

Talk or Walk the Talk?

The Real Impact of ESG Investing*

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Abstract

I propose a model to examine how ESG investors influence firms' real green investments and greenwashing jointly. Paradoxically, stronger investor ESG preferences may reduce real green investments due to increased greenwashing, which undermines the reliability of ESG information. When this information distortion is severe, firms are disincentivized to make real green investments, as the market-perceived ESG gains are obscured by misinformation, while financial losses are fully reflected in stock prices. This unintended consequence is most likely when the cost of manipulating ESG information is low, the correlation between fundamentals is weak, and financial information quality is high. In addition, brown firms with poor financial performance are particularly prone to greenwashing, benefiting from ESG investors despite their actual impact. These findings raise concerns that ESG investing could backfire without effective disclosure regulations. I discuss policy measures to enhance real impact by curbing greenwashing, such as diversifying green technology options and linking executive compensation to ESG outcomes.

Keywords: Greenwashing, ESG, real effects, socially responsible investing, ESG reporting, externality

JEL Classification: G11, G23, G32, M14

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1 Introduction

Environmental, social, and governance (ESG) investing, also known as sustainable investing, has grown dramatically in recent years. A distinctive characteristic of many ESG investors is their desire to make a real impact by incentivizing firms to reduce negative externalities, such as environmental pollution, through their investments.¹ However, the empirical evidence on the real impact of ESG investing is mixed², while the prevalence of greenwashing has been widely documented³: As investors increasingly prioritize ESG outcomes, firms are more inclined to manipulate their ESG disclosures to cater to investors, which can result in significant discrepancies between their claims and their actual practices. Given the controversial empirical observations, my paper proposes a model to analyze how the rise in ESG investing influences firms' real green investments and greenwashing jointly.

There is widespread concern that firms are engaging in greenwashing or diversity-washing while still benefiting from ESG investors. For example, Baker et al. (2024) finds that firms may make commitments to diversity, equity, and inclusion (DEI) in their disclosures, yet have poor hiring practices that result in less workplace diversity and future outflows of diverse employees. They also highlight that those diversity-washing firms get superior ESG scores and attract investment from ESG funds. As the industry observations suggest, “corporate leaders who talk the most about diversity may benefit from greater investment in their companies by socially conscious funds, even if hiring and promotion efforts are lackluster.”⁴

¹Most institutional investors have made commitments to support real ESG activities. For example, The collective AUM represented by all 3826 PRI signatories has reached \$121 trillion as of March 31, 2021 (<https://www.unpri.org/annual-report-2021/how-we-work/building-our-effectiveness/enhance-our-global-footprint>); Survey evidence also shows that investors are willing to support ESG activities: e.g., Haber et al. (2022).

²The impact of ESG investing on corporate ESG practices is a subject of ongoing debate. A growing body of empirical literature addresses this issue, such as Chava (2014); Berk and van Binsbergen (2021); De Angelis et al. (2022); Gantchev et al. (2022); Hartzmark and Shue (2022); Gormsen et al. (2023); Heath et al. (2023, etc.).

³There are numerous real-world cases of companies being accused of greenwashing: for example, see <https://www.bloomberg.com/news/articles/2024-04-30/us-lawmakers-call-out-exxon-chevron-s-hell-bp-for-greenwashing>.

⁴CEOs Who Are All Talk and No Action on Inclusion Still Benefit (Bloomberg): <https://www.bloomberg.com/news/articles/2023-01-19/-diversity-washing-funds-can-aid-companies-even-if-the-y-don-t-improve-hiring#xj4y7vzkg>

Exacerbating the issue is the fact that investors lack reliable information to monitor ESG performance and identify greenwashing. In reality, ESG information is usually subjective, multi-dimensional, and lacks a definite realization to discipline ex-ante evaluations. Even ESG rating agencies rely heavily on voluntarily disclosed data from firms to generate ratings and have substantial disagreements over firms' ESG performance (Berg et al., 2022).⁵ Thus, it is challenging for investors to distinguish actual green firms from greenwashing firms.

I propose a model in which ESG investors influence firms' real green investment and greenwashing through their impact on market prices.⁶ Paradoxically, stronger investor ESG preferences may reduce real green investments due to increased greenwashing, which undermines the reliability of ESG information. A novel channel driving this result is highlighted in the analysis: as investors increasingly value ESG outcomes, more greenwashing is induced since brown firms have stronger incentives to manipulate ESG information and mimic green firms.⁷ This greenwashing channel intensifies when the cost of manipulating ESG information is low, the correlation between fundamentals is weak, and financial information quality is high. Therefore, investors are less able to distinguish actual green firms from greenwashing firms. This reduces firms' incentives to make real green investments, as the market-perceived ESG gains are obscured by misinformation, while financial losses are fully reflected in stock prices.

My model highlights the intrinsic paradox of incentivizing ESG real investment through financial markets. On the one hand, we want investors to focus more on ESG outcomes (e.g., carbon emissions, gender equality, etc.) relative to traditional business performance, such that firms are willing to allocate resources to ESG activities rather than just maximizing

⁵A case illustrating the challenges of subjective ESG evaluations involves Apple's annual meeting in March 2022. A majority of investors supported a resolution for a third-party "civil rights audit" on issues like pay equity and leadership diversity. In response, Apple opposed the proposal, stating that it already met these objectives through existing practices, including impact assessments, governance, and public reporting (as discussed in "Shareholders Push an Array of ESG Proposals": <https://www.wsj.com/articles/shareholders-push-array-of-esg-proposals-11651004156>).

⁶Throughout this paper, I use the terms ESG investors, impact investors, and socially responsible investors interchangeably to refer to those who value firms' ESG performance.

⁷Note that for concreteness, I use the words "brown firm" and "green firm" to refer to firms with bad and good ESG outcomes respectively. Generally, the same analysis can be applied to other ESG issues.

profits. On the other hand, it also means that investors increasingly value the outcomes that are subject to more manipulation, which naturally induces more greenwashing and thus less incentive for real green efforts.

My model naturally fits a wide range of empirical contexts in which principals with ESG preference incentivize agents to undertake ESG activities. For example, the model can be applied to analyze the greenwashing of ESG funds: the customers of ESG funds want to invest in green stocks, but fund managers might just want to maximize their own payoff and they might label themselves as ESG funds in order to get a higher management fee than traditional funds. The key insight of the model rationalizes the empirical findings that ESG funds hold stocks with more voluntary ESG disclosure but worse actual ESG performance (e.g., Raghunandan and Rajgopal, 2022). In addition, my model can be applied to other empirical contexts such as green bond issuance, ESG-focused venture capital, etc.

The model has three stages: real investment stage, information disclosure stage, and trading stage. To fix ideas, we consider the case of green versus brown firms:

- (i) At the real investment stage, the firm has no project in place initially. It can get either a green or brown investment opportunity, and the firm manager must decide whether to make the investment or not. The project has both an ESG fundamental and a financial fundamental: specifically, the green (brown) project increases (decreases) the firm's ESG performance, with a decrease (increase) expected financial performance. For example, we can think of the green project as the adoption of new clean energy, which reduces carbon emissions but the transition is costly and requires substantial upfront expenditure, and the brown project as the expansion of production using traditional energy, which increases carbon emissions but generates high profits.
- (ii) At the information disclosure stage, two public signals about the financial performance and ESG performance are disclosed respectively: The financial signal is exogenous, while the ESG signal is subject to manipulation. The brown firm (i.e., the firm without green investment) can greenwash and manipulate the ESG information. Increased

greenwashing makes the ESG signal less informative, as a brown firm is more likely to have a misleadingly green signal. We can think of financial performance as cash flow, which investors can objectively assess through earnings reports. In contrast, we can think of ESG performance as the reduction in environmental pollution, and its data can be manipulated when disclosed to ESG rating agencies and other market participants.⁸

- (iii) At the trading stage, a competitive financial market opens, and investors with heterogeneous ESG preferences trade shares of the firm conditional on the public information released at the disclosure stage, which determines the market price of the firm.⁹

Note that the firm manager’s compensation is determined by the market price of the firm. Therefore, with distinction in the information structure of the two fundamentals, the market price reflects the performance in each fundamental differently, thus influencing the incentive for green investment at the real investment stage.

I show that stronger investor ESG preferences have two countervailing effects on the reward for green investment. On the one hand, as investors internalize more ESG performance, the market price of the firm has a larger weight on ESG performance (referred to as the market ESG preference) and becomes more sensitive to changes in it. This directly incentivizes green investment, and we call it the “performance weighting effect”. On the other hand, stronger investor ESG preferences induce more greenwashing in equilibrium, worsening ESG information quality endogenously. This happens because brown firms gain more by pooling with green firms than by being identified as brown. For investors, lower information quality makes it harder to distinguish actual green firms from greenwashing firms. As a result, they adjust their expectations downward for actual green firms and upward for

⁸For example, the ESG signal can be interpreted as ESG ratings. Because rating agencies use firms’ voluntary ESG disclosure as an important benchmark to evaluate their ESG performance, brown firms can strategically manipulate the release of ESG information and influence their ESG ratings.

⁹The key of the last stage is that investors reward or punish the manager depending on the perceived externality value according to their beliefs. We can also think of investors’ actions as activism and engagement, i.e., there is a representative ESG investor issuing compensation to the manager contingent on the disclosure.

brown firms. This creates a larger discrepancy between a firm’s actual ESG performance and the market-perceived ESG performance reflected in its price, causing green firms to receive less reward for their true ESG efforts. Therefore, firms are disincentivized from making real green investments ex-ante, as the market-perceived gains in ESG performance are obscured by greenwashing. I refer to this effect as the “information distortion effect”. These two opposing forces lead to non-monotonic effects of investor ESG preferences on incentives for green investment.

Based on the two competing effects, I highlight an important caveat for ESG investing: If greenwashing is prevalent, then stronger investor ESG preference could backfire and disincentivize real green investment. In other words, to incentivize firms’ green investment, investor ESG preference should be strong enough such that sufficient ESG performance is internalized through market price. However, it should not be too large such that too much greenwashing undermines the information quality substantially.

The implications are critical. First, for empirical research, the growing literature has focused on and debated whether a higher shareholding of ESG institutional investors incentivizes firms to become greener (e.g., Gantchev et al., 2022; Heath et al., 2023, etc.). My findings suggest that the real effect may depend on the extent to which ESG fundamentals are susceptible to greenwashing, and thus some of the discrepancies in previous empirical results might be reconciled by information frictions. I propose a set of empirical predictions related to the information environment for future research, and I also discuss real-world implications for different ESG fundamentals. Second, for policymakers, my findings suggest that under certain conditions, curbing greenwashing may be more crucial than simply promoting ESG investing to drive green transitions. I also discuss potential policy measures to enhance real impact by curbing greenwashing.

When does the information distortion effect intensify and drive unintended consequences? I identify three key conditions. First, a low cost of manipulating ESG information directly leads to more severe greenwashing. Second, a weak correlation between financial and ESG

fundamentals prevents investors from inferring ESG performance from financial performance, allowing greenwashing to effectively obscure actual ESG performance. Third, high-quality financial information ensures that the financial losses from real green investment are fully reflected in the market price even when greenwashing is severe, which discourages real green investment. Consequently, when the above conditions are satisfied, the firm is disincentivized to make real green investments, as perceived ESG gains are obscured by misinformation, while financial losses are fully reflected in stock prices.

Interestingly, the analysis on greenwashing suggests that brown firms with worse financial performance engage in higher levels of greenwashing. Intuitively, when financial information suggests weak financial fundamentals from the firm's real investments, this could stem from two possibilities: either the firm's traditional investments are underperforming, or resources have been diverted towards ESG investment. In situations where ESG information is easily manipulable but financial information is not, firms tend to claim the latter, using ESG as an excuse for poor performance and seeking compensation from ESG investors. This result rationalizes empirical observations that many companies publicly embrace ESG initiatives as a cover for poor business performance (e.g., Flugum and Souther, 2022; Baker et al., 2024, etc.).

Last, I discuss policy measures to enhance real impact by curbing greenwashing. First, diversifying green technology options available to firms could serve as a barrier to greenwashing. I demonstrate that firms might avoid investing in moderate green projects if investors cannot distinguish these from greenwashing efforts. However, they may be more inclined to invest in advanced green projects if these projects clearly differentiate them from greenwashing firms (e.g., through green patents). Second, I show that linking executive compensation to long-term ESG outcomes can discourage greenwashing and incentivize real green investments. Specifically, relying solely on market incentives may fail, even when investors have strong ESG preferences, but aligning executive compensation with long-term ESG goals can effectively complement market mechanisms.

Related Literature My paper adds to the growing literature on ESG investing and its real impact. On the empirical side, many studies report contradictory findings. Chava (2014), Gantchev et al. (2022), Gormsen et al. (2023), and show that ESG investing generates substantial real impact and motivates firms to adopt ESG practices. On the other hand, Berk and van Binsbergen (2021), Berg et al. (2022), and Heath et al. (2023) show that ESG investing does not have a significant effect on disciplining firms. On the theoretical side, most existing models (e.g., Heinkel et al., 2001; Chowdhry et al., 2019; Pástor et al., 2021; Oehmke and Opp, 2022; Edmans et al., 2022; De Angelis et al., 2022, etc.) show that when investors internalize more social benefits and costs (or the share of ESG investors increases), more efficient social outcomes can be induced. However, my model emphasizes the unintended consequence of ESG investing: stronger investors' ESG preference might backfire and harm real efficiency when information regulation is weak. Moreover, in their models, the information quality about ESG practices is either irrelevant or taken as exogenous, but in my model, it is endogenous to the extent of greenwashing by brown firms, which drives the key result.

My paper also closely relates to the growing literature on ESG information disclosure. On the one hand, empirical evidence suggests that ESG investors induce more voluntary disclosure related to ESG (Ilhan et al., 2023; Flammer et al., 2021). On the other hand, empirical studies show that the quality of ESG disclosure is questionable and greenwashing is prevalent (Baker et al., 2024; Bailey et al., 2022; Liang et al., 2022).¹⁰ Specifically, there are significant discrepancies between firms' disclosure and actual ESG practices, and firms may selectively release favorable information due to the absence of standards and frameworks for ESG disclosure. Another important source of ESG information is ESG rating. Berg et al. (2022), Berg et al. (2021), Serafeim and Yoon (2022), and Christensen et al. (2022) analyze the disagreement among ESG ratings and how it affects asset prices and predicts

¹⁰My model can also be applied to analyze the greenwashing of ESG funds, which is highlighted by many empirical papers (e.g., Kim and Yoon, 2023; Raghunandan and Rajgopal, 2022; Gibson Brandon et al., 2022; Liang et al., 2022).

future news. Avramov et al. (2022) theoretically analyzes how ESG rating uncertainty affects market risk premium and alpha in an asset pricing framework. Distinct from existing literature that either considers ESG real effects or information disclosure only, my paper jointly considers incentives for real ESG activities and ESG information manipulation, and my model emphasizes the interaction between greenwashing and real efforts.

From a theoretical perspective, my paper relates to the broad literature on information manipulation and earnings management. Particularly, Goldman and Slezak (2006) analyzes how stock-based compensation induces managers to exert productive effort but also to misreport performance. One key difference between my model and their model is that in their model market participants can perfectly predict the agent's equilibrium choices and they derive a signal-jamming equilibrium (e.g., Fudenberg and Tirole, 1986; Stein, 1989, etc.), while in my model there is uncertainty about the agent's type (green vs. brown). In this sense, my model is more closely connected to the earnings management literature in which the equilibrium choice is not perfectly predictable (e.g., Dye, 1988; Fischer and Verrecchia, 2000, etc.). Importantly, my model features a manipulable ESG fundamental versus a non-manipulable financial fundamental. The dilemma is that when market participants value the ESG fundamental more in order to incentivize socially optimal real decisions, it inevitably induces more information manipulation, which may undermine real efficiency unexpectedly.

In addition, my paper can connect to the literature that explores the relationship between ESG criteria in CEO compensation and firms' ESG performance. Gillan et al. (2021) and Bebchuk and Tallarita (2022) provide a comprehensive overview, suggesting that while incorporating ESG metrics in compensation could incentivize ESG activities, it may also have detrimental effects on welfare by exacerbating severe agency problems. A growing body of empirical evidence, including studies by Cohen et al. (2022) and Berrone and Gomez-Mejia (2009), indicates that environmental governance mechanisms and ESG metrics in executive compensation contracts can enhance firms' ESG performance.

2 Model

The model has three dates, $t \in \{1, 2, 3\}$. Figure 1 describes the timing of actions and events in the model.

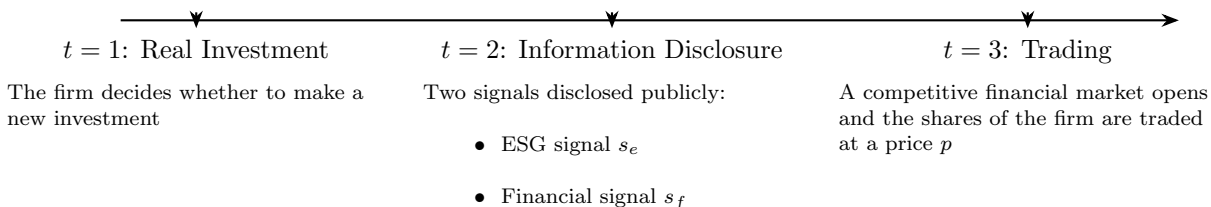


Figure 1: Timeline

2.1 Real Investment Stage

The firm initially has no project in place. At $t = 1$, it gets a new investment opportunity, and the project type is denoted by $\theta \in \{G, B\}$: With probability μ , $\theta = G$, representing that the firm gets a green investment opportunity; with probability $1 - \mu$, $\theta = B$, representing that the firm gets a brown investment opportunity. For example, we can think of the firm's green investment as adoption of new clean energy technologies, and the brown investment as expansion of production using traditional energy sources. The investment decision of the manager is denoted by $I \in \{1, 0\}$, where $I = 1$ represents that the manager makes the new investment, and $I = 0$ represents that the manager keeps the status quo.

The real investment influences both the ESG performance and the financial performance of the firm, denoted by $v_e(\theta, I)$ and $v_f(\theta, I)$ respectively. Specifically, if the firm manager keeps the status quo, the performance of the firm does not depend on project type θ : The ESG performance is $v_e(\theta, I = 0) = 0$, and the financial performance is $v_f(\theta, I = 0) = v_0$. If the firm manager makes the investment, the performance of the firm depends on project

type θ , which is defined as follows:

$$v_e(\theta, I = 1) = \begin{cases} e_G & \text{if } \theta = G, \\ e_B & \text{if } \theta = B, \end{cases} \quad (1)$$

where $e_G > 0 > e_B$, indicating that green projects generate positive externalities while brown projects produce negative externalities.

$$v_f(\theta, I = 1) = \begin{cases} v_H & \text{w.p. } \rho_\theta, \\ v_L & \text{w.p. } 1 - \rho_\theta, \end{cases} \quad (2)$$

where $v_H > v_0 > v_L$, $\rho_B = \rho > \frac{1}{2}$, $\rho_G = 1 - \rho < \frac{1}{2}$.

This setup introduces uncertainty at the time of real investment, with brown projects more likely to yield higher financial performance than green ones. The parameter ρ captures the correlation between the two fundamentals: A larger ρ indicates that the negative correlation between fundamentals is stronger. It also implies that the expected financial performance of the brown project is larger than the green project, i.e., $\mathbb{E}[v_f | \theta = B, I = 1] > \mathbb{E}[v_f | \theta = G, I = 1]$. We further impose a mild assumption on the expected financial performance of the project:

Assumption 1 $\mathbb{E}[v_f | \theta = B, I = 1] > v_0 > \mathbb{E}[v_f | \theta = G, I = 1]$.

This assumption highlights the trade-off between pursuing environmental and social benefits and achieving financial gains. Specifically, the green (brown) investment increases (decreases) ESG performance, while decreasing (increasing) expected financial performance.

Remark 1: The model's focus on two dimensions of firm fundamentals underscores the inherent trade-off between green and brown investments in real-world scenarios. Specifically, a green project—such as adopting new clean energy technologies—helps reduce carbon emissions, but this transition can be costly, requiring significant upfront investment. Conversely,

a brown project—like expanding production using traditional energy sources—may increase carbon emissions but generate substantial profits.

Remark 2: The firm does not always get the green investment opportunity, which implies that there is a probability that the firm remains brown even if the opportunity is always taken (whenever it is available) in equilibrium. In the subsequent analysis, we will demonstrate how the possibility of greenwashing by brown firms substantially distorts green investment decisions. In addition, the availability of green investment opportunities can be interpreted as reflecting the heterogeneous costs of such investments. Specifically, those firms lacking opportunities may face prohibitively high costs that deter them from pursuing green investments. For example, firms with extensive infrastructure dependent on traditional energy sources may find the costs of transitioning to be exorbitant.

Henceforth, we will refer to firms with new green projects as “green firms” and those with new brown projects as “brown firms”.

2.2 Information Disclosure Stage

At the beginning of $t = 2$, the firm manager observes the realization of financial performance. I use $\omega \in \{H, L\}$ to represent the state of financial performance. Subsequently, if the new investment is made, two public signals about the ESG performance and financial performance are disclosed respectively.¹¹ The financial signal, s_f , fully revealing financial performance v_f (i.e., $s_f = \omega$), is exogenous and disclosed with probability $\eta = 1$.¹²

The ESG signal s_e , about the ESG performance v_e , is subject to manipulation and

¹¹This setup implies that investors can observe whether the firm manager invests, but they are uncertain about the type of investment.

¹²The key assumption here is that the financial information s_f is exogenous and therefore not subject to manipulation. Additionally, I assume the financial performance is revealed with probability $\eta = 1$ to simplify the analysis in the baseline model. I will analyze the extension where the financial performance is not always revealed (i.e., $\eta \in [0, 1]$) in Section ???. In that case, we need to consider an additional learning channel where investors could infer the financial performance v_f from the ESG signal s_e .

described below:

$$\begin{aligned} \Pr(s_e = G \mid \theta = G, I = 1) &= 1, \Pr(s_e = B \mid \theta = G, I = 1) = 0; \\ \Pr(s_e = G \mid \theta = B, I = 1) &= w, \Pr(s_e = B \mid \theta = B, I = 1) = 1 - w. \end{aligned} \tag{3}$$

Particularly, $w \in [0, 1]$ is endogenous, representing the greenwashing efforts chosen by the brown firm. Greenwashing incurs a private cost given by $C(w) = \frac{1}{2}cw^2$. This strategic manipulation of the ESG signal through greenwashing obscures the actual ESG performance of firms, making it difficult for investors to distinguish between actual green firms and greenwashing firms based on the ESG signal s_e . The cost of greenwashing $C(W)$ can be interpreted in different ways: it could result from penalties following a probabilistic ex post state verification, such as an ESG audit if greenwashing is detected, or it could stem from the expenses managers incur to falsify ESG information and mimic green firms. These costs reflect the potential financial and ethical risks associated with manipulating ESG information.

Remark: This framework underscores the inherent differences between ESG performance and financial performance in the real world. Financial performance, by its nature, has an objective realization. Standard financial disclosures, such as earnings reports and credit ratings, universally represent the fundamental value of a firm. In contrast, ESG performance often lacks such objective benchmarks, making the potential for manipulating ESG information—commonly known as greenwashing—extremely concerning. Two features of ESG information that significantly exacerbate greenwashing are highlighted below:

- (i) Disagreement on ESG performance: ESG data is inherently subjective, multi-dimensional, and lacks a concrete benchmark that could standardize assessments. This lack of consistency is exemplified by the disagreements among ESG rating agencies, as noted in Berg et al. (2022). The absence of uniform standards leaves investors without the necessary tools to effectively monitor ESG performance or detect greenwashing.
- (ii) Dependence on voluntary disclosure: ESG assessments heavily rely on the information

that firms choose to disclose voluntarily. Key players in this arena include ESG rating agencies like MSCI and data vendors such as the Carbon Disclosure Project (CDP). Their evaluations are largely based on the ESG disclosures that firms provide, which underscores the potential for bias and manipulation in reported ESG performance.

2.3 Trading Stage

At $t = 3$, a competitive financial market opens and a continuum $[0, 1]$ of investors trade the shares of the firm based on the public signals disclosed at $t = 2$. Investors have heterogeneous ESG preferences, and each investor i submits an order $q_i \in [-1, 1]$ ¹³ to maximize his utility given by

$$U_i = (\beta_i v_e + v_f - p)q_i, \quad (4)$$

where β_i is the degree of ESG preference, v_e is the ESG performance of the firm, v_f is the financial performance of the firm, p is the market-clearing price. In this model, having ESG preference means that investors derive utility (disutility) from holding shares of green (brown) firms, consistent with previous literature on ESG investing (e.g., Fama and French, 2007; Pástor et al., 2021). The degree of ESG preference β_i captures the heterogeneous non-pecuniary benefit or loss derived from a given level of ESG performance by different investors. The distribution of β_i among investors is denoted by $F(\cdot)$, which is strictly increasing and differentiable on $[0, +\infty)$. The net supply of shares is normalized to 0.

The payoff to the firm manager is realized at the end of $t = 3$, and his utility is defined as

$$U_M = p - \mathbb{1}_{\{\theta=B\}}C(w), \quad (5)$$

i.e., the manager's utility consists of his compensation determined by the market price of the firm, minus any private cost if the firm is brown and engages in greenwashing.

¹³Since investors are risk-neutral, this limit on trading order q_i ensures that the market clears in equilibrium. This limit can be justified by limited short-selling or borrowing constraints faced by investors.

2.4 Equilibrium Concept

The equilibrium concept of the model is Perfect Bayesian Equilibrium (PBE), formally defined as follows:

Definition 1 *The trading strategy of investors, the investment strategy of the firm, and the greenwashing strategy of the firm constitute a PBE if the following conditions are met:*

- (1) *Given the firm's investment and disclosure strategies, investors trade the stock to maximize their utility, conditional on public signals. This trading behavior generates a competitive market pricing function.*
- (2) *Given the competitive market pricing function, the firm manager chooses the investment decision and the greenwashing effort (if the firm makes a brown investment) to maximize his utility.*
- (3) *Investors update their beliefs according to Bayes' rule whenever possible.*

Furthermore, we define the concept of a green-investment equilibrium as follows:

Definition 2 *A green-investment equilibrium is a Perfect Bayesian Equilibrium of the model in which the firm with a green investment opportunity always invests.*

3 Equilibrium

To solve for the PBE, we begin by conjecturing an equilibrium and subsequently verify it. We will focus on the interesting case where the brown investment is always made, which allows us to explore how greenwashing intensifies with increasing investor ESG preferences and how it distorts real green investments. In this case, an equilibrium where only brown investment occurs can always exist, provided that the off-equilibrium-path beliefs are specified

appropriately.¹⁴ In our subsequent analysis, we will conjecture a green-investment equilibrium as defined in Definition 2. Our focus is on deriving the conditions under which this equilibrium exists, particularly examining the impact of investors’ ESG preferences on the firm’s decision to make real green investments.

3.1 Trading Stage

In equilibrium, the trading of each investor i is characterized by

$$q_i^* = \begin{cases} 1 & \text{if } \mathbb{E}[v_f + \beta_i v_e \mid s_e, s_f] > p, \\ -1 & \text{if } \mathbb{E}[v_f + \beta_i v_e \mid s_e, s_f] \leq p. \end{cases} \quad (6)$$

That is, investor i submits a buy order if the expected utility from holding it, which comprises both the financial performance and ESG performance of the firm, exceeds the price. Otherwise, investor i submits a sell order. The market clears if

$$\int_0^1 q_i^* di = 0. \quad (7)$$

Definition 3 *If $F_1(\cdot)$ first-order stochastically dominates $F_2(\cdot)$, then we say **investors have stronger ESG preference** when the distribution of β_i changes from $F_2(\cdot)$ to $F_1(\cdot)$.*

We will use the term “investors have stronger ESG preference” throughout the paper, which means that the share of investors with higher degrees of ESG preference increases.

The following lemma characterizes the equilibrium at the trading stage:

Lemma 1 *In equilibrium, the market clearing price is*

$$p = \beta \mathbb{E}[v_e \mid s_e, s_f] + \mathbb{E}[v_f \mid s_e, s_f], \quad (8)$$

¹⁴The off-equilibrium-path beliefs can be specified as follows: investors believe that the firm is brown with probability 1 if they observe any signal realization off the equilibrium path.

where $\beta = F^{-1}(\frac{1}{2})$ is the marginal investor's degree of ESG preference. Particularly, if investors have stronger ESG preference, the weight β on the ESG component is larger.

We will henceforth refer to β as the market ESG preference, as it captures the overall ESG preference of investors. The lemma shows that the market clearing price has two components: a financial performance component $\mathbb{E}[v_f | s_e, s_f]$ and an ESG performance component $\beta\mathbb{E}[v_e | s_e, s_f]$. Importantly, the weight on the ESG performance β depends on investors' ESG preference: when investors have stronger ESG preference, the market clearing price p becomes more sensitive to the firm's ESG performance, which affects the incentive for real green investment and greenwashing jointly.

Assumption 2 $\beta \in [0, \bar{\beta}]$.

Note that β is a sufficient statistic from the distribution $F(\cdot)$ to derive the equilibrium. For convenience of exposition, we will vary β and conduct comparative statics over β in our subsequent analysis. This bounded interval assumption specifies that β cannot exceed $\bar{\beta}$. For example, we can think of $\bar{\beta}$ as an upper-bound expectation of future ESG preference, reflecting the continuing growth trend in ESG investing, or as a maximum hypothetical level of ESG preference that policymakers might be interested in. We will restrict our attention to this region of market ESG preference β to generate realistic predictions and provide relevant policy implications.

Assumption 3 $\bar{\beta}e_B + \mathbb{E}[v_f | \theta = B, I = 1] - v_0 > 0$

This assumption ensures the brown investment can increase the market price of the firm, even when the market ESG preference reaches the upper bound and the brown firm does not engage in any greenwashing. Therefore, it is a sufficient condition for brown investment to be made in any equilibrium.

3.2 Information Disclosure Stage

In this subsection, we analyze the information disclosure stage of the green-investment equilibrium.¹⁵ At the beginning of this stage, investors can observe that the firm has already made an investment, but they are uncertain about the type of investment. Therefore, the prior belief of investors in the green-investment equilibrium is that the firm is green with probability μ and brown with probability $1-\mu$, reflecting the probability of obtaining either a green or brown investment opportunity. Subsequently, we will demonstrate how investors update their beliefs upon receiving public signals (which generates the firm's market-perceived performance), and how the brown firm determines greenwashing efforts in equilibrium.

First, the financial signal s_f fully reveals the financial fundamental v_f with probability $\eta = 1$,¹⁶ so the market-perceived financial performance equals the actual financial performance, i.e., $\mathbb{E}_I[v_f | s_e, s_f = \omega] = \mathbb{E}_I[v_f | s_f = \omega] = v_\omega$. As a result, greenwashing does not affect the market-perceived financial performance.

In addition, investors could infer the ESG performance from the financial information, due to the correlation between the two dimensions of fundamentals determined by the real investment at $t = 1$. We use q_ω ($\omega \in \{H, L\}$) to denote the probability that the firm is green conditional on the financial performance $v_f = v_\omega$, which is given by

$$q_H = \Pr(G | \omega = H) = \frac{\mu\rho_G}{\mu\rho_G + (1-\mu)\rho_B} < \mu, \quad (9)$$

$$q_L = \Pr(G | \omega = L) = \frac{\mu(1-\rho_G)}{\mu(1-\rho_G) + (1-\mu)(1-\rho_B)} > \mu. \quad (10)$$

Because a brown firm is more likely to have high financial performance (i.e., $\rho_B > \rho_G$),

¹⁵There is no greenwashing in equilibrium if only the brown investment is made at $t = 1$, provided that we specify the off-equilibrium-path belief that the probability of the firm being brown is always 1 even if investors receive a green signal (i.e., $s_e = G$).

¹⁶In Section ??, we will relax the assumption regarding the financial signal s_f and consider the case where $\eta < 1$, thereby introducing the possibility that greenwashing may affect the market-perceived financial performance.

investors believe that the firm is more (less) likely to be green if they observe the financial performance is low (high), which implies that $q_L > q_H$.

Next, we analyze the belief updating with respect to ESG information and derive the endogenous choice of greenwashing effort w . The greenwashing effort w affects the signal structure of s_e , which determines investors' expectations about ESG performance. Specifically, the market-perceived ESG performance is

$$\mathbb{E}[v_e \mid s_e = G, s_f = \omega] = \frac{q_\omega e_G + (1 - q_\omega) w e_B}{q_\omega + (1 - q_\omega) w}, \quad (11)$$

$$\mathbb{E}[v_e \mid s_e = B, s_f = \omega] = e_B. \quad (12)$$

Particularly, $\mathbb{E}[v_e \mid s_e = G, s_f = \omega]$ is decreasing in w , indicating that when the greenwashing effort w increases, investors discount the expected ESG performance of the firm more when they observe a green signal.

It is important to note that the firm manager chooses the greenwashing effort w after observing the realized financial performance v_f . Consequently, the realization of v_f influences investors' beliefs about the probability of the firm being green, thereby impacting the greenwashing effort w . With a slight abuse of notation, we denote the equilibrium greenwashing strategy as a function $w^*(\cdot) : \omega \rightarrow w$, indicating that greenwashing effort w is contingent on the realization of v_f in equilibrium. Given financial performance $v_f = v_\omega$, the brown firm's problem is

$$\max_{w \in [0,1]} w \beta \mathbb{E}[v_e \mid s_e = G, s_f = \omega] + (1 - w) \beta e_B - C(w). \quad (13)$$

The equilibrium greenwashing effort $w^*(\omega)$ is determined by

$$\underbrace{\beta (\mathbb{E}[v_e \mid s_e = G, s_f = \omega] - e_B)}_{\text{marginal benefit of greenwashing}} = \underbrace{C'(w)}_{\text{marginal cost of greenwashing}}. \quad (14)$$

This equilibrium condition of greenwashing is intuitive: the brown firm benefits from greenwashing because it can obscure the ESG information. Specifically, when the ESG signal

$s_e = G$ is disclosed, the brown firm pools with green firms, resulting in a higher market-perceived ESG performance than its actual ESG performance. Therefore, the brown firm determines the greenwashing effort w by balancing this benefit against the private cost of greenwashing.

Notably, as greenwashing increasingly benefits brown firms, green firms are worse off because they cannot effectively signal their actual ESG value. Specifically, as the ESG signal s_e becomes less informative, their market-perceived ESG performance is lower, and the gap between the market-perceived and actual ESG performance becomes larger. As we will analyze in the real investment stage in Section 3.3, this effect undermines the incentive for real green investment.

The following lemma characterizes the solution to the problem:

Lemma 2 *In the green-investment equilibrium, when the financial performance of the brown firm is $v_f = v_\omega$, the firm manager's greenwashing effort is given by*

$$w^*(\omega) = \min \left\{ \frac{2\frac{\beta}{c}(e_G - e_B)}{\sqrt{1 + 4\frac{\beta}{c}\frac{1-q_\omega}{q_\omega}(e_G - e_B)} + 1}, 1 \right\}. \quad (15)$$

Assumption 4 $c > \underline{c} := \bar{\beta}q_L(e_G - e_B)$

Assumption 4 ensures that the equilibrium greenwashing effort is an interior solution (i.e., $w^*(\omega) \in (0, 1)$) when the market ESG preference $\beta \in [0, \bar{\beta}]$. This guarantees that the level of greenwashing responds to changes in investor ESG preferences in equilibrium. We will impose this assumption in the analysis henceforth, as it defines a parameter region that not only keeps the model analytically interesting but also closely reflects the real-world trend of rising greenwashing alongside the rapid growth of ESG investing.

The following lemmas further illustrate key properties of the greenwashing strategy:

Lemma 3 *The equilibrium greenwashing effort $w^*(\omega)$ is increasing in the ratio of market ESG preference to manipulation cost $\frac{\beta}{c}$.*

Brown firms with low financial performance engage in more greenwashing, i.e., $w^*(L) \geq w^*(H)$;

The expected level of greenwashing by brown firms, defined as

$$w^* = \mathbb{E}[w^*(\omega) \mid \theta = B, I = 1] = \rho_B w^*(H) + (1 - \rho_B) w^*(L), \quad (16)$$

is decreasing in the correlation between fundamentals ρ .

Lemma 3 implies that the equilibrium level of greenwashing is increasing in the market ESG preference β and decreasing in the manipulation cost c . Intuitively, as investors increasingly value ESG performance, the stock price weighs more on ESG performance and thus is more sensitive to ESG information. This is reflected as an increase in the marginal benefit of greenwashing in equation (14). On the other hand, a decrease in c leads to a lower marginal cost of greenwashing in equation (14). In either case, the brown firm engages in more greenwashing.

Lemma 4 *Brown firms with low financial performance engage in more greenwashing, i.e., $w^*(L) \geq w^*(H)$, and the gap $|w^*(L) - w^*(H)|$ is increasing in the correlation between fundamentals ρ . Moreover, the expected level of greenwashing by brown firms, defined as*

$$w^* = \mathbb{E}[w^*(\omega) \mid \theta = B, I = 1] = \rho_B w^*(H) + (1 - \rho_B) w^*(L), \quad (17)$$

is decreasing in the correlation between fundamentals ρ .

Given the negative correlation between ESG and financial fundamentals, equation (9) and (10) imply that $q_L > q_H$, i.e., having low financial performance suggests that the firm is more likely to be green. Therefore, when the brown firm already exhibits low financial performance and a green signal is disclosed, the firm's market-perceived ESG performance is elevated even further. This incentivizes the brown firm to intensify greenwashing when its financial fundamentals are weak. If the negative correlation between ESG and financial

fundamentals is stronger, low financial performance becomes even more indicative that the firm is green, thereby incentivizing more greenwashing by firms with poor financial performance compared to those with better financial performance. Furthermore, a strong negative correlation between fundamentals means that the financial performance alone serves as a reliable indicator of the firm’s ESG performance, diminishing the impact of greenwashing on market-perceived ESG performance. As a result, the equilibrium level of greenwashing is lower.

Interestingly, this result aligns with empirical observations that companies publicly embrace ESG initiatives as a cover for poor business performance. For example, Flugum and Souther (2022) finds that firms falling short of earnings expectations are more likely to cite stakeholder-focused objectives in their public communications around earnings announcements. Similarly, Baker et al. (2024) finds that large, well-established firms experiencing negative profits and returns are more likely to engage in diversitywashing. Additionally, Bhagat and Yoon (2023) finds that firms exhibit significantly negative abnormal operating performance in the year of green bond announcements, supporting the argument that these announcements are used to mask poor business performance.

3.3 Investment Stage

In this subsection, we derive the conditions under which the firm benefits from making green investments, thereby establishing the conditions for the existence of the green-investment equilibrium. Formally, a firm manager who receives the green investment opportunity will invest if the expected market price after going green exceeds the market price if keeping the status quo. The condition is given by:

$$\underbrace{\mathbb{E}_M[\beta\mathbb{E}_I[v_e | s_e, s_f] + \mathbb{E}_I[v_f | s_e, s_f] | \theta = G, I = 1]}_{\text{expected market price of green firm}} \geq v_0, \quad (18)$$

where $\mathbb{E}_M[\cdot]$ denotes the manager's expectation and $\mathbb{E}_I[\cdot]$ denotes investors' expectation. It is important to note that the manager's decision is influenced by the iterated expectations of the firm's two-dimensional fundamentals, rather than these fundamentals themselves. Consequently, information structure determines how each dimension of fundamentals is reflected in the stock price, thereby influencing the manager's real decision.

To analyze the incentive for green investment, we can rewrite condition (18) as follows:

$$\underbrace{\beta \mathbb{E}_M[\mathbb{E}_I[v_e | s_e, s_f] | \theta = G, I = 1]}_{\Delta p_e: \text{ increase in ESG component of price}} \geq \underbrace{v_0 - \mathbb{E}_M[\mathbb{E}_I[v_f | s_e, s_f] | \theta = G, I = 1]}_{\Delta p_f: \text{ decrease in financial component of price}} \quad (19)$$

We define $\Delta p_f = v_0 - \mathbb{E}_M[\mathbb{E}_I[v_f | s_e, s_f] | \theta = G, I = 1]$ as the expected decrease in financial component of price from making the green investment, and $\Delta p_e = \beta \mathbb{E}_M[\mathbb{E}_I[v_e | s_e, s_f] | \theta = G, I = 1]$ as the expected increase in ESG component of price from making the green investment. This condition indicates that the green investment can be incentivized if the increase in the ESG component of the price can sufficiently offset the decrease in the financial component of the price.

3.3.1 Benchmark Case: No Greenwashing

First, we completely shut down greenwashing (i.e., $w^*(\omega) = 0$) and analyze the incentive for green investments. We assume investors can observe the firm's actual performance, so there is no information asymmetry between the firm manager and investors.

In this case, the expected price components in condition (19) are equal to the firm's actual performance:

$$\mathbb{E}_M[\mathbb{E}_I[v_f | s_e, s_f] | \theta = G, I = 1] = \mathbb{E}[v_e | \theta = G, I = 1] = \rho_G v_H + (1 - \rho_G) v_L, \quad (20)$$

$$\mathbb{E}_M[\mathbb{E}_I[v_e | s_e, s_f] | \theta = G, I = 1] = \mathbb{E}[v_e | \theta = G, I = 1] = e_G. \quad (21)$$

Therefore, condition (19) simplifies to

$$\Delta p_e = \beta e_G \geq \Delta p_f = v_0 - \mathbb{E}[v_f | \theta = G, I = 1]. \quad (22)$$

It implies that the firm will make the green investment if the market ESG preference is sufficiently high, i.e., $\beta \geq \beta_{\text{No-gw}} := \frac{v_0 - \mathbb{E}[v_f | \theta = G, I = 1]}{e_G}$. In scenarios without greenwashing, as market ESG preference increases, the market price reflects more actual gains in ESG performance from green investment relative to the loss in financial performance, thereby incentivizing real green investment. I refer to this effect as the “performance weighting effect”. This result is consistent with predictions from previous models which analyze the real impact of ESG investing in environments without information frictions (e.g., Heinkel et al., 2001; Chowdhry et al., 2019; Pástor et al., 2021; Oehmke and Opp, 2022).

Proposition 1 (Green-investment Equilibrium without Greenwashing) *Suppose investors can observe the actual ESG and financial performance of the firm. The green-investment equilibrium exists as long as $\beta \geq \beta_{\text{No-gw}} := \frac{v_0 - \mathbb{E}[v_f | \theta = G, I = 1]}{e_G}$.*

3.3.2 Main Case: Greenwashing Deteriorates Incentives for Green Investment

We now focus on the main case in which greenwashing may deteriorate incentives for green investment in equilibrium.

First, similar to the benchmark case, the market-perceived financial performance equals the actual financial performance as shown in equation (20), since the financial signal s_f is exogenous and fully reveals financial performance. Consequently, the right-hand side of condition (19), Δp_f , reflects the expected loss in actual financial performance from green investment and is thus constant.¹⁷

The key difference from the benchmark case is the market-perceived ESG performance.

¹⁷In section ??, we will consider an extension where financial uncertainty is not fully resolved at the time of trading. In this scenario, greenwashing can also influence investors’ beliefs about financial fundamentals. Consequently, changes in market ESG preference β may affect Δp_f .

Specifically, investors now rely on both ESG signal s_e and financial signal s_f to infer the firm’s ESG performance. Due to the manipulation of ESG information, there is a “wedge” between market-perceived and actual ESG performance of green firms in equilibrium, which we denote by Δe_G and refer to as the “information distortion” henceforth. Formally, Δe_G is given by

$$\begin{aligned}\Delta e_G &= e_G - \mathbb{E}_M[\mathbb{E}_I[v_f | s_e, s_f] | \theta = G, I = 1], \\ &= \mathbb{E}\left[\frac{(1 - q_\omega)w^*(\omega)}{q_\omega + (1 - q_\omega)w^*(\omega)}(e_G - e_B) | \theta = G, I = 1\right].\end{aligned}\tag{23}$$

It is easy to see that the information distortion Δe_G depends on the level of greenwashing $w^*(\omega)$: with a higher level of greenwashing, the ESG signal becomes less informative about the ESG fundamental, thereby increasing the information distortion.

When we take this information distortion into consideration, the reward for real green investment Δp_e may become non-monotonic in market ESG preference β . Specifically, we can decompose the effect of a larger market ESG preference on the reward for real green investment Δp_e into two countervailing effects:

$$\frac{\partial \Delta p_e}{\partial \beta} = \frac{\partial \beta(e_G - \Delta e_G)}{\partial \beta} = \underbrace{e_G - \Delta e_G}_{\text{Performance Weighting Effect}} - \underbrace{\beta \frac{\partial \Delta e_G}{\partial \beta}}_{\text{Information Distortion Effect}}.\tag{24}$$

First, consistent with the benchmark case in Section 3.3.1, an increased weight on ESG performance in stock price directly enhances rewards for real green investment. Again, we refer to this as the “performance weighting effect”. However, our above analysis also suggests that a larger market ESG preference β exacerbates greenwashing. It widens the wedge between market-perceived ESG performance and actual ESG performance, resulting in larger information distortion Δe_G , and ultimately reducing rewards for real green investment. We refer to this as the “information distortion effect”.

Proposition 2 (Reward for Green Investment) *In the green investment equilibrium, the reward for green investment Δp_e is decreasing in market ESG preference β if the level of*

greenwashing $w^*(\omega)$ is sufficiently large such that the following condition is satisfied:

$$\frac{1 - \rho}{1 + 2 \frac{1-\mu}{\mu} \frac{\rho}{1-\rho} w^*(H)} + \frac{\rho}{1 + 2 \frac{1-\mu}{\mu} \frac{1-\rho}{\rho} w^*(L)} < \frac{-e_B}{e_G - e_B}. \quad (25)$$

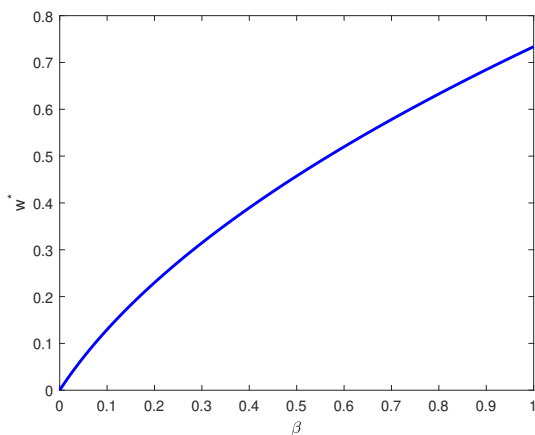
Proposition 2 states that the information distortion effect can dominate the performance weighting effect when the level of greenwashing $w^*(\omega)$ is large. This can be seen from the decomposition (24): when the information distortion Δe_G is already substantial, the market-perceived ESG performance, even when a green signal is disclosed, remains low. Consequently, the marginal effect of increasing the weight on ESG performance in the market price is diminished, making the performance weighting effect relatively weak compared to the information distortion effect.

Proposition 3 (Green-investment Equilibrium with Greenwashing) *If condition (25) in Proposition 2 is satisfied for some $\beta \in [0, \bar{\beta}]$, then there exists Δp_f such that the green-investment equilibrium exists only when β belongs to a subset \mathcal{B} of the interval $(\beta_{No-gw}, \bar{\beta})$.*

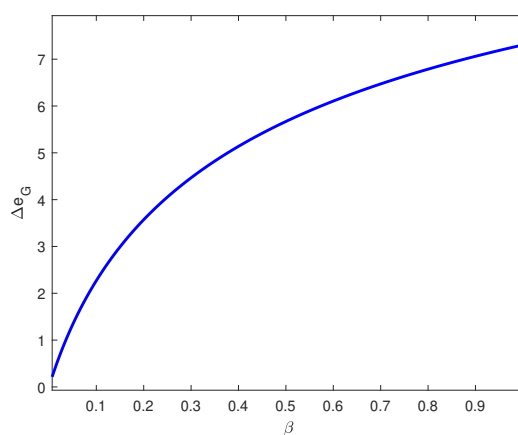
Proposition 3 is derived from the non-monotonic relationship between Δp_e and β , alongside the constant value of Δp_f . As illustrated in Figure 3, the green-investment equilibrium exists only for an intermediary interval of market ESG preference β where $\Delta p_e > \Delta p_f$. This implies that to incentivize green investment, the market ESG preference β must be sufficiently large for the firm manager to internalize enough ESG performance through market price. However, β should not be so large that it encourages excessive greenwashing, which would lead to substantial pooling of green firms with greenwashing firms.

This result highlights an important caveat for the real impact of ESG investing. Particularly, if greenwashing is prevalent, then a stronger market ESG preference could backfire and disincentivize real green investment. The implications are critical. First, for empirical research, the growing literature has focused on and debated whether a higher shareholding of ESG institutional investors incentivizes firms to become greener. My findings suggest that the real effect may depend on the extent to which ESG fundamentals are susceptible

to greenwashing, and thus some of the discrepancies in previous empirical results might be reconciled by information frictions. Combined with the conditions illustrated in Section 4, we propose a set of empirical predictions related to the information environment for future research in Section 5. Second, for policymakers, my findings suggest that under certain conditions, curbing greenwashing may be more crucial than simply promoting ESG investing to drive green transitions. Potential policy measures to enhance real impact by curbing greenwashing are discussed in Section 6.



(a) Level of Greenwashing w^*



(b) Information Distortion Δe_G

4 When Does the Unintended Consequence Arise?

The previous section has characterized the green-investment equilibrium and highlighted the unintended consequence: Stronger investor ESG preferences may reduce real green investment due to increased greenwashing. In this section, we further characterize the conditions for such unintended consequences to arise in equilibrium. Particularly, we will focus on three key parameters: the cost of manipulating ESG information c , the correlation between ESG fundamentals and financial fundamentals ρ , and financial information quality η .

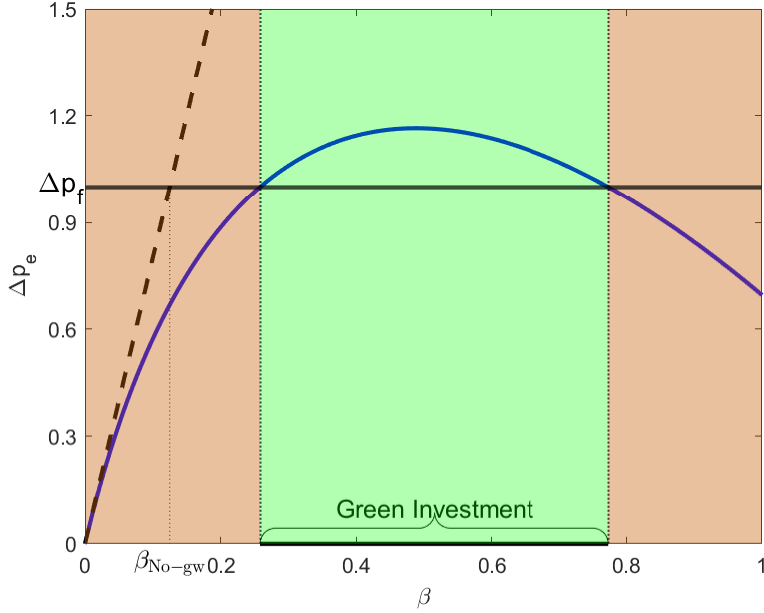


Figure 3: Interval with Green Investment

4.1 Cost of Manipulating ESG Information

Lemma 5 *In the green-investment equilibrium, Δp_e is increasing in the cost of manipulating ESG information c .*

A higher manipulation cost reduces greenwashing, which decreases information distortion and consequently increases the reward for green investment. This further implies that the interval of market ESG preferences supporting the green-investment equilibrium will expand.

Proposition 4 *As the cost of manipulating ESG information c increases, the interval \mathcal{B} expands, i.e., there is a larger interval of the market ESG preference where the green-investment equilibrium exists.*

Figure 4 further illustrates the result. If the manipulation cost c is very small, the maximum reward for green investment provided by the financial market is highly limited. Consequently, if the maximum reward is less than the financial value loss from the green investment, green investment cannot be incentivized. In contrast, if the manipulation cost c is very large, green investment can be incentivized as long as the market ESG preference β is

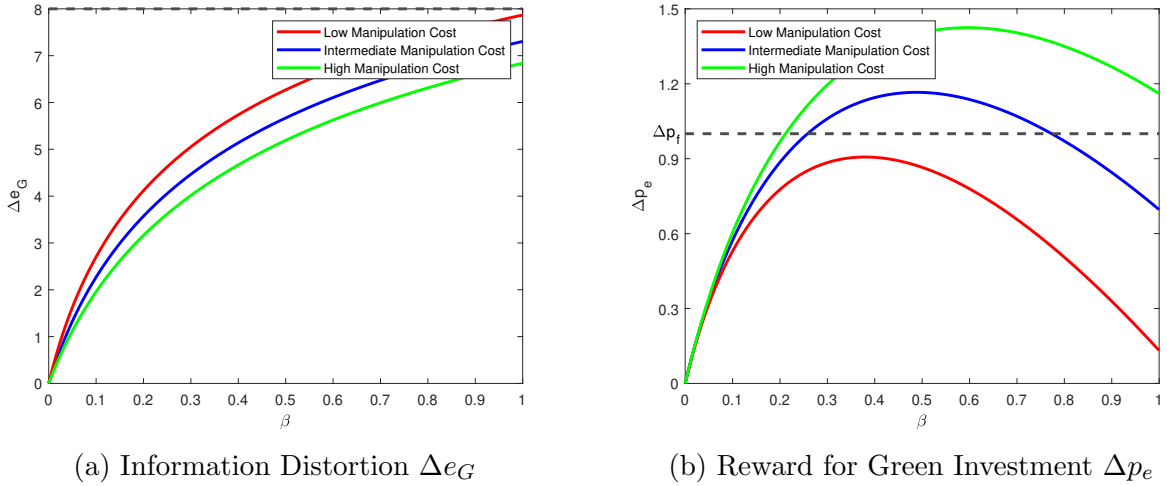


Figure 4: Green-investment equilibrium under different costs of manipulating ESG information.

sufficiently large because the level of greenwashing increases slowly with β . Interestingly, for an intermediate level of manipulation cost c , to incentivize green investment, green investment can be incentivized only for an intermediate interval of β : β must be large enough for the firm manager to internalize sufficient ESG performance through market price, but not so large that it encourages excessive greenwashing, which would lead to substantial pooling of green firms with greenwashing firms.

This result has very important policy implications: for ESG outcomes that are hard to measure or have substantial disagreement (e.g., corporate inclusion in the workplace), a unified framework for evaluation with stringent scrutiny is more crucial than increasing incentivization from ESG investors. For ESG outcomes that are relatively more measurable but still subject to greenwashing concerns (e.g., progress toward net-zero commitments), we should be cautious about the rapid growth of ESG investing, as excessive focus on ESG performance can backfire and reduce real green investment. For ESG outcomes that are easy to measure (e.g., corporate governance quality), the growth in ESG investing can consistently play a positive role.

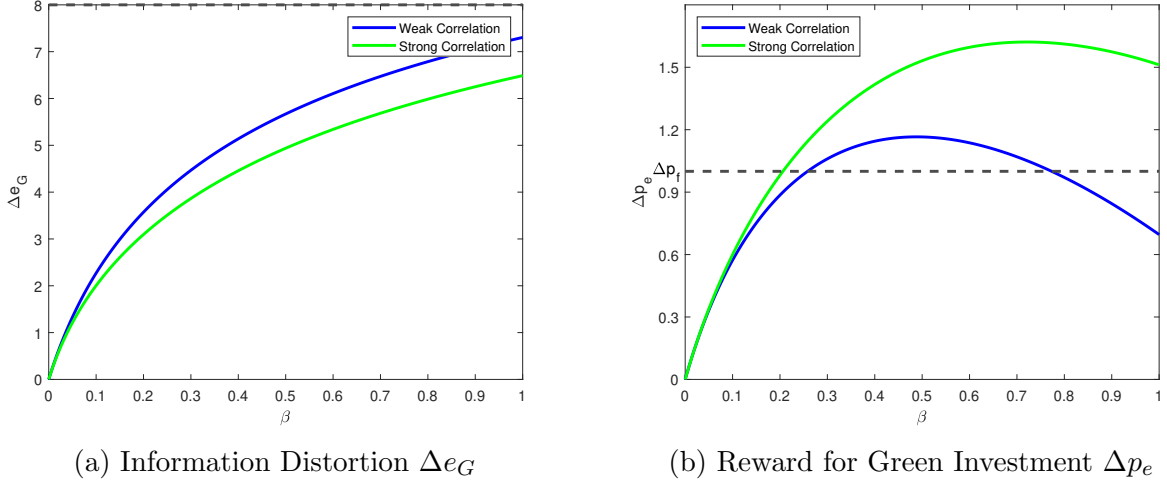


Figure 5: Green-investment equilibrium under different correlations between fundamentals

4.2 Correlation between ESG and Financial Fundamentals

Lemma 6 *In the green-investment equilibrium, Δp_e is increasing in the correlation between fundamentals ρ .*

In reality, this correlation coefficient ρ can be interpreted as the cash flow uncertainty associated with real investment. A larger correlation between fundamentals means that the realization of financial performance is more informative about the actual ESG performance, which decreases the information distortion caused by greenwashing. This further implies that the interval of market ESG preferences supporting the green-investment equilibrium will expand.

Proposition 5 *Given that the conditional expectation of financial performance $\mathbb{E}[v_f | \theta = G, I = 1]$ is fixed, as the correlation between fundamentals ρ increases, the interval \mathcal{B} expands, i.e., there is a larger interval of the market ESG preference where the green-investment equilibrium exists.*

4.3 Financial Information Quality

In the previous analysis, we assume the financial signal s_f reveals the financial performance v_f with probability $\eta = 1$. However, despite the generally higher quality of financial information compared to ESG information, uncertainty about financial fundamentals persists in financial markets. This uncertainty can arise from varying levels of transparency in financial disclosures, which are influenced by factors such as industry, governance structure, and financial conditions. Additionally, even within a single firm, the level of uncertainty about financial fundamentals can fluctuate depending on the specific projects undertaken. To incorporate this reality, we now assume that the financial signal s_f has the following structure:

$$\Pr(s_f = \omega \mid v_f = v_\omega) = \eta, \quad \Pr(s_f = \emptyset \mid v_f = v_\omega) = 1 - \eta,$$

i.e., the signal s_f revealing v_f is disclosed with probability $\eta \in [0, 1]$.

In this case, the equilibrium greenwashing effort $w^*(\omega)$ is determined by the following equation:

$$\begin{aligned} cw^*(\omega) = & \underbrace{\eta \{ \beta \mathbb{E}[v_e \mid s_e = G, s_f = \omega] - \beta \mathbb{E}[v_e \mid s_e = B, s_f = \omega] \}}_{\text{marginal benefit of greenwashing when } s_f \text{ is disclosed}} \\ & + (1 - \eta) \underbrace{\{ \mathbb{E}[\beta v_e + v_f \mid s_e = G, s_f = \emptyset] - \mathbb{E}[\beta v_e + v_f \mid s_e = B, s_f = \emptyset] \}}_{\text{marginal benefit of greenwashing when } s_f \text{ is not disclosed}}. \end{aligned} \quad (26)$$

Note that we will need to solve for a system of two equations determined by (26) for $\omega \in \{H, L\}$, since the marginal benefit of greenwashing when s_f is not disclosed is influenced by both $w^*(H)$ and $w^*(L)$.

Lemma 7 *In the case where $\eta < 1$, the equilibrium greenwashing effort $w^*(\omega)$ is determined by a system of two equations, i.e., equation (26) for $\omega \in \{H, L\}$. There exists $\underline{\beta}_\eta$ such that the solution to the system of equations is unique when $\beta \geq \underline{\beta}_\eta$ (where $\underline{\beta}_\eta$ is specified in the appendix).*

Throughout this subsection, to ensure that the green-investment equilibrium is unique, we impose the following assumption:

Assumption 5 $\beta \in [\underline{\beta}_\eta, \bar{\beta}]$

Lemma 8 *In the case where $\eta < 1$, Δp_f is smaller compared to the case where $\eta = 1$. In addition, Δp_f is decreasing in the level of greenwashing $w^*(\omega)$ in equilibrium.*

Lemma 8 highlights how market-perceived financial performance changes due to uncertainty about financial fundamentals at the trading stage. Intuitively, if the financial signal s_f revealing financial performance is always disclosed, greenwashing has no effect on the market-perceived financial performance. However, when the financial signal s_f is not disclosed, investors rely on the ESG signal s_e to infer the firm's financial performance. With a higher level of greenwashing, a firm with a green signal is more likely to be a brown firm engaging in greenwashing, which has higher expected financial performance. Consequently, the market-perceived financial performance increases. The resulting decrease in Δp_f encourages firms to make green investments when the financial information quality is lower.

Lemma 9 *Suppose $\rho < \bar{\rho}_\eta$ (where $\bar{\rho}_\eta$ is specified in the appendix). In the case where $\eta < 1$, Δp_e is larger compared to the case where $\eta = 1$.*

Lemma 9 states that the reward for green investment Δp_e increases when financial information quality is lower, provided that the correlation between fundamentals is weak. Intuitively, lower financial information quality has two opposing effects on greenwashing. On the one hand, the market-perceived financial performance of the brown firm decreases when investors infer financial performance from the ESG signal, reducing the incentive of greenwashing. On the other hand, it becomes harder for investors to infer ESG performance from financial performance, which encourages more greenwashing. When the correlation between fundamentals is weak (i.e., when the realization of financial performance is uninformative about ESG performance), the first effect dominates, leading to less greenwashing and a corresponding increase in Δp_e .

Based on the above lemmas, it is clear that when financial information quality is lower, the condition for green investment, $\Delta p_e > \Delta p_f$, is satisfied over a larger interval of market ESG preference β , indicating that the interval for green investment expands.

Proposition 6 *Suppose $\rho < \bar{\rho}_\eta$ (where $\bar{\rho}_\eta$ is specified in the appendix). In the case where $\eta < 1$, the interval of the market ESG preference where the green-investment equilibrium exists, \mathcal{B} , is larger compared to the case where $\eta = 1$.*

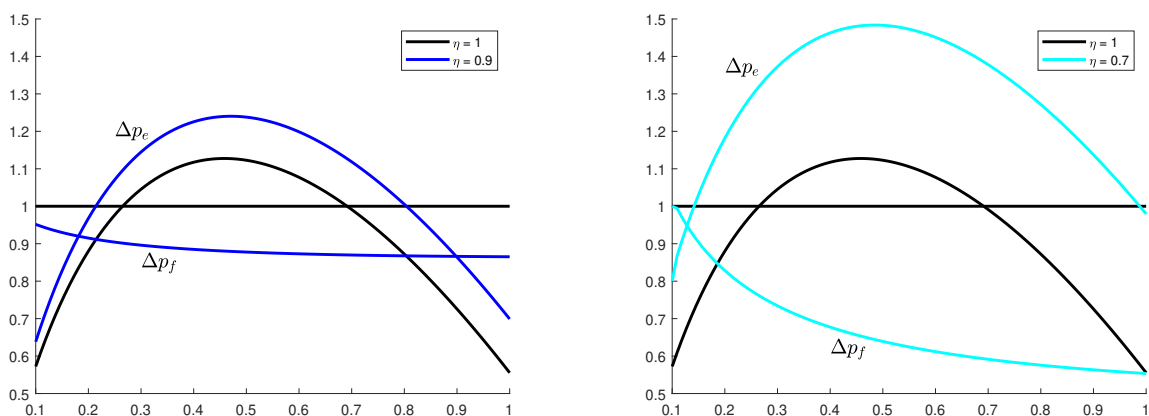


Figure 6: Quality of Financial Information Affects Green Investment

5 Empirical Predictions

In this section, I summarize empirical predictions from the model.

Prediction 1: When the shareholding of ESG investors increases, firms engage in more greenwashing activities. They are more likely to make green claims publicly (such as issuing CSR reports), but these claims become less reliable.

Prediction 2: Firms with poor business performance engage in more greenwashing activities compared to firms with strong business performance.

Prediction 3: An increase in the shareholding of ESG investors can enhance firms' performance in ESG fundamentals that are easy to measure (e.g., scope-1 carbon emissions).

However, it may reduce performance in ESG fundamentals that are hard to measure (e.g., scope-3 carbon emissions).

Prediction 4: An increase in the shareholding of ESG investors can improve firms' ESG performance when financial information quality is low. However, it may reduce ESG performance when financial information quality is high.

Prediction 5: An increase in the shareholding of ESG investors can increase green investments with certain cash flow. However, it may decrease green investments with uncertain cash flow.

6 Policy Implications: How to Enhance Real Impact?

6.1 Diversifying Green Project Options

In this section, we consider an extension in which the firm manager has a choice set of green projects instead of a single green project. We want to analyze how the availability of projects with different levels of greenness affects real investment decisions.

We focus on the case with two green investment opportunities¹⁸: a green project, as described in the baseline model, and an upgraded green project, which we detail below. We use $\theta = UG$ to refer to the state of the firm that has undertaken the upgraded green project. Compared to the original green project, this upgraded green project generates a higher ESG performance $v_e(\theta = UG) = (1 + x)e_G$ with a lower expected financial value $\mathbb{E}[v_f | \theta = UG] = [1 - k(x)]\mathbb{E}[v_f | \theta = G]$.¹⁹

If the firm invests in the upgraded green project, then the structure of s_e becomes:

$$\Pr(s_e = UG | \theta = UG, I = 1) = h(x), \Pr(s_e = UG | \theta = G, I = 1) = 1 - h(x), \quad (27)$$

¹⁸For ease of exposition, we limit the number of choices to two. Our analysis can be generalized to more green project choices without altering the key economic forces.

¹⁹Specifically, the probability of generating high financial value v_H is $\rho'_G = \rho_G - \delta_\rho$, and the probability of generating low financial value v_L is $1 - \rho'_G$, where $\delta_\rho = \frac{k(x)\mathbb{E}[v_f|G]}{v_H - v_L}$.

where $h(x)$ satisfies $h'(x) > 0$, $h(0) = 0$, and $\lim_{x \rightarrow +\infty} h(x) = 1$. In other words, if the firm invests in a greener project, it is more likely to generate a signal realization that cannot be imitated by greenwashing. For example, we can interpret $s_e = UG$ as developing a green patent, which can be verified and distinguished from greenwashing activities.

We assume x and $k(x)$ satisfy:

Assumption 6

$$\frac{k(x)\mathbb{E}[v_f | G]}{xe_G} > \frac{v_0 - \mathbb{E}[v_f | G]}{e_G}. \quad (28)$$

This inequality indicates that the financial cost of pursuing a greener investment is convex, meaning that incremental increases in ESG performance are associated with progressively higher financial costs. Assumption 6 implies the following inequality:

$$\frac{v_0 - (1 - k(x))\mathbb{E}[v_f | G]}{(1 + x)e_G} > \frac{v_0 - \mathbb{E}[v_f | G]}{e_G} = \beta_{\text{No-gw}}. \quad (29)$$

If $\beta > \frac{v_0 - (1 - k(x))\mathbb{E}[v_f | G]}{(1 + x)e_G}$, inequality (29) implies that $\beta > \beta_{\text{No-gw}}$. Therefore, in the case without greenwashing (i.e., investors can observe the actual ESG and financial performance of firms), whenever firms are willing to undertake the upgraded green project, they must also be willing to undertake the original green project. In other words, the upgraded green project requires stronger ESG incentivization from the financial market.

The following proposition demonstrates that the presence of greenwashing in an asymmetric information environment changes the situation:

Proposition 7 *Suppose $\beta \in [\beta_{\text{No-gw}}, \bar{\beta}]$, and the firm manager does not invest in the original green project under the market ESG preference β . If the firm manager gets the opportunity to invest in an upgraded green project, which satisfies $\frac{(1+x)e_G - e_B}{v_0 - (1-k(x))\mathbb{E}[v_f | G]} < \beta$, then there exists $\underline{h} \in (0, 1)$ such that an equilibrium where the firm manager invests in the upgraded green project exists as long as $h(x) > \underline{h}$.*

Proposition 7 suggests that when greenwashing is considered, the upgraded green project could be incentivized even though the original green project is not. Intuitively, by opting for

the upgraded green project initially, the green firm can deter brown firms from engaging in greenwashing and mimicking green firms. For the real investment to occur, two conditions are required: First, the increasing marginal cost of undertaking the upgraded green project must be moderate, ensuring that the market ESG preference β still provides sufficient incentives. Second, the green firm must be sufficiently distinguished from greenwashing firms through its investment in the upgraded green project.

Remark: For concreteness, we can think of the original green project as a common green initiative accessible to most firms, such as buying carbon credit to reach net-zero targets. In contrast, the upgraded green project involves more advanced green technologies that require further innovation, such as innovation and adoption of carbon capture technology. Adopting such advanced green technologies substantially enhances the firm’s ESG performance, but it also requires more capital expenditures that further undermine financial performance. Moreover, these advanced projects help green firms significantly differentiate from brown firms. One reason is that they generally generate more observable characteristics indicating better ESG performance, such as new green patents, which are harder for brown firms to mimic. The analysis in this extension suggests that advanced green technologies might be easier to incentivize relative to the common green initiatives in some scenarios, as they could serve as barriers to deterring greenwashing. This result highlights the importance of encouraging green innovation and making more green technologies available for green transitions.

6.2 Linking Executive Compensation to ESG Outcomes

In this section, we consider direct incentivization to induce green investment, i.e., compensation to the firm manager contingent on the realization of ESG value. Specifically, we assume the firm manager’s utility function is

$$U_M = \lambda v_e + p - \mathbb{1}_{\{\theta=B\}} C(w), \tag{30}$$

where λ represents the extent to which the manager's compensation is tied to ESG outcomes. Note that we focus on the integration of the actual ESG performance into executive compensation, which should be interpreted as part of long-term incentive plans instead of short-term or annual incentive plans.

Proposition 8 *As the firm manager's compensation is more strongly linked to actual ESG performance (i.e., λ increases), the interval \mathcal{B} expands, i.e., there is a larger interval of the market ESG preference where the green-investment equilibrium exists.*

Intuitively, as the firm manager directly cares more about ESG performance, brown firms have lower greenwashing incentives and green firms get larger rewards for real investments, so the regions of market ESG preference β supporting green investment become larger. Particularly, if the link to ESG performance λ is large enough, the green investment can be incentivized as long as the market ESG preference β is sufficiently large.

The above results support the argument to add ESG criteria into clawback policies, which will directly affect executive compensation if the long-term ESG objectives claimed during their tenure are not achieved and thus induce more green investment. More importantly, this direct incentivization can even make market discipline more efficient, as it decreases the greenwashing motive through long-term penalties.

7 Conclusion

My model highlights one key distinction between financial fundamentals and ESG fundamentals. Particularly, financial value has an objective realization that is fully reflected in price, but the ESG performance lacks an objective realization and is subject to manipulation. When investors have stronger ESG preference, the stock price of the firm is more sensitive to the ESG fundamental, which directly incentivizes the firm manager to make green investments. On the other hand, the information quality about the ESG fundamental becomes worse because the brown firm chooses a higher level of greenwashing, which attenuates the

gain in ESG performance reflected in price and thus reduces the incentive for green investment. Particularly, my analysis suggests that when ESG information regulation is weak, the ESG incentivization from financial markets is highly limited.

My model has important policy implications for the ongoing revolutions in ESG investing. Particularly, regulation on ESG information disclosure (such as unified ESG disclosure frameworks, discipline on ESG rating agencies, etc.) is critical and should be developed in parallel with the rapid growth of ESG investing and increasing concern over ESG issues.

Appendix A Proof of Propositions

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