and price volatility is positive when the firm imposes a negative externality ($\eta < 0$) and negative when it*

generates a positive externality ($\eta > 0$).

The intuition for Proposition 5 mirrors the logic underlying the relationship between ES and governance quality established in Section 5.2. In our model, higher price volatility reflects more informative prices about the firm's financial payoff. When social concerns are strong, the realization of a high externality—whether positive or negative—distorts the informed investor's trading, making it less responsive to her private information about the financial payoff. A higher probability of a low externality (higher p_E) increases the likelihood that the informed investor's trading reflects financial information rather than the externality, increasing price volatility.

When the firm imposes a negative externality, the informed investor abstains from buying upon observing a high externality, even if the financial payoff is high. A firm with better ES quality imposes a negative externality less frequently (higher p_E), allowing the informed investor to trade more often on her financial information. This more frequent informed trading makes the firm's stock price both more informative about managerial effort and more volatile.

In contrast, when the firm generates a positive externality, the informed investor buys upon observing a high externality, even if the financial payoff is low. A firm with better ES quality generates a positive externality more frequently (lower p_E), leading the informed investor to trade more often based on the externality rather than financial information. This makes the firm's stock price both less informative about managerial effort and less volatile.

Our framework demonstrates how sustainable investing impacts corporate governance by altering the information content of stock prices, thereby affecting the cost-effectiveness of market-based incentive schemes. This mechanism differs fundamentally from traditional cost-of-capital explanations for how sustainable investing affects firm behavior. For instance, Edmans et al. (2023) study markets with limited risk-bearing capacity, where the exit of sustainable investors reduces the market's limited risk-bearing capacity and increases the firm's cost of capital. In contrast, our model features risk-neutral markets where all firms have the same cost of capital. Nevertheless, sustainable investing has real effects.

Our mechanism provides a formal theoretical foundation for concerns that sustainability objectives can distract from core business objectives and undermine corporate governance (e.g., Bebchuk and Tallarita, 2020). However, as Sections 6.2 and 6.3 demonstrate, this negative governance effect can generate positive real effects.

6 Extensions and Robustness

We explore several extensions that demonstrate the robustness of our core mechanism while yielding additional insights. Section 6.1 analyzes how public news about the firm's externality affects market monitoring. Section 6.2 examines the initial shareholders' incentive to reduce the probability of a high externality. Section 6.3 introduces managerial social effort to improve the firm's ES quality. Section 6.4 studies how the precision of the informed investor's signal about the firm's externality influences our results. Section 6.5 allows the financial payoff and externality to be correlated. Section 6.6 studies the prevalence of sustainable investors in the market. Throughout this section, we consider the case in which the informed investor's social concerns are sufficiently strong such that she does not buy when the firm imposes a high negative externality and buys when the firm generates a high positive externality, independent of the firm's financial performance.

6.1 Public News about the Externality

In this section, we examine how public news about the firm's externality interacts with market monitoring. We assume that a public signal $\sigma \in \{L,H\}$ about the realized externality arrives after trading occurs at $t = 1$.[15] This signal may correspond to ES news and incidents (e.g., Krüger, 2015; Glossner, 2021; Derrien et al., 2025). It satisfies $\Pr(\sigma = L|E = 0) > \Pr(\sigma = L|E = \eta)$,[16] implying that

$$\underline{p}_E := \Pr(E = 0|\sigma = H) < p_E < \Pr(E = 0|\sigma = L) =: \bar{p}_E.$$

The public signal helps the firm interpret market outcomes, allowing contracts to condition on both the order flow q and the signal σ.[17]

Proposition 6. *When the informed investor's social concerns are sufficiently strong, an optimal incentive-compatible contract conditions the manager's compensation on both the order flow (q) and the public signal about the firm's externality (σ).*

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

[16] For instance, we can set $\Pr(\sigma = L|E = 0) = \Pr(\sigma = H|E = \eta) = 1 - \frac{1}{2}(1-\rho)$, and, symmetrically, $\Pr(\sigma = L|E = \eta) = \Pr(\sigma = H|E = 0) = \frac{1}{2}(1-\rho)$, with $\rho \in (0,1)$ capturing the precision of the signal.

[17] If the signal arrives before trading at $t = 1$, it also helps market participants update their beliefs about p_E to either $\underline{p}_E$ or $\bar{p}_E$. In this case, the market equilibrium construction is identical to that identified in Section 5, with $p_E = \underline{p}_E$ given a negative signal ($\sigma = H$) and with $p_E = \bar{p}_E$ given a positive signal ($\sigma = L$).

ES-linked compensation helps financially motivated shareholders extract more information about managerial effort from market outcomes, thereby improving market governance. A public signal about the externality allows shareholders to partially correct for the reduced effort informativeness when the informed investor has sufficiently strong social concerns by including the signal in the contract, compensating the manager in states where informed trading is less likely to be distorted by the firm's externality.

Corollary 3. *When the informed investor's social concerns are sufficiently strong, including the signal σ in the compensation contract lowers the cost of managerial incentives and can enhance governance quality by inducing shareholders to switch from not inducing effort to inducing effort.*

Corollary 3 establishes that ES-linked compensation can improve governance quality and firm value by reducing the cost of inducing managerial effort. The optimal ES-linked compensation structure depends on whether the firm generates a positive or negative externality. When the firm imposes a negative externality ($\eta < 0$), the optimal contract pays the manager a bonus only when the order flow is positive ($q > 0$) and the signal indicates a low externality ($\sigma = L$). This contract rewards the manager for better ES performance, ostensibly aligning managerial incentives with social welfare. However, financially motivated shareholders design this contract not to incentivize better ES performance but rather to use the signal to identify when market outcomes are most informative about managerial effort, thereby reducing the cost of managerial incentives. Indeed, in our baseline model, the probability that the firm generates a high externality ($1 - p_E$) is exogenous.

The same logic applies when the firm generates a positive externality ($\eta > 0$). Here, the optimal contract similarly pays the manager a bonus when the order flow is positive ($q > 0$) and the signal indicates a low externality ($\sigma = L$). The manager is now rewarded for worse ES performance. Contracts that explicitly reward low ES performance are uncommon in practice, likely reflecting reputational constraints. However, under a broader interpretation, the same economic logic extends to punishing high ES performance in alternative ways, such as dismissals or withheld promotions. Consistent with this interpretation, several high-profile CEO departures have been attributed to shareholders penalizing managers for prioritizing social objectives.[18]

Existing literature on ES-linked compensation examines whether it improves ES performance

[18] See, for example, Vivienne Walt, "A Top CEO Was Ousted After Making His Company More Environmentally Conscious. Now He's Speaking Out," TIME, 21 November 2021; Frank Van Gansbeke, "Sustainability And The Downfall Of Danone CEO Faber (1/2)," Forbes, 20 March 2021; and Jonathan Stempel and Jessica DiNapoli, "Ben & Jerry's Says Unilever Ousting Ice Cream Maker's CEO Over Social Activism," Reuters, 20 March 2025.

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

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

6.2 Investment to Reduce the Externality

We analyze an extension where the firm can invest to reduce its externality. At $t = 0$, the firm's initial controlling shareholders can pay a cost $c > 0$ to increase the probability of a low externality ($E = 0$) from p_E to $p_E + \Delta_E$, where $0 < \Delta_E < 1 - p_E$. When the firm imposes a negative externality ($\eta < 0$), this investment reduces the probability of a negative externality. When the firm generates a positive externality ($\eta > 0$), it reduces the probability of a positive externality. Note that because shareholders are purely financially motivated, they have no incentive to increase the probability of a high externality, as this would reduce effort informativeness and increase the cost of incentivizing the manager. Thus, even if such a technology were available, shareholders would never pay to increase the probability of a high externality.

Proposition 7. *When the informed investor's social concerns are sufficiently strong, investing to increase the probability of a low externality reduces managerial incentive costs. Moreover, if effort is induced under the investment, there exists a cost threshold $\bar{c} > 0$ such that the firm's initial controlling shareholders invest if and only if $c \leq \bar{c}$.*

Proposition 4 shows that the effort informativeness of the firm's stock price increases with the probability of a low externality. Investing to increase this probability, therefore, improves market monitoring and reduces incentive costs. The firm's initial controlling shareholders—being financial investors—do not inherently care about externalities. They invest if and only if the cost of reducing the externality is below the benefit from improved market monitoring. Beyond affecting the distribution of rents between the manager and shareholders, the investment may have real financial effects by enabling effort induction when incentive costs would otherwise be prohibitively high.

The ES implications depend critically on whether the firm generates a positive or negative externality. When the firm imposes a negative externality ($\eta < 0$), the investment reduces the probability of a high externality, thereby improving ES quality. This improvement can also enhance governance quality by lowering incentive costs. "Doing well by doing good" thus arises endogenously through our market governance channel. Beyond traditional arguments that sustainable practices enhance financial performance through reduced risks or increased revenues (e.g., Derrien et al., 2025), our model demonstrates an additional mechanism: better ES quality improves financial performance through enhanced market governance.

Our analysis reveals a novel complementarity between exit and voice for reducing externalities.[19] When the informed investor with social concerns can exit firms with a negative externality, this can motivate financial shareholders to exercise voice and reduce the firm's externality. This complementarity provides a new perspective, as exit and voice are typically viewed as competing approaches (e.g., Broccardo et al., 2022).

Conversely, when the firm generates a positive externality ($\eta > 0$), the investment reduces the probability of a positive externality, thereby worsening ES quality. Here, financially motivated shareholders may invest to reduce positive externalities purely to improve market monitoring. Section 7 discusses the welfare implications further.

This analysis can help explain the prevalence of net-zero strategies among firms. Our framework suggests that shareholders have financial incentives to drive externalities toward zero, as this maximizes effort informativeness and minimizes managerial incentive costs. This governance ad-

[19]While we interpret the informed investor's decision not to buy a share despite observing favorable financial performance as "exit," our model does not explicitly feature divestment. The same market monitoring mechanism would operate with explicit divestment—an informed investor holding shares may sell despite observing strong financial performance if the firm generates a high externality. More broadly, our mechanism requires only that informed sustainable investors deviate from purely financial trading.

vantage can make net-zero commitments preferable to carbon-negative commitments, despite the superior environmental impact of the latter.

6.3 Managerial Social Effort

Section 6.2 demonstrates that financially motivated shareholders may directly invest to increase the probability of a low externality because doing so improves market monitoring. We now consider a related question: what if the manager can affect the firm's externality? This introduces a multitasking problem between financial and social effort that shareholders must address through contracting. Specifically, we extend the model to allow the manager to exert social effort that improves ES quality. As we show below, addressing externalities through delegated managerial effort fundamentally differs from doing so through direct shareholder-controlled investment.

We extend the baseline model by allowing the manager to exert social effort $e_E \in \{0,1\}$ to improve the firm's ES quality.[20] Social effort ($e_E = 1$) increases the probability of socially desirable outcomes by Δ_E—reducing the probability of a high externality by Δ_E when the firm imposes a negative externality ($\eta < 0$) or increasing the probability of a high externality by Δ_E when the firm generates a positive externality ($\eta > 0$). The manager enjoys a private benefit $B_E > 0$ from shirking ($e_E = 0$).

When the informed investor's social concerns are sufficiently strong, both financial and social efforts affect the order flow (q). Financial effort improves the financial payoff, increasing the probability of informed buying and, consequently, high order flow. Therefore, contracts that induce financial effort reward high order flow. When the firm imposes a negative externality ($\eta < 0$), social effort reduces the probability of a high externality, increasing informed buying when financial performance is strong. When the firm generates a positive externality ($\eta > 0$), social effort increases the probability of a high externality, encouraging buying even when financial performance is weak. In both cases, social effort makes a high order flow ($q > 0$) more likely. Consequently, contracts that induce financial effort by rewarding high order flow also naturally create incentives for social effort.

Whether sustainable investing induces managerial social effort depends on the relative severity

[20] We focus on effort that improves ES quality—reducing negative externalities or increasing positive externalities. Neither shareholders nor the manager would benefit from increasing negative externalities. While shareholders might prefer the manager to reduce positive externalities to improve market monitoring, they cannot incentivize such effort without violating incentive compatibility for financial effort.

of the two agency problems. The severity of each agency problem is determined by the manager's private benefit from shirking relative to the effort's effectiveness in improving outcomes. We say that the agency problem associated with financial effort is more severe when its private benefit (B_F) is large relative to the private benefit for social effort (B_E).[21]

Proposition 8. *When the informed investor's social concerns are sufficiently strong, and the agency problem associated with financial effort is more severe, any contract that induces financial effort ($e_F^* = 1$) also induces social effort ($e_E^* = 1$).*

When the agency problem associated with financial effort is more severe, the bonus required to induce financial effort is large enough to simultaneously induce social effort. Intuitively, social effort is relatively inexpensive to incentivize—the manager finds it worthwhile to exert social effort given the incentives already in place for financial effort. Consequently, any contract satisfying incentive compatibility for financial effort ($e_F^* = 1$) automatically satisfies incentive compatibility for social effort ($e_E^* = 1$). Notably, Proposition 8 does not require social effort to be socially efficient, but only that it effectively increases the probability of high order flow.

Proposition 9. *When the informed investor's social concerns are sufficiently strong, and the agency problem associated with financial effort is less severe, the optimal contract does not induce the manager to exert social effort ($e_E^* = 0$).*

The controlling shareholders are indifferent to the firm's externality and induce social effort only if doing so improves effort informativeness and reduces the cost of inducing financial effort. When the firm generates a positive externality, shareholders do not induce social effort, as it worsens market monitoring and increases compensation costs. More surprisingly, shareholders also do not induce social effort when the firm imposes a negative externality, even though social effort would improve monitoring in this case. This result arises because when the agency problem associated with financial effort is less severe, the bonus required to induce financial effort is insufficient to induce social effort. Inducing social effort, therefore, becomes expensive—the manager requires substantially higher-powered incentives to exert social effort. Any reduction in compensation costs from improved monitoring is dominated by the additional compensation required to induce social effort. The optimal contract, therefore, does not induce social effort ($e_E^* = 0$).

[21] The proofs of Propositions 8 and 9 derive the exact conditions by comparing $\frac{B_F}{B_E}$ to a threshold $\mu > 0$ that captures the relative effectiveness of financial versus social effort in affecting the order flow.

Whether shareholders benefit from the availability of the social effort technology depends on the sign of the externality. With negative externalities, shareholders are strictly better off when social effort is induced, as it improves market monitoring and reduces equilibrium incentive costs. In sharp contrast, with positive externalities, shareholders are strictly worse off when social effort is induced, as it worsens market monitoring and increases equilibrium incentive costs. This asymmetry implies that shareholders prefer the social effort technology to be available with negative externalities but not with positive externalities.

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

6.4 Precision of Private Information about Externalities

The baseline model assumes that the informed investor perfectly observes the firm's externality (E). We relax this assumption to examine how signal precision affects the equilibrium. The informed investor now receives a noisy private signal $\xi \in \{L,H\}$ satisfying $\Pr(E=0|\xi=L) = \psi + (1-\psi)p_E$ and $\Pr(E=0|\xi=H) = (1-\psi)p_E$, where $\psi \in [0,1]$ captures signal precision. When $\psi = 0$, the signal is uninformative. Higher ψ corresponds to greater signal precision and more dispersed posterior beliefs about the firm's externality. The baseline model corresponds to $\psi = 1$.

The effect of signal precision on effort informativeness depends on the unconditional probability of a high externality $(1-p_E)$. We say that this probability is sufficiently high when it alone—without any private signal—would cause the informed investor to deviate from the benchmark strategy: abstaining from buying regardless of F in the case of negative externalities or buying regardless of F in the case of positive externalities. Otherwise, we say that the unconditional probability is sufficiently low.

Proposition 10. *Assume that the informed investor's social concerns are sufficiently strong. When*

the unconditional probability of a high externality is sufficiently high, increasing signal precision (ψ) enhances effort informativeness. When the unconditional probability is sufficiently low, increasing signal precision worsens effort informativeness.

When the unconditional probability of a high externality is sufficiently high, the informed investor would deviate from the benchmark strategy with a sufficiently noisy signal—abstaining from buying regardless of F when the firm imposes a negative externality or buying regardless of F when the firm generates a positive externality. A more precise signal allows the informed investor to occasionally learn that the actual probability of a high externality is small enough to follow the benchmark strategy and trade on financial information alone, buying when $F = 1$ and abstaining when $F = 0$. Thus, increasing signal precision increases informed trading on financial information and enhances effort informativeness.

Conversely, when the unconditional probability of a high externality is sufficiently low, the informed investor would follow the benchmark strategy with a sufficiently noisy signal. A more precise signal allows the informed investor to occasionally learn that the actual probability of a high externality is large enough to deviate from the benchmark strategy, abstaining when $F = 1$ in the case of negative externalities or buying when $F = 0$ in the case of positive externalities. Thus, increasing signal precision reduces informed trading on financial information and worsens effort informativeness.

In the classic Holmström and Tirole (1993) setting with only financial investors, more precise private information about financial payoffs increases effort informativeness and reduces agency costs. Our analysis shows that this monotonicity result does not hold for information about externalities when investors have social concerns. Increasing signal precision about the firm's externality can either enhance or reduce effort informativeness, depending on its effect on the informed investor's trading on financial information. This non-monotonic relationship implies that as technology for processing ES information improves, the agency costs of sustainable investing may rise or fall. Technological advances in ES analytics, therefore, do not necessarily benefit corporate governance.

6.5 Correlated Financial Payoff and Externality

The baseline model assumes that the firm's financial payoff (F) and externality (E) are uncorrelated: $\Pr(E = \eta|F = 1) = \Pr(E = \eta|F = 0) = 1 - p_E$. We now examine how correlation affects the impact of sustainable investing on market governance by allowing the conditional probabilities $\Pr(E = \eta|F = 1)$ and $\Pr(E = \eta|F = 0)$ to differ from the unconditional probability $1 - p_E$.

Proposition 11. *Assume that the informed investor's social concerns are sufficiently strong. If* $\Pr(E = \eta|F = 1) > 0$ *and* $\Pr(E = \eta|F = 0) > 0$*, the cost of providing managerial incentives is higher relative to the benchmark without social concerns (*$\gamma = 0$*).*

When the informed investor's social concerns are sufficiently strong, a high externality distorts her trading on financial information in specific states. With negative externalities, this distortion occurs in the state where the firm has a high financial payoff but imposes a high externality—she abstains from buying despite favorable financial information. With positive externalities, the distortion occurs in the state where the firm generates a high externality despite having a low financial payoff—she buys despite unfavorable financial information. As long as these states occur with a positive probability, social concerns distort trading on financial information, weakening market monitoring. Hence, the market-governance channel of sustainable investing operates as long as the firm's financial payoff and its externality are not perfectly correlated. Specifically, if they are perfectly correlated such that $\Pr(E = \eta|F = 1) = 0$ in the case of negative externalities or $\Pr(E = \eta|F = 0) = 0$ in the case of positive externalities, the informed trader trades as in the benchmark without social concerns.

The financial payoff and externality are positively correlated when $\Pr(E = \eta|F = 1) > 1 - p_E$ and are negatively correlated when $\Pr(E = \eta|F = 1) < 1 - p_E$. For example, in the case of negative externalities, a positive correlation arises when a high financial payoff results from increased production that generates higher carbon emissions. A factory accident that simultaneously lowers production and releases toxic pollutants represents a negative correlation.

Corollary 4. *Assume that the informed investor's social concerns are sufficiently strong. When the firm imposes a negative externality (*$\eta < 0$*), a positive correlation between the financial payoff and externality increases the cost of managerial incentives relative to zero correlation, while a negative correlation reduces it. When the firm generates a positive externality (*$\eta > 0$*), a negative correlation increases the cost of managerial incentives relative to zero correlation, while a positive*

correlation reduces it.

The degree of correlation modulates the strength of the market-governance channel of sustainable investing by affecting the likelihood of the state in which the informed investor's trading is distorted. When the firm imposes a negative externality, the informed investor's trading is distorted in the state $(F = 1, E = \eta)$ where high financial performance coincides with a high negative externality. A positive correlation increases the likelihood of this state, thereby amplifying the negative impact of sustainable investing on market monitoring. A negative correlation makes this state less likely, thereby dampening the impact. When the firm generates a positive externality, the informed investor's trading is distorted in the state $(F = 0, E = \eta)$ where low financial performance coincides with a high positive externality. Here, a negative correlation makes this state more likely, amplifying the negative impact on governance, while a positive correlation makes it less likely, dampening the impact. In both cases, the correlation determines how frequently the informed investor's social concerns distort her trading on financial information.

Our analysis has implications for understanding industry heterogeneity in the effects of sustainable investing. For example, when firms impose negative externalities, market monitoring declines more in industries with a positive correlation between financial performance and externalities. Consequently, firms in those industries face stronger incentives to reduce negative externalities. Sustainable investing strategies should therefore be tailored to industry-specific correlation structures.

6.6 Prevalence of Sustainable Investing

Our baseline model focuses on a single informed investor to isolate the market-governance channel of sustainable investing. In practice, private information about firm fundamentals is acquired by both sustainable investors with social concerns and purely financial investors without such concerns. In this section, we analyze an extension incorporating both types of informed investors. The key insight is that the strength of the market-governance channel of sustainable investing increases with the prevalence of sustainable investors among informed investors.

We extend the baseline model to include two types of informed investors. The informed investor who learns private information about the firm at $t = 1$ is a sustainable investor with probability n_S and a purely financial investor with probability $1 - n_S$. The parameter $n_S \in [0, 1]$ can be inter-

preted as capturing the prevalence of sustainable investing among active, information-producing traders. Our benchmark model (only financial investors) and baseline model (only sustainable investors) correspond to $n_S = 0$ and $n_S = 1$, respectively.

Proposition 12. *When the social concerns of sustainable investors are sufficiently strong, the cost of providing managerial incentives C_γ strictly increases with the prevalence of sustainable investors among informed investors (n_S).*

Proposition 12 establishes two insights. First, our market-governance channel operates even with a modest presence of sustainable investors among informed investors. Second, the effect increases with the prevalence of sustainable investors. As the prevalence of sustainable investors, proxied by n_S, increases, the market-governance channel of sustainable investing becomes quantitatively more significant.

Crucially, the mechanism is driven by the prevalence of social concerns among the limited pool of active, information-producing traders, not by aggregate assets under management in sustainable funds. Passive sustainable funds that allocate funds based on publicly available signals do not affect the effort informativeness of prices in our framework. Consequently, as assets under management in active sustainable investing strategies grow, the empirical predictions of our framework—less informative and less volatile prices, stronger correlations between ES and governance quality, reduced use of stock-based compensation, higher expected compensation and pay-for-performance sensitivity when incentives are provided, and increased contracting on public ES information—should become more pronounced in financial markets.

7 Empirical Implications and Discussion

This section presents the empirical implications of our framework and discusses broader implications that extend beyond our formal analysis.

7.1 Empirical Implications

Our framework generates the following empirical predictions.

Prevalence of Active Sustainable Investing: As assets under management in active sustainable investing strategies grow, the effects identified by our framework should become more pro-

nounced. Our mechanism predicts: (1) Decreased stock price volatility due to less informed trading, even absent changes in expected returns; (2) lower prevalence of stock-based compensation across firms, as the cost of providing managerial incentives becomes prohibitively high for some firms; (3) Higher pay-for-performance sensitivity and expected compensation levels at firms that continue using stock-based compensation, as these firms must pay larger bonuses to maintain incentive compatibility; (4) Greater prevalence of ES-linked compensation, as shareholders use ES signals to extract more information about managerial effort; and (5) Stronger correlations between ES and governance quality. Crucially, these effects should be driven by active rather than passive sustainable investors.

Positive versus Negative Screening: Our analysis reveals a fundamental asymmetry between negative screening strategies—which exclude firms with the highest negative externalities—and positive screening strategies—which seek firms with the highest positive externalities. These strategies correspond to the negative and positive externality cases in our model, respectively, and generate different predictions for firm behavior, governance quality, and price volatility.

In the negative externality case, negative screening leads to more informed trading among firms with better ES quality, as these firms are less likely to be excluded. In the positive externality case, positive screening leads to less informed trading among firms with better ES quality, as these firms are more likely to be included. This asymmetry generates testable implications: Firms *excluded* through negative screening should exhibit worse governance and lower price volatility. Similarly, firms *included* through positive screening should exhibit worse governance and lower price volatility. In contrast, firms included through negative screening or excluded through positive screening should exhibit better governance and higher price volatility due to more informed trading on financial information.

Firms with Net-Zero Mandates: Our mechanism suggests that firms adopting net-zero mandates should exhibit superior governance quality. By eliminating externalities, net-zero commitments maximize price informativeness about managerial effort and minimize the agency costs arising from sustainable investing. This governance advantage makes net-zero a natural focal point for corporate sustainability commitments. Our model predicts that firms facing sustainable investor trading should disproportionately announce net-zero rather than carbon-negative targets.

ES-Linked Compensation Contracts: Our model generates nuanced predictions about ES-linked compensation that depend on firm characteristics. First, ES-linked compensation should be

more prevalent in firms with stronger governance structures and more precise public ES information. Second, the structure of ES-linked compensation should differ depending on whether the firm generates positive or negative externalities. In firms imposing negative externalities, compensation should reward managers following positive ES-signals. Conversely, in firms generating positive externalities, compensation should punish managers following positive ES-signals. As discussed in Section 6.1, several high-profile CEO departures have been attributed to shareholders penalizing managers for prioritizing social objectives. If reputational constraints make such penalties for strong ES performance difficult to implement, our model predicts a greater prevalence of ES-linked compensation among firms generating negative externalities.

Frequency and Magnitude of the Externality: Our mechanism exhibits a complementarity between the frequency $(1 - p_E)$ and the magnitude $(|\eta|)$ of the externality. While these parameters play the same conceptual role—varying either delivers the same qualitative result—they complement each other in driving the magnitude of our main mechanism. When the externality is small in magnitude, changes in its frequency have little effect, as the externality does not affect the informed investor's trading behavior. Similarly, when the externality occurs infrequently, changes in its magnitude have little effect, as the distortion rarely materializes. Consequently, all the predictions outlined above should be most pronounced for firms with both frequent and large externalities—providing cross-sectional variation for empirical tests of the market-governance channel of sustainable investing.

7.2 Discussion

Our framework yields several broader implications for understanding sustainable investing and corporate governance.

Consequentialist Preferences: We model the informed investor's valuation per share as $F + \gamma E$, which has a natural interpretation as "warm glow" or deontological preferences. However, our mechanism also provides a foundation for consequentialist investment strategies. By avoiding firms with high negative externalities—despite strong financial performance—such strategies create incentives for firms to reduce negative externalities. Through our market governance channel, a consequentialist investor who commits to abstaining from trading on positive financial information about high-negative-externality firms raises the cost of providing managerial incentives, encouraging shareholders to invest in reducing negative externalities. This strategic consideration suggests

that our trading patterns and real effects can emerge even among investors who do not experience direct disutility from holding shares in firms with poor ES performance, thereby broadening our mechanism's scope beyond deontological sustainability preferences.

Welfare Implications of Sustainable Investing: Our framework demonstrates that the impact of sustainable investing on ES quality depends critically on the mechanism for change—managerial effort versus shareholder-controlled investment—with strikingly different implications for each.

When ES improvement is driven by managerial effort, sustainable investing improves ES outcomes. Contracts designed to induce financial effort by rewarding good stock market performance naturally encourage social effort as well—improving ES outcomes even though shareholders and managers remain purely financially motivated. Importantly, this mechanism always moves in the socially desirable direction: reducing negative externalities or increasing positive externalities.

When changes in the firm's ES outcomes occur through shareholder-controlled investment, however, sustainable investing generates asymmetric effects. For negative externalities, the mechanism aligns financial and ES objectives: sustainable investing motivates purely financially motivated shareholders to lower negative externalities because doing so simultaneously improves governance through sharper price signals. But, for positive externalities, this same mechanism backfires—shareholders reduce positive externalities to enhance market monitoring.

This asymmetry implies that consequentialist pro-social investors should be careful in adopting screening mandates. Negative screening—excluding firms with the highest negative externalities—reliably spurs firms to reduce their negative externalities through corporate action. However, positive screening—favoring firms with the highest positive externalities—may inadvertently undermine the very outcomes they seek to promote.

Investor Specialization and Sorting: Our framework generates implications for how informed investors with social concerns sort across firms with different ES profiles. Because such investors face reduced trading opportunities and experience disutility from holding shares in firms with high negative externalities, they may prefer to acquire information only about firms with better ES characteristics. This natural sorting results in such investors concentrating in "green" firms while avoiding "brown" firms with poor ES profiles.

For negative-externality firms, such sorting can amplify our identified governance effects: high-negative-externality firms face both reduced informed trading from existing sustainable investors

and reduced overall participation by informed sustainable investors. Conversely, low-negative-externality firms benefit from both more intensive informed trading on financial information and greater participation by informed sustainable investors. Given the scarcity of informed capital, this sorting mechanism suggests that the governance divide between green and brown firms may be larger than our baseline analysis implies, as it incorporates both the intensive margin (how much sustainable investors trade) and the extensive margin (whether they invest at all) of sustainable investor participation.

For positive-externality firms, sorting creates offsetting effects: high-positive-externality firms face reduced informed trading on financial information from existing sustainable investors but attract greater overall participation by informed sustainable investors. Conversely, low-positive-externality firms benefit from more intensive informed trading on financial information but attract less participation by informed sustainable investors.

This sorting pattern would change significantly under a consequentialist interpretation of our model. Rather than avoiding firms with poor ES performance, consequentialist investors would strategically target firms where their trading behavior generates the strongest incentives for externality reduction. This approach focuses on firms with high potential for reducing negative externalities and where the governance costs of sustainable investing create the most powerful incentives for shareholders to invest in mitigating negative externalities. Such firms might initially have poor ES profiles but a strong capacity to reduce negative externalities, making them optimal targets for consequentialist sustainable investors. In contrast, targeting firms with large positive externalities risks shareholders investing to reduce them.

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

However, stakeholders increasingly view governance through a broader lens, incorporating incentives for desirable social outcomes. Under this expanded definition, the relationship between ES and governance quality changes. For firms generating negative externalities, providing incentives to reduce negative externalities directly enhances governance under both the narrow and broad definitions, reinforcing the positive relationship between ES and governance quality. For firms

generating positive externalities, providing incentives to increase positive externalities enhances social governance but dampens financial governance.

In practice, ESG ratings providers differ significantly in their measurement of governance (e.g., Berg et al., 2022). For example, Refinitiv considers the firm's "CSR Strategy" within its governance pillar alongside classical financial outcomes (LSEG, 2024). Moody's focuses on the firm's financial strategy, assigning environmental and social oversight to the separate E and S profiles (Moody's Investors Service, 2021). Empirical tests of ES and governance quality should therefore consider the differences in the construction of governance measures.

Substitutability of Informed Capital: An important question is whether the decreased trading intensity of informed sustainable investors can be offset by increased trading activity of purely profit-motivated informed investors. This question connects to the broader debate about the substitutability between green and brown capital (e.g., Berk and Van Binsbergen, 2025). Critically, our mechanism operates through informed capital: acquiring and processing private information requires specialized skills, resources, and institutional capabilities that are not uniformly distributed across investors, making informed capital scarce and concentrated (e.g., Kacperczyk et al., 2014). This scarcity implies that the withdrawal of informed sustainable investors cannot be easily offset, thereby allowing sustainable investing to have significant and persistent effects on corporate governance.

Carbon Taxation: Our analysis in Section 6.2 reveals an additional role for carbon taxation. Carbon taxes can improve both social and financial efficiency. When shareholders maximize the firm's financial payoff net of managerial compensation, they may forgo both reducing negative externalities and incentivizing managerial effort. A carbon tax creates a direct financial benefit from the reduction of negative externalities through lower tax payments. This direct benefit can induce shareholders to reduce negative externalities, which improves market monitoring and lowers incentive costs, making effort induction worthwhile. Thus, the tax may simultaneously increase both financial and social efficiency—providing a novel justification for carbon pricing beyond its traditional Pigouvian rationale.

8 Conclusion

This paper identifies a novel mechanism through which sustainable investing affects firm behavior and performance: the market-governance channel of sustainable investing. When informed investors care about firm externalities, they may choose not to trade on their private information about financial performance, thereby reducing price informativeness and making it more costly to incentivize managers. This reduction in market governance can lead to lower managerial effort and worse financial performance, highlighting an important agency cost of sustainable investing. This channel creates an endogenous link between firms' ES and governance quality. Our governance mechanism can impact ES outcomes by incentivizing firm shareholders and managers to change externalities.

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A Proofs: Baseline Model

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

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

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

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

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

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

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

In particular, in any equilibrium that does not fully reveal the informed investor's private information, the expected market-clearing price at $t = 1$ when the informed investor buys must be strictly greater than zero and strictly less than one, implying that the informed investor strictly prefers to buy upon observing $F = 1$ and to abstain when $F = 0$. Hence, the trading strategy described above is the unique best response, and the associated pricing rule is uniquely pinned down by Bayesian updating. ■

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

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

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 Lemma 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	E	Probability	Informed Trade x	Order Flow q	$\Pr(q)$
0	η	$(1-p_F)(1-p_E)$	$x=0$	$q\in\mathbb{N}_0$	$(1-\lambda)^q\lambda$
0	0	$(1-p_F)p_E$	$x=0$	$q\in\mathbb{N}_0$	$(1-\lambda)^q\lambda$
1	η	$p_F(1-p_E)(1-a)$	$x=0$	$q\in\mathbb{N}_0$	$(1-\lambda)^q\lambda$
1	η	$p_F(1-p_E)a$	$x=1$	$q\in\mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$
1	0	$p_F p_E$	$x=1$	$q\in\mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$

Table 1: Distribution of Aggregate Order Flow

In this case, Bayesian updating implies

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

and

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

Hence, the market makers' pricing rule is given by

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

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 $E=0$ 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 $E=\eta<0$. First, consider an

equilibrium with $a = 1$, which requires

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

where $\eta = -|\eta|$ because the negative-externality case corresponds to $\eta < 0$. Second, consider an equilibrium with $a = 0$, which requires

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

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

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

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

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 and weakly decreasing function of γ. In particular, the equilibrium is unique. ■

Proof of Lemma 3. Let $\tau_\gamma^* = p_E + (1-p_E)a^*$ 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

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

Straightforward algebra confirms that this expression is equal to the one stated in the lemma. ■

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

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

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

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

Hence, the maximum likelihood ratio weakly decreases in γ, strictly so when $\gamma \in (\underline{\gamma}, \bar{\gamma})$, implying that $\phi_\gamma^* < \phi_0^*$ when the informed investor's social concerns are sufficiently strong. ■

Proof of Lemma 4. This result follows immediately from solving

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

for $W_\gamma^*(q > 0)$ 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 3. ■

Proof of Corollary 2. 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 Proposition 3. Assume that the manager exerts effort ($e_F = 1$). Then there exists an equilibrium in which the informed investor: (i) buys one share ($x = 1$) upon observing a high financial

payoff ($F=1$), (ii) abstains from buying ($x=0$) upon observing a low financial payoff ($F=0$) and low externality ($E=0$), (iii) buys a share upon observing a low financial payoff and a high positive externality ($F=0$ and $E=\eta>0$) when $\gamma>\bar{\bar{\gamma}}$ and abstains otherwise, where the threshold is given by

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

To solve for the informed investor's trading strategy, denote by a the probability with which she buys upon observing a low financial payoff and a high positive externality ($F=0$ and $E=\eta$). Given this trading strategy, Table 2 shows the distribution of the aggregate order flow in different states of the world.

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

Table 2: Distribution of Aggregate Order Flow

In this case, Bayesian updating implies

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

and

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

Hence, the market makers' pricing rule is given by

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

We next solve for the informed investor's optimal trading strategy. To begin with, note that it is straightforward to confirm that the informed investor prefers to buy one share when she learns

that $F = 1$ and to abstain from buying when she learns that $F = 0$ and $E = 0$. What remains to be determined is the optimal trading strategy when $F = 0$ and $E = \eta > 0$. To generate an equilibrium in which $x = 0$ in this state, we require

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

To generate an equilibrium in which $x = 1$ in this state, we require

$$0 - P_\gamma(q > 0)\big|_{a=1} + \gamma\eta \geq 0 \Leftrightarrow \gamma \geq \frac{1}{\eta}\frac{p_F}{1-(1-p_F)\lambda p_E} := \underline{\underline{\gamma}},$$

which is strictly less than $\bar{\bar{\gamma}}$, implying that when $\gamma \in [\underline{\underline{\gamma}}, \bar{\bar{\gamma}}]$, both equilibria ($a^* = 0$ and $a^* = 1$) are possible. In this region, we select the more informative equilibrium ($a^* = 0$). Hence, the informed investor's optimal trading strategy is summarized by

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

When the informed investor's social concerns are sufficiently strong ($\gamma > \bar{\bar{\gamma}}$), the equilibrium effort informativeness of prices is

$$\phi^*_\gamma = \frac{p_F + (1-p_F)(1-\lambda p_E)}{(p_F - \Delta_F) + (1-p_F+\Delta_F)(1-\lambda p_E)} < \frac{p_F + (1-p_F)(1-\lambda)}{(p_F - \Delta_F) + (1-p_F+\Delta_F)(1-\lambda)} = \phi^*_0,$$

implying that the cost of providing managerial incentives increases

$$C_\gamma = \frac{1}{1-\frac{1}{\phi^*_\gamma}} > \frac{1}{1-\frac{1}{\phi^*_0}} = C_0,$$

which completes the proof. ■

Proof of Proposition 4. Recall that when the informed investor's social concerns are sufficiently strong, the realization of the firm's externality affects her trading strategy. When the firm imposes a negative externality ($\eta < 0$), the realization of a high externality discourages her from buying even when $F = 1$ (i.e., $\gamma > \bar{\gamma}$ and $\tau^*_\gamma = p_E$), resulting in equilibrium effort informativeness

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

which strictly increases in p_E:

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

When the firm generates a positive externality ($\eta > 0$), the realization of a high externality encourages the informed trader to buy even when $F = 0$ (i.e., $\gamma > \bar{\bar{\gamma}}$), resulting in equilibrium effort informativeness

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

which strictly increases in p_E:

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

In both cases, the equilibrium effort informativeness (ϕ_γ^*) is higher when the probability of a low externality (p_E) is higher.

The relationship between ES and governance quality depends on how p_E relates to ES quality: for negative externalities, higher p_E indicates better ES quality, whereas for positive externalities, higher p_E indicates worse ES quality. Since ϕ_γ^* increases with p_E in both cases and a higher ϕ_γ^* implies better governance, we obtain a positive relationship between ES and governance quality when $\eta < 0$ but a negative one when $\eta > 0$. ■

Proof of Proposition 5. Recall that when the informed investor's social concerns are sufficiently strong, the realization of the firm's externality affects her trading strategy. When the firm imposes a negative externality ($\eta < 0$), the realization of a high externality discourages her from buying even when $F = 1$ (i.e., $\gamma > \bar{\gamma}$). In this case, the variance of the firm's stock price is

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

which strictly increases in p_E:

$$\frac{\partial \operatorname{Var}[P_\gamma]}{\partial p_E} = p_F^2(1-p_F)^2\lambda\left(\frac{p_E(2-p_Ep_F)}{(1-p_Fp_E)^2}+\lambda\frac{2p_E(1-\lambda)+p_E^2p_F\lambda}{(1-\lambda+p_F\lambda p_E)^2}\right)>0.$$

When the firm generates a positive externality ($\eta > 0$), the realization of a high externality encourages the informed trader to buy even when $F = 0$ (i.e., $\gamma > \bar{\bar{\gamma}}$). In this case, the variance of the firm's stock price is

$$\begin{aligned}\operatorname{Var}[P_\gamma] =& \ (1-p_F)\lambda p_E(0-p_F)^2+(1-(1-p_F)\lambda p_E)\left(\frac{p_F}{p_F+(1-p_F)(1-\lambda p_E)}-p_F\right)^2\\ =& \ (1-p_F)\lambda p_E p_F^2+(1-(1-p_F)\lambda p_E)\left(\frac{(1-p_F)\lambda p_E}{p_F+(1-p_F)(1-\lambda p_E)}\right)^2 p_F^2\\ =& \ \frac{p_F^2(1-p_F)\lambda p_E}{1-(1-p_F)\lambda p_E},\end{aligned}$$

which strictly increases in p_E.

The relationship between ES quality and price volatility depends on how p_E relates to ES quality: for negative externalities, higher p_E indicates better ES quality, whereas for positive externalities, higher p_E indicates worse ES quality. Since $\operatorname{Var}[P_\gamma]$ increases with p_E, we obtain a positive relationship between ES quality and volatility when $\eta < 0$ but a negative one when $\eta > 0$. ■

B Proofs: Extensions and Robustness

Proof of Proposition 6. Under the assumption that the manager exerts effort ($e_F = 1$) so that $\Pr(F = 1) = p_F$, the equilibrium market outcomes at $t = 1$ do not depend on the realization of σ, which arrives after trading. When the informed investor's social concerns are sufficiently strong, the realization of the firm's externality affects her trades.

In the case of negative externalities, the informed investor abstains from trading when the realized externality is high ($E = \eta < 0$) even when $F = 1$. Let $\phi_\gamma^*(\sigma = L)$ correspond to the likelihood ratio for the state $(q > 0, \sigma = L)$, which is given by

$$\frac{\lambda p_F\bar{p}_E+(1-\lambda)}{\lambda(p_F-\Delta_F)\bar{p}_E+(1-\lambda)},$$

and $\phi^*_\gamma(\sigma = H)$ be the likelihood ratio for the state $(q > 0, \sigma = H)$, which is given by

$$\frac{\lambda p_F \underline{p}_E + (1-\lambda)}{\lambda(p_F - \Delta_F)\underline{p}_E + (1-\lambda)}.$$

Note that $\phi^*_\gamma(\sigma = L) > \phi^*_\gamma(\sigma = H)$ because $\bar{p}_E > \underline{p}_E$. Thus, an optimal contract pays the manager a bonus $W^*_\gamma(q > 0, \sigma = L)$ in the state $(q > 0, \sigma = L)$.

In the case of positive externalities, the informed investor buys a share when the realized externality is high ($E = \eta > 0$) even when $F = 0$. In this case, the likelihood ratios that correspond to the states $(q > 0, \sigma = L)$ and $(q > 0, \sigma = H)$ are

$$\phi^*_\gamma(\sigma = L) = \frac{p_F + (1-p_F)(\bar{p}_E(1-\lambda) + (1-\bar{p}_E))}{(p_F - \Delta_F) + (1 - p_F + \Delta_F)(\bar{p}_E(1-\lambda) + (1-\bar{p}_E))} = \frac{1 - (1-p_F)\lambda\bar{p}_E}{1 - (1 - p_F + \Delta_F)\lambda\bar{p}_E},$$

and

$$\phi^*_\gamma(\sigma = H) = \frac{p_F + (1-p_F)(\underline{p}_E(1-\lambda) + (1-\underline{p}_E))}{(p_F - \Delta_F) + (1 - p_F + \Delta_F)(\underline{p}_E(1-\lambda) + (1-\underline{p}_E))} = \frac{1 - (1-p_F)\lambda\underline{p}_E}{1 - (1 - p_F + \Delta_F)\lambda\underline{p}_E}.$$

As before, $\phi^*_\gamma(\sigma = L) > \phi^*_\gamma(\sigma = H)$ because $\bar{p}_E > \underline{p}_E$. Thus, an optimal contract pays the manager a bonus $W^*_\gamma(q > 0, \sigma = L)$ in the state $(q > 0, \sigma = L)$. ■

Proof of Corollary 3. Recall that the expected cost of providing incentives under an optimal contract in our framework is given by

$$C = \frac{B_F}{1 - \frac{1}{\phi^*}},$$

where ϕ^* is the maximum likelihood ratio associated with the state in which the bonus is paid. In the baseline model, the expected cost of providing incentives under an optimal contract is

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

where ϕ^*_γ is the maximum likelihood ratio in the baseline model.

In the case of negative externalities, conditioning on the public signal σ increases the maximum likelihood ratio from $\phi^*_\gamma = \frac{\lambda p_F p_E + (1-\lambda)}{\lambda(p_F - \Delta_F)p_E + (1-\lambda)}$ in the baseline model to $\phi^*_\gamma(\sigma = L) = \frac{\lambda p_F \bar{p}_E + (1-\lambda)}{\lambda(p_F - \Delta_F)\bar{p}_E + (1-\lambda)}$.

In the case of positive externalities, conditioning on the public signal σ increases the maximum likelihood ratio from $\phi^*_\gamma = \frac{1-(1-p_F)\lambda p_E}{1-(1-p_F+\Delta_F)\lambda p_E}$ in the baseline model to $\phi^*_\gamma(\sigma = L) = \frac{1-(1-p_F)\lambda\bar{p}_E}{1-(1-p_F+\Delta_F)\lambda\bar{p}_E}$.

In both cases, conditioning on the public signal allows the firm's shareholders to increase the maximum likelihood ratio associated with the bonus in the optimal contract, lowering agency costs. Let C_γ^σ be the expected cost of providing managerial incentives given a contractable public signal σ. If $C_\gamma^\sigma < N\Delta_F < C_\gamma$, then the signal enhances governance quality by encouraging shareholders to switch from not inducing effort to inducing effort. ■

Proof of Proposition 7. When the informed investor's social concerns are sufficiently strong, the firm's externality affects her trading strategy even when the investment to reduce the externality has been taken. Note that the threshold $\bar{\gamma}$ from Lemma 2 is decreasing in p_E such that if $\gamma > \bar{\gamma}$ for p_E, we also have $\gamma > \bar{\gamma}$ for $p_E + \Delta_E$. In the case of negative externalities, the informed investor abstains from buying when the firm's negative externality is high, even when $F = 1$.

The effort informativeness of the firm's stock price is

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

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

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

which strictly decreases in ϕ_γ^*. Let $\phi_\gamma^*(p_E + \Delta_E)$ and $\phi_\gamma^*(p_E)$ be the effort informativeness of the firm's stock price with and without the investment in reducing the firm's externality, respectively. Proposition 4 implies that $\phi_\gamma^*(p_E + \Delta_E) > \phi_\gamma^*(p_E)$. Let $C_\gamma(p_E + \Delta_E)$ and $C_\gamma(p_E)$ be the cost of incentivizing effort with and without the investment in reducing the firm's negative externality, respectively.

The firm's shareholders find it optimal to invest if and only if the cost c is below a threshold that depends on whether effort is induced:

Case 1: If $C_\gamma(p_E + \Delta_E) > N\Delta_F$ (effort not induced even after investment), shareholders do not invest since the investment provides no benefit.

Case 2: If $C_\gamma(p_E) > N\Delta_F > C_\gamma(p_E + \Delta_E)$ (effort not induced initially but induced after investment), shareholders' payoff without investment is $N(p_F - \Delta_F)$ while with investment it is $Np_F - C_\gamma(p_E + \Delta_E) - c$. The investment enables effort provision, generating a real financial gain. Shareholders invest if and only if $c \leq N\Delta_F - C_\gamma(p_E + \Delta_E)$.

Case 3: If $C_\gamma(p_E+\Delta_E) < C_\gamma(p_E) < N\Delta_F$ (effort induced both with and without investment), shareholders' payoff without investment is $Np_F - C_\gamma(p_E)$ while with investment it is $Np_F - C_\gamma(p_E+\Delta_E) - c$. The investment reduces managerial compensation costs while maintaining effort. Shareholders invest if and only if $c \leq C_\gamma(p_E) - C_\gamma(p_E+\Delta_E)$.

In Cases 2 and 3, the investment threshold is strictly positive: in Case 2 because $N\Delta_F > C_\gamma(p_E+\Delta_E)$ by the case definition, and in Case 3 because $C_\gamma(p_E) > C_\gamma(p_E+\Delta_E)$ by Proposition 4.

In the case of positive externalities, the informed investor's sufficiently strong social concerns motivate her to buy when the firm's realized positive externality is high, even when $F = 0$. Note that the threshold $\bar{\bar{\gamma}}$ from Proposition 3 is independent of p_E. As before, the expected cost of incentivizing effort under the optimal incentive-compatible contract is $C_\gamma = \frac{B_F}{1-\frac{1}{\phi^*_\gamma}}$, where effort informativeness ϕ^*_γ is derived in the proof of Proposition 3:

$$\phi^*_\gamma = \frac{1-(1-p_F)\lambda p_E}{1-(1-p_F+\Delta_F)\lambda p_E}.$$

As in the case of negative externalities, the cost of providing incentives decreases with ϕ^*_γ, which in turn increases with p_E. Let $C_\gamma(p_E+\Delta_E)$ and $C_\gamma(p_E)$ denote the costs of incentivizing effort with and without the investment to reduce the firm's positive externality, respectively. For positive externalities, the same three cases (Cases 1-3) apply as in the negative externality case. ■

Proof of Proposition 8. For algebraic convenience, let the manager's pay be denoted by w_0 when the aggregate order flow at $t = 1$ is $q = 0$, and by w_1 when $q > 0$.

We begin with the case where the firm imposes a negative externality. When the informed investor's social concerns are sufficiently strong, she abstains from buying when $F = 1$ but $E = \eta < 0$. Let $\mu_- := \frac{p_E\Delta_F}{p_F\Delta_E}$. We will show that if $\frac{B_F}{B_E} \geq \mu_-$, then any contract that induces financial effort ($e^*_F = 1$) also induces social effort ($e^*_E = 1$). Suppose, by contradiction, that $\frac{B_F}{B_E} \geq \mu_-$ and there exists a contract (w_0, w_1) that induces the manager to exert financial effort ($e_F = 1$) but not social effort ($e_E = 0$). In this case, the manager's incentive compatibility constraint for financial effort is

$$\lambda\Delta_F p_E(w_1 - w_0) \geq B_F. \tag{2}$$

Because this contract does not induce the manager to exert social effort, the manager's incentive

compatibility constraint for social effort is violated:

$$\lambda p_F \Delta_E (w_1 - w_0) < B_E. \tag{3}$$

Together, (2) and (3) imply that

$$\frac{B_E}{p_F \Delta_E} > \lambda (w_1 - w_0) \geq \frac{B_F}{p_E \Delta_F},$$

which contradicts the assumption that $\frac{B_F}{B_E} \geq \mu_-$.

The case where the firm generates a positive externality follows the same logic. When the informed investor's social concerns are sufficiently strong, she buys when $E = \eta$ even when $F = 0$. Let $\mu_+ := \max\left\{\frac{\Delta_F(p_E - \Delta_E)}{(1-p_F)\Delta_E}, \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E}\right\}$. We will show that if $\frac{B_F}{B_E} > \mu_+$, then any contract that induces financial effort ($e_F^* = 1$) also induces social effort ($e_E^* = 1$). Suppose, by contradiction, that $\frac{B_F}{B_E} > \mu_+$ and there exists a contract (w_0, w_1) that induces the manager to exert financial effort ($e_F = 1$) but not social effort ($e_E = 0$).

Assume that the manager exerts financial effort. She prefers not to exert social effort if and only if

$$\lambda (w_1 - w_0) \leq \frac{B_E}{(1-p_F)\Delta_E}.$$

Assume that the manager does not exert social effort. She prefers to exert financial effort rather than no effort if and only if

$$\lambda (w_1 - w_0) \geq \frac{B_F}{\Delta_F p_E}. \tag{4}$$

Finally, the manager prefers to exert only financial effort rather than only social effort if and only if

$$\begin{aligned}(1-p_F)p_E\lambda w_0 + [1-(1-p_F)p_E\lambda]w_1 + B_E \geq \\ (1-p_F+\Delta_F)(p_E-\Delta_E)\lambda w_0 + [1-(1-p_F+\Delta_F)(p_E-\Delta_E)\lambda]w_1 + B_F,\end{aligned}$$

which simplifies to

$$[\Delta_F p_E - (1-p_F+\Delta_F)\Delta_E]\lambda(w_1 - w_0) \geq B_F - B_E. \tag{5}$$

There are three cases to consider. Case 1: $\mu_+ = \frac{\Delta_F(p_E-\Delta_E)}{(1-p_F)\Delta_E} > \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E}$

When $\mu_+ = \frac{\Delta_F(p_E-\Delta_E)}{(1-p_F)\Delta_E} > \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E}$, we have

$$\frac{(p_E-\Delta_E)}{(1-p_F)} > \frac{p_E}{(1-p_F+\Delta_F)} \Leftrightarrow (p_E-\Delta_E)(1-p_F+\Delta_F) > (1-p_F)p_E \Leftrightarrow \Delta_F(p_E-\Delta_E)-(1-p_F)\Delta_E > 0.$$

Hence, condition (5) simplifies to

$$\lambda(w_1-w_0) \geq \frac{B_F-B_E}{\Delta_F(p_E-\Delta_E)-(1-p_F)\Delta_E}.$$

Note that

$$\frac{B_F-B_E}{\Delta_F(p_E-\Delta_E)-(1-p_F)\Delta_E} > \frac{B_E}{(1-p_F)\Delta_E}$$

because $\frac{B_F}{B_E} > \frac{\Delta_F(p_E-\Delta_E)}{(1-p_F)\Delta_E}$. However, this implies that the manager prefers to exert social effort as well, a contradiction.

Case 2: $\frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E} = \frac{\Delta_F(p_E-\Delta_E)}{(1-p_F)\Delta_E}$

When $\mu_+ = \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E} = \frac{\Delta_F(p_E-\Delta_E)}{(1-p_F)\Delta_E}$, we have

$$\Delta_F p_E - (1-p_F+\Delta_F)\Delta_E = 0,$$

implying that $\mu_+ = 1$. Moreover, condition (5) now requires that $B_F \leq B_E$. Hence, we have

$$\frac{B_F}{B_E} \leq 1 = \frac{\Delta_F(p_E-\Delta_E)}{(1-p_F)\Delta_E},$$

contradicting the assumption that $\frac{B_F}{B_E} > \mu_+$.

Case 3: $\mu_+ = \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E} > \frac{\Delta_F(p_E-\Delta_E)}{(1-p_F)\Delta_E}$

When $\mu_+ = \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E} > \frac{\Delta_F(p_E-\Delta_E)}{(1-p_F)\Delta_E}$, condition (5) implies that the manager does not find deviating to exerting social effort profitable if and only if

$$\lambda(w_1-w_0) \leq \frac{B_E-B_F}{(1-p_F+\Delta_F)\Delta_E-\Delta_F p_E}.$$

Combining with condition (4), we have

$$\frac{B_E-B_F}{(1-p_F+\Delta_F)\Delta_E-\Delta_F p_E} \geq \frac{B_F}{\Delta_F p_E} \Leftrightarrow \frac{B_F}{B_E} \leq \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E},$$

contradicting the assumption that $\frac{B_F}{B_E} > \mu_+$. ■

Proof of Proposition 9. We begin with the case where the firm imposes a negative externality. When the informed investor's social concerns are sufficiently strong, she abstains from buying when $F = 1$ but $E = \eta < 0$. We consider the case $\frac{B_F}{B_E} < \mu_-$, where $\mu_- = \frac{p_E \Delta_F}{p_F \Delta_E}$ is the threshold from the proof of Proposition 8. There are two incentive-compatible contracts to consider. The first only incentivizes financial effort; the second incentivizes both financial and social effort. Note that shareholders never find it optimal to induce only social effort.

First, consider the contract that incentivizes only financial effort. If the manager does not exert social effort ($e_E = 0$), her incentive compatibility constraint for financial effort is given by

$$\lambda \Delta_F p_E (w_1 - w_0) \geq B_F. \tag{6}$$

Standard arguments imply that the lowest-cost incentive-compatible contract pays nothing when $q = 0$ (i.e., $w_0 = 0$) and the incentive compatibility constraint (6) binds: $w_1^* = \frac{B_F}{\lambda p_E \Delta_F}$. Note that the assumption that $\frac{B_F}{B_E} < \mu_-$ implies that this contract does not induce the manager to exert social effort:

$$\underbrace{[p_F(p_E + \Delta_E) + (1 - p_F(p_E + \Delta_E))(1 - \lambda)] \frac{B_F}{\lambda p_E \Delta_F}}_{\text{Payoff when } e_F = 1 \text{ and } e_E = 1} < \underbrace{[p_F p_E + (1 - p_F p_E)(1 - \lambda)] \frac{B_F}{\lambda p_E \Delta_F} + B_E}_{\text{Payoff when } e_F = 1 \text{ and } e_E = 0},$$

which is equivalent to $\frac{B_F}{B_E} < \mu_-$.

Further, the manager does not find it profitable to deviate to exerting only social effort instead of only financial effort:

$$\begin{aligned} &\underbrace{[(p_F - \Delta_F)(p_E + \Delta_E) + (1 - (p_F - \Delta_F)(p_E + \Delta_E))(1 - \lambda)] \frac{B_F}{\lambda p_E \Delta_F} + B_F}_{\text{Payoff when } e_F = 0 \text{ and } e_E = 1} \\ < \; &\underbrace{[p_F p_E + (1 - p_F p_E)(1 - \lambda)] \frac{B_F}{\lambda p_E \Delta_F} + B_E}_{\text{Payoff when } e_F = 1 \text{ and } e_E = 0}, \end{aligned}$$

which is equivalent to $B_F < \frac{p_E \Delta_F}{(p_F - \Delta_F)\Delta_E} B_E$, and implied by our assumption that $\frac{B_F}{B_E} < \mu_-$. In this case, the expected managerial compensation cost is

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

Next, consider the contract that incentivizes both financial and social effort. Suppose the manager exerts social effort ($e_E = 1$), then her incentive compatibility constraint for financial effort is given by

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

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

$$\lambda \Delta_E p_F (w_1 - w_0) \geq B_E. \tag{8}$$

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

$$\lambda (\Delta_E p_F + \Delta_F p_E)(w_1 - w_0) \geq B_E + B_F. \tag{9}$$

Clearly, (9) is satisfied whenever (7) and (8) are satisfied. Standard arguments imply that the lowest-cost incentive-compatible contract pays the manager nothing when $q = 0$ (i.e., $w_0 = 0$). Since $\frac{B_F}{B_E} < \mu_-$, the lowest-cost incentive compatible contract that induces both types of effort binds constraint (8): $w_1^* = \frac{B_E}{\lambda p_F \Delta_E}$. In this case, the firm's expected managerial compensation cost is

$$\begin{aligned} C_{e_E=1} = & \left[p_F(p_E + \Delta_E) + (1 - p_F(p_E + \Delta_E))(1 - \lambda)\right] \frac{B_E}{\lambda p_F \Delta_E} \\ = & \underbrace{\left[p_F p_E + (1 - p_F p_E)(1 - \lambda)\right] \frac{B_E}{\lambda p_F \Delta_E}}_{> C_{e_E=0}} + \underbrace{\lambda p_F \Delta_E \frac{B_E}{\lambda p_F \Delta_E}}_{>0} > C_{e_E=0}. \end{aligned}$$

The firm's initial shareholders do not care about its externality, and both contract types induce financial effort ($e_F = 1$). Hence, they strictly prefer not to induce social effort because $C_{e_E=0} < C_{e_E=1}$.

The case where the firm generates a positive externality follows a similar logic. Recall from the proof of Proposition 8 that $\mu_+ := \max\left\{\frac{\Delta_F(p_E - \Delta_E)}{(1-p_F)\Delta_E}, \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E}\right\}$. To complete the proof of Proposition 9, we only need to show that $\frac{B_F}{B_E} \leq \mu_+$ implies that inducing the manager to only exert financial effort is implementable, and is strictly preferable to inducing the manager to exert both efforts.

To begin, we construct the optimal contract that implements both types of effort. A contract

that implements both types of effort must satisfy

$$\lambda(w_1 - w_0) \geq \frac{B_F}{\Delta_F(p_E - \Delta_E)},$$

$$\lambda(w_1 - w_0) \geq \frac{B_E}{(1-p_F)\Delta_E}. \tag{10}$$

Standard arguments imply that $w_0^* = 0$. There are two cases to consider.

Case 1: $\mu_+ = \frac{\Delta_F(p_E - \Delta_E)}{(1-p_F)\Delta_E} > \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E}$.

In this case, the binding constraint is (10):

$$\lambda w_1^* = \frac{B_E}{(1-p_F)\Delta_E} \geq \frac{B_F}{\Delta_F(p_E - \Delta_E)}$$

because $\frac{B_F}{B_E} \leq \mu_+ = \frac{\Delta_F(p_E - \Delta_E)}{(1-p_F)\Delta_E}$. The expected cost of this contract is

$$C_{e_E=1} = [1 - (1-p_F)(p_E - \Delta_E)\lambda] \left(\frac{1}{\lambda} \frac{B_E}{(1-p_F)\Delta_E} \right).$$

Case 2: $\mu_+ = \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E} \geq \frac{\Delta_F(p_E - \Delta_E)}{(1-p_F)\Delta_E}$. In this case, the optimal contract is characterized by

$$\lambda w_1^* = \max \left\{ \frac{B_F}{\Delta_F(p_E - \Delta_E)}, \frac{B_E}{(1-p_F)\Delta_E} \right\}.$$

The expected cost of this contract is

$$C_{e_E=1} = [1 - (1-p_F)(p_E - \Delta_E)\lambda] \frac{1}{\lambda} \max \left\{ \frac{B_F}{\Delta_F(p_E - \Delta_E)}, \frac{B_E}{(1-p_F)\Delta_E} \right\}.$$

Next, we construct the optimal contract that only implements financial effort. A contract that only implements financial effort must satisfy the following constraints

$$\lambda(w_1 - w_0) \leq \frac{B_E}{(1-p_F)\Delta_E},$$

$$\lambda(w_1 - w_0) \geq \frac{B_F}{\Delta_F p_E}, \tag{11}$$

and

$$[\Delta_F(p_E - \Delta_E) - (1-p_F)\Delta_E]\lambda(w_1 - w_0) \geq B_F - B_E. \tag{12}$$

Standard arguments imply that $w_0^* = 0$. We consider the same two cases from before.

Case 1: $\mu_+ = \frac{\Delta_F(p_E-\Delta_E)}{(1-p_F)\Delta_E} > \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E}$. In this case, condition (12) simplifies to

$$\lambda(w_1 - w_0) \geq \frac{B_F-B_E}{\Delta_F(p_E-\Delta_E)-(1-p_F)\Delta_E}.$$

Hence, the optimal payment must satisfy

$$\lambda w_1^* = \max\left\{\frac{B_F-B_E}{\Delta_F(p_E-\Delta_E)-(1-p_F)\Delta_E}, \frac{B_F}{\Delta_F p_E}\right\}.$$

Moreover, note that

$$\frac{B_F-B_E}{\Delta_F(p_E-\Delta_E)-(1-p_F)\Delta_E} \leq \frac{B_E}{(1-p_F)\Delta_E}$$

and

$$\frac{B_F}{\Delta_F p_E} \leq \frac{B_E}{(1-p_F)\Delta_E}$$

because $\frac{B_F}{B_E} \leq \frac{\Delta_F(p_E-\Delta_E)}{(1-p_F)\Delta_E} = \mu_+ < \frac{\Delta_F p_E}{(1-p_F)\Delta_E}$. Hence, this contract implements financial effort only ($e_F = 1$ and $e_E = 0$). Moreover, it is less costly:

$$C_{e_E=0} = [1-(1-p_F)p_E\lambda]\frac{1}{\lambda}\max\left\{\frac{B_F-B_E}{\Delta_F(p_E-\Delta_E)-(1-p_F)\Delta_E}, \frac{B_F}{\Delta_F p_E}\right\} < C_{e_E=1}.$$

Case 2: $\mu_+ = \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E} \geq \frac{\Delta_F(p_E-\Delta_E)}{(1-p_F)\Delta_E}$. In this case, the binding constraint is condition (11): $\lambda w_1^* = \frac{B_F}{\Delta_F p_E}$, noting that

$$[\Delta_F(p_E-\Delta_E)-(1-p_F)\Delta_E]\left(\frac{B_F}{\Delta_F p_E}\right) \geq B_F - B_E \Leftrightarrow \frac{B_F}{B_E} \leq \mu_+ = \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E}.$$

Moreover,

$$\lambda w_1^* = \frac{B_F}{\Delta_F p_E} \leq \frac{B_E}{(1-p_F)\Delta_E}$$

because

$$\frac{B_F}{B_E} \leq \frac{\Delta_F p_E}{(1-p_F+\Delta_F)\Delta_E} < \frac{\Delta_F p_E}{(1-p_F)\Delta_E}.$$

Hence, this contract implements financial effort only ($e_F = 1$ and $e_E = 0$), and is less costly than the one that implements both efforts:

$$C_{e_E=0} = [1-(1-p_F)p_E\lambda]\frac{1}{\lambda}\left(\frac{B_F}{\Delta_F p_E}\right) < C_{e_E=1}$$

In both cases, the bonus under the both-effort contract is (weakly) higher and is paid with strictly higher probability. Because the firm's shareholders do not care about its positive externality, they strictly prefer the contract that only induces financial effort. ■

Proof of Proposition 10. Let $\bar{E}_H = \mathbb{E}[|E||\xi = H]$ and $\bar{E}_L = \mathbb{E}[|E||\xi = L]$ be the expected magnitude of the firm's externality conditional on a high ($\xi = H$) and low signal ($\xi = L$), respectively. A more precise private signal about E results in a more dispersed posterior:

$$\frac{\partial \Pr(E = 0|\xi = L)}{\partial \psi} = 1 - p_E > 0$$

and

$$\frac{\partial \Pr(E = 0|\xi = H)}{\partial \psi} = -p_E < 0,$$

implying that $\bar{E}_L$ decreases in ψ while $\bar{E}_H$ increases in ψ. From the Law of Total Probability, we have

$$p_E = \Pr(E = 0) = \Pr(\xi = L)(\psi + (1 - \psi)p_E) + \Pr(\xi = H)(1 - \psi)p_E,$$

and

$$1 - p_E = \Pr(E = \eta) = \Pr(\xi = L)(1 - \psi)(1 - p_E) + \Pr(\xi = H)(1 - (1 - \psi)p_E),$$

which imply that $\Pr(\xi = L) = p_E$ and $\Pr(\xi = H) = 1 - p_E$.

Note that, for a given signal precision ψ, the model is isomorphic to one where the magnitude of the firm's externality is $\bar{E}_L$ and $\bar{E}_H$ with probabilities p_E and $1 - p_E$, respectively, and the informed investor perfectly observes the externality.

We begin with the case of negative externalities ($\eta < 0$). 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. As a first step, we show that if $\psi > 0$, the informed investor's optimal trading strategy must feature at least one corner solution: $a_H^* \in (0,1) \Rightarrow a_L^* = 1$ and $a_L^* \in (0,1) \Rightarrow a_H^* = 0$. To see this, 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 $q > 0$. 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 $1 - P_\gamma(q > 0) - \gamma \bar{E}_H = 0$. However, since $\bar{E}_L < \bar{E}_H$ when $\psi > 0$, it must be that $1 - P_\gamma(q > 0) - \gamma \bar{E}_L > 0$, which implies that the informed investor strictly prefers to buy upon observing

$F = 1$ and $\xi = L$, a contradiction. Finally, since $1 - P_\gamma(q > 0) - \gamma\bar{E}_L > 1 - P_\gamma(q > 0) - \gamma\bar{E}_H$, $a_H^* \in (0,1) \Rightarrow a_L^* = 1$ or $a_L^* \in (0,1) \Rightarrow a_H^* = 0$.

We first consider the case in which the unconditional probability of a high externality is sufficiently low, meaning that, in the absence of any private signal, the informed investor prefers to buy upon observing $F = 1$ at the expected market-clearing price in the benchmark:

$$1 - P_0(q>0) + \gamma(1-p_E)\eta \geq 0 \Leftrightarrow 1 - P_0(q>0) - \gamma(1-p_E)|\eta| \geq 0 \Leftrightarrow \gamma(1-p_E)|\eta| \leq \tfrac{(1-p_F)(1-\lambda)}{p_F+(1-p_F)(1-\lambda)}.$$

By assumption, the informed investor's social concerns are sufficiently strong such that an equilibrium in which she perfectly observes the firm's externality features a distorted trading strategy relative to the benchmark. In the case of negative externalities, this implies

$$1 - P_0(q>0) - \gamma|\eta| < 0 \Leftrightarrow \gamma|\eta| > \tfrac{(1-p_F)(1-\lambda)}{p_F+(1-p_F)(1-\lambda)}. \tag{13}$$

implying that there exists a threshold $\bar{E} < |\eta|$ for the expected externality that sets (13) to equality. Since an increase in signal precision (ψ) increases $\bar{E}_H$ and decreases $\bar{E}_L$, the informed investor always buys upon observing $F = 1$ and $\xi = L$. However, when $\bar{E}_H > \bar{E}$, the informed investor strictly prefers not to buy at the expected market-clearing price in the benchmark. Following the logic of the proof of Lemma 2, the informed investor's optimal trading strategy involves abstaining when $F = 0$, buying with certainty when $F = 1$ and $\xi = L$, and buying with probability $a_H^* < 1$ when $F = 1$ and $\xi = H$:

$$a_H^* = \max\left\{0, \frac{(1-p_F)(1-\lambda) - \gamma\bar{E}_H(1-(1-p_F p_E)\lambda)}{\gamma\bar{E}_H p_F \lambda(1-p_E)}\right\},$$

and the equilibrium pricing rule is

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

Note that when $a_H^* > 0$, it decreases in $\bar{E}_H$. Moreover, the equilibrium effort informativeness is

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

which increases in a_H^*. Hence, an increase in the precision of the private signal (ψ) increases $\bar{E}_H$, which lowers a_H^*, and worsens market monitoring.

We next consider the case in which the unconditional probability of a high externality is sufficiently high, meaning that, in the absence of any private signal, the informed investor prefers to abstain upon observing $F = 1$ given the expected market-clearing price in the benchmark:

$$1 - P_0(q > 0) - \gamma(1 - p_E)|\eta| < 0 \Leftrightarrow \gamma(1 - p_E)|\eta| > \tfrac{(1-p_F)(1-\lambda)}{p_F + (1-p_F)(1-\lambda)}.$$

Note that an increase in signal precision (ψ) increases $\bar{E}_H$ and decreases $\bar{E}_L$. Hence, the informed investor will always abstain upon observing $F = 1$ and $\xi = H$: $a_H^* = 0$. If the market makers believe that the informed investor always abstains when $F = 0$ or $\xi = H$ and buys with probability a_L when $F = 1$ and $\xi = L$, then they expect the following distribution of order flow:

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

Table 3: Distribution of Equilibrium Aggregate Order Flow

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

$$P_\gamma(q > 0) = \Pr(F = 1|q > 0) = \frac{p_F(1 - \lambda + \lambda p_E a_L)}{p_F(1 - \lambda + \lambda p_E a_L) + (1 - p_F)(1 - \lambda)}.$$

The informed investor is indifferent between buying and abstaining upon observing that $F = 1$ and $\xi = L$ if

$$1 - \frac{p_F(1 - \lambda + \lambda p_E a_L)}{p_F(1 - \lambda + \lambda p_E a_L) + (1 - p_F)(1 - \lambda)} - \gamma\bar{E}_L = 0. \tag{14}$$

Rearranging (14) yields

$$a_L^* = \frac{(1-\lambda)(1 - p_F - \gamma\bar{E}_L)}{\gamma\bar{E}_L\lambda p_F p_E},$$

which implies that the equilibrium level of informed trading is

$$\tau_L^* = p_E a_L^* = \frac{(1-\lambda)(1 - p_F - \gamma\bar{E}_L)}{\gamma\bar{E}_L\lambda p_F}.$$

Note that τ_L^* is decreasing in $\bar{E}_L$. A more precise signal (higher ψ) corresponds to a lower $\bar{E}_L$, and more informed trading and improved effort informativeness. For completeness, note that when the signal is sufficiently precise, such that $\gamma\bar{E}_L < \frac{(1-p_F)(1-\lambda)}{p_F(1-\lambda+\lambda p_E)+(1-p_F)(1-\lambda)}$, the informed investor strictly prefers buying when observing $F=1$ and $\xi = L$, corresponding to $a_L^* = 1$.

We continue with the case of positive externalities ($\eta > 0$), which follows a similar logic. We first consider the case in which the unconditional probability of a high externality is sufficiently low, meaning that, in the absence of any private signal, the informed investor prefers to abstain upon observing $F=0$ given the expected market-clearing price in the benchmark:

$$0-P_0(q>0)+\gamma(1-p_E)\eta \leq 0 \Leftrightarrow 0-P_0(q>0)+\gamma(1-p_E)|\eta| \leq 0 \Leftrightarrow \gamma(1-p_E)|\eta| \leq \frac{p_F}{p_F+(1-p_F)(1-\lambda)}.$$

By assumption, the informed investor's social concerns are sufficiently strong that an equilibrium in which she perfectly observes the firm's externality features a distorted trading strategy relative to the benchmark. In the case of positive externalities, this corresponds to

$$0-P_0(q>0)+\gamma\eta > 0 \Leftrightarrow \gamma\eta > \frac{p_F}{p_F+(1-p_F)(1-\lambda)}. \tag{15}$$

Note that there exists a threshold $\bar{E} < |\eta|$ for the expected externality that sets (15) to equality. Since an increase in signal precision (ψ) increases $\bar{E}_H$ and decreases $\bar{E}_L$, the informed investor always abstains upon observing $F=0$ and $\xi = L$. Moreover, when $\bar{E}_H \leq \bar{E}$, there exists an equilibrium in which the informed investor also abstains when $F=0$ and $\xi = H$, resulting in the same effort informativeness as the benchmark. However, when $\bar{E}_H > \bar{E}$, the informed investor strictly prefers to buy at the expected market-clearing price in the benchmark. Following the logic of the proof of Proposition 3, the informed investor's optimal trading strategy involves buying when $F=1$, abstaining when $F=0$ and $\xi = L$, and buying when $F=0$ and $\xi = H$ and the equilibrium pricing rule is

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

The corresponding effort informativeness in this equilibrium is

$$\phi_\gamma^* = \frac{p_F+(1-p_F)(1-\lambda p_E)}{(p_F-\Delta_F)+(1-p_F+\Delta_F)(1-\lambda p_E)} < \frac{p_F+(1-p_F)(1-\lambda)}{(p_F-\Delta_F)+(1-p_F+\Delta_F)(1-\lambda)} = \phi_0^*.$$

Hence, when the private signal becomes sufficiently precise, so that $\bar{E}_H > \bar{E}$, the trading equilibrium switches from the benchmark case to one with lower effort informativeness.

We next consider the case in which the unconditional probability of a high externality is sufficiently high, meaning that, in the absence of any private signal, the informed investor prefers to buy at the expected market-clearing price in the benchmark even upon observing $F = 0$:

$$0 - P_0(q > 0) + \gamma(1 - p_E)|\eta| > 0 \Leftrightarrow \gamma(1 - p_E)|\eta| > \tfrac{p_F}{p_F + (1-p_F)(1-\lambda)}. \tag{16}$$

Note that there exists a threshold $\bar{E} < |\eta|$ that sets (16) to equality. Since an increase in signal precision (ψ) increases $\bar{E}_H$ and decreases $\bar{E}_L$, the informed investor always buys upon observing $F = 0$ and $\xi = H$. Moreover, when $\bar{E}_L \geq \bar{E}$, the informed investor also buys when $F = 0$ and $\xi = L$, resulting in an uninformative trading equilibrium (i.e., $\phi^*_\gamma = 1$). However, when $\bar{E}_L < \bar{E}$, there exists an equilibrium where the informed investor abstains from buying when $F = 0$ and $\xi = L$. Following the logic of the proof of Proposition 3, the informed investor's optimal trading strategy involves buying when $F = 1$, abstaining when $F = 0$ and $\xi = L$, and buying when $F = 0$ and $\xi = H$ and the equilibrium pricing rule is

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

The corresponding effort informativeness in this equilibrium is

$$\phi^*_\gamma = \frac{p_F + (1-p_F)(1-\lambda p_E)}{(p_F - \Delta_F) + (1 - p_F + \Delta_F)(1-\lambda p_E)} > 1.$$

Hence, when the private signal becomes sufficiently precise, so that $\bar{E}_L < \bar{E}$, the trading equilibrium switches from the uninformative trading equilibrium to one with higher effort informativeness. ■

Proofs of Proposition 11 and Corollary 4. For algebraic convenience, let $\Pr(E = 0|F = 1) = p_{E,1}$ and $\Pr(E = 0|F = 0) = p_{E,0}$.

Consider first the case of negative externalities ($\eta < 0$). The underlying logic of Lemma 2 is that the firm's negative externality discourages the informed investor from acquiring a share, even when the firm's financial payoff is high. The proof of Lemma 2 only depends on the conditional probability $\Pr(E = \eta|F = 1)$ because the informed investor abstains from trading when the firm's

financial payoff is low ($F=0$), regardless of its externality (i.e., $\Pr(q|F=0)$ is independent of the distribution of E). Suppose $1-p_{E,1}>0$. We can simply replace p_E with $p_{E,1}$ in the formulas in the proof of Lemma 2. As a result, when the manager exerts financial effort ($e_F=1$), the unique trading equilibrium is characterized by the pricing rule

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

and the informed investor (i) buys one share ($x=1$) upon observing a high financial payoff and a low externality ($F=1$ and $E=0$), (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 externality ($F=1$ and $E=\eta$), where

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

The thresholds for the intensity of social concerns are given by

$$\underline{\gamma}=\frac{(1-p_F)(1-\lambda)}{|\eta|(1-(1-p_F)\lambda)}<\frac{(1-p_F)(1-\lambda)}{|\eta|(1-(1-p_Fp_{E,1})\lambda)}=\bar{\gamma}.$$

Then, as in the baseline model, an increase in the intensity of the informed investor's social concerns reduces her equilibrium informed trading intensity, $\tau^*_\gamma=p_{E,1}+(1-p_{E,1})a^*$, which decreases the effort informativeness of the firm's stock price. Taking the derivative of ϕ^*_γ with respect to $p_{E,1}$ yields the result of the corollary.

Consider next the case of positive externalities ($\eta>0$). The underlying logic of Proposition 3 is that the firm's high positive externality encourages the informed investor to buy a share even when its financial payoff is low. The proof of Proposition 3 only depends on the conditional probability $\Pr(E=\eta|F=0)$ because the informed investor buys when the firm's financial payoff is high ($F=1$), regardless of its externality (i.e., $\Pr(q|F=1)$ is independent of E). Suppose $1-p_{E,0}>0$. We can simply replace p_E with $p_{E,0}$ in the formulas in the proof of Proposition 3, and the result that effort informativeness is lower when the informed investor's social concerns are sufficiently

strong continues to hold. Taking the derivative of ϕ_γ^* with respect to $p_{E,0}$ yields the result of the corollary. ■

Proof of Proposition 12 . We begin with the case of negative externalities ($\eta < 0$). Due to noise trading, the expected equilibrium market-clearing price conditional on buying a share lies strictly between 0 and 1. As a result, the informed investor without social concerns ($\gamma = 0$) buys a share if and only if she learns that $F = 1$. When the sustainable informed investor's social concerns are sufficiently strong, she buys if and only if $F = 1$ and $E = 0$. Hence, the market makers expect the following distributions of the aggregate order flow across different states:

F	E	Probability	Informed Trade x	Order Flow q	$\Pr(q)$
0	0 or η	$(1-p_F)$	$x=0$	$q \in \mathbb{N}_0$	$(1-\lambda)^q\lambda$
1	η	$p_F(1-p_E)n_S$	$x=0$	$q \in \mathbb{N}_0$	$(1-\lambda)^q\lambda$
1	η	$p_F(1-p_E)(1-n_S)$	$x=1$	$q \in \mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$
1	0	$p_F p_E$	$x=1$	$q \in \mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$

Table 4: Distribution of Aggregate Order Flow in the Case of Negative Externalities ($\eta < 0$)

The market makers' pricing rule is

$$P_\gamma(q=0) = \mathbb{E}[F|q=0] = \frac{p_F(1-p_E)n_S}{p_F(1-p_E)n_S + (1-p_F)}$$

and

$$P_\gamma(q>0) = \mathbb{E}[F|q>0] = \frac{p_F[(p_E+(1-p_E)(1-n_S))+[1-(p_E+(1-p_E)(1-n_S))](1-\lambda)]}{p_F[(p_E+(1-p_E)(1-n_S))+[1-(p_E+(1-p_E)(1-n_S))](1-\lambda)]+(1-p_F)(1-\lambda)}.$$

In this case, if the informed investor's social concerns are sufficiently strong, she strictly prefers abstaining upon observing $F = 1$ and $E = \eta$ when $1 - P_\gamma(q>0) - \gamma|\eta| < 0$, which corresponds to

$$\gamma > \frac{1}{|\eta|}\frac{(1-p_F)(1-\lambda)}{p_F[(p_E+(1-p_E)(1-n_S))+[1-(p_E+(1-p_E)(1-n_S))](1-\lambda)]+(1-p_F)(1-\lambda)}.$$

The equilibrium effort informativeness of the firm's stock price is

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

which strictly decreases in n_S because $\Delta_F > 0$, $p_E < 1$, and $\lambda < 1$.

The above logic also extends to the case of positive externalities ($\eta > 0$). The presence of noise trading implies that the expected equilibrium market-clearing price conditional on buying a share is strictly between 0 and 1. Hence, the informed trader without social concerns buys a share if and only if she learns that $F = 1$. In contrast, when the sustainable informed investor's social concerns are sufficiently strong, she buys a share when $F = 1$ but also when $F = 0$ and $E = \eta$.

Hence, the market makers expect the following distributions of the aggregate order flow across different states:

F	E	Probability	Informed Trade x	Order Flow q	$\Pr(q)$
0	0	$(1-p_F)p_E$	$x=0$	$q \in \mathbb{N}_0$	$(1-\lambda)^q\lambda$
0	η	$(1-p_F)(1-p_E)(1-n_S)$	$x=0$	$q \in \mathbb{N}_0$	$(1-\lambda)^q\lambda$
0	η	$(1-p_F)(1-p_E)n_S$	$x=1$	$q \in \mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$
1	0 or η	p_F	$x=1$	$q \in \mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$

Table 5: Distribution of Aggregate Order Flow in the Case of Positive Externalities ($\eta > 0$)

As in the case of negative externalities, we can derive the equilibrium price and a threshold for the sustainable investor's social concerns such that she strictly prefers buying upon observing $F = 0$ and $E = \eta$. The resulting effort informativeness is given by

$$\phi_\gamma^* = \frac{1-(1-p_F)\lambda[1-(1-p_E)n_S]}{1-(1-p_F+\Delta_F)\lambda[1-(1-p_E)n_S]},$$

which strictly decreases in n_S because $\Delta_F > 0$, $p_E < 1$ and $\lambda > 0$. ■

C Additional Results and Robustness

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

C.1 Information Acquisition

In our baseline model, the informed investor is endowed with information about both F and E. We now consider the informed investor's incentives to acquire information about E. Specifically, the investor privately observes F but must pay a cost $\kappa_E > 0$ to observe E. The central insight is that the investor may acquire information about the firm's externality because doing so allows

the investor to trade more selectively, avoiding exposure to high negative externalities or capturing gains from high positive externalities.

Without information on E, the informed investor can profit by trading on her private information about F, but her utility is also affected by the firm's externality. Without acquiring information about E, the ex-ante expected utility of informed trading on F is

$$p_F(1-P_0(q>0)+\gamma(1-p_E)\eta),$$

where $P_0(q>0)$ is the equilibrium price given in Proposition 1.[22]

If the investor acquires information on E, then she trades according to the analysis in Section 5. The advantage of having information on E is that the informed trader can make her trading decision contingent on both F and E. When the firm imposes negative externalities, she can avoid disutility by abstaining upon observing a high externality ($E=\eta<0$). When the firm generates positive externalities, she can capture utility gains by buying upon observing a high externality ($E=\eta>0$). In both cases, private information about E can enhance her expected utility from informed trading.

Proposition C.1. *When the informed investor's social concerns are sufficiently strong, she acquires information about E if the cost is sufficiently low.*

Proof of Proposition C.1. We begin with the case of negative externalities ($\eta<0$). Define

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

and

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

Note that the two utility functions have the following properties. First, $U_0(\gamma)=U_\gamma(\gamma)>0$ 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_E sufficiently low, we have $U_\gamma(\gamma)-\kappa_E\geq U_0(\gamma)$ and $U_\gamma(\gamma)-\kappa_E\geq 0$, whenever $\gamma\geq\hat{\gamma}$.

[22] When the firm imposes a negative externality ($\eta<0$), 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 negative externality.

We continue with the case of positive externalities ($\eta > 0$), which follows a similar logic. Define

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

and

$$U_\gamma(\gamma) := p_F(1 - P_\gamma(q > 0) + \gamma(1 - p_E)\eta) + (1 - p_F)(1 - p_E)a^*(-P_\gamma(q > 0) + \gamma\eta).$$

Note that $1 - P_\gamma(q > 0) \geq 1 - P_0(q > 0)$, strictly so when $\gamma > \bar{\bar{\gamma}}$. Moreover, $a^*(-P_\gamma(q > 0) + \gamma\eta) \geq 0$, strictly so when $\gamma > \bar{\bar{\gamma}}$ due to the informed investor's optimal trading strategy. Hence, when $\gamma > \bar{\bar{\gamma}}$, $U_\gamma(\gamma) - U_0(\gamma) > 0$. As long as $\kappa_E \leq U_\gamma(\gamma) - U_0(\gamma)$, the informed investor finds it optimal to pay the information acquisition cost. ■

When the informed investor's social concerns are sufficiently strong, trading on private information about F alone becomes less valuable—either due to the disutility from negative externalities or the forgone utility gain from positive externalities. Information about E allows the informed investor to better manage the consequences of the firm's externalities—avoiding disutility from negative externalities or capturing utility gains from positive externalities—making information about F more valuable. As long as the cost of acquiring information about E is not too high, the informed investor finds it optimal to do so. This complementarity between these two types of private information naturally gives rise to the information structure in our baseline model.

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

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

C.2 Continuous Distribution for the Externality

C.2.1 Market-Governance Channel

In the baseline model, the firm's externality is a binary random variable E taking values 0 and η with probabilities p_E and $1-p_E$, respectively. In this section, we allow E to be distributed continuously on the interval $[0,\eta]$, where $\eta > 0$ with a differentiable cumulative distribution function G. Let $s \in [0,\eta]$ denote the realization of the random variable E. For notational convenience, we parameterize $E \geq 0$ as the magnitude of the externality. In the case of negative externalities, the informed investor's valuation is $F - \gamma E$. In the case of positive externalities, her valuation is $F + \gamma E$.

When the informed investor has no social concerns ($\gamma = 0$), the equilibrium is described by the benchmark in Section 5. Specifically, if the informed investor does not care about the firm's externality, then the exact distribution of the firm's externality does not affect her trading strategy.

Before presenting the formal result, we provide an intuitive description of how our mechanism operates under a continuous distribution for the externality. We begin with the case where the firm imposes a negative externality. As in the baseline model, the presence of noise trading implies that the expected market-clearing price conditional on buying a share is strictly between 0 and 1. As a result, her optimal trading decision is clear when $F = 0$: buying results in a negative payoff, hence abstaining is optimal. When $F = 1$, she faces a trade-off between trading profits and the disutility associated with the firm's negative externality. Let $\bar{P}$ be the expected market-clearing price when she buys when $F = 1$. The externality threshold that makes her indifferent is given by $\bar{E}$, such that $1 - \bar{P} - \gamma\bar{E} = 0 \Leftrightarrow 1 - \gamma\bar{E} = \bar{P}$. In this case, the informed investor's optimal trading strategy involves a threshold rule: when $F = 1$, buy if and only if $E \leq \bar{E}$. Note that $G(\bar{E})$ is the probability that the firm's negative externality is sufficiently small that the informed investor buys upon observing $F = 1$, and plays the same role as p_E in the baseline model. An increase in the intensity of her social concerns makes her less willing to buy when $F = 1$, lowering the externality-trading threshold $\bar{E}$ and decreasing equilibrium effort informativeness.

The same logic extends to the case where the firm generates a positive externality. Again, the presence of noise trading implies that the expected market-clearing price conditional on buying a share is strictly between 0 and 1, implying the informed investor strictly prefers to buy when $F = 1$. When $F = 0$, she faces a trade-off between trading losses and the utility gain from the

firm's positive externality. In this case, the informed investor's optimal trading strategy involves a threshold rule: when $F = 0$, buy if and only if $E > \bar{E}$. Note that $G(\bar{E})$ is the probability that the firm's positive externality is sufficiently small that the informed investor abstains when observing $F = 0$, and plays the same role as p_E in the baseline model. An increase in the intensity of her social concerns makes her more willing to buy when $F = 0$, lowering the externality-trading threshold $\bar{E}$ and decreasing equilibrium effort informativeness.

In both cases, an increase in the intensity of the informed investor's social concerns distorts her trading strategy relative to the benchmark, worsening market monitoring.

Proposition C.2. *When the informed investor's social concerns are sufficiently strong, the cost of providing managerial incentives is higher relative to the benchmark without social concerns.*

Proof of Proposition C.2. We begin with the case of negative externalities. Given that the informed investor abstains when $F = 0$ and follows a threshold strategy when $F = 1$, buying if and only if $E \leq \bar{E}$, the market makers expect the following distributions of the aggregate order flow across different states:

F	E	Probability	Informed Trade x	Order Flow q	$\Pr(q)$
0	$0 \leq s \leq \eta$	$1 - p_F$	$x = 0$	$q \in \mathbb{N}_0$	$(1-\lambda)^q \lambda$
1	$s > \bar{E}$	$p_F(1 - G(\bar{E}))$	$x = 0$	$q \in \mathbb{N}_0$	$(1-\lambda)^q \lambda$
1	$s \leq \bar{E}$	$p_F G(\bar{E})$	$x = 1$	$q \in \mathbb{N}_+$	$(1-\lambda)^{q-1} \lambda$

Table 6: Distribution of Aggregate Order Flow in the Case of Negative Externalities

Bayesian updating implies that the market makers' pricing rule is

$$P_\gamma(q) = \begin{cases} \frac{p_F(1-G(\bar{E}))}{p_F(1-G(\bar{E}))+(1-p_F)} & q = 0 \\ \frac{p_F(1-\lambda+\lambda G(\bar{E}))}{p_F(1-\lambda+\lambda G(\bar{E}))+(1-p_F)(1-\lambda)} & q > 0. \end{cases}$$

Note that when $\gamma \leq \frac{1}{\eta} \frac{(1-p_F)(1-\lambda)}{p_F+(1-p_F)(1-\lambda)}$, the firm's negative externality is never large enough to dissuade her informed trading, implying that $\bar{E} = \eta$. When $\gamma > \frac{1}{\eta} \frac{(1-p_F)(1-\lambda)}{p_F+(1-p_F)(1-\lambda)}$, the informed investor's trading threshold $\bar{E}$ is defined implicitly by

$$\gamma \bar{E} = \frac{(1-p_F)(1-\lambda)}{p_F(1-\lambda+\lambda G(\bar{E}))+(1-p_F)(1-\lambda)},$$

with $\bar{E} < \eta$, implying that $G(\bar{E}) < 1$ (i.e., the probability that the informed investor buys a share

when $F = 1$ is strictly less than 1). In this case, the equilibrium effort informativeness is

$$\phi_\gamma^* = \frac{(1-\lambda) + \lambda p_F G(\bar{E})}{(1-\lambda) + \lambda (p_F - \Delta_F) G(\bar{E})} < \phi_0^*.$$

Hence, when the informed investor's social concerns are sufficiently strong, there is less informed trading and worse market monitoring—the market-governance channel in our framework.

The case of positive externalities follows a similar logic. In this case, the informed investor's valuation of the firm is given by $F + \gamma E$. Given that the informed investor buys when $F = 1$ and follows a threshold strategy when $F = 0$, buying if and only if $E > \bar{E}$, the market makers expect the following distributions of the aggregate order flow across different states:

F	E	Probability	Informed Trade x	Order Flow q	$\Pr(q)$
0	$s \leq \bar{E}$	$(1-p_F)G(\bar{E})$	$x = 0$	$q \in \mathbb{N}_0$	$(1-\lambda)^q \lambda$
0	$s > \bar{E}$	$(1-p_F)(1-G(\bar{E}))$	$x = 1$	$q \in \mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$
1	$0 \leq s \leq \eta$	p_F	$x = 1$	$q \in \mathbb{N}_+$	$(1-\lambda)^{q-1}\lambda$

Table 7: Distribution of Aggregate Order Flow in the Case of Positive Externalities

Bayesian updating implies that the market makers' pricing rule is

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

Note that if $\gamma \leq \frac{1}{\eta} \frac{p_F}{p_F + (1-p_F)(1-\lambda)}$, the firm's positive externality is never large enough to induce the informed investor to buy when $F = 0$ in equilibrium, implying that $\bar{E} = \eta$. When $\gamma > \frac{1}{\eta} \frac{p_F}{p_F + (1-p_F)(1-\lambda)}$, the externality threshold for trading is defined implicitly by

$$\gamma \bar{E} = \frac{p_F}{p_F + (1-p_F)(1 - G(\bar{E})\lambda)},$$

with $\bar{E} < \eta$, implying that $G(\bar{E}) < 1$ (i.e., the probability that the informed investor abstains when $F = 0$ is strictly less than 1). In this case, equilibrium effort informativeness is

$$\phi_\gamma^* = \frac{p_F + (1-p_F)(1-\lambda G(\bar{E}))}{(p_F - \Delta_F) + (1 - p_F + \Delta_F)(1 - \lambda G(\bar{E}))} < \phi_0^*.$$

Hence, when the informed investor's social concerns are sufficiently strong, her trading strategy

is distorted from the benchmark, worsening market monitoring. ■

C.2.2 ES and Governance Relationships

We now consider the effect of a strict first-order stochastically dominant (FOSD) shift in the distribution of the firm's externality E. Denote the new distribution by $\hat{G}$, where $1-\hat{G}(s) > 1-G(s)$ for all $0 < s < \eta$.

Proposition C.3. *When the informed investor's social concerns are sufficiently strong, effort informativeness (ϕ_γ^*) decreases with a strict FOSD shift in the distribution of the firm's externality E. The resulting relationship between ES and governance quality is positive when the firm imposes a negative externality and negative when it generates a positive externality.*

Proof of Proposition C.3. We begin with the case of negative externalities. As shown in the proof of Proposition C.2, effort informativeness strictly increases in the probability that the informed investor buys when $F = 1$ (i.e., $G(\bar{E})$). Let $\hat{E}$ be the equilibrium cutoff when E is distributed according to $\hat{G}$. We assume that the informed investor's social concerns are sufficiently strong such that both $\hat{E}$ and $\bar{E}$ are interior. To demonstrate that a lower ES quality, resulting from a strict FOSD shift in the distribution of the firm's externality, worsens market monitoring, we need only show that $\hat{G}(\hat{E}) < G(\bar{E})$. Suppose this is not the case, such that $\hat{G}(\hat{E}) \geq G(\bar{E})$. Let $M(G) = 1-P_\gamma(q>0|G)$ be the profitability of informed trading conditional on the state where the informed investor trades, where G is the probability that the informed investor buys upon observing $F = 1$:

$$M(G) = \frac{(1-p_F)(1-\lambda)}{p_F(1-\lambda+\lambda G)+(1-p_F)(1-\lambda)},$$

which strictly decreases in G. Since $\hat{G}(\hat{E}) \geq G(\bar{E})$ by supposition, the threshold equalities imply

$$\gamma\hat{E} = M(\hat{G}(\hat{E})) \leq M(G(\bar{E})) = \gamma\bar{E}.$$

A strict FOSD shift in the distribution of the externality implies that $\hat{G}(s) < G(s)$ for all $0 < s < \eta$. Hence, $\hat{G}(\hat{E}) \geq G(\bar{E})$ implies that $\hat{E} > \bar{E}$ and $\gamma\hat{E} > \gamma\bar{E}$, a contradiction. This establishes the claim that a firm with worse ES quality also suffers from worse market monitoring.

In the case of positive externalities, let $\hat{E}$ be the equilibrium cutoff when E is distributed according to $\hat{G}$. We assume that the informed investor's social concerns are sufficiently strong such

that both $\hat{E}$ and $\bar{E}$ are interior and unique. Following the proof of Proposition C.2, to demonstrate that better ES quality worsens market monitoring, we need only show that $\hat{G}(\hat{E}) < G(\bar{E})$. Define the expected market-clearing price when the informed investor buys as a function of G, the probability that the externality is not large enough to distort her trading:

$$\bar{P}(G) = \frac{p_F}{p_F + (1-p_F)(1-G\lambda)},$$

which strictly increases in G. Hence, when the distribution shifts from G to a strictly first-order stochastically dominant $\hat{G}$, we have

$$\gamma\bar{E} = \frac{p_F}{p_F + (1-p_F)(1-G(\bar{E})\lambda)} > \frac{p_F}{p_F + (1-p_F)(1-\hat{G}(\bar{E})\lambda)}.$$

Equality is restored by lowering the externality threshold from $\bar{E}$ to $\hat{E}$, implying that $\hat{G}(\hat{E}) \leq \hat{G}(\bar{E}) < G(\bar{E})$. Hence, an improvement in the firm's ES quality (from G to $\hat{G}$) worsens market monitoring. ■

A strict FOSD shift in the distribution of the firm's externality E makes it more likely that the firm's externality is large enough to distort the informed investor's trading strategy. Consequently, such a shift in the distribution further distorts the informed investor's trading strategy away from the benchmark, worsening market monitoring. In the case of negative externalities, a strict FOSD shift for E means that the firm imposes higher negative externalities, corresponding to a decline in ES quality. Hence, for firms that impose negative externalities, there is a positive relationship between ES and governance quality. In the case of positive externalities, a strict FOSD shift for E means that the firm generates higher positive externalities, corresponding to an improvement in ES quality. Hence, for firms that generate positive externalities, there is a negative relationship between ES and governance quality.

C.3 Short Selling

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

market-clearing price conditional on short-selling a share.

Following the logic underlying Proposition 1, it is straightforward to show that in the benchmark without social concerns, the informed investor's optimal strategy is to buy a share when $F = 1$ and short-sell a share when $F = 0$. The equilibrium pricing rule is

$$P_0(q) = \begin{cases} 0, & \text{if } q \leq 0 \\ \frac{p_F}{p_F + (1-p_F)(1-\lambda)^2}, & \text{if } q > 0. \end{cases}$$

The equilibrium effort informativeness in this new benchmark is

$$\phi_0^* = \frac{p_F + (1-p_F)(1-\lambda)^2}{(p_F - \Delta_F) + (1 - p_F + \Delta_F)(1-\lambda)^2}.$$

The following proposition demonstrates that our market governance channel is robust when the informed trader can short the stock. In particular, as in our baseline model, stronger social concerns of the informed investor lead to less informed trading on financial information, thus reducing price informativeness for governance purposes.

Note that, since short selling effectively yields more informative order flow, the negative impact of sustainable investing on market monitoring is reduced. This effect is analogous to adding an informed investor who cares only about F to the model.

Proposition C.4. *When the informed investor's social concerns are sufficiently strong, the effort informativeness of the firm's stock price is lower relative to the benchmark without social concerns ($\gamma = 0$): $\phi_\gamma^* < \phi_0^*$ even when short-selling is allowed.*

Proof of Proposition C.4. We begin with the case of negative externalities ($\eta < 0$). Consider an equilibrium in which the manager exerts effort ($e_F = 1$). Table 8 shows the distribution of the aggregate order flow in different states of the world.

In this case, Bayesian updating implies

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

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

Table 8: Distribution of Equilibrium Aggregate Order Flow

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

and

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

Hence, the market makers' pricing rule is given by

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

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 $E=0$ and to sell one share short when she learns that $F=0$. Additionally, because the informed investor does not receive a utility gain from shorting a firm with a high negative externality, she strictly prefers abstaining to shorting when $F=1$ and $E=\eta$. What remains to be determined is the optimal trading strategy when $F=1$ and $E=\eta$. 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

$$1 - P_\gamma(q > 0)\big|_{a=0} - \gamma|\eta| \leq 0,$$

which is equivalent to

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

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

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

$$1 - P_\gamma(q > 0) - \gamma|\eta| = 0 \Leftrightarrow a^* = \frac{(1-p_F)(1-\lambda)^2 - \gamma|\eta|\left(p_F(1-\lambda(1-p_E)) + (1-p_F)(1-\lambda)^2\right)}{\gamma|\eta|p_F\lambda(1-p_E)}.$$

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 (weakly) decreasing function of γ. In particular, the equilibrium is unique.

When the informed investor's social concerns are sufficiently strong, she abstains when $F = 1$ and $E = \eta$. In this case, the equilibrium effort informativeness is

$$\phi^*_\gamma = \frac{p_F(p_E + (1-p_E)(1-\lambda)) + (1-p_F)(1-\lambda)^2}{(p_F - \Delta_F)(p_E + (1-p_E)(1-\lambda)) + (1-p_F+\Delta_F)(1-\lambda)^2} < \phi^*_0$$

We continue with the case of positive externalities, which follows a similar logic. Due to the presence of noise trading, the expected market-clearing price is strictly between 0 and 1. This implies that, when $F = 1$, the informed investor's valuation is weakly larger than 1, but the expected market-clearing price is strictly less than 1. The investor thus buys one share (i.e., $x = 1$). When $F = 0$ and $E = 0$, 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 $F = 0$ and $E = \eta$. When the informed investor's social concerns are sufficiently strong, she prefers to buy a firm's shares for the utility gain from the firm's positive externality rather than short the firm's shares for the financial trading gain. Note that shorting a firm with positive externalities does not result in additional disutility. Table 9 shows the distribution of the aggregate order flow in different states of the world.

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

Table 9: Distribution of Equilibrium Aggregate Order Flow

Bayesian updating implies that the pricing rule is

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

Upon observing that $F = 0$ and $E = \eta$, the informed investor strictly prefers to buy rather than short-sell if $-P_\gamma(q>0) + \gamma\eta > (1-\lambda)^2 P_\gamma(q>0)$, which is satisfied when γ is sufficiently large.

The effort informativeness associated with this equilibrium is

$$\phi^*_\gamma = \frac{p_F + (1-p_F)((1-p_E)+p_E(1-\lambda)^2)}{(p_F-\Delta_F)+(1-p_F+\Delta_F)((1-p_E)+p_E(1-\lambda)^2)} < \phi^*_0.$$

Hence, when the informed investor's social concerns about the firm's externality become sufficiently strong, the effort informativeness of the firm's stock price declines. ■

C.4 Market Makers who Consider Externalities

In the baseline model, we assumed that the market makers' equilibrium pricing rule reflects the preferences of the marginal financial investor, imposing that the firm's stock price at $t = 1$ depends solely on the expected value of the firm's financial payoff F at $t = 2$: $P_\gamma(q) = \mathbb{E}[F|q]$. In this section, we consider an equilibrium pricing rule that reflects the preferences of the average investor in the economy, which may include sustainable investors. Specifically, we assume that the market

makers assign a weight $\theta \in (0,1)$ to sustainable investors, such that $P_\gamma(q) = \mathbb{E}[F + \theta\gamma E|q]$. Intuitively, θ may capture the share of sustainable investors in the economy who have social concerns γ, and $1-\theta$ the share of financial investors who do not care about the firm's externality. For instance, the market makers may expect to sell any shares they own at $t=2$ to a sustainable investor with probability θ and to a financial investor with probability $1-\theta$.

The following proposition demonstrates that our main mechanism remains robust when market makers incorporate the firm's externality into pricing, provided that θ is not too large. In particular, as in our baseline model, when the informed investor's social concerns are sufficiently strong, the firm's externality distorts her trading relative to the benchmark, thereby reducing the effort informativeness of prices.

Proposition C.5. *Assume that $\theta < \bar{\theta}$ (defined in the proof). When the informed investor's social concerns are sufficiently strong, the cost of providing managerial incentives is higher relative to the benchmark without social concerns ($\gamma = 0$).*

Proof of Proposition C.5. Consider an equilibrium in which the manager exerts effort ($e_F = 1$). Suppose the informed investor's social concerns are sufficiently strong such that the firm's externality distorts her trading relative to the benchmark.

In the case of negative externalities ($\eta < 0$), we thus consider the case in which the informed investor buys when $F = 1$ and $E = 0$, and abstains otherwise. Table 1 in the proof of Lemma 2 shows the distribution of the aggregate order flow in different states of the world.

As shown in the proof of Lemma 2, for $a = 0$, we have

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

and

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

In addition, Bayesian updating implies

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

and

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

Hence, the market makers' pricing rule is given by

$$P_\gamma(q=0) = \frac{p_F(1-p_E)}{p_F(1-p_E)+(1-p_F)} - \theta\gamma\frac{(1-p_E)}{(1-p_E)+(1-p_F)p_E}|\eta|,$$

and

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

Note that we have

$$\frac{\partial P_\gamma(q>0)}{\partial\theta} < 0$$

and

$$P_\gamma(q>0) > 0 \Leftrightarrow \theta < \frac{p_F(1-\lambda(1-p_E))}{\gamma|\eta|(1-p_E)(1-\lambda)} =: \bar{\theta}.$$

Thus, for $\theta < \bar{\theta}$, we have $P_\gamma(q>0) > 0$ for all a. Note that $\bar{\theta}$ 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 $\bar{\theta}$.

Next, we need to confirm that the informed investor abstains upon observing $F=1$ and $E=\eta$,

which requires[23]

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

Consequently, when the informed investor's social concerns become sufficiently strong ($\gamma > \bar{\gamma}$), her optimal trading strategy deviates from the benchmark, corresponding to less informed trading (she abstains when $F = 1$ but $E = \eta$) and lower effort informativeness ($\phi_\gamma^* < \phi_0^*$).

The proof for the case of positive externalities follows a similar line of reasoning. Suppose the informed investor abstains when $F = 0$ and $E = 0$, buys when $F = 1$, and buys when $F = 0$ and $E = \eta$.

As shown in the proof of Proposition 3, setting $a = 1$, we have $\Pr(F = 1|q = 0) = 0$ and

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

In addition, Bayesian updating implies $\Pr(E = \eta|q = 0) = 0$ and

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

Hence, the market makers' pricing rule is given by $P_\gamma(q = 0) = 0$ and

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

Note that we have $P_\gamma(q > 0) > 0$ since $\eta > 0$.

To generate an equilibrium in which the informed investor buys when $F = 0$ and $E = \eta$, we require

$$0 - P_\gamma(q > 0) + \gamma\eta \geq 0.$$

Note that the left-hand side is strictly increasing in γ since $\theta < 1$. The condition can thus be written

[23] Note that $1 - P_\gamma(q > 0) - \gamma|\eta|$ is strictly decreasing in γ since $\theta < 1$.

as

$$\gamma \geq \frac{p_F}{\eta(1-\lambda(1-p_F)p_E-\theta(1-p_E))} =: \underline{\gamma},$$

where the denominator is positive since $\theta < 1$.

Note that there is again a region of multiple equilibria as in the original result. That is, there exists a threshold $\bar{\bar{\gamma}}$ such that if $\gamma \leq \bar{\bar{\gamma}}$ there exists an equilibrium in which the informed investor abstains when $F = 0$ and $E = \eta$. Again, we select the more informative equilibrium. Hence, when the informed investor's social concerns are sufficiently strong (i.e., $\gamma > \bar{\bar{\gamma}}$), her optimal trading strategy is distorted away from the benchmark, resulting in lower effort informativeness. ■

C.5 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.6 demonstrates that our findings remain robust when the manager's compensation ($W(q)$) is paid directly from firm profits.

Proposition C.6. *Assume that the manager exerts effort ($e_F = 1$). If the manager's compensation ($W(q)$) is paid directly from firm profits, then there exists an equilibrium in which the informed investor's optimal trading strategy and the equilibrium effort informativeness of prices are identical to our characterization in Section 5.*

Proof of Proposition C.6. We begin with the case of negative externalities ($\eta < 0$). Consider an equilibrium in which the manager exerts effort ($e_F = 1$), and the equilibrium as outlined in Table 1 from the proof of Lemma 2 in which the informed investor buys one share ($x = 1$) upon observing $F = 1$ and $E = 0$, and abstains ($x = 0$) upon observing $F = 0$. Upon observing $F = 1$ and $E = \eta$, she buys with probability a. We now show that the same equilibrium as in Lemma 2 can be sustained if the manager's compensation is paid directly from firm profits.

Following the proof of Lemma 2, Bayesian updating implies the same expressions for $\Pr(F = 1|q = 0)$ and $\Pr(F = 1|q > 0)$. Given that the manager's compensation $W_\gamma(q)$, the market makers' pricing rule is given by $\tilde{P}_\gamma(q) = P_\gamma(q) - W_\gamma(q)$, where $P_\gamma(q)$ denotes the price gross of compensation from the proof of Lemma 2. Importantly, the net financial payoff of a share at $t = 2$ is $V(q) = F - W_\gamma(q)$, where q is the order flow at $t = 1$.

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

What remains to be determined is the optimal trading strategy when $F = 1$ and $E = \eta$. Note that the investor's 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 Lemma 2.

We continue with the case of positive externalities ($\eta > 0$), which follows the same logic. Consider an equilibrium in which the manager exerts effort ($e_F = 1$), and the equilibrium as outlined in the proof of Proposition 3 in which the informed investor buys when the financial payoff is high, regardless of the externality ($F = 1$ and $E = 0$ or $E = \eta$), abstains when both the financial payoff and the externality are low ($F = 0$ and $E = 0$), and buys with probability a when observing a low financial payoff and a high externality ($F = 0$ and $E = \eta$). We now show that the same equilibrium as in Proposition 3 can be sustained if the manager's compensation is paid directly from firm profits.

Bayesian updating implies the same expressions for $\Pr(F = 1|q = 0)$ and $\Pr(F = 1|q > 0)$. As in the case of negative externalities, the market makers' pricing rule takes into account the manager's compensation $W_\gamma(q)$: $\tilde{P}_\gamma(q) = P_\gamma(q) - W_\gamma(q)$, where $P_\gamma(q)$ denotes the price gross of compensation from the proof of Proposition 3. The net financial payoff of a share at $t = 2$ is $V(q) = F - W_\gamma(q)$, where q is the order flow at $t = 1$.

The informed investor's optimal strategy involves buying when $F = 1$: $1 - W_\gamma(q > 0) + \gamma E - \tilde{P}_\gamma(q) = 1 - P_\gamma(q > 0) + \gamma E > 0$. Moreover, she prefers abstaining when $F = 0$ and $E = 0$: $0 - W_\gamma(q > 0) - \tilde{P}_\gamma(q) = 0 - P_\gamma(q > 0) < 0$. Finally, she prefers buying when $F = 0$ and $E = \eta$ if $0 - W_\gamma(q > 0) + \gamma\eta - \tilde{P}_\gamma(q) = 0 - P_\gamma(q > 0) + \gamma\eta > 0$, which is identical to the condition in the proof of Proposition 3. As a result, the derivation of the trading behavior is identical to that derived in the proof of Proposition 3. ■

When the manager is compensated from the firm's financial payoff, the stock price reflects the net-of-wages financial payoff. Because 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 rule does not affect the informed investor's trading behavior—both the price of a share

at $t = 1$ and its associated financial payoff at $t = 2$ shift by the compensation owed to the manager. Consequently, all our results regarding the impact of sustainable investing on market governance remain valid under this alternative specification.

C.6 Competitive Informed Trading

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

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

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

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

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

We begin with the case of negative externalities ($\eta < 0$). The following proposition characterizes the trading equilibrium at $t = 1$ when $\gamma > 0$.

Proposition C.7. *Assume that the manager exerts effort ($e_F = 1$). Then there exists an equilibrium in which: (i) all informed investors buy one share ($x_i^* = 1$) upon observing a high financial payoff and a low externality ($F = 1$ and $E = 0$), (ii) all informed investors abstain from buying ($x_i^* = 0$) upon observing a low financial payoff ($F = 0$), and (iii) a fraction a^* of informed investors buy a*

share upon observing a high financial payoff and a high externality ($F = 1$ and $E = \eta$) while the remaining abstain, where

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

and is defined implicitly by

$$\gamma|\eta| = \frac{\left(1 - e^{-\lambda(1-a^*)}\right)(1-p_F)e^{-\lambda}}{p_F(1-p_E)e^{-\lambda(1-a^*)} + (1-p_F)e^{-\lambda}} + \frac{\left(e^{-\lambda(1-a^*)}\right)(1-p_F)e^{-\lambda}}{p_F(p_E + (1-p_E)e^{-\lambda(1-a^*)}) + (1-p_F)e^{-\lambda}}$$

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

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

and

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

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

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

Proof of Proposition C.7. Consider an equilibrium in which the manager exerts effort ($e_F = 1$) and a fraction a of informed investors buy a share upon observing a high financial payoff and a high externality ($F = 1$ and $E = \eta$). Table 10 shows the distribution of the aggregate order flow in different states of the world when informed investors follow the trading strategies described in the proposition.

In this case, Bayesian updating implies

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

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

Table 10: Distribution of Equilibrium Aggregate Order Flow

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

and

$$\Pr(F=1|q\geq 1) = \frac{p_F\left(p_E+(1-p_E)e^{-\lambda(1-a)}\right)}{p_F\left(p_E+(1-p_E)e^{-\lambda(1-a)}\right)+(1-p_F)e^{-\lambda}}.$$

Hence, the market makers' pricing rule is given by

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

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

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

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

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

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

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

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

$$\begin{aligned} 1-\mathbb{E}[P_\gamma|a\in(0,1)]-\gamma|\eta| &= 0, \\ 1-\left(1-e^{-\lambda(1-a)}\right)P_\gamma(q\in[a,1))\big|_{a\in(0,1)}-\left(e^{-\lambda(1-a)}\right)P_\gamma(q\geq 1)\big|_{a\in(0,1)}-\gamma|\eta| &= 0. \end{aligned} \tag{17}$$

Note that the left-hand side of (17) strictly decreases in a because

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

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

and

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

Moreover, $\gamma \in (\underline{\gamma},\bar{\gamma})$ implies that the left-hand side of (17) is strictly positive when $a=0$ and strictly negative when $a=1$. Hence, the intermediate value theorem implies that there is a unique $a^* \in (0,1)$ such that (17) holds with equality.

Evaluating the left-hand side of (17) at $a=0$ and $a=1$ yields the thresholds $\bar{\gamma}$ and $\underline{\gamma}$, respectively. Moreover, differentiating (17) with respect to γ yields

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

implying that $\frac{da^*}{d\gamma}<0$. Hence, the total amount of informed trading (a^*) when $F=1$ and $E=\eta$ is

a continuous decreasing function of γ for $\gamma \in [0,1]$ as in the main specification of the model. ■

Proposition C.7 implies that effort informativeness in equilibrium is given by

$$\phi_\gamma^* = \frac{p_F\left(p_E + (1-p_E)e^{-\lambda(1-a^*)}\right) + (1-p_F)e^{-\lambda}}{(p_F-\Delta_F)\left(p_E+(1-p_E)e^{-\lambda(1-a^*)}\right) + (1-p_F+\Delta_F)e^{-\lambda}},$$

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

The same logic also extends to the case of positive externalities ($\eta > 0$). When the informed investors' social concerns are sufficiently strong, they buy upon learning that $F = 0$ and $E = \eta$. In this case, the market makers expect the following distribution for the aggregate order flow.

F	E	$\Pr(F,E)$	Informed Trade x	Order Flow q	Conditional Density
0	0	$(1-p_F)p_E$	$x=0$	$q \geq 0$	$\lambda e^{-\lambda q}$
0	η	$(1-p_F)(1-p_E)$	$x=1$	$q \geq 1$	$\lambda e^{-\lambda(q-1)}$
1	η	$p_F(1-p_E)$	$x=1$	$q \geq 1$	$\lambda e^{-\lambda(q-1)}$
1	0	$p_F p_E$	$x=1$	$q \geq 1$	$\lambda e^{-\lambda(q-1)}$

Table 11: Distribution of Equilibrium Aggregate Order Flow

Bayesian updating implies that the pricing rule is

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

As before, the informed investors strictly prefer to buy when $F = 1$ (due to positive expected trading profits) and abstain when $F = 0$ and $E = 0$ (due to negative expected trading profits). The informed investors prefer to buy a share upon observing $F = 0$ and $E = \eta$ if

$$\gamma\eta > \frac{p_F}{p_F+(1-p_F)((1-p_E)+p_E e^{-\lambda})}.$$

Note that there is again a region of multiple equilibria as in the original result. That is, there exists a threshold $\bar{\bar{\gamma}}$ such that if $\gamma \leq \bar{\bar{\gamma}}$ there exists an equilibrium in which the informed investors abstain when $F = 0$ and $E = \eta$. Again, we select the more informative equilibrium. Hence, when the informed investors' social concerns are sufficiently strong (i.e., $\gamma > \bar{\bar{\gamma}}$), her optimal trading

strategy is distorted away from the benchmark.

The effort informativeness of the firm's stock price in this trading equilibrium is

$$\phi_\gamma^* = \frac{p_F + (1-p_F)\left((1-p_E) + p_E e^{-\lambda}\right)}{(p_F - \Delta_F) + (1-p_F+\Delta_F)\left((1-p_E) + p_E e^{-\lambda}\right)} < \phi_0^*.$$

Hence, when the social concerns of the informed investor become sufficiently strong, market monitoring worsens.

C.7 Realized Returns

In our framework, expected returns are equal across firms, but realized returns differ with the realization of the firm's externality. This difference arises because the realized externality affects the informed investor's trading strategy when her social concerns are sufficiently strong. Denote the realized returns from $t=1$ to $t=2$ conditional on the externality by $R_{E=0} = \mathbb{E}[F - P_\gamma(q)|E=0]$ and $R_{E=\eta} = \mathbb{E}[F - P_\gamma(q)|E=\eta]$. For instance, when the firm imposes a negative externality, these quantities can be interpreted as the realized returns of green and brown firms, classified by the realized externality. We consider dollar returns because this yields a simple linear relationship between expected and realized returns: $p_E R_{E=0} + (1-p_E) R_{E=\eta} = 0$.

Proposition C.8. *When the informed investor's social concerns are sufficiently strong, a firm with lower ES performance has a higher realized return than one with higher ES performance.*

Proof of Proposition C.8. When the informed investor's social concerns are sufficiently strong, the realization of the firm's externality distorts her trading behavior from the benchmark.

When the firm imposes a negative externality ($\eta < 0$), the informed investor abstains from trading when observing $F=1$ and $E=\eta$. Lemma 2 implies the expected market-clearing price at $t=1$ of a firm with high externality ($E=\eta<0$) is

$$\begin{aligned}
\mathbb{E}[P_\gamma(q)|E=\eta] =& \ \lambda P_\gamma(q=0) + (1-\lambda) P_\gamma(q>0) \\
=& \ \lambda \frac{p_F(1-p_E)}{p_F(1-p_E)+(1-p_F)} + (1-\lambda)\frac{p_F(1-(1-p_E)\lambda)}{p_F(1-(1-p_E)\lambda)+(1-p_F)(1-\lambda)} \\
=& \ \frac{\lambda p_F(1-p_E)}{1-p_F p_E} + \frac{(1-\lambda)p_F(1-(1-p_E)\lambda)}{1-\lambda(1-p_F p_E)} < p_F
\end{aligned}$$

because

$$p_F - \frac{\lambda p_F(1-p_E)}{1-p_F p_E} - \frac{(1-\lambda)p_F(1-(1-p_E)\lambda)}{1-\lambda(1-p_F p_E)} = \frac{\lambda p_E^2 p_F^2(1-p_F)}{(1-p_F p_E)(1-\lambda(1-p_F p_E))} > 0.$$

Hence, the average realized return of firms with high negative externalities is

$$R_{E=\eta} = p_F - \mathbb{E}[P_\gamma(q)|E=\eta] > 0.$$

The market-clearing condition implies that the expected price at $t=1$ is

$$p_E \mathbb{E}[P_\gamma(q)|E=0] + (1-p_E)\mathbb{E}[P_\gamma(q)|E=\eta] = p_F.$$

Hence, the average return of firms with high negative externalities is higher than that of firms with low negative externalities:

$$R_{E=\eta} = p_F - \mathbb{E}[P_\gamma(q)|E=\eta] > 0 > p_F - \mathbb{E}[P_\gamma(q)|E=0] = R_{E=0}.$$

A similar logic extends to the case of positive externalities ($\eta > 0$). When the informed investor's social concerns are sufficiently strong, she buys when $E=\eta>0$ and $F=0$. Using the equilibrium pricing rule from the proof of Proposition 3, the expected market-clearing price at $t=1$ for a firm with a low positive externality ($E=0$) is

$$\begin{aligned}\mathbb{E}[P_\gamma(q)|E=0] =& \ (1-p_F)\lambda P_\gamma(q=0) + (1-(1-p_F)\lambda)P_\gamma(q>0) \\ =& \ 0 + (1-(1-p_F)\lambda)\frac{p_F}{p_F + (1-p_F)(p_E(1-\lambda)+(1-p_E))} < p_F\end{aligned}$$

because $1-(1-p_F)\lambda < p_F + (1-p_F)(p_E(1-\lambda)+(1-p_E))$. The market-clearing condition implies that the expected price at $t=1$ is

$$p_E \mathbb{E}[P_\gamma(q)|E=0] + (1-p_E)\mathbb{E}[P_\gamma(q)|E=\eta] = p_F.$$

Hence, the average return of firms with low positive externalities is higher than that of firms with high positive externalities:

$$R_{E=0} = p_F - \mathbb{E}[P_\gamma(q)|E=0] > 0 > p_F - \mathbb{E}[P_\gamma(q)|E=\eta] = R_{E=\eta}.$$

Overall, the above results imply that firms with better ES performance (i.e., higher positive externality or lower negative externality) have lower average returns from $t = 1$ to $t = 2$. ■

This result stems from the market-governance mechanism of sustainable investing. When the firm imposes a negative externality, the informed investor refrains from buying when its externality is high despite strong financial performance, causing prices to under-reflect positive financial information. Prices are therefore too low at $t = 1$ and rise when the financial payoff becomes public at $t = 2$, yielding higher realized returns for firms with a high negative externality ($E = \eta < 0$). When the firm generates a positive externality, the informed investor buys when its externality is high despite weak financial performance. This trading pushes up stock prices of firms with a positive externality ($E = \eta > 0$) at $t = 1$, leaving less room for price appreciation and thus lower realized returns. In both cases, firms with better ES performance earn lower realized returns.

Sustainable investing, therefore, generates realized return differentials even absent risk premia, as the realization of the externality affects informed trading. Our framework provides a novel information-based explanation for the mixed empirical evidence on the greenium, which partly reflects the empirical challenge of distinguishing between expected and realized returns (e.g., Pastor et al., 2022; Eskildsen et al., 2024).

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