Implications of introducing investor-focused ESG reporting

Henry L. Friedman Mirko S. Heinle Irina Luneva

Abstract: Firms and jurisdictions are increasingly adopting ESG reporting, driving a growing empirical literature on the consequences of ESG reporting for investors, firms, and other stakeholders. We develop a model to understand the nuanced effects of the introduction of ESG reporting. In our model, a firm provides ESG and financial reports, which investors use to price the firm's stock, influencing management's real and reporting incentives. We characterize how investors respond to new ESG reporting; how the introduction of ESG reports affects corporate performance, stock prices, and market responses to financial disclosures; and trace these effects to ESG performance, expected cash flows, and financial misreporting. We provide conditions under which the introduction of ESG reporting discourages corporate ESG, and under which it encourages corporate ESG but lowers equity price at the same time. We discuss empirical implications of our results and how our model can be applied to settings involving non-ESG disclosures.

Keywords: ESG reporting, ESG valuation, stock price, earnings response coefficients
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*Henry L. Friedman is at the Anderson School of Management, University of California, Los Angeles, 110 Westwood Plaza, D402, Los Angeles, CA 90095; email: henry.friedman@anderson.ucla.edu. Mirko S. Heinle is at The Wharton School, University of Pennsylvania, 3720 Locust Walk, Suite 1300, Philadelphia, PA 19104; email: miheinle@wharton.upenn.edu. Irina Luneva is at the Stern School of Business, New York University, 44 West 4th Street, Office 10-88, New York, NY 10012; email: luneva.irina@stern.nyu.edu. For helpful comments, we thank our colleagues at UCLA, Wharton, and NYU, Edwige Cheynel (discussant), Mandy Ellison (discussant), Ginger Zhe Jin (discussant), Georg Schneider (discussant), Iman Sheibany (discussant), Pingyang Gao, and workshop participants at Alberta, UC Riverside, HKU, the 14th Workshop in Accounting and Economics, Purdue, Mannheim, DAR/DART, the Columbia/Georgetown ADP, the FARS Midyear Meeting, the AAA Annual Meeting, the AAA Sustainability, ESG, and Accounting Conference, the Utah Winter Accounting Conference, the NBER Conference on Measuring and Reporting Corporate Carbon Footprints and Climate Risk Exposure, the Stanford Corporate Climate Disclosure Conference, the Accounting and Economics Society 2022 Retreat, and the Miami Winter Warm-up Conference. Friedman thanks the UCLA Anderson Center for Impact for generous financial support of this research. The usual caveat applies.

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1 Introduction

Mandatory environmental, social, and governance (ESG) disclosures by corporations are becoming a reality in jurisdictions around the world.[1] The effects of the adoption of ESG reporting are of interest to policy-makers, standard-setters, researchers, and corporate managers.[2] But despite the good intentions of the various parties behind the spread of ESG reporting, many of the potential effects of ESG reporting—on cash flows, ESG performance, stock prices, greenwashing, and financial misreporting incentives—are nuanced and subject to potential unintended consequences or erroneous inferences.

To better understand the potential effects and implications of ESG reporting, we develop a stylized model that captures what we believe are the key forces relevant to ESG reporting in a capital market setting. A publicly traded firm faces different types of investors: all investors value cash flows, and a subset of investors also directly value ESG performance. The firm's manager, who cares about the firm's stock price, takes actions that affect both ESG and cash flow performance, and issues financial and ESG reports to investors. The focal action improves ESG performance but can have cash flow effects that are either positive (e.g., a low-cost renewable electricity source) or negative (e.g., a high-cost carbon-capture technology).

Our first set of analyses explores a benchmark in which the firm issues only a financial report regarding financial performance, consistent with the current mandatory reporting environment in the U.S. and for many firms globally. Absent ESG reporting, investors use the

[1] For instance, the Corporate Sustainability Reporting Directive (CSRD) in the European Union has entered into force (European Commission, 2024); climate disclosure and assurance in California will be effective for large companies by 2026; (KPMG, 2024); in China, three main stock exchanges will require companies to publish sustainability reports by 2026 (Lee, 2024); roughly 30 jurisdictions worldwide have either adopted or taken steps to adopt IFRS Sustainability Standards into their mandatory reporting environment (Deloitte, 2025); the SEC passed a rule requiring certain climate-related disclosures starting in 2026, though this rule has since been stayed (SEC, 2024; Binnie, 2024) and is likely to be effectively overturned.

Note that while we use the term ESG, our analysis can be also interpreted as capturing aspects of corporate sustainability, corporate social responsibility (CSR), specific dimensions of environmental or social performance, or other externalities potentially valued by some investors. Recently, such activities have also been referred to as related to 'resilience' (Khan, 2025).

[2] For discussions of the recent ESG literature, see Grewal and Serafeim (2020), Christensen et al. (2021), and Friedman and Ormazabal (2024).

financial report to learn about both cash flows and the ESG performance of the firm: cash-flow-only-interested investors learn about financial performance; ESG-interested investors make inferences about the firm's ESG performance through its relation with reported cash flows. The price reaction to the financial report combines these two learning channels and feeds back into the manager's effort choice. The manager adjusts their efforts both to influence cash flows and to influence the inference that ESG-interested investors make about ESG performance from the cash flow information contained in financial reports.

Next, we introduce ESG reporting. Because investors can learn about ESG activities from the financial report, the ESG report provides an incremental rather than a completely novel signal about firm performance.[3] Furthermore, because underlying corporate activities affect both cash flows and ESG performance, the ESG report is informative about cash flows as well. As with any additional signal, the ESG report can thus change how investors use the financial report, i.e., how they update beliefs based on it and consequently how prices react to it. The underlying symmetry is straightforward: if a financial report is informative about ESG performance, then ESG performance likely conveys information about financial performance. What distinguishes our model from other models featuring multiple signals (e.g. Holmstrom and Milgrom, 1991; Feltham and Xie, 1994) is the presence of a capital market with ESG-oriented investors.

To provide guidance on how newly introduced ESG reporting can affect firms and investors, we compare equilibria for the financial-report-only and financial-and-ESG-reports settings. We describe when and why, i.e., for what parameters: 1) market reactions to ESG reports (ESG response coefficients, i.e., ESG-RCs) would be positive or negative; 2) ERCs increase or decrease; and 3) stock prices can be expected to increase or decrease.

ESG reports are higher, in expectation, when the firm's ESG performance is higher. However, because ESG reports also convey information about cash flows, ESG-RCs can be

[3]This is a nontrivial point that has recently been emphasized in the empirical literature, notably contrasting Bolton and Kacperczyk (2021, 2023) with Zhang (2025), where the former find that emissions predict returns, while the latter finds that this effect is attributable to the relation between emissions data released at a significant lag and financial performance (e.g., sales).

negative if the correlation between ESG and cash flow performance is negative and investors, in aggregate, care more about the cash flow implications than the ESG implications. This happens, in particular, when the fraction of ESG-concerned investors is relatively low. In turn, when the fraction is high, the ESG-RC can be positive even when the implications for cash flows are negative, because investors' net reaction is driven by the ESG implications of the report.

The effects of introducing ESG reporting on ERCs are more nuanced, because they depend on a set of forces. In particular, when cash flows and ESG performance are positively correlated, all investors reduce their weight on the financial report when they also have an ESG report available. However, when improving ESG performance comes at a cost to cash flows, this is no longer the case. The ERC, in turn, can increase as a result of introducing ESG reporting. The reason is that ESG investors, without an ESG report, place a negative weight on the financial report. When the ESG report is released, this negative weight is reduced, and the ERC increases. That is, the ERC increases not because the financial report is more informative about cash flows, but because it provides less incremental information about the firm's ESG performance.

We focus on implications of introducing ESG reporting for ex-ante price, i.e., prices before the release of disclosures. This allows us to abstract away from the average effects of disclosures on prices and increases in price driven by straightforward reductions in risk premiums. Our results emphasize how prices change in anticipation of ESG reporting, which can be empirically affected by variation in plans and probabilities of future ESG reporting mandates, for instance.

We find that the effects of introducing ESG reporting on ex-ante stock price are driven by changes in expected cash flow and ESG performance. These in turn are determined by changes in market incentives that our focal firm faces due to anticipated market reactions to financial and ESG reports. Nonetheless, the relations between the three focal outcomes (ESG-RC, ERC, and ex-ante prices) can be nuanced.

In a setting where the manager can only affect cash flows, the price of the firm tends to be positively related to the ERC. In our setting, this need not be the case. Specifically, when ESG improvements come at a cost to cash flows and a sufficient amount of investors care about ESG, an increase in the ERC arises together with a positive ESG response coefficient. The manager will then increase the firm's expected ESG performance, even when the average investor does not value this tradeoff. As a result, an increased ERC can occur together with a decrease in expected cash flows and a decrease in price.

This potential for ESG reporting to decrease *ex-ante* price (while increasing ESG performance) is our most interesting theoretical result. Even with an ESG effort that has a moderately negative impact on cash flows, ESG reporting provides valuable information to investors and increases ESG efforts. At the same time, however, the firm's stock price decreases with the introduction of ESG reporting. This happens because some investors value the firm's ESG output. While standard investors view a high ESG report as a negative signal of firm value (when ESG has a negative correlation to cash flows), green investors do not. This can lead to a positive overall weight of the ESG report in price so that the manager increases the ESG effort, even more than the average investor prefers. We further discuss the intuition and empirical implications of our results in more detail below.

Many empirical studies have examined consequences of introducing ESG reporting (e.g., Chen et al., 2018; Grewal et al., 2022; Krueger et al., 2024). Our results so far suggest caution when interpreting documented effects of ESG reporting. First, changes in ERCs should not be seen as prima facie evidence of changes in the quality of financial reporting—ERCs change when introducing the ESG report even though we hold the quality of financial reporting fixed.[4] Second, a positive stock price reaction to the introduction of ESG reporting does not imply that investors, on average, would like greater ESG efforts from firms. This is explicitly not the case when ESG has a moderately negative cash-flow impact. Third, the ESG-RC may not be directly informative about whether the underlying activity is good for

[4]See Petrov and Stocken (2024), discussed below, for an alternative model in which the introduction of ESG reporting can explicitly and directly improve the quality of financial reporting.

ESG or financial performance. It depends on what information is provided *incrementally*, not in isolation.

An important driver of variation in our results is the effect of ESG activities on cash flows, which has non-trivial policy implications. If a policy-maker's goal is to provide cash flow relevant information to investors, then mandatory ESG reporting might seem more justifiable when the cash flow effects are larger, whether positive or negative. However, large cash flow effects of ESG activities imply that they are already captured substantially by financial reports. If the goal is instead to encourage ESG activities, such as greenhouse gas emissions reductions, then, perhaps counterintuitively, ESG reporting should be curtailed for activities with very negative cash flow implications. Market incentives will tend to discourage rather than encourage these activities when investors are given more information about them.

In addition to real effects of introducing ESG reporting, we study implications for financial misreporting and greenwashing (i.e., misreporting of ESG performance). We find that introducing ESG reporting provides incentives for both ESG efforts and greenwashing. That is, all ESG efforts and greenwashing increase in the ESG-RC. This implies that corporations' exaggeration of their ESG performance is more likely when their actual ESG efforts are also higher.[5] In contrast, financial misreporting is primarily motivated by the ERC. Introducing ESG reporting tends to exacerbate (mitigate) financial misreporting when it is associated with an increase (decrease) in the ERC.

We explore an extension in which the manager's ESG concerns are directly affected by investors' concerns. This effect creates an additional mechanism through which investor valuation of ESG performance affects the manager's action choices, which in turn affect stock price. Notably, market responses to financial and ESG reports are the same as in the main model, since the internalization of investor preferences by the manager, in an anticipatable way, does not affect the information that investors glean from the financial and ESG reports.

In the last part of the paper, we discuss applications for the predictions from our model.

[5]For an example of investors and regulators realizing this phenomena, see AMBA (2023).

As noted above, we hope to contribute to the growing empirical literature exploring the introduction of ESG reporting. Several of the mandated ESG reporting rules are amenable to empirical exploration, as they feature size-based thresholds useful for regression discontinuity designs or have advanced in stages, which allows for exploration of market reactions to changes in the probability of passage.

We also discuss applications outside of the ESG space. The key elements of our model are: 1) investor disagreement about the value implications of certain corporate activities; and 2) disclosures about these activities. These key elements plausibly apply in several other domains, in which the 'certain corporate activities' featuring disagreement and disclosure could be, for instance, R&D investments, long-term expectations, tax-planning strategies, digital assets holdings, or executive compensation.

2 Related Literature

Our model builds on the recent and rapidly expanding literature on ESG reporting. It also incorporates features from other literature streams involving multiple performance measures, investor disagreement, and real effects.

We begin our review of related literature with a discussion of ESG investors. Central to our analysis is that some investors who receive reports incorporate their beliefs about the firm's ESG when forming their demand, as in Friedman and Heinle (2016). Pástor et al. (2020) show that investors' tastes for green holdings affect asset prices in equilibrium, and their effects on returns can be represented by a green factor. Zerbib (2022) develops an asset-pricing model where ESG performance is priced due to the impact of two investor groups: those that exclude certain assets from their investment options and those that internalize private costs of externalities in their expected returns. These investors cause two types of premia to occur: taste premia and exclusion premia. Pedersen et al. (2020) analyze an economy where the ESG score contains information related to firm fundamentals

and some investors have preferences about firms' non-financial performance. They show that in equilibrium, prices of assets satisfy a four-fund separation theorem incorporating both financial and ESG performance. Chowdhry et al. (2018), Oehmke and Opp (2025), and Friedman and Heinle (2021) derive conditions for impact investment to affect social outcomes when some investors value impact as well as cash flows.

A separate literature has focused on the materiality of ESG disclosures (e.g., Khan et al., 2016; Jebe, 2019). For example, Amel-Zadeh and Serafeim (2018) report survey evidence that mainstream investment organizations primarily use ESG information because of its relevance to investment performance, ahead of client demand and ethical considerations. Although Moss et al. (2020) find no evidence of retail investors reacting to ESG press releases, Moss et al. (2022) show that stock prices respond to ESG performance information. The Sustainability Accounting Standards Board (SASB, now part of the IFRS Foundation's International Sustainability Standards Board) has promulgated industry-specific sustainability standards that focus on materiality, while the SEC recently finalized a climate disclosure rule mandating disclosure of certain items based on materiality considerations.[6] Materiality implies "relevant to investor decision-making," and can be evaluated based either on relevance to fundamentals, i.e., future cash flows or discount rates, or based on investor responses to ESG information releases. Our model, by clearly delineating cash flow relevance, ESG relevance, and investor response, allows us to show how focusing on different definitions of materiality in designing ESG reports can affect prices, greenwashing, and corporate ESG efforts.

Prior studies have examined how trading activity and investor engagement affect firms' ESG performance. Landier and Lovo (2020) show how the policy of an ESG fund forces companies to internalize (at least partially) their externalities. An ESG fund's optimal strategy is to invest in firms with the strongest capital search frictions and most inefficient externalities. Green and Roth (2025) derive optimal strategies for social investors to maximize social

[6]For further details on the SASB standards and SEC disclosure rules, respectively, see SASB (2024) and SEC (2024). Note that the SEC's climate disclosure rule was stayed shortly after finalization (Binnie, 2024).

welfare in an environment of competition between commercial and social investors. De Angelis et al. (2022) show how companies' greenhouse gas emissions can be reduced through the increase in the cost of capital for those companies, wherein the cost of capital becomes more sensitive to emissions as the share of green investors and environmental stringency increase.[7] Concurrent studies have also incorporated real effects of investor, competitor, and customer responses to firms' ESG disclosures (see, e.g., Goldstein et al. (2022) and Xue (2025), which feature rational expectations equilibria, and Fritz (2023), which focuses on disclosures to customers and competitors). Our model features real effects whereby price responses to reports encourage both real activities and reporting choices (e.g., Kanodia, 2007). Our analysis illustrates how market reactions to ESG reports, in the presence of financial reports that also provide information about the firm's ESG performance, can provide incentives to managers to alter their firms' ESG performance.

Our results are consistent with prior studies' evidence on the real effects of ESG disclosures. A number of studies show that companies subject to mandatory or standardized ESG disclosure regimes reduced their emissions (Chen et al., 2018; Grewal et al., 2022; Downar et al., 2021; Yang et al., 2021; Bochkay et al., 2023) and improved ESG performance (Fiechter et al., 2022; Christensen et al., 2019), consistent with our prediction that the introduction of ESG reporting can increase expected ESG performance as long as the effect of ESG performance on the firm's cash flows is not too negative. Consistent with our setup, Yang et al. (2021) find that stock prices can motivate firms to change their ESG-related behavior. Wang (2023) finds similar results when focusing on lending-related incentives: corporate U.S. borrowers of non-U.S. banks that are exposed to ESG disclosure regulations improve their environmental and social performance.[8] Thomas et al. (2022) highlight the trade-off between cash flows and ESG performance that some companies face, and how the pressure

[7]Several studies have noted potential unintended consequences of disclosure and capital market pressure related to ESG performance, including shifting of emissions to geographic areas, subsidiaries, suppliers, peer firms, or unlisted competitors where they are less likely to be scrutinized (e.g., Bartram et al., 2022; Hartzmark and Shue, 2022; Mahieux et al., 2025).

[8]While we do not focus on debt channels per se, the intuition behind our results applies for both equity and debt securities.

to beat a financial reporting benchmark pushes the firms to choose financial performance over non-financial. Banerjee et al. (2025) show how investment in projects with systematic factor (e.g., climate) exposure alters the content of price feedback the manager receives: the price informs the manager both about the project's cash flows and its discount rate. How systematic factor exposure affects investment behavior differs substantially depending on the firm manager's objective function.

Our contribution to the ESG literature comes via explicitly considering the introduction of ESG reports. We analyze how price and market reactions to the reports vary with the cash flow-ESG performance relations and investor composition. Our study supports and offers a mechanism to explain existing empirical findings. We demonstrate how investors, even if they do not inherently value ESG, can learn cash-flow relevant information from ESG reports, consistent with Amel-Zadeh and Serafeim (2018)'s evidence that one of the most frequent reasons for investors using ESG data is to improve financial performance. The introduction of value-relevant ESG disclosures in our model can cause positive price reactions, consistent with the results of Arif et al. (2022). Matsumura et al. (2014) find that investors can "penalize" firms for low ESG performance; this penalty is dampened if companies provide more detailed ESG disclosures. Broadly, we address calls for research to better understand implications of ESG reporting (Christensen et al., 2019; Grewal and Serafeim, 2020; Bochkay et al., 2025).

Petrov and Stocken (2024) also model the introduction of ESG/non-financial reporting. However, their main feature is that ESG reporting can directly affect the quality of financial reporting, particularly in an integrated reporting environment. While this is an interesting mechanism, we focus on how the introduction of ESG reporting changes investor learning about multiple dimensions of firm performance, which does not require spillovers (positive or negative) onto the financial reporting process or the integration of financial and ESG reporting. Göx and Wagenhofer (2025) show that the introduction of emissions reporting can provide incentives to the manager to overinvest in an emissions-reducing technology,

even relative to a social planner. Although not explicitly in the context of ESG disclosure, Antle et al. (1994) show how the presence of other information sources may change how investors react to financial disclosure.

We focus on implications of ESG reporting, which requires a model with multiple performance measures (e.g., Lambert, 2001), investor disagreement (e.g., Hong and Stein, 2007), and real effects (e.g., Kanodia, 2007). Although many prior papers have studied multiple performance measures, (e.g., Datar et al., 2001; Feltham and Xie, 1994; Holmstrom and Milgrom, 1991), they mainly focus on weights on performance measures in a contract. Although prior studies have examined price as a performance measure in a contract, the focus is often on whether price subsumes other potential performance measures. For instance, Paul (1992) highlights that investors disregard the productivity of (predictable) effort when they aggregate information and, instead, emphasize value-relevant components outside of the manager's control. Furthermore, although the contracting models feature managerial decisions generating real effects, they tend not to feature investor disagreement. In contrast, many of the ESG-related studies cited above feature investor disagreement about the value of ESG performance and the potential for managerial actions to generate real effects. The nature of these effects, which may be externalities from the firm's purely financial perspective, drive the potential for investor disagreement.

In the main model, we focus on noisy reports. In the extensions, we allow for strategic misreporting (e.g., Dye and Sridhar, 2004; Fischer and Verrecchia, 2000). Our model extends the literature on earnings management (e.g., Dye and Sridhar, 2008) by allowing the firm to manipulate its ESG report, i.e., to engage in greenwashing and financial misreporting. This allows us to examine how the two types of misreporting interact. There is relatively little existing theoretical research on greenwashing or on misreporting across multiple performance measures. Fischer and Verrecchia (2000), for instance show how uncertainty around the manager's incentives creates the potential for misreporting that the manager can benefit from *ex ante*, without a consideration of how additional metrics change the manager's

incentives. More closely related to our paper, Lyon and Maxwell (2011) provide a model of greenwashing. However, their model is based on discretionary disclosure of favorable signals (e.g., Jung and Kwon, 1988), in contrast to our model of greenwashing as reporting bias with uncertain costs, which interacts with financial reporting bias. Despite the relative paucity of theoretical research, there exists rich empirical evidence for firms' greenwashing or providing inappropriate information on their ESG activities (e.g., Bingler et al., 2022; Basu et al., 2022; Delmas and Burbano, 2011; Marquis et al., 2016; Raghunandan and Rajgopal, 2022), as well as numerous examples from the popular and business press (e.g., Brogger and Marsh, 2021; Kowsmann and Brown, 2021).

3 Model setup

We build our model to capture the following key aspects of introducing ESG reporting: (1) a non-financial dimension of the firm's performance, (2) some investors who value this dimension in addition to the firm's cash flows, and (3) the presence of another report – about the firm's cash flows.

The model features a firm whose manager makes production and reporting choices and a continuum of investors who allocate their wealth between shares in the firm and a risk-free asset that is assumed to have a gross return of 1. The timeline is as follows. First, the manager chooses her levels of effort. Second, the manager's efforts and exogenous parameters determine the firm's cash flows and ESG performance, which are reported to investors in noisy cash flow and ESG reports, respectively. Investors trade the firm's shares in a competitive market and establish a stock price. Finally, firm performance is realized and all parties consume.

The firm has two dimensions of stochastic output: cash flows, $\tilde{x}$, and ESG performance, $\tilde{y}$. The outputs are defined as functions of the manager's choices, random factors outside the manager's control, and known parameters. Specifically, $\tilde{x} = \theta_\phi \tilde{\phi} + \theta_e e + e_x + \tilde{\varepsilon}_x$, and

$\tilde{y} = \eta_\phi \tilde{\phi} + \eta_e e + e_y + \tilde{\varepsilon}_y$. In this formulation, the manager's actions are e, an action that affects both cash flows and ESG; e_x, which affects only cash flows; and e_y, which affects only ESG performance. The random factors follow a similar structure, with $\tilde{\phi} \sim N\left(\bar{\phi}, \sigma_\phi^2\right)$ affecting both outputs, and $\tilde{\varepsilon}_x \sim N\left(0, \sigma_x^2\right)$ and $\tilde{\varepsilon}_y \sim N\left(0, \sigma_y^2\right)$ affecting only cash flows and ESG performance, respectively. The commonly-known parameters $(\theta_\phi, \theta_e, \eta_\phi, \eta_e)$ capture the sensitivities of cash flows and ESG to $\tilde{\phi}$ and e, respectively the random and manager-chosen inputs that affect both types of firm performance. We normalize to one the sensitivities of outputs to the random and manager-chosen inputs that affect only one output (i.e., $e_x, e_y, \tilde{\varepsilon}_x$, and $\tilde{\varepsilon}_y$). To simplify the exposition, we focus our analysis on a setting with $\eta_\phi, \eta_e > 0$, such that higher values of the manager's action, e, and the random term, $\tilde{\phi}$ are associated with more positive ESG performance.[9,10] Thus we can interpret e as an ESG choice that affects cash flows.

The common term $\tilde{\phi}$ present in both cash flows and ESG performance causes them to be correlated. This could reflect, for instance, the effect of weather on a firm's delivery operations and costs. If weather is good, the firm faces fewer constraints on route optimization, allowing for higher ESG and cash flow performance. In this instance, $\theta_\phi > 0$ and there is a positive correlation driven by $\tilde{\phi}$. Alternatively, $\tilde{\phi}$ could reflect the level and dispersion of customer demand. If demand is high and dispersed, the firm will have higher cash flows but generate greater emissions getting its products to customers. In this case, $\theta_\phi < 0$, and $\tilde{\phi}$ causes a negative correlation.

The parameters θ_e and η_e capture the effects of the manager's action, e on the firm's cash flows and ESG performance. Firms can take various actions that affect both cash flows and

[9] Note that we allow $e < 0$, meaning that the manager can take actions that reduce expected ESG output. As such, the assumption of $\eta > 0$ is for convenience, such that higher e increases expected ESG performance and to limit the relevant parameter space, since $\eta < 0$ will flip interpretations without changing economic substance. The nature of the results, and their dependence on correlation and what investors learn from reports, would be similar if we instead assumed $\theta > 0$ and allowed $\eta \in \Re$.

[10] In the analysis below, we focus on θ_ϕ as a key parameter of interest. An important economic force in the model is investors learning about what they value. We separate θ_ϕ from θ_e to emphasize the importance of using reports to learn about $\tilde{\phi}$, rather than their dependence on the productivity defined by θ_e. Additionally, we avoid setting $\eta_\phi = 1$ in order to make clear the dependence of results below on covariance between ESG and financial performance, reflected in $\theta_\phi \eta_\phi \sigma_\phi^2$.

ESG performance. For example, costly CO_2 capture and storage improve the firm's ESG performance but reduce cash flows ($\theta_e < 0$). Alternatively, team-building activities among employees can increase both job satisfaction (increasing the firm's ESG) and productivity (increasing the firm's cash flows), yielding ESG and cash flows that are positively related ($\theta_e > 0$).

In addition to common factors, cash flows and ESG depend on the manager's efforts that only affect cash flows and ESG performance, e_x and e_y. The effort e_x may represent operational decisions that have no effect on the firm's ESG performance, such as ESG-neutral aspects of the marketing strategy. The effort e_y, in parallel, represents the manager's actions to change the firm's ESG performance that do not affect the firm's financial performance. An example of such an action could be encouraging employees to volunteer for non-profit organizations during their non-work hours.

Finally, both cash flows and ESG are affected by unrelated exogenous factors outside of the manager's control, $\tilde{\varepsilon}_x$ and $\tilde{\varepsilon}_y$. The exogenous parameter $\tilde{\varepsilon}_x$ can capture, for instance, the fluctuation in demand for the firm's product. The exogenous parameter $\tilde{\varepsilon}_y$ can capture employees' choices to volunteer during their free-time, separate from managerial encouragement. In Appendix A.7, we show that our results are similar if $\tilde{\varepsilon}_x = \tilde{\varepsilon}_y = 0$.

We assume that the continuum of investors has unit mass and that the supply of shares is fixed at 1. The risk-free asset (money) serves as the numeraire in which investors can borrow or lend. It is supplied elastically, such that its price and gross return, both 1, are not affected by demand.

Investors are heterogeneous with regard to their preferences over the firm's ESG performance but have homogeneous preferences with regard to cash flows.[11] Specifically, although

[11] Several studies provide evidence that individuals value the societal impacts of their investments. For example, Krueger et al. (2020) show that many institutional investors recognize the importance of climate risks for their portfolios' cash flows. Similarly, Bauer et al. (2021) find that two-thirds of pension fund members they surveyed are willing to sacrifice some financial benefits to invest in companies whose goals are aligned with the United Nations' Sustainable Development Goals (SDG). Heath et al. (2023) show that Socially Responsible Investment (SRI) funds tend to choose portfolio firms that perform well on ESG dimensions. Bonnefon et al. (2025) provide evidence suggesting that investors obtain "warm glow giving" utility when their investments are aligned with social values, and Barber et al. (2021) demonstrate this

all investors value cash flows and are risk averse with respect to their cash holdings, a λ-fraction of investors also value the firm's ESG performance.[12] To simplify the analysis, we assume that the ESG-concerned investors are risk-neutral with respect to ESG performance.[13]

Let q_i and l_i denote the amounts of shares and money, respectively, held by investor i. We denote type-1 investors as those who care only about cash flows. Their utility is $u_1 = -exp[-\rho(q_1\tilde{x} + l_1)]$. Type-2 investors, who also value the firm's ESG performance (in risk-neutral expectation), have utility defined by $u_2 = -exp[-\rho(q_2\,(\tilde{x} + E[\tilde{y}|\Omega]) + l_2)]$. Ω is the information on which investors condition their expectations.

The firm's manager is concerned about their firm's stock price, and it is costly for them to exercise any kind of effort. Specifically, the manager's utility is:

$$u_m = p - \frac{c_e}{2}e^2 - \frac{c_x}{2}e_x^2 - \frac{c_y}{2}e_y^2, \tag{1}$$

where c_e, c_x, and c_y parameterize the cost of taking an additional effort affecting both cash flows and ESG, only cash flows, and only ESG, respectively.[14,15]

Investors learn about the firm's financial and ESG performance from two reports: one

phenomenon for venture capital investors. Bolton and Kacperczyk (2021) provide further evidence of trade-offs between ESG and market performance in investors' preferences.

[12] We treat λ as an exogenous parameter, and discuss comparative statics on λ in Appendix A.5. We also discuss implications of the fraction of ESG-interested investors potentially changing after the introduction of ESG reporting in Section 7.3. Empirical evidence, discussed above, shows that some investors exhibit preferences for non-financial dimensions of portfolio holdings. Future work might consider the drivers of λ, which could include, for instance, the potential for λ to depend on the availability of information about firms' ESG performance.

[13] There is little evidence on the degree of risk aversion with respect to ESG outcomes. Our assumption of risk neutrality is made here to keep the model tractable and ease interpretation of the effects we identify. It sidesteps issues of ESG risk sharing between investors, as a risk-efficient allocation would have the non-ESG concerned type 1 investors hold all of the ESG risk. Broadly, adding risk aversion in ESG performance, as in Friedman and Heinle (2016), would introduce additional trade-offs such as clientele effects that we leave for future work.

[14] A weight of 1 on price in equation (1) is without loss of generality, relative to other weights, since the cost parameter, c_e, can be viewed as scaling the importance of effort cost relative to the importance of stock price.

[15] Making the efforts costly to the manager and not to the firm implies that the parameter θ_e represents the net benefit (i.e., after investment cost) of the effort e for the firm's cash flows. Alternatively, we can explicitly model separate costs to the firm and the manager. Appendix A.4 provides this alternative formulation. Our main results still hold.

about financial performance and the other about ESG performance. The financial report, f, provides a noisy measure of the firm's cash flows, x: $\tilde{f} = \tilde{x} + \tilde{\varepsilon}_f$, with $\tilde{\varepsilon}_f \sim N\left(0, \sigma_f^2\right)$. The noise in the financial report, $\tilde{\varepsilon}_f$, captures any exogenous factors that prevent the report from truthfully revealing the company's actual cash flows, such as inherent limitations of the accounting system. Paralleling the financial report, the ESG report, $\tilde{r}$, provides a noisy measure of the firm's ESG performance, $\tilde{y}$. As such, the ESG report disclosed to investors is $\tilde{r} = \tilde{y} + \tilde{\varepsilon}_r$, where $\tilde{\varepsilon}_r \sim N\left(0, \sigma_r^2\right)$ represents exogenous idiosyncratic noise. An example of such noise can be measurement error of the apparatus measuring or estimating CO_2 emissions.

The timeline is as follows. At $t = 0$, the manager chooses the efforts, e, e_x, and e_y, to maximize her utility function. At $t = 1$, the financial and ESG reports, f and r, are disclosed to investors. Investors then trade in the company's shares and establish the stock price, p. Specifically, stock price is set to ensure that the market for shares clears in a competitive Walrasian equilibrium with market-clearing condition: $(1 - \lambda) q_1 + \lambda q_2 = 1$. At $t = 2$, cash flows are paid out and ESG performance is revealed.

4 Equilibrium

In this section, we present and discuss the model equilibrium. First, we show an equilibrium in the model without ESG reporting; next, we present an equilibrium of the full model. In both equilibria, stock price takes the form: $p = E[x|\Omega] + \lambda E[y|\Omega] - \rho * Var[x|\Omega]$. The effects of financial and ESG reporting on stock price thus flow through updated expectations of financial and ESG performance, and reductions in risk borne by the risk-averse investors. The manager internalizes the effects of her actions on price, intermediated by the reports. As such, the price responses to the reports play important roles in the equilibria. We denote these by $\psi_f = \frac{\partial p}{\partial f}$ and $\psi_r = \frac{\partial p}{\partial r}$. We refer to the former as the ERC (earnings response coefficient), and the latter as the ESG-RC (ESG response coefficient). Additionally, note that our setup is such that investors can infer and predict the manager's actions, e, e_x, and

e_y with certainty. The sources of uncertainty and risk are the uncertain common factor affecting the firm's cash flows and ESG performance, $\tilde{\phi}$, the exogenous factor in cash flows, $\tilde{\varepsilon}_x$, and the exogenous factor in ESG performance, $\tilde{\varepsilon}_y$. Investors learn about these from the reports but their learning and updating is limited by the noise in the reports, given by $\tilde{\varepsilon}_f$ and $\tilde{\varepsilon}_r$.

4.1 Equilibrium in the model without ESG reporting

Lemma 1 below summarizes the equilibrium price, actions, and financial report in a world in which only the financial report is issued. The equilibrium represents an economy without ESG reporting and thus serves as a benchmark to analyze how the introduction of ESG reporting may affect capital market and real outcomes.[16] An important aspect of the equilibrium is the price response to the financial report – the ERC. We use a superscript † to indicate the equilibrium without ESG reporting.

Lemma 1 *In equilibrium in the model with only financial reporting, the ERC, the ex-ante stock price, manager's efforts, and expected cash flows and ESG performance are given by:* $\psi_f^\dagger = 1 * \left(1 - \frac{\sigma_f^2}{\Sigma_f}\right) + \lambda \frac{\theta_\phi \eta_\phi \sigma_\phi^2}{\Sigma_f}$, $e^\dagger = \frac{\psi_f^\dagger \theta_e}{c_e}$, $e_x^\dagger = \frac{\psi_f^\dagger}{c_x}$, $e_y^\dagger = 0$, $E\left[x^\dagger\right] = \theta_e e_x^\dagger + \theta_\phi \bar{\phi} + e_x^\dagger$, $E\left[y^\dagger\right] = \eta_e e^\dagger + \eta_\phi \bar{\phi}$, *and* $E\left[p^\dagger\right] = E\left[x^\dagger\right] + \lambda E\left[y^\dagger\right] - \rho \Sigma_x$, *where* $\Sigma_f \equiv Var[\tilde{f}] = \theta_\phi^2 \sigma_\phi^2 + \sigma_x^2 + \sigma_f^2$ *and* $\Sigma_x \equiv Var[\tilde{x}] = \theta_\phi^2 \sigma_\phi^2 + \sigma_x^2$.

In the equilibrium described by Lemma 1, the financial report plays multiple roles. First, it provides information useful to all investors about expected cash flows, which depend on factors under the manager's control, via e and e_x, and factors outside of the manager's control, including $\tilde{\phi}$ and $\tilde{\varepsilon_x}$. Second, the financial report provides information about the firm's ESG activities, which are stochastic from investors' perspective because investors do not observe $\tilde{\phi}$. Learning about $\tilde{\phi}$ is useful to all investors as long as $\theta_\phi \neq 0$, such that ESG activities affect cash flows, and is incrementally useful to type-2 investors due to the effects on ESG performance, parameterized by $\eta_\phi > 0$. Fundamentally, investors' response to the

[16] This benchmark model is similar in spirit to models explored in Lambert (2001, Section 3.3.5) and Feltham and Xie (1994, Section V), though these focus on using market price as a contractual performance measure in a multi-action agency.

financial report is driven by the degree to which it contains information about relevant cash flow and ESG outcomes as opposed to reflecting the idiosyncratic noise in the financial report due to $\tilde{\varepsilon_f}$.

Investors' reaction to the financial report, ψ_f, is a function of investor learning. The equilibrium ERC, $\psi_f^\dagger$ is expressed as the sum of a component that captures learning about cash flows (multiplied by $1 \equiv$ the fraction of investors concerned about cash flows), and a component that captures learning about ESG performance (multiplied by $\lambda \equiv$ the fraction of investors concerned about ESG performance). The former is expressed as $1 - \sigma_f^2/\Sigma_f$, which represents a full response of 1 shaded by the fraction of the variance in the financial report that comes from noise. The latter is increasing in the covariance between the financial report and ESG performance $\left(\theta_\phi \eta_\phi \sigma_\phi^2\right)$ and decreasing in the overall variance of the financial report, Σ_f.

Equilibrium efforts, $e^\dagger$, $e_x^\dagger$, and $e_y^\dagger$ are chosen by the manager to equalize the marginal benefit of increasing price with the cost of effort. For $e^\dagger$, the benefit comes from a unit of effort increasing expected financial performance by θ_e, which increases the financial report in expectation by the same amount, and leads to an expected price increase of $\psi_f^\dagger$. For $e_x^\dagger$, the benefit comes similarly through increasing expected financial performance, but with a coefficient of 1 instead of θ_e. The marginal cost effects are captured by c_e and c_x, respectively. For the ESG-only effort, $e_y^\dagger$, there is no effect on the financial report, and the ESG report is absent in the "†" benchmark equilibrium, so the manager gets no benefit, via an increase in expected price, from exerting this effort. Note that investors anticipate the managers' efforts, so these are not stochastic from investors' perspective.[17]

Expected financial and ESG performance ($E[x^\dagger]$ and $E[y^\dagger]$, respectively), are functions of equilibrium efforts and the expected common factor, $E[\tilde{\phi}] = \bar{\phi}$. Expected price, i.e., the stock price prior to the release of the financial report, is given by expected performance weighted by investor preferences, minus a risk premium of $\rho\Sigma_x$. There is no risk premium associated

[17] A previous version of this paper allowed for the manager's effort costs to be stochastic. Please see that version for details.

with uncertainty in ESG performance, $\tilde{y}$, because we have assumed it is the expectation of $\tilde{y}$ that enters into type-2 investors' utility.[18]

4.2 Equilibrium in the model with financial and ESG reporting

In this section we introduce the ESG report. We characterize the equilibrium in Lemma 2:

Lemma 2 *In the equilibrium of the model with financial and ESG reporting, the ERC and ESG RC are given by*

$$\psi_f^* = \left(1 - \frac{\sigma_f^2}{\Sigma_f}\beta_1\right) + \lambda\frac{\theta_\phi\eta_\phi\sigma_\phi^2}{\Sigma_f}\beta_2, \text{ and}$$

$$\psi_r^* = \lambda\left(1 - \frac{\sigma_r^2}{\Sigma_r}\gamma_1\right) + \frac{\theta_\phi\eta_\phi\sigma_\phi^2}{\Sigma_r}\gamma_2;$$

the manager's efforts, expected cash flows and ESG performance, and the ex-ante stock price are: $e^* = \frac{\psi_r^*\eta_e + \psi_f^*\theta_e}{c_e}$, $e_x^* = \frac{\psi_f^*}{c_x}$, $e_y^* = \frac{\psi_r^*}{c_y}$, $E[x^*] = \theta_e e^* + \theta_\phi\bar{\phi} + e_x^*$, $E[y^*] = \eta_e e^* + \eta_\phi\bar{\phi} + e_y^*$, *and* $E[p^*] = E[x^*] + \lambda E[y^*] - \rho\Sigma_x$;
where $\Sigma_x \equiv Var[\tilde{x}] = \theta_\phi^2\sigma_\phi^2 + \sigma_x^2$, $\Sigma_f \equiv Var[\tilde{f}] = \Sigma_x + \sigma_f^2$, $\Sigma_r \equiv Var[\tilde{r}] = \eta_\phi^2\sigma_\phi^2 + \sigma_y^2 + \sigma_r^2$,
$\beta_1 = \Sigma_f / \left(\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2}\right)$, $\beta_2 = \Sigma_f\sigma_r^2 / \left(\Sigma_r\left(\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2}\right)\right)$,
$\gamma_1 = \Sigma_r / \left(\Sigma_r - \eta_\phi^2\sigma_\phi^2\frac{\theta_\phi^2\sigma_\phi^2}{\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2}\right)$, *and* $\gamma_2 = \Sigma_r\sigma_f^2 / \left(\Sigma_f\left(\Sigma_r - \eta_\phi^2\sigma_\phi^2\frac{\theta_\phi^2\sigma_\phi^2}{\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2}\right)\right)$,
with $\beta_1, \gamma_1 > 1$ *and* $\beta_2, \gamma_2 \in (0, 1)$.

As in Lemma 1, equilibrium expected/pre-disclosure price is given by expected cash flows and ESG performance, weighted by investor interest (i.e., 1 and λ), minus the risk premium of $\rho\Sigma_x$. Similarly, expected financial and ESG performance take the same form, as weighted functions of efforts and $E[\tilde{\phi}] = \bar{\phi}$. The primary difference between Lemmas 1 and 2 is that the latter includes e_y^* as contributing to expected ESG performance. This is, of course, because, except for a knife edge case, $e_y^* \neq 0$, whereas $e_y^\dagger = 0$ in Lemma 1. As can be seen from the expression for $e_y^* = \psi_r^*/c_y$, the ESG report allows for ESG-specific effort to be reflected in price, which motivates the manager to choose a non-zero amount of this effort.

The existence of the ESG report also influences the manager's choice of the joint ESG-cash-flow effort, e^*, which affects both financial and ESG performance. The total motivation

[18] Allowing for risk aversion with respect to $\tilde{y}$ would introduce a risk premium associated with $\tilde{y}$ as well as clientele effects, both of which are discussed in detail in Friedman and Heinle (2016).

for e^* in Lemma 2 comes from the effect of e on price through both its effects on financial performance and ESG performance, as reflected in the financial and ESG reports. In the remainder of this section, we go into greater detail on the economic forces driving the market responses to the financial and ESG reports, when both are present.

The responses to the financial and ESG reports, the ERC (ψ_f^*) and ESG-RC (ψ_r^*), respectively, can be characterized as the sum of components representing: 1) a frictionless investor response to the information in each report about its underlying primary performance variable (i.e., $\tilde{x}$ for the ERC and $\tilde{y}$ for the ESG-RC); 2) a reduction of item (1) due to noise in the report; and 3) the amount investors learn from one report about the other performance dimension (i.e., learning about ESG from the financial report and financial performance from the ESG report). In a frictionless world, with only the financial report and without any financial reporting noise, the ERC would be $\psi_f = 1$, as investors are willing to pay \$1 more for the stock when noiseless earnings indicate underlying cash flows are higher by \$1. The response is attenuated, however, by noise in the financial report, as indicated by the term $-\frac{\sigma_f^2}{\Sigma_f}\beta_1$. The reduction due to noise is stronger in the presence of the ESG report than in an environment without ESG reporting. Without the ESG report (see Lemma 1) this term captured the proportion of financial report variance due to noise. In the presence of the ESG report, the relevant metric is the fraction of *residual* variance due to noise. Here, investors learn about the cash flows from the ESG report, leaving less fundamental uncertainty. As a result, the residual fraction of noise is larger than in setting without an ESG report.[19]

The second additive term in the Lemma 2 expression for ψ_f^* reflects investors' learning about ESG performance from the financial report. This is indicated by the product of $\lambda\theta_\phi\eta_\phi\sigma_\phi^2\beta_2$ in the numerator, which reflects, respectively: the fraction of investors, λ, who care about ESG performance; the effect of stochastic ESG performance, $\tilde{\phi}$, on the financial report via its effect on cash flows, θ_ϕ; the effect of $\tilde{\phi}$ with variance σ_ϕ^2, on ESG output, η_ϕ; and the relative noise in the ESG report, β_2. The last term, β_2, appears because higher noise

[19] $\beta_1 > 1$ captures the ratio of total to residual variance in the financial report.

in the ESG report implies that investors learn less about ESG performance from the ESG report, leaving more to be learned about ESG performance from the financial report.

The structure of the ESG-RC parallels that of the ERC. In a frictionless world, with only the ESG report and without any ESG reporting noise, the ESG-RC would be $\psi_r^* = \lambda$, as a λ fraction of investors are willing to pay \$1 more for the stock when the ESG report indicates underlying performance is higher by a single unit. As with the ERC, the response to the ESG report is attenuated, by noise, as indicated by the term $-\frac{\sigma_r^2}{\Sigma_r}\gamma_1$, which reflects the ratio of noise to residual variance in the ESG report.[20] The second term reflects investors' learning about financial performance from the financial report. This is indicated by the product of $\theta_\phi \eta_\phi \sigma_\phi^2 \gamma_2$ in the numerator, which reflects, respectively: the effect of stochastic ESG performance, $\tilde{\phi}$, on cash flows, θ_ϕ; the effect of ESG performance, on the ESG report, via its effect on ESG performance, η_ϕ; the variance in the ESG report coming from its reflection of $\tilde{\phi}$, σ_ϕ^2; and the noise in the financial report, γ_2. The last term, γ_2, appears because higher noise in the financial report implies that investors learn less about financial performance from the financial report, leaving more to be learned about financial performance from the ESG report. Note that the second additive term in the ESG-RC does not contain λ, since it reflects the effect of all investors learning about financial performance, implying a multiplier of 1 (dropped because it is the multiplicative identity).

5 Effects of introducing ESG reporting

The direct effect of introducing ESG reporting is that the market now can respond to the information contained in the ESG report. Proposition 1 provides conditions for that response to be positive.

Proposition 1 *The ESG-RC is positive, $\psi_r^* > 0$, if and only if*

$$\lambda > \frac{-\theta_\phi \eta_\phi \sigma_\phi^2 \sigma_f^2}{\sigma_y^2 \Sigma_f + \eta_\phi^2 \sigma_\phi^2 \left(\sigma_x^2 + \sigma_f^2\right)}. \tag{2}$$

[20] As before, $\gamma_1 > 1$ captures the ratio of total to residual variance in the ESG report.

As discussed above, investors use the ESG report to learn about the firm's financial and ESG performance. When $\theta_\phi > 0$, a higher ESG report has positive implications for both ESG and financial performance, so the response to the ESG report is positive (the condition in Proposition 1 is always satisfied). When $\theta_\phi < 0$, a higher ESG report has positive implications for ESG performance but negative implications for cash flows. In this case, the net response to the ESG report is positive if and only if the fraction of investors concerned about ESG performance, λ, is sufficiently positive. Otherwise, prices will respond negatively to the ESG report because of its negative implications for cash flows.

5.1 Earnings response coefficient

Introducing the ESG report changes how investors respond to the financial report, as reflected in the ERC, ψ_f. Notably, the ERC can increase or decrease. Proposition 2 provides the condition for the ERC to increase when ESG reporting is introduced.

Proposition 2 *The ERC increases after the introduction of ESG reporting (i.e., $\psi_f^* - \psi_f^\dagger > 0$) if and only if*

$$\lambda\theta_\phi\eta_\phi < \frac{-\theta_\phi^2\eta_\phi^2\sigma_\phi^2\sigma_f^2}{\sigma_y^2\Sigma_f + \eta_\phi^2\sigma_\phi^2\left(\sigma_x^2+\sigma_f^2\right)}. \tag{3}$$

Note that because θ_ϕ can be negative, the conditions in (2) and (3) are either the same condition (for $\theta_\phi < 0$) or mutually exclusive (for $\theta_\phi > 0$). When the ESG report is provided, investors learn less from the financial report about cash flows. This decreased learning can be seen by comparing the first terms in the post-ESG-reporting and pre-ESG-reporting ERCs, ψ_f^* and $\psi_f^\dagger$, in Lemmas 1 and 2, respectively: $\left(1-\frac{\sigma_f^2}{\Sigma_f}\beta_1\right) - \left(1-\frac{\sigma_f^2}{\Sigma_f}\right) = \frac{\sigma_f^2}{\Sigma_f}(1-\beta_1) < 0$. In particular, while the discount in $\psi_f^\dagger$ only accounts for noise in the cash flow report, the discount in ψ_f^* also accounts for the cash flow related information that investors infer from the ESG report. This pushes the ERC down when ESG reporting is introduced.

Similarly, when the ESG report is provided, investors learn less from the financial report about ESG performance. This can be seen in the comparison of the last terms, as $\lambda\frac{\theta_\phi\eta_\phi\sigma_\phi^2}{\Sigma_f}\beta_2 -$

$\lambda \frac{\theta_\phi \eta_\phi \sigma_\phi^2}{\Sigma_f} \propto -\theta_\phi$. That is, when θ_ϕ is positive, the positive last term reduces, indicating that the financial report is less important to investors in inferring ESG performance.

Taken together, whenever $\theta_\phi > 0$, the ERC reduces after the introduction of ESG reporting (as we can see in equation 3 given $\lambda > 0$). However, when $\theta_\phi < 0$, the term $\left(1 - \frac{\sigma_f^2}{\Sigma_f}\right)$ in $\psi_f^\dagger$ reduces, while the term $\lambda \frac{\theta_\phi \eta_\phi \sigma_\phi^2}{\Sigma_f}$ increases. This implies that when $\tilde{\phi}$ has a negative impact on cash flows, the ERC can increase or decrease, depending on parameter values. In particular, Proposition 2 shows that λ has to be sufficiently large for the ERC to increase. This can also be seen from equation 3: for $\theta_\phi < 0$ the ERC increases iff $\lambda > \frac{(-\theta_\phi)\eta_\phi \sigma_\phi^2 \sigma_f^2}{\sigma_y^2 \Sigma_f + \eta_\phi^2 \sigma_\phi^2 \left(\sigma_x^2 + \sigma_f^2\right)}$. Note that because $\lim_{\theta_\phi \to \infty} \Sigma_f \to \infty$, the ERC always increases for sufficiently negative θ_ϕ (assuming that $\lambda > 0$). Figure 1 shows that for $\theta_\phi < 0$, the impact of ESG reporting on the ERC is not monotone in θ_ϕ.

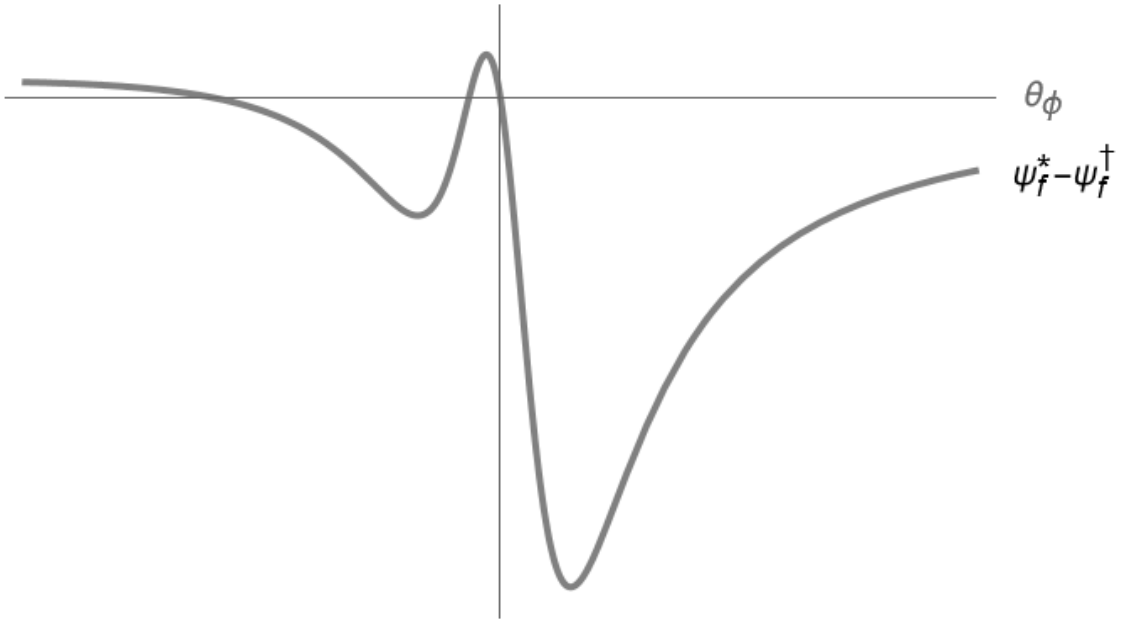

Figure 1: Change in the ERC from introducing ESG reporting. Here: $\lambda = \frac{1}{3}$, $\eta_\phi = \sigma_r = \sigma_x = \sigma_y = 1$, $\sigma_f = 2$, and $\sigma_\phi = 3$. The other parameters do not affect the response coefficients.

In particular, for θ_ϕ sufficiently close to zero, the ERC increases. In this region, ESG investors used to place a negative weight on the financial report to learn about ESG performance. Because the ESG measure provides this information more efficiently, they extract less ESG information from the financial report. As θ_ϕ moves further away from zero, in-

vestors again infer valuable ESG information from the financial report. Because there is less financial information to be gleaned, the ERC reduces for intermediate negative θ_ϕ. Finally, for very negative values of θ_ϕ, investors obtain substantial ESG information from the financial report. This implies a strong negative component in the ERC absent ESG reporting. The introduction of ESG reporting reduces the negative component, increasing the ERC. Notably, the reason for the ERC to increase as a result of the introduction of ESG reporting is the change the amount of ESG related information that ESG investors infer from the financial report. In order for this to dominate the updating about financial performance, there need to be a sufficient amount of ESG investors, as Proposition 2 shows.

5.2 Ex-ante price

We focus on the ex-ante price, which is the stock price that prevails prior to the release of reports. One reason to focus on this price is that it reflects the effects of anticipating disclosure but without incorporating the information released in specific disclosures. Empirically, it may be thought of as unconfounded by the information in *realized* reports. It may also be useful for empirical examinations of price changes in response to changes in the probability of future ESG reporting (e.g., around news events).

In our setting, the ex-ante price can be expressed as a function of expected financial and ESG performance net of a risk premium, $E[x] + \lambda E[y] - \rho\Sigma_x$. So, the change in the ex-ante price is given by $\Delta p = E\left[p^*\right] - E\left[p^\dagger\right] = E\left[x^* + \lambda y^*\right] - E\left[x^\dagger + \lambda y^\dagger\right]$.[21] Changes in expected performance are in turn driven by the equilibrium actions the firm takes. As discussed above, these actions are determined by market incentives. So, changes in ex-ante price are consequences of changes in the ERC and ESG-RC. Substituting the expressions for the expected outputs as functions of the ERC and ESG-RC yields

$$\Delta p = \left(\psi_f^* - \psi_\dagger^*\right)\left(\left(\theta_e + \lambda\eta_e\right)\frac{\theta_e}{c_e} + \frac{1}{c_x}\right) + \psi_r^*\left(\left(\theta_e + \lambda\eta_e\right)\frac{\eta_e}{c_e} + \frac{\lambda}{c_y}\right),$$

[21] Note that Σ_x is the ex ante variance of $\tilde{x}$, which is not affected by the reporting regime as modeled.

where the first term is the change in incentives due to a change in the ERC and the second term captures the incentives arising from the price response to the new ESG report. Each term shows the change in the effort that affects both cash flows and ESG performance ($(1+\lambda\eta_e)\frac{\theta_e}{c_e}$ and $(\theta_e+\lambda\eta_e)\frac{\eta_e}{c_e}$, respectively) as well as the change in effort that affects either cash flows or ESG ($\frac{1}{c_x}$ and $\frac{\lambda}{c_y}$, respectively). Proposition 3 incorporates equilibrium expressions for the ERC and ESG-RC from Lemmas 1 and 2, providing conditions for the ex-ante price to increase with the introduction of the ESG report.

Proposition 3 *The ex-ante price increases after the introduction of ESG reporting (i.e., $E[p^*]-E\left[p^\dagger\right]>0$), if and only if*

$$(\theta_e+\lambda\eta_e)\left[\frac{\theta_e}{c_e}\times\theta_\phi\eta_\phi\sigma_\phi^2\times\left(\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2-\lambda\chi\right)+\frac{\eta_e}{c_e}\times\Sigma_f\times\left(\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2+\lambda\chi\right)\right]$$
$$+\frac{1}{c_x}\times\theta_\phi\eta_\phi\sigma_\phi^2\times\left(\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2-\lambda\chi\right)+\frac{\lambda}{c_y}\times\Sigma_f\times\left(\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2+\lambda\chi\right)>0,$$

where $\chi\equiv\sigma_y^2\Sigma_f+\eta_\phi^2\sigma_\phi^2\left(\sigma_x^2+\sigma_f^2\right)$.

Fundamentally, our focus is a setting where a noisy but informative signal is introduced. When a second informative signal is disclosed, the weight on the first signal often reduces. As the change in the ERC above shows, this need not be the case in our setting. Instead, the ERC can increase or decrease. The reason is a combination of two aspects of our setting: there is a common random term ($\tilde{\phi}$) that affects both signals; and some investors are also interested in the firm's ESG performance,

The manager's incentives to just change cash flows, via e_x, arise from the ERC. As a result, price changes from incentives to exert e_x move hand-in-hand with ERC changes. That is, an increase in the ERC increases the expected cash flows. Similarly, the manager's incentives to just change ESG performance, via e_y, arise from the price response to the ESG report. The ESG-RC tends to be lower for negative values of θ, because, while ESG investors value increased ESG performance, all investors dislike the negative cash flow implications.

The most interesting price effect arises from efforts that are material both to cash flows and to the firm's ESG performance. However, because we have so far separated the co-

movement between cash flows and ESG through a random term ($\theta_\phi\tilde{\phi}$) and through a predictable term ($\theta_e e$), changes in the ERC do not affect this effort. For the remainder of the analysis, we denote (with slight abuse of notation) $\theta_\phi = \theta_e = \theta$. The coefficients on effort and on the random term are naturally identical when the random term affects outcomes only through its effect on the manager's effort, e.g., capturing the manager's unobservable preferences[22] or a random impact of the manager's effort on the output. In this situation, when a sufficient fraction of investors cares about ESG and when θ is moderately negative, the price of the firm decreases even though the response coefficient to the ESG report is positive and the ERC increases. The reason is that the positive price response to the ESG report motivates a higher effort (increasing the expected ESG performance) but this effort reduces expected cash flows. However, the manager's choice does not reflect the investors' optimal tradeoff between ESG and cash flows such that the ex-ante price decreases. Figure 2 depicts such a situation. As we discuss above, this result occurs precisely because we have a non-zero fraction of investors that values ESG in addition to cash flows. The two investor groups use the new information differently, which also changes their response to the existing financial report.

Once θ becomes sufficiently negative, the manager reduces e (increasing cash flows) and price increases as a result of the ESG reporting. Similarly, when θ is positive, the manager increases e and increases both cash flows and the ESG performance. In the full model, the price effect is a weighted average of the three impacts via e_x, e_y, and e. Depending on parameter values, any of the three could dominate, though the specific condition expressed as a function of exogenous parameters is provided in Proposition 3.

In Appendix A.5-A.6 we discuss how the effects of introducing ESG reporting vary with the fraction of ESG-conscious investors in the market (λ) and with the effect of the manager's joint ESG-cash-flow effort on the firm's cash flows (θ_e).

[22] We explored a such setting, with the cost of effort equal to $\frac{1}{c_e}(e-\tilde{\phi})^2$, in a previous version of this paper, available on SSRN and from the authors.

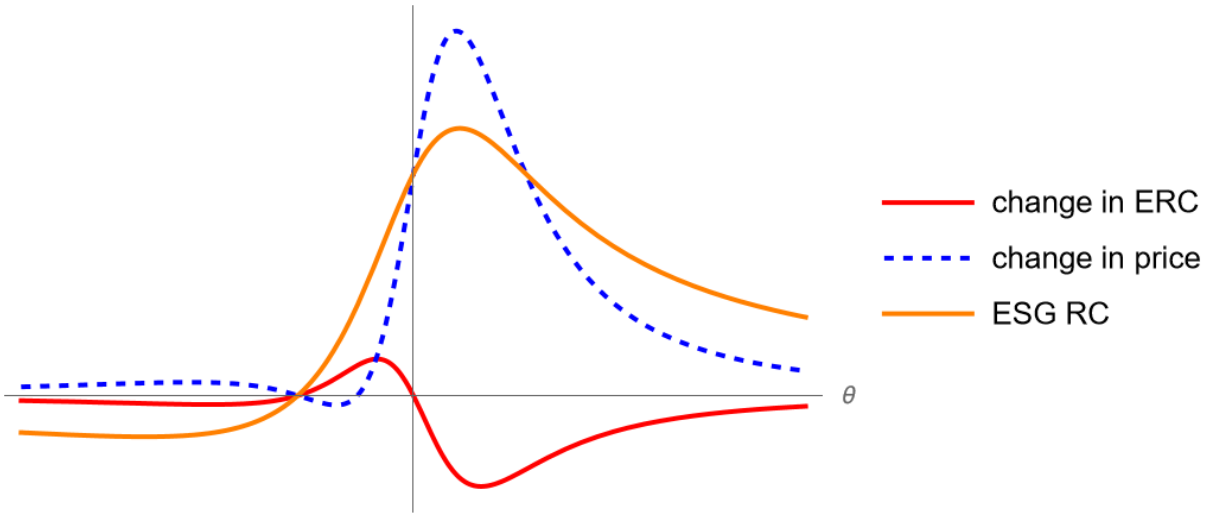

Figure 2: Change in price due to the joint effort from introducing ESG reporting. Here: $\lambda = \eta_\phi = \eta_e = \sigma_r = \sigma_x = \sigma_f = \sigma_\phi = 1$, $\sigma_y = \frac{1}{10}$, $\theta_\phi = \theta_e = \theta$ and we let $c_x = c_y \to \infty$ in order to focus on the effects of the joint effort.

6 Pre-existing ESG reporting

In this section, we consider the effects of improving ESG reporting, which can capture the effect of introducing enhanced ESG reporting to a setting where some degree of ESG reporting is already in place. This is the case, for instance, for large firms in the EU, who are moving from reporting under the NFRD (Non-Financial Reporting Directive) to reporting under the CSRD. Corollary 1 characterizes how the price response coefficients, the manager's actions, and the firm's performance change when the amount of noise in the ESG report, σ_r^2, changes.

Corollary 1 *When the amount of noise in the ESG report, σ_r^2, increases,*

1. *The ERC increases iff* $\frac{d\psi_f^*}{d\sigma_r^2} = \frac{\theta_\phi^2\eta_\phi^2\sigma_\phi^4\sigma_f^2}{\chi_f\Sigma_r} + \lambda\theta_\phi\eta_\phi\sigma_\phi^2\frac{\Sigma_f\sigma_y^2+\left(\sigma_x^2+\sigma_f^2\right)\eta_\phi^2\sigma_\phi^2}{\Sigma_r^2\chi_f} > 0$;
2. *The ESG-RC increases iff* $\frac{d\psi_r^*}{d\sigma_r^2} = -\lambda\frac{\Sigma_f\sigma_y^2+\left(\sigma_x^2+\sigma_f^2\right)\eta_\phi^2\sigma_\phi^2}{\Sigma_f\chi_r} - \frac{\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2}{\Sigma_f\chi_r} > 0$;
3. *The manager's joint ESG-cash-flow effort, e^*, increases iff* $\frac{de^*}{d\sigma_r^2} = \frac{\eta_e}{c_e}\frac{d\psi_r^*}{d\sigma_r^2} + \frac{\theta_e}{c_e}\frac{d\psi_f^*}{d\sigma_r^2} > 0$; *the cash flow effort, e_x^*, increases iff* $\frac{de_x^*}{d\sigma_r^2} = \frac{1}{c_x}\frac{d\psi_f^*}{\sigma_r^2} > 0$; *and the ESG effort, e_y^*, increases iff* $\frac{de_y^*}{d\sigma_r^2} = \frac{1}{c_y}\frac{d\psi_r^*}{\sigma_r^2} > 0$;

4. *The firm's expected cash flow,* $E[x^*]$*, increases iff* $\theta_e \frac{de^*}{d\sigma_r^2} + \frac{de_x^*}{d\sigma_r^2} > 0$*; the firm's expected ESG performance,* $E[y^*]$*, increases iff* $\eta_e \frac{de^*}{d\sigma_r^2} + \frac{de_y^*}{d\sigma_r^2} > 0$*; and the firm's ex-ante price,* $E[p^*]$*, increases iff* $\theta_e \frac{de^*}{d\sigma_r^2} + \frac{de_x^*}{d\sigma_r^2} + \lambda\left(\eta_e \frac{de^*}{d\sigma_r^2} + \frac{de_y^*}{d\sigma_r^2}\right) > 0$;
where $\chi_f = \left(\Sigma_f - \theta_\phi^2 \sigma_\phi^2 \frac{\eta_\phi^2 \sigma_\phi^2}{\Sigma_r}\right)^2$ *and* $\chi_r = \left(\Sigma_r - \eta_\phi^2 \sigma_\phi^2 \frac{\theta_\phi^2 \sigma_\phi^2}{\Sigma_f}\right)^2$.

Recall from Lemma 2 that both financial and ESG reports inform investors about the firm's cash flows and ESG performance. Both reports' response coefficients contain a term describing learning about the main dimension of the report (cash flows or ESG), reduced because of reporting noise relative to residual variance, and a term describing learning about the other dimension. This latter term is higher if the other report about the other dimension is less informative.

First, consider the ERC. When the ESG report becomes noisier (σ_r^2 increases), the amount of residual variance of the firm's cash flow increases because investors do not learn as much about cash flows from the ESG report. Therefore, the ratio of the noise in the financial report to the residual variance, and thus a reduction due to this noise, decreases. This effect pushes the ERC up. The summand $\frac{\theta_\phi^2 \eta_\phi^2 \sigma_\phi^4 \sigma_f^2}{\chi_f \Sigma_r} > 0$ represents the increase in the ERC due to this increase in its first term. As for the second term, the noisier the ESG report, the more valuable is the cash flow report to learn about the firm's ESG performance. The sign of this learning depends on the sign of the relation between cash flow and ESG performance. The summand $\lambda \theta_\phi \eta_\phi \sigma_\phi^2 \frac{\Sigma_f \sigma_y^2 + \left(\sigma_x^2 + \sigma_f^2\right)\eta_\phi^2 \sigma_\phi^2}{\Sigma_r^2 \chi_f} \propto \theta_\phi$ represents the change in the second term of the ERC. How the ERC changes when σ_r^2 changes depends on the sum of the effects on the two terms.

The ESG-RC changes with σ_r^2 according to a similar logic. When σ_r^2 increases, σ_r^2 as a proportion of residual variance of ESG after the cash flow report increases, increasing the reduction in the ESG-RC due to its noise and pushing the ESG-RC down. This effect is represented by the summand $-\lambda \frac{\Sigma_f \sigma_y^2 + \left(\sigma_x^2 + \sigma_f^2\right)\eta_\phi^2 \sigma_\phi^2}{\Sigma_f \chi_r} < 0$. For the second term, when the ESG report is noisier, it is less useful for learning about the firm's cash flows. The summand $-\frac{\theta_\phi \eta_\phi \sigma_\phi^2 \sigma_f^2}{\Sigma_f \chi_r} \propto -\theta_\phi$ represents this reduction in the usefulness of the ESG report. The ultimate

effect of the change in the noise, σ_r^2, depends on the sum of the two effects.

Changes in the manager's efforts when ESG reporting becomes more precise depend on changes in price responses and the effects of the manager's efforts on the financial and ESG reports. When the ERC or the ESG-RC increase, the marginal benefit from a unit of the manager's effort increases. For example, for the joint ESG-cash-flow effort, imagine that after the ESG reporting quality improves, the ESG-RC increases but the ERC decreases. Since the joint effort increases ESG ($\eta_e > 0$), the increase in the ESG-RC will push the manager's optimal level of joint effort up. Whether the ERC decrease pushes the joint effort down or up depends on the effect of the joint effort on cash flows (θ_e). If the joint effort increases cash flows, the manager will prefer to reduce the effort when the ERC decreases. If the joint effort reduces cash flows, the manager will prefer to increase the effort. The overall effect of increased ESG reporting quality depends on the sum of the two forces.

How the firm's expected cash flows, ESG performance, and price will change, in turn, depend on: (1) how the manager's optimal effort choices change; and (2) the productivities of these efforts. For example, if more precise ESG reporting, via changes in price responses, cause the manager to choose higher levels of e and e_y, then expected ESG performance will increase.

7 Extensions

In this section, we consider three extensions of our model. In the first extension, we allow for financial misreporting and greenwashing. In the second extension, we make the costs of ESG-related efforts a function of the fraction of ESG-conscious investors in the market. In the third extension, we discuss how the results are affected if we assume the fraction of ESG-concerned investors increases after the introduction of ESG reporting.

7.1 Financial misreporting and greenwashing

Our main model specification assumes that the reports about the firm's cash flows and ESG performance are noisy but unbiased reports to investors. In reality, however, firms might have incentives to overstate their financial and ESG performance. Also, more recently, various corporate stakeholders have raised concerns about greenwashing (see, for example, Toplensky (2023), Financial Times (2024)), or corporations misrepresenting their ESG performance in public reports. Concerns have extended to green-hushing, whereby firms downplay their ESG-related activities when facing anti-ESG threats (e.g., Fisher et al., 2023).

We extend our model to allow the manager to bias cash flow and ESG reports at a cost. Specifically, in period 0, after the manager chooses their efforts and learns shocks to cash flows and ESG performance (ϕ, ε_x, and ε_y), the manager can choose the values of the cash flow and ESG reports that are provided to investors, f and r.

Following Dye and Sridhar (2004), we incorporate randomness in the reporting environment, captured by ε_r and ε_f, into the manager's reporting cost function. This prevents investors from fully unraveling the equilibrium reporting biases. Specifically, the manager's reporting cost of choosing the financial report, f, after they observe ϕ, ε_x, and ε_f, is $\frac{c_f}{2}\left(f-\theta_e e-\theta_\phi\phi-e_x-\varepsilon_x-\varepsilon_f\right)^2$, with $c_f>0$ capturing costs of financial misreporting. The manager's reporting cost of choosing the ESG report, r, after they observe ϕ, ε_y, and ε_r, is $\frac{c_r}{2}\left(r-\eta_e e-\eta_\phi\phi-e_y-\varepsilon_y-\varepsilon_r\right)^2$, with $c_r>0$ capturing the cost of misreporting ESG performance. Both financial and ESG misreporting costs might be driven by litigation or reputation concerns, as well as by direct costs of using accounting or ESG reporting discretion in the manager's favor.

The manager's modified utility function is

$$\begin{aligned} u_m = \quad & p-\frac{c_e}{2}e^2-\frac{c_x}{2}e_x^2-\frac{c_y}{2}e_y^2 \\ & -\frac{c_f}{2}\left(f-\theta_e e-\theta_\phi\phi-e_x-\varepsilon_x-\varepsilon_f\right)^2-\frac{c_r}{2}\left(r-\eta_e e-\eta_\phi\phi-e_y-\varepsilon_y-\varepsilon_r\right)^2. \end{aligned}$$

The lemma below describes the equilibrium of the modified model with financial misreporting and greenwashing.

Lemma 3 *In equilibrium in the model with financial misreporting and greenwashing, the manager's efforts, expected cash flows and ESG performance, the ex-ante stock price, and financial and ESG reports are given by* $e^{\ddagger} = \frac{\psi_r^{\ddagger}\eta_e + \psi_f^{\ddagger}\theta_e}{c_e}$, $e_x^{\ddagger} = \frac{\psi_f^{\ddagger}}{c_x}$, $e_y^{\ddagger} = \frac{\psi_r^{\ddagger}}{c_y}$, $E\left[x^{\ddagger}\right] = \theta_e \frac{\psi_r^{\ddagger}\eta_e + \psi_f^{\ddagger}\theta_e}{c_e} + \theta_\phi \bar{\phi} + \frac{\psi_f^{\ddagger}}{c_x}$, $E\left[y^{\ddagger}\right] = \eta_e \frac{\psi_r^{\ddagger}\eta_e + \psi_f^{\ddagger}\theta_e}{c_e} + \eta_\phi \bar{\phi} + \frac{\psi_r^{\ddagger}}{c_y}$, $E\left[p^{\ddagger}\right] = E\left[x^{\ddagger}\right] + \lambda E\left[y^{\ddagger}\right] - \rho\Sigma_x$, $f^{\ddagger} = \frac{\psi_f^{\ddagger}}{c_f} + x^{\ddagger} + \varepsilon_f$, *and* $r^{\ddagger} = \frac{\psi_r^{\ddagger}}{c_r} + y^{\ddagger} + \varepsilon_r$, *where* $\psi_f^{\ddagger} = \psi_f^*$ *and* $\psi_r^{\ddagger} = \psi_r^*$ *are price responses to the financial and ESG reports in the main model specification.*

When the manager can choose the values of financial and ESG reports, the manager in expectation biases the reports in equilibrium proportionally to the price responses to the financial and ESG reports (terms $\frac{\psi_f^{\ddagger}}{c_f}$ and $\frac{\psi_r^{\ddagger}}{c_r}$). Investors anticipate the expected biases and adjust for them in equilibrium.

The key insight from the model with misreporting is that all ESG efforts (the joint ESG-cash-flow effort, e, and the ESG-only effort, e_y) and greenwashing increase in the ESG-RC. The stronger the market reacts to an additional reported unit of ESG, the more the manager exerts the productive (e_y and e) and the unproductive (misreporting) efforts to boost the reported ESG performance. This finding goes against the intuition that corporations that greenwash are those that do worse on their real ESG performance. We find that corporations' exaggeration of their ESG performance is more likely when their actual ESG efforts are also higher, due to capital market incentives for both.

As for financial misreporting, the bias in the cash flow report is proportional to the ERC. The effect of introducing ESG reporting on financial misreporting thus depends on whether, as a result of the introduced ESG reporting, the ERC increases or decreases. If ESG reporting increases the ERC, financial misreporting is exacerbated (and cash-flow-related efforts increase); if ESG reporting decreases the ERC, financial misreporting is mitigated (and cash-flow-related efforts decrease).

Another interesting observation is about the cross-relations between greenwashing and

expected cash flows and between financial misreporting and ESG performance. These cross-relations depend on whether the manager's joint ESG-cash-flow effort has a positive or negative impact on the firm's cash flows. If cash flows and ESG performance are negatively related through the manager's effort ($\theta_e < 0$), more greenwashing goes together with lower cash flows, and more financial misreporting goes together with lower ESG performance. When the ESG-RC is higher, the manager greenwashes more ($\frac{\psi_r^\ddagger}{c_r}$ is higher) and at the same time sacrifices cash flows to deliver a higher ESG report to the market through a lower cash flow report ($\frac{\theta_e \eta_e \psi_r^\ddagger}{c_e}$ is lower). Similarly, when the ERC is higher, the manager biases the cash flow report upwards ($\frac{\psi_f^\ddagger}{c_f}$ is higher) and at the same time sacrifices ESG performance to deliver a higher cash flow report to the market ($\frac{\theta_e \eta_e \psi_f^\ddagger}{c_e}$ is lower). If cash flows and ESG performance are positively related through the manager's effort ($\theta_e > 0$), the intuition is similar to the discussion above about greenwashing and financial misreporting having the same drivers as ESG performance and cash flows, respectively. When the ESG-RC is higher, the manager greenwashes more and exerts a higher cash flow effort to produce a high ESG performance report ($\frac{\theta_e \eta_e \psi_r^\ddagger}{c_e}$ is higher). When the ERC is higher, the manager misreports more and exerts a higher ESG effort to produce a high ESG performance report ($\frac{\theta_e \eta_e \psi_f^\ddagger}{c_e}$ is higher). The relation between cash flows and ESG performance through a manager's effort is a channel through which reporting on one dimension of the firm's performance (e.g., ESG) affects the other dimension (e.g., cash flows).

7.2 Correlation between investors' ESG concerns and the costs of ESG efforts and greenwashing

In the baseline model and the model discussed in the previous section, we treat the manager's costs of ESG efforts and greenwashing as exogenously given. It is possible, though, that investors affect these costs at least to some extent by imposing restrictions on the firm or

encouraging a corporate strategy consistent with their preferences.[23] In this section, we consider an extension where we allow the costs of ESG efforts and greenwashing to vary with the fraction of ESG-conscious investors on the market.

We modify the manager's cost functions in the model presented in the previous section: the new costs of ESG-only and joint ESG-cash-flow efforts are $\frac{c_y}{2}\left(e_y - z_y\lambda\right)^2$ and $\frac{c_e}{2}\left(e - z_e\lambda\right)^2$, respectively, and the new cost of greenwashing is $\frac{c_r}{2}\left(r - \eta_e e - \eta_\phi\phi - e_y - \varepsilon_y - \varepsilon_r - z_r\lambda\right)^2$. The parameters z_e, z_y, and z_r capture the way in which investors' preferences impact the cost-minimizing efforts and ESG report. By doing so, they introduce a direct effect of investor preferences on corporate actions, separate from effects that run through price via the ERC and ESG-RC. For instance, in the model where the cost of ESG-only effort is unrelated to investors' preferences, the cost-minimizing ESG-only effort is zero. In the modified model, the cost-minimizing ESG-only effort is a function of investors' preferences – $z_y\lambda$ such that $z_y > 0$ will shift the optimal e_y up as λ increases. The parameters z_e, z_y, and z_r can be positive or negative. For example, if ESG-conscious investors have a lot of power over the company management's strategy choice and prefer rather conservative sustainability reporting, z_e and z_y would be positive, and z_r would be negative.

The lemma below provides the equilibrium of the extended model in which investors' ESG preferences directly affect managerial incentives.

Lemma 4 *In equilibrium in the model where the manager's costs of ESG and ESG-cash-flow efforts and greenwashing depend on the fraction of ESG-conscious investors, the manager's efforts, expected cash flows and ESG performance, the ex-ante stock price, and financial and ESG reports are given by* $e^{¤} = z_e\lambda + \frac{\psi_r^{¤}\eta_e + \psi_f^{¤}\theta_e}{c_e}$, $e_x^{¤} = \frac{\psi_f^{¤}}{c_x}$, $e_y^{¤} = z_y\lambda + \frac{\psi_r^{¤}}{c_y}$,

$$E\left[x^{¤}\right] = \theta_e\left(z_e\lambda + \frac{\psi_r^{¤}\eta_e + \psi_f^{¤}\theta_e}{c_e}\right) + \theta_\phi\bar{\phi} + \frac{\psi_f^{¤}}{c_x},$$

$$E\left[y^{¤}\right] = \eta_e\left(z_e\lambda + \frac{\psi_r^{¤}\eta_e + \psi_f^{¤}\theta_e}{c_e}\right) + \eta_\phi\bar{\phi} + \left(z_y\lambda + \frac{\psi_r^{¤}}{c_y}\right),$$

[23] For example, Dikolli et al. (2022) find that U.S. mutual funds with ESG-related objectives "are more likely than other mutual funds to vote in support of environmental and social (ES) shareholder proposals and governance (G) shareholder proposals."

$E[p^{\text{¤}}] = E[x^{\text{¤}}] + \lambda E[y^{\text{¤}}] - \rho\Sigma_x$, $f^{\text{¤}} = \frac{\psi_f^{\text{¤}}}{c_f} + x^{\text{¤}} + \varepsilon_f$, $r^{\text{¤}} = z_r\lambda + \frac{\psi_r^{\text{¤}}}{c_r} + y^{\text{¤}} + \varepsilon_r$, *where* $\psi_f^{\text{¤}} = \psi_f^*$ *and* $\psi_r^{\text{¤}} = \psi_r^*$ *are price responses to the financial and ESG reports in the main model specification.*

Introducing a direct relation between investors' preferences and the costs of efforts and greenwashing allows us to consider and contrast direct and indirect effects of investor preferences. The baseline model incorporated the effects of investor preferences only indirectly—through the price responses to the financial and ESG reports, ψ_f^* and ψ_r^*. The modified model in addition includes direct impacts of investor preferences on the manager's choices. In particular, the manager's ESG-only and joint ESG-cash-flow efforts and ESG report are shifted by the respective effects of investor preferences. To illustrate, if ESG-conscious investors require some minimal level of ESG activities at a firm, the manager would take at least $z_y\lambda$ of ESG effort and the company's ESG performance would be at least $z_y\lambda$ higher, even without any stock market incentives. This increase is due to the direct effect of investor preferences. In addition, if the proportion of ESG-interested investors increases the price response to the ESG report, $\frac{\partial\psi_r^{\text{¤}}}{\partial\lambda} > 0$, the manager's ESG-only effort would increase even more, through the $\frac{\psi_r^{\text{¤}}}{c_y}$ component. Similarly, the extension here can capture investors imposing direct costs on the company's greenwashing. If investors' ESG-consciousness is negatively related to the greenwashing investors tolerate ($z_r < 0$), the direct effect ($z_r\lambda$) would reduce the level of greenwashing, while the indirect effect $\left(\frac{\psi_r^{\text{¤}}}{c_r}\right)$ will push greenwashing up.

Note that the ERC and ESG-RC are the same as in the main model. This is because the market responses to the reports are based on what can be learned from the reports. The extension builds a relation between investor preferences and corporate actions via the cost function, whose effects can be anticipated by investors. Alternative modeling choices or institutional details, particularly involving investors learning about managerial incentives from the financial and/or ESG reports, would lead to changes in the equilibrium ERC and ESG-RC.

7.3 Disclosure-related change in investors' ESG concerns

When investors have limited awareness of ESG issues, the introduction of ESG disclosure has the potential to raise investors' ESG concerns. For example, when firms start disclosing their CO_2 emissions, the media may start publishing industry-specific emissions rankings. Investors may then develop a distaste for high emissions that they did not have before the disclosure, e.g., because the media provides social cues about what is important.

In the model, we can represent such a situation by assuming that without ESG reporting, the fraction of type-2 investors is λ_1 whereas with the introduction of ESG reporting, the fraction of type-2 investors is $\lambda_2 > \lambda_1$. This adjustment to the model would add a second economic force to the results. In particular, prices and response coefficients in Lemmas 1 and 2 each have a component that reflects the type-2 investors' interest in the firm's ESG performance. This component will receive a higher weight following the introduction of ESG reporting because the fraction of type-2 investors increases. As a result, for $\theta_\phi < 0$ the ERC is less likely to increase. The reason that the ERC increases (in the baseline model) is that the previous negative weight that type-2 investors applied to the financial report becomes less negative. However, type-2 investors continue to apply a negative weight. Therefore, when $\lambda_2 > \lambda_1$, more investors apply a negative weight to the financial report, even though the negative weight per investor is less than without the ESG report. Whether the ERC can continue to increase as a result of the ESG reporting depends on parameter values. For $\theta_\phi > 0$, the ERC always decreases because all investors place a lower weight on the financial report (in the presence of a second informative report). Again, the increase in λ provides a countervailing force because more investors now place an additional positive weight. The ERC can even increase as a result of introducing ESG reporting.

As far as prices are concerned, the firm's expected ESG performance will receive a higher weight. As a result, prices are more likely to increase (decrease) for firms with positive (negative) baseline expected ESG performance. That is, while expected cash flows and expected ESG performance do not play a role for the changes we document in Section 5,

the firm's baseline expected ESG performance does play a role when the fraction of type-2 investors changes.

8 Applications

8.1 Empirical implications for the introduction of ESG reports

Our results in the Lemmas, Propositions, and Corollaries above have testable empirical implications around the introduction of ESG reporting. The three focal outcomes in our Propositions all have natural and familiar empirical analogues. The ESG-RC and ERC are market reactions to information releases, which can be estimated via regressions of returns on proxies for the information in the ESG or financial reports.[24] Ex-ante prices are observable for listed firms, though researchers will have to make choices about measurement timing (e.g., how long in advance of report releases should ex-ante prices be captured).

Empirical implementations of our predictions benefit from consideration of the relation between ESG and cash flow performance (θs) and the fraction of investors concerned about ESG performance (λ). The former plausibly varies across industries and business models, and with variation in subsidies or taxes tied to ESG activities, such as renewable energy production or consumption. The latter may be captured by variation in the types of owners, including PRI signatories or EU funds categorized under Articles 8 or 9 of the SFDR (Sustainable Finance Disclosure Regulation).

Taking our Propositions to the data, we predict that ESG-RCs will be more positive when θ and λ are more positive; market responses to ESG reports may be negative for firms with low λ if $\theta < 0$. We expect ERCs to decrease (increase) modestly with the introduction of ESG reporting when $\theta >> 0$ ($\theta << 0$), and expect to see larger decreases in ERCs when

[24] Estimating the novel information content in financial reports is non-trivial, with analyst forecasts or time series models used to proxy for the expected component of the report. Estimating the information content of ESG reports is plausibly more difficult, though time series models for, e.g., emissions expectations are feasible.

θ is moderately positive (see Figure 1). Ex-ante price is predicted to have small positive reactions to the introduction of ESG reporting when the cash flow implications of ESG activities are large in absolute terms ($|\theta| >> 0$), with potentially negative reactions when the effect on cash flows is *moderately* negative (see Figure 2). Empirical studies can test our predictions in a setting where θ can be ordered and using a specification that would allow for non-monotonicity in ERCs, prices, and ESG-RCs. These predictions can be operationalized around the passage of ESG reporting mandates, firm-specific adoptions, or news/legislative events that affect the probability or scope of ESG reporting, similar to prior studies on the effects of the Sarbanes-Oxley Act or IFRS adoption (e.g., Armstrong et al., 2010; Jain and Rezaee, 2006).

Our analysis focuses on how variation in λ and θ_e affect the implications of introducing ESG reporting for ERCs, expected cash flows, and expected ESG performance. The latter two could be captured by future performance, as reflected in realized cash flows, ESG ratings, emissions, or identified ESG controversies. Our extension in Section 7.1 shows how managerial greenwashing responds to capital market incentives, which drives relations between greenwashing, financial misreporting, ERCs, ESG-RCs, and pricing. Just like financial misreporting, measuring greenwashing can be difficult empirically (Bernini et al., 2024). Our extensions in Sections 7.2 and 7.3 illustrate how managerial concerns linked to investor preferences and direct effects of ESG reporting on investor preferences would affect our results, leading to additional implications for settings that feature these effects.

Although we focus on ESG reporting, our results are plausibly applicable to settings in which ESG information is released by third parties. In our main model, there is nothing that specifically restricts the ESG report, r, to come from the firm, rather than representing new ESG ratings coverage. Our results speak to how such coverage can affect stock prices, ERCs, and corporate activities. Corollary 1 covers the case of changes in the quality of pre-existing ESG reporting, rather than a *de novo* introduction.

8.2 Implications for other settings

The central features of our modeled setting are: 1) investor disagreement about whether ESG performance is valuable; and 2) the introduction of ESG reporting. There are many other settings where our model may be applicable, due to investor disagreement (feature 1) and novel reporting (feature 2). For instance, investors may disagree about the value implications of certain R&D investments. As well, mandatory disclosures about innovation, whether in securities or patent-related filings, have increased over time. Our model can help researchers understand how the introduction of new patent disclosures (e.g., around patent filing rather than granting) can affect corporate incentives and ERCs. Similarly, investors can take different views on the importance of management and analyst forecasts, particularly over long horizons. Our model shows that the implications of introducing long-horizon forecasts depend on whether long- and short-term performance are complements or substitutes. Accounting standard setters and securities regulators have also introduced or are considering introducing additional disclosures around corporate taxes (Accounting Standards Update [ASU] 2023-09), digital asset holdings (ASU 2023-08), and executive compensation[25] Our model, with some relabeling, could provide guidance on how the introduction of reporting on these corporate activities could affect ERCs and firm value.

As a final note, there are two edge cases of our model that capture no-disagreement settings: $\lambda \in \{0, 1\}$. When $\lambda = 0$, no investors specifically value ESG performance (or R&D, tax strategies, etc.), our model collapses to one in which there is only one important dimension of performance and second noisy report is introduced. Investors still react to the new disclosure because it is informative about financial performance. Similarly, when $\lambda = 1$, all investors value ESG/other performance. Interactions between the two disclosures continue to be important, with effects driven by forces discussed above. Disagreement, while descriptive of the ESG investor setting, is not necessary for many of our predictions above.

[25]The Compensation Discussion and Analysis (CD&A) disclosures were mandated in 2006. See for details and Bloomfield (2021) for analysis of the effect of these disclosures on competition.

9 Conclusion

In response to growing interest in ESG reporting, we develop a framework for considering the effects of introducing ESG reports to a capital market setting featuring existing financial reporting. We show how introducing the ESG report affects stock prices, market responses to financial reports, and corporate activities. We provide conditions related to measurable economic constructs that characterize when investors can be expected to react favorably, on average, to ESG reports, and when introducing ESG reporting will tend to increase or decrease ERCs and stock prices.

Overall, our paper contributes to the emerging literature on ESG reporting, providing a framework for developing and interpreting empirical results in a capital market setting. While we focus on a setting with expanding ESG reporting, our results are also applicable to recent shifts away from expansionary policy in sustainability reporting. Though our results highlight the importance of investor preferences, we view welfare implications as important but outside the scope of our endeavor. We also focus on corporate incentives provided by market pricing, rather than explicit compensation contracts. Considering welfare and contracting is likely to result in additional interesting implications of the expansion or contraction of ESG reporting and shifts in investors' interests in firms' ESG performance. Exploring these, however, requires care around the specification of regulatory and welfare objectives and clarity on how corporate governance structures balance different investors' preferences in the contracting process.

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A Proofs and Additional Analysis

A.1 Proof of Lemmas 1 and 2

We solve for the model with both reports via backward induction, then derive the equilibrium of Lemma 1 as a special case.

Given the CARA-normal setting, share demands are given by $q_1 = \frac{E[x|r,f]-p}{\rho Var[x|r,f]}$ and $q_2 = \frac{E[x+y|r,f]-p}{\rho Var[x|r,f]}$. Substituting demands into the market clearing condition $1 = \lambda q_2 + (1-\lambda) q_1$ gives the price function as

$$\begin{aligned} 1 &= \lambda \frac{E[x+y|r,f]-p}{\rho Var[x|r,f]} + (1-\lambda)\frac{E[x|r,f]-p}{\rho Var[x|r,f]} \\ \Leftrightarrow p &= E[x|r,f] + \lambda E[y|r,f] - \rho Var[x|r,f]. \end{aligned} \tag{4}$$

Conjecture that the manager's choices of effort in equilibrium are constants: $e^\dagger = \alpha_e, e_x^\dagger = \alpha_x, e_y^\dagger = \alpha_y$.

The joint distribution of x, y, f, and r is:

$$\begin{pmatrix} \tilde{x} \\ \tilde{y} \\ \tilde{r} \\ \tilde{f} \end{pmatrix} \sim N\left(\begin{pmatrix} \theta\alpha_e + \theta_\phi\bar{\phi} + \alpha_x \\ \eta_e\alpha_e + \eta_\phi\bar{\phi} + \alpha_y \\ \eta_e\alpha_e + \eta_\phi\bar{\phi} + \alpha_y \\ \theta\alpha_e + \theta_\phi\bar{\phi} + \alpha_x \end{pmatrix}, \begin{pmatrix} \theta_\phi^2\sigma_\phi^2 + \sigma_x^2 & \theta_\phi\eta_\phi\sigma_\phi^2 & \theta_\phi\eta_\phi\sigma_\phi^2 & \theta_\phi^2\sigma_\phi^2 + \sigma_x^2 \\ . & \eta_\phi^2\sigma_\phi^2 + \sigma_y^2 & \eta_\phi^2\sigma_\phi^2 + \sigma_y^2 & \theta_\phi\eta_\phi\sigma_\phi^2 \\ . & . & \eta_\phi^2\sigma_\phi^2 + \sigma_y^2 + \sigma_r^2 & \theta_\phi\eta_\phi\sigma_\phi^2 \\ . & . & . & \theta_\phi^2\sigma_\phi^2 + \sigma_x^2 + \sigma_f^2 \end{pmatrix} \right)$$

Conditional means are given by

$$\begin{aligned} E\left[\begin{matrix} \tilde{x} \\ \tilde{y} \end{matrix} \middle| r, f \right] = & \begin{bmatrix} \theta\alpha_e + \theta_\phi\bar{\phi} + \alpha_x \\ \eta_e\alpha_e + \eta_\phi\bar{\phi} + \alpha_y \end{bmatrix} + \begin{bmatrix} \theta_\phi\eta_\phi\sigma_\phi^2 & \theta_\phi^2\sigma_\phi^2 + \sigma_x^2 \\ \eta_\phi^2\sigma_\phi^2 + \sigma_y^2 & \theta_\phi\eta_\phi\sigma_\phi^2 \end{bmatrix} \\ & \begin{bmatrix} \eta_\phi^2\sigma_\phi^2 + \sigma_y^2 + \sigma_r^2 & \theta_\phi\eta_\phi\sigma_\phi^2 \\ \theta_\phi\eta_\phi\sigma_\phi^2 & \theta_\phi^2\sigma_\phi^2 + \sigma_x^2 + \sigma_f^2 \end{bmatrix}^{-1} \begin{bmatrix} r - (\eta_e\alpha_e + \eta_\phi\bar{\phi} + \alpha_y) \\ f - (\theta\alpha_e + \theta_\phi\bar{\phi} + \alpha_x) \end{bmatrix} \end{aligned}$$

Simplifying,

$$
\begin{aligned}
E\left[\tilde{x}|r,f\right] = & \quad \theta_e\alpha_e + \theta_\phi\bar{\phi} + \alpha_x \\
& + \frac{\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2}{\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)-\theta_\phi^2\eta_\phi^2\sigma_\phi^4}\left(r-\left(\eta_e\alpha_e+\eta_\phi\bar{\phi}+\alpha_y\right)\right) \\
& + \frac{\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2\right)\left(\sigma_y^2+\sigma_r^2\right)+\eta_\phi^2\sigma_x^2\sigma_\phi^2}{\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)-\theta_\phi^2\eta_\phi^2\sigma_\phi^4}\left(f-\left(\theta\alpha_e+\theta_\phi\bar{\phi}+\alpha_x\right)\right) \\
E\left[\tilde{y}|r,f\right] = & \quad \eta_e\alpha_e + \eta_\phi\bar{\phi} + \alpha_y \\
& + \frac{-\theta_\phi^2\eta_\phi^2\sigma_\phi^4+\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2\right)}{\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)-\theta_\phi^2\eta_\phi^2\sigma_\phi^4}\left(r-\left(\eta_e\alpha_e+\eta_\phi\bar{\phi}+\alpha_y\right)\right) \\
& + \frac{\theta_\phi\eta_\phi\sigma_\phi^2\sigma_r^2}{\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)-\theta_\phi^2\eta_\phi^2\sigma_\phi^4}\left(f-\left(\theta\alpha_e+\theta_\phi\bar{\phi}+\alpha_x\right)\right)
\end{aligned}
$$

Knowing that $p = E\left[x|r,f\right] + \lambda E\left[y|r,f\right] - \rho Var\left[x|r,f\right]$, the response coefficients are

$$
\begin{aligned}
\psi_f^* \equiv \frac{\partial p}{\partial f} = & \quad \frac{\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2\right)\left(\sigma_y^2+\sigma_r^2\right)+\eta_\phi^2\sigma_x^2\sigma_\phi^2+\lambda\left(\theta_\phi\eta_\phi\sigma_\phi^2\sigma_r^2\right)}{\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)-\theta_\phi^2\eta_\phi^2\sigma_\phi^4} \\
\psi_r^* \equiv \frac{\partial p}{\partial r} = & \quad \frac{\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2+\lambda\left(-\theta_\phi^2\eta_\phi^2\sigma_\phi^4+\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2\right)\right)}{\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)-\theta_\phi^2\eta_\phi^2\sigma_\phi^4}
\end{aligned}
$$

The manager's problem (reduced to only controlled parts) is

$$
\begin{aligned}
\max_{e,e_x,e_y} \quad & \psi_r^*\left(\eta_e e+\eta_\phi\phi+e_y\right)+\psi_f^*\left(\theta_e e+\theta_\phi\phi+e_x\right)-\tfrac{c_e}{2}e^2-\tfrac{c_x}{2}e_x^2-\tfrac{c_y}{2}e_y^2 \\
\Rightarrow \quad & e^* = \frac{\psi_r^*\eta_e+\psi_f^*\theta_e}{c_e}, e_x^* = \frac{\psi_f^*}{c_x}, e_y^* = \frac{\psi_r^*}{c_y}
\end{aligned}
$$

Lemma 1 can be derived by setting $\sigma_r^2 \to \infty$.

A.2 Proof of Propositions 1, 2, and 3

The ESG-RC can be written as

$$
\begin{aligned}
\psi_r^* = & \quad \frac{1}{\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)\left(\left(\sigma_x^2+\sigma_f^2\right)\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)+\theta_\phi^2\sigma_\phi^2\left(\sigma_y^2+\sigma_r^2\right)\right)} \\
& \times\left(\lambda\left(\eta_\phi^2\sigma_\phi^2\left(\sigma_x^2+\sigma_f^2\right)+\sigma_y^2\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)\right)+\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2\right)\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)
\end{aligned}
$$

The ESG-RC is positive when

$$\left(\lambda\left(\eta_\phi^2\sigma_\phi^2\left(\sigma_x^2+\sigma_f^2\right)+\sigma_y^2\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)\right)+\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2\right)\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)>0$$

$$\Sigma_f\left(\lambda\left(\sigma_y^2\Sigma_f+\eta_\phi^2\sigma_\phi^2\left(\sigma_x^2+\sigma_f^2\right)\right)+\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2\right)$$

$$\lambda>\frac{-\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2}{\sigma_y^2\Sigma_f+\eta_\phi^2\sigma_\phi^2\left(\sigma_x^2+\sigma_f^2\right)}$$

The change in ERC can be written as

$$\begin{aligned}
\psi_f^*-\psi_f^\dagger &= \frac{\theta_\phi^2\sigma_\phi^2\left(\sigma_y^2+\sigma_r^2\right)+\sigma_x^2\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)}{\left(\sigma_x^2+\sigma_f^2\right)\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)+\theta_\phi^2\sigma_\phi^2\left(\sigma_y^2+\sigma_r^2\right)}-\frac{\theta_\phi^2\sigma_\phi^2+\sigma_x^2}{\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2} \\
&\quad +\lambda\left(\frac{\theta_\phi\eta_\phi\sigma_\phi^2\sigma_r^2}{\left(\sigma_x^2+\sigma_f^2\right)\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)+\theta_\phi^2\sigma_\phi^2\left(\sigma_y^2+\sigma_r^2\right)}-\frac{\theta_\phi\eta_\phi\sigma_\phi^2}{\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2}\right) \\
&= \frac{1}{\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)\left(\left(\sigma_x^2+\sigma_f^2\right)\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)+\theta_\phi^2\sigma_\phi^2\left(\sigma_y^2+\sigma_r^2\right)\right)} \\
&\quad \left[\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)\left(\theta_\phi^2\sigma_\phi^2\left(\sigma_y^2+\sigma_r^2\right)+\sigma_x^2\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)\right)\right. \\
&\quad -\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2\right)\left(\left(\sigma_x^2+\sigma_f^2\right)\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)+\theta_\phi^2\sigma_\phi^2\left(\sigma_y^2+\sigma_r^2\right)\right) \\
&\quad \left.+\lambda\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)\left(\theta_\phi\eta_\phi\sigma_\phi^2\sigma_r^2\right)-\lambda\theta_\phi\eta_\phi\sigma_\phi^2\left(\theta_\phi^2\sigma_\phi^2\left(\sigma_y^2+\sigma_r^2\right)+\left(\sigma_f^2+\sigma_x^2\right)\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)\right)\right] \\
&= \frac{\left(\theta_\phi^2\sigma_\phi^2\sigma_f^2\eta_\phi^2\sigma_\phi^2-\lambda\theta_\phi\eta_\phi\sigma_\phi^2\left(\theta_\phi^2\sigma_\phi^2\sigma_y^2+\left(\sigma_x^2+\sigma_f^2\right)\left(\sigma_y^2+\eta_\phi^2\sigma_\phi^2\right)\right)\right)}{\left(\theta_\phi^2\sigma_\phi^2+\sigma_x^2+\sigma_f^2\right)\left(\left(\sigma_x^2+\sigma_f^2\right)\left(\eta_\phi^2\sigma_\phi^2+\sigma_y^2+\sigma_r^2\right)+\theta_\phi^2\sigma_\phi^2\left(\sigma_y^2+\sigma_r^2\right)\right)}
\end{aligned}$$

The change in the ERC is positive when

$$\theta_\phi^2\sigma_\phi^2\sigma_f^2\eta_\phi^2\sigma_\phi^2-\lambda\theta_\phi\eta_\phi\sigma_\phi^2\left(\theta_\phi^2\sigma_\phi^2\sigma_y^2+\left(\sigma_x^2+\sigma_f^2\right)\left(\sigma_y^2+\eta_\phi^2\sigma_\phi^2\right)\right)>0$$

$$\theta_\phi\eta_\phi\sigma_\phi^2\left(\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2-\lambda\left(\sigma_y^2\Sigma_f+\eta_\phi^2\sigma_\phi^2\left(\sigma_x^2+\sigma_f^2\right)\right)\right)>0$$

$$\lambda\theta_\phi\eta_\phi<\frac{\theta_\phi^2\eta_\phi^2\sigma_\phi^2\sigma_f^2}{\sigma_y^2\Sigma_f+\eta_\phi^2\sigma_\phi^2\left(\sigma_x^2+\sigma_f^2\right)}$$

Because the change in the ERC and the ESG-RC can be re-written as fractions with the same denominator, the change in price, $\Delta p=\left(\psi_f^*-\psi_f^\dagger\right)\left(\left(\theta_e+\lambda\eta_e\right)\frac{\theta_e}{c_e}+\frac{1}{c_x}\right)+\psi_r^*\left(\left(\theta_e+\lambda\eta_e\right)\frac{\eta_e}{c_e}+\frac{\lambda}{c_y}\right)$,

is positive when

$$(\theta_e + \lambda\eta_e)\left(\frac{\theta_e}{c_e}\left(\theta_\phi^2\eta_\phi^2\sigma_\phi^2\sigma_f^2 - \lambda\theta_\phi\eta_\phi\sigma_\phi^2\chi\right) + \frac{\eta_e}{c_e}\left(\lambda\chi + \theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2\right)\Sigma_f\right)$$
$$+\frac{1}{c_x}\left(\theta_\phi^2\eta_\phi^2\sigma_\phi^2\sigma_f^2 - \lambda\theta_\phi\eta_\phi\sigma_\phi^2\chi\right) + \frac{\lambda}{c_y}\left(\lambda\chi + \theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2\right)\Sigma_f > 0,$$

where $\chi \equiv \sigma_y^2\Sigma_f + \eta_\phi^2\sigma_\phi^2\left(\sigma_x^2 + \sigma_f^2\right)$.

A.3 Proof of Corollary 1

In this section, we derive comparative statics with respect to the amount of noise in the ESG report, σ_r^2.

First, derive the comparative statics of the reduction in the first part of the ERC due to the noise in the financial report:

$$\frac{d}{d\sigma_r^2}\left(\frac{\sigma_f^2}{\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\Sigma_r}}\right) = -\frac{\sigma_f^2}{\left(\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\Sigma_r}\right)^2}\frac{\theta_\phi^2\eta_\phi^2\sigma_\phi^4}{\Sigma_r^2} < 0$$

The comparative statics of the second term in the ERC:

$$\frac{d}{d\sigma_r^2}\left(\lambda\theta_\phi\eta_\phi\sigma_\phi^2\frac{\sigma_r^2}{\Sigma_r\left(\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\Sigma_r}\right)}\right) =$$
$$\lambda\theta_\phi\eta_\phi\sigma_\phi^2\frac{\Sigma_r\left(\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\Sigma_r}\right) - \sigma_r^2\left(\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\Sigma_r} + \Sigma_r\frac{\theta_\phi^2\eta_\phi^2\sigma_\phi^4}{\Sigma_r^2}\right)}{\Sigma_r^2\left(\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\Sigma_r}\right)^2} =$$
$$\lambda\theta_\phi\eta_\phi\sigma_\phi^2\frac{\left(\sigma_y^2 + \eta_\phi^2\sigma_\phi^2\right)\left(\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\Sigma_r}\right) - \sigma_r^2\frac{\theta_\phi^2\eta_\phi^2\sigma_\phi^4}{\Sigma_r}}{\Sigma_r^2\left(\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\Sigma_r}\right)^2} =$$
$$\lambda\theta_\phi\eta_\phi\sigma_\phi^2\frac{-\theta_\phi^2\eta_\phi^2\sigma_\phi^4 + \Sigma_f\left(\sigma_y^2 + \eta_\phi^2\sigma_\phi^2\right)}{\Sigma_r^2\left(\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\Sigma_r}\right)^2} \propto \theta_\phi$$

The resulting comparative statics of the ERC:

$$\frac{d\psi_f^*}{d\sigma_r^2} = \frac{\sigma_f^2}{\left(\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\Sigma_r}\right)^2}\frac{\theta_\phi^2\eta_\phi^2\sigma_\phi^4}{\Sigma_r} + \lambda\theta_\phi\eta_\phi\sigma_\phi^2\frac{-\theta_\phi^2\eta_\phi^2\sigma_\phi^4 + \Sigma_f\left(\sigma_y^2 + \eta_\phi^2\sigma_\phi^2\right)}{\Sigma_r^2\left(\Sigma_f - \theta_\phi^2\sigma_\phi^2\frac{\eta_\phi^2\sigma_\phi^2}{\Sigma_r}\right)^2}$$

To derive the comparative statics of the ESG-RC, similarly, first derive the comparative statics of the first term in the ESG-RC:

$$\frac{d}{d\sigma_r^2}\left(\frac{\sigma_r^2}{\Sigma_r - \eta_\phi^2\sigma_\phi^2\frac{\theta_\phi^2\sigma_\phi^2}{\Sigma_f}}\right) = \frac{\eta_\phi^2\sigma_\phi^2 + \sigma_y^2 - \frac{\theta_\phi^2\eta_\phi^2\sigma_\phi^4}{\Sigma_f}}{\left(\Sigma_r - \eta_\phi^2\sigma_\phi^2\frac{\theta_\phi^2\sigma_\phi^2}{\Sigma_f}\right)^2} > 0$$

The comparative statics of the second term in the ESG-RC:

$$\frac{d}{d\sigma_r^2}\left(\frac{\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2}{\Sigma_f\left(\Sigma_r - \eta_\phi^2\sigma_\phi^2\frac{\theta_\phi^2\sigma_\phi^2}{\Sigma_f}\right)}\right) = -\frac{\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2}{\Sigma_f\left(\Sigma_r - \eta_\phi^2\sigma_\phi^2\frac{\theta_\phi^2\sigma_\phi^2}{\Sigma_f}\right)^2} \propto -\theta_\phi$$

The resulting comparative statics of the ESG-RC:

$$\frac{d\psi_r^*}{d\sigma_r^2} = -\lambda\frac{\eta_\phi^2\sigma_\phi^2 + \sigma_y^2 - \frac{\theta_\phi^2\eta_\phi^2\sigma_\phi^4}{\Sigma_f}}{\left(\Sigma_r - \eta_\phi^2\sigma_\phi^2\frac{\theta_\phi^2\sigma_\phi^2}{\Sigma_f}\right)^2} - \frac{\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2}{\Sigma_f\left(\Sigma_r - \eta_\phi^2\sigma_\phi^2\frac{\theta_\phi^2\sigma_\phi^2}{\Sigma_f}\right)^2}$$

The remaining conditions can be derived by differentiating the expressions for the effort levels, cash flows, ESG performance, and prices in Proposition 2.

A.4 Extension where the actions are costly to the firm

In this section, we consider a more general formulation of our model in which the firm bears convex costs (i.e., reductions to cash flow) related to e, e_y, and e_x.

The purpose of this section is to make more concrete the idea that e, e_y, and e_x can be interpreted as investments of firm resources (i.e., spending) that also requires managerial oversight, not just as costly personal efforts. Although we interpret θ_e as capturing the *net*

(i.e., after investment cost) benefit of e for cash flows, the main model assumes only a linear form for the effect on the firm. In this section, we add convex costs borne by the firm, which may reflect, for instance, adjustment costs for different levels of investment.

We define the new cash flow of the firm as $\tilde{x} = \theta_\phi \tilde{\phi} + \theta_e e + e_x - \frac{c_{fe}}{2} e^2 - \frac{c_{fx}}{2} e_x^2 - \frac{c_{fy}}{2} e_y^2 + \tilde{\varepsilon}_x$, and the ESG performance stays the same as in the original model. The new financial report is thus $\tilde{f} = \theta_\phi \tilde{\phi} + \theta_e e + e_x - \frac{c_{fe}}{2} e^2 - \frac{c_{fx}}{2} e_x^2 - \frac{c_{fy}}{2} e_y^2 + \tilde{\varepsilon}_x + \tilde{\varepsilon}_f$, and the ESG report stays the same. The manager's new utility function is $u_m = p - \frac{c_{me}}{2} e^2 - \frac{c_{mx}}{2} e_x^2 - \frac{c_{my}}{2} e_y^2$. Instead of c_e, c_x, and c_y in the original model, in the this extension we let c_{fe}, c_{fx}, and c_{fy} denote the marginal costs of efforts/investments/actions to the firm, and c_{me}, c_{mx}, and c_{my} denote the marginal costs of efforts/investments/actions to the manager.

Conjecture that the manager's choices of effort in equilibrium are constants: $e^* = \alpha_e, e_x^* = \alpha_x, e_y^* = \alpha_y$.

The joint distribution of x, y, f, and r is:

$$\begin{pmatrix} \tilde{x} \\ \tilde{y} \\ \tilde{r} \\ \tilde{f} \end{pmatrix} \sim N \left(\begin{pmatrix} \theta\alpha_e + \theta_\phi \bar{\phi} + \alpha_x - \frac{c_e}{2}\alpha_e^2 - \frac{c_x}{2}\alpha_x^2 - \frac{c_y}{2}\alpha_y^2 \\ \eta_e \alpha_e + \eta_\phi \bar{\phi} + \alpha_y \\ \eta_e \alpha_e + \eta_\phi \bar{\phi} + \alpha_y \\ \theta\alpha_e + \theta_\phi \bar{\phi} + \alpha_x - \frac{c_e}{2}\alpha_e^2 - \frac{c_x}{2}\alpha_x^2 - \frac{c_y}{2}\alpha_y^2 \end{pmatrix}, \right.$$
$$\left. \begin{pmatrix} \theta_\phi^2\sigma_\phi^2 + \sigma_x^2 & \theta_\phi\eta_\phi\sigma_\phi^2 & \theta_\phi\eta_\phi\sigma_\phi^2 & \theta_\phi^2\sigma_\phi^2 + \sigma_x^2 \\ . & \eta_\phi^2\sigma_\phi^2 + \sigma_y^2 & \eta_\phi^2\sigma_\phi^2 + \sigma_y^2 & \theta_\phi\eta_\phi\sigma_\phi^2 \\ . & . & \eta_\phi^2\sigma_\phi^2 + \sigma_y^2 + \sigma_r^2 & \theta_\phi\eta_\phi\sigma_\phi^2 \\ . & . & . & \theta_\phi^2\sigma_\phi^2 + \sigma_x^2 + \sigma_f^2 \end{pmatrix} \right)$$

Price responses to the financial and ESG report are the same as in the original model:

$$\begin{aligned} \psi_r^* &= \frac{\theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2 + \lambda\left(-\theta_\phi^2\eta_\phi^2\sigma_\phi^4 + \left(\theta_\phi^2\sigma_\phi^2 + \sigma_x^2 + \sigma_f^2\right)\left(\eta_\phi^2\sigma_\phi^2 + \sigma_y^2\right)\right)}{\left(\eta_\phi^2\sigma_\phi^2 + \sigma_y^2 + \sigma_r^2\right)\left(\theta_\phi^2\sigma_\phi^2 + \sigma_x^2 + \sigma_f^2\right) - \theta_\phi^2\eta_\phi^2\sigma_\phi^4} \\ \psi_f^* &= \frac{\left(\theta_\phi^2\sigma_\phi^2 + \sigma_x^2\right)\left(\sigma_y^2 + \sigma_r^2\right) + \eta_\phi^2\sigma_x^2\sigma_\phi^2 + \lambda\theta_\phi\eta_\phi\sigma_\phi^2\sigma_r^2}{\left(\eta_\phi^2\sigma_\phi^2 + \sigma_y^2 + \sigma_r^2\right)\left(\theta_\phi^2\sigma_\phi^2 + \sigma_x^2 + \sigma_f^2\right) - \theta_\phi^2\eta_\phi^2\sigma_\phi^4} \end{aligned}$$

The manager's problem (reduced to only controlled parts) is

$$\begin{aligned}
\max_{e,e_x,e_y} \quad & \psi_r^* \left(\eta_e e + \eta_\phi \phi + e_y\right) + \psi_f^* \left(\theta_e e + \theta_\phi \phi + e_x - \frac{c_{fe}}{2} e^2 - \frac{c_{fx}}{2} e_x^2 - \frac{c_{fy}}{2} e_y^2\right) \\
& - \frac{c_{m_e}}{2} e^2 - \frac{c_{m_x}}{2} e_x^2 - \frac{c_{m_y}}{2} e_y^2 \\
\Rightarrow \quad & e^* = \frac{\psi_r^* \eta_e + \psi_f^* \theta_e}{\psi_f^* c_{f_e} + c_{m_e}}, \quad e_x^* = \frac{\psi_f^*}{\psi_f^* c_{f_x} + c_{m_x}}, \quad \text{and} \quad e_y^* = \frac{\psi_r^*}{\psi_f^* c_{f_y} + c_{m_y}}
\end{aligned}$$

$$\begin{aligned}
E\left[x^*\right] &= \theta_e \frac{\psi_r^* \eta_e + \psi_f^* \theta_e}{\psi_f^* c_{f_e} + c_{m_e}} + \theta_\phi \bar{\phi} + \frac{\psi_f^*}{\psi_f^* c_{f_x} + c_{m_x}} \\
&\quad - \frac{c_{f_e}}{2} \left(\frac{\psi_r^* \eta_e + \psi_f^* \theta_e}{\psi_f^* c_{f_e} + c_{m_e}}\right)^2 - \frac{c_{f_x}}{2} \left(\frac{\psi_f^*}{\psi_f^* c_{f_x} + c_{m_x}}\right)^2 - \frac{c_{f_y}}{2} \left(\frac{\psi_r^*}{\psi_f^* c_{f_y} + c_{m_y}}\right)^2 \\
E\left[y^*\right] &= \eta_e \frac{\psi_r^* \eta_e + \psi_f^* \theta_e}{\psi_f^* c_{f_e} + c_{m_e}} + \eta_\phi \bar{\phi} + \frac{\psi_r^*}{\psi_f^* c_{f_y} + c_{m_y}} \\
E\left[p^*\right] &= E\left[x^*\right] + \lambda E\left[y^*\right] - \rho Var\left[x^*\right]
\end{aligned}$$

Note that we recover our main model by letting the firm's direct convex costs go to zero: $c_{fe}, c_{fx}, c_{fy} = 0$.

To obtain the equilibrium in the financial-report-only setting, set $\sigma_r^2 \to \infty$. The ERC is the same as in the original model. The manager's efforts, cash flows, and ESG performance are

$$\begin{aligned}
e^\dagger &= \frac{\psi_f^\dagger \theta_e}{\psi_f^\dagger c_{f_e} + c_{m_e}} \\
e_x^\dagger &= \frac{\psi_f^\dagger}{\psi_f^\dagger c_{f_x} + c_{m_x}} \\
e_y^\dagger &= 0 \\
E\left[x^\dagger\right] &= \theta_e \frac{\psi_f^\dagger \theta_e}{\psi_f^\dagger c_{f_e} + c_{m_e}} + \theta_\phi \bar{\phi} + \frac{\psi_f^\dagger}{\psi_f^\dagger c_{f_x} + c_{m_x}} - \frac{c_{f_e}}{2} \left(\frac{\psi_f^\dagger \theta_e}{\psi_f^\dagger c_{f_e} + c_{m_e}}\right)^2 - \frac{c_{f_x}}{2} \left(\frac{\psi_f^\dagger}{\psi_f^\dagger c_{f_x} + c_{m_x}}\right)^2 \\
E\left[y^\dagger\right] &= \eta_e \frac{\psi_f^\dagger \theta_e}{\psi_f^\dagger c_{f_e} + c_{m_e}} + \eta_\phi \bar{\phi}
\end{aligned}$$

$$E\left[p^{\dagger}\right] = E\left[x^{\dagger}\right] + \lambda E\left[y^{\dagger}\right] - \rho Var\left[x^{\dagger}\right].$$

A.5 Effects of changes in investor preferences

In this section, we study how changes in the fraction of ESG-conscious investors (λ) alter the effects of introducing ESG reporting. Specifically, we analyze the comparative statics of changes in ERC, expected cash flows, expected ESG performance, and ex-ante firm price with respect to the fraction of ESG-conscious investors, λ.

Several business press articles and academic studies have noted the secular increase in investor concerns over ESG, as exemplified in the massive run-up in ESG-related assets under management, the surge in PRI signatories, and increases in survey respondents who indicate ESG-related preferences in the past two decades (e.g., Hong and Shore, 2022; Kim and Yoon, 2022; Ľuboš Pástor et al., 2022). More recently, corporations have faced an anti-ESG movement from some politicians and investors (Winston, 2023), consistent with a decrease in λ. Besides time-series patterns, different jurisdictions or markets are likely to differ in the degree to which their investors display ESG concerns. Investors in coastal California, for instance, may be more concerned with climate change than investors in Texas's Permian Basin. The implications of temporal and cross-sectional patterns for the effects of introducing ESG reporting are borne out in the following corollary.

Corollary 2 *An increase in the fraction of investors who value the firm's ESG performance, λ, leads the introduction of ESG reporting to have:*

1. *A higher (lower) effect on the ERC if the correlation between the firm's cash flows and ESG performance is negative (positive):* $\frac{d\left(\psi_f^* - \psi_f^{\dagger}\right)}{d\lambda} \propto -\theta_{\phi}$.
2. *A higher (lower) effect on expected cash flows* $\left(\frac{d\left(E[x^*] - E\left[x^{\dagger}\right]\right)}{d\lambda} > 0\right)$ *if*

$$\frac{\theta_e \eta_e}{c_e} > (<) \frac{\theta_{\phi}\eta_{\phi}\sigma_{\phi}^2}{\theta_{\phi}^2\sigma_{\phi}^2 + \sigma_x^2 + \sigma_f^2}\left(\frac{\theta_e^2}{c_e} + \frac{1}{c_x}\right).$$

3. A lower (higher) effect on the expected ESG performance $\left(\frac{d\left(E[y^*]-E\left[y^\dagger\right]\right)}{d\lambda} > 0\right)$ *if*

$$\frac{\theta_\phi \eta_\phi \sigma_\phi^2}{\left(\theta_\phi^2 \sigma_\phi^2 + \sigma_x^2 + \sigma_f^2\right)} \frac{\theta_e \eta_e}{c_e} > (<) \left(\frac{\eta_e^2}{c_e} + \frac{1}{c_y}\right).$$

Corollary 2, part 1 focuses on the effects of introducing the ESG report on the market response to the financial report, i.e., the ERC. As can be seen in Section 5.1, the fraction of ESG-concerned investors affects the ERC via the amount that these investors can learn about ESG performance from the financial report. When the ESG report is introduced, there is less to learn from the financial report about ESG performance, such that the ERC is attenuated. When cash flows and ESG performance are positively correlated, a higher financial report implies higher ESG performance, and a relatively stronger response from ESG-concerned investors to the financial report. Introducing the ESG report weakens this response, because the ESG-concerned investors learn less from the financial report about ESG performance when the ESG report is available. This negative effect on the ERC is stronger when there are more ESG-concerned investors, i.e., when λ is higher. Conversely, when cash flows and ESG performance are negatively correlated, introducing ESG reporting pushes the ERC up, because ESG-concerned investors react less negatively to the bad news that the financial report conveys about ESG performance. As noted above, this directional effect is stronger when there are more ESG-concerned investors.

Parts 2 and 3 of Corollary 2 describe how the effect of introducing ESG reporting on the firm's expected cash flows, $E[x]$, and ESG performance, $E[y]$, vary with the fraction of ESG-interested investors, λ. Observe from the Lemma 2 expressions for $E[x]$ and $E[y]$ that changes in expected performance are driven by changes in the manager's choices of e, e_x, and e_y, which in turn depend on the ERC and ESG-RC. The previous paragraph discusses effects on the ERC, which affect equilibrium e and e_x.

Turning to the effect via the ESG-RC channel, a special case is if $\theta_\phi = 0$, which implies that the financial report provides no information about ESG performance. In this case, the

effect of introducing the ESG report on expected performance comes through the ESG-RC, ψ_r^*, only. Its effect on expected cash flows is driven by the incentives it provides for the manager around the dual-impact e. When $\theta_e > 0$, the effort increases cash flows. It also increases ESG performance, so a positive ESG-RC encourages this effort. Higher λ tends to increase the ESG-RC (as can be seen in Lemma 2), yielding more e and higher expected cash flows. The opposite obtains if $\theta_e < 0$, since a larger ESG-RC instead encourages more e that is cash flow-reducing. Regarding expected ESG performance, the effect of introducing the ESG report is positive in the special case of $\theta_\phi = 0$, and larger when λ is higher, because the ESG-RC encourages ESG efforts and is increasing in the fraction of ESG-concerned investors.

The net effects on expected cash flows and ESG performance in Corollary 2, parts 2 and 3, depend on the balance between the effects described above. That is, an increase in λ could mute the effects on an ESG reporting introduction on cash flows but amplify them on ESG performance depending on, for example, the size of the cash-flow and ESG effort costs, c_x and c_y, respectively.

A.6 Effects of changes in ESG effort's cash-flow effect

The magnitude and direction of the cash-flow effects of ESG activities, θ_e can vary cross-sectionally with corporations' business models, production technologies, or pro-ESG policies such as subsidies or taxes.[26] Corollary 3 characterizes how variation in θ_e changes the effects of introducing ESG reporting on ESG and cash flow performance.

Corollary 3 *An increase in the effect of ESG effort on cash flows, θ_e, leads the introduction of ESG reporting to have:*

1. *A higher (lower) effect on the expected cash flows, $\frac{d\left(E[x^*]-E\left[x^\dagger\right]\right)}{d\theta_e} > (<)\ 0$, if*

$$2\left(\theta_\phi^2\eta_\phi^2\sigma_\phi^2\sigma_f^2 - \lambda\theta_\phi\eta_\phi\chi\right)\theta_e + \Sigma_f\left(\lambda\chi + \theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2\right)\eta_e > (<)\ 0.$$

[26] See, for example, KPMG (2020), on how corporations could estimate cash flow implications of their ESG activities.

2. A higher (lower) effect on the expected ESG performance, $\frac{d\left(E[y^*]-E\left[y^\dagger\right]\right)}{d\theta_e} > (<)\ 0$*, if*

$$\lambda\theta_\phi\eta_\phi < (>)\ \frac{\theta_\phi^2\eta_\phi^2\sigma_\phi^2\sigma_f^2}{\sigma_y^2\Sigma_f + \eta_\phi^2\sigma_\phi^2\left(\sigma_x^2+\sigma_f^2\right)}.$$

The cash-flow productivity of the joint ESG-cash-flow effort, θ_e, affects the manager's choice of ESG-cash-flow effort proportionally to the change in ERC. If the market reacts stronger to the cash flow report (ψ_f^* is higher) and the manager can increase the cash flow report more per unit of their effort (θ_e is higher), the manager chooses a higher joint ESG-cash-flow effort. This effort choice, in turn, affects the firm's cash flows and ESG performance proportionally to its cash flow and ESG productivities (θ_e and η_e), respectively.

The firm's expected cash flows are affected by the cash-flow productivity of the joint ESG-cash-flow effort through both of these channels. The first half of the first summand $\left(\left(\theta_\phi^2\eta_\phi^2\sigma_\phi^2\sigma_f^2 - \lambda\theta_\phi\eta_\phi\chi\right)\theta_e\right)$ on the left-hand side part 1 of Corollary 3 represents the effect on the firm's cash flows from the fact that the manager's choice of joint ESG-cash-flow effort, e, increases. The increase is proportional to the change in the ERC, $\left(\theta_\phi^2\eta_\phi^2\sigma_\phi^2\sigma_f^2 - \lambda\theta_\phi\eta_\phi\chi\right)$, and translates into higher cash flows proportionally to θ_e. The remaining component on the left-hand side part 1 of Corollary 3 $\left(\left(\theta_\phi^2\eta_\phi^2\sigma_\phi^2\sigma_f^2 - \lambda\theta_\phi\eta_\phi\chi\right)\theta_e + \Sigma_f\left(\lambda\chi + \theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2\right)\eta_e\right)$ represents the effect on the firm's cash flows from the increased cash flow productivity of the manager's joint ESG-cash-flow effort. One unit of increased productivity, θ_e, keeping the manager's choice of effort fixed, increases the firm's cash flows by $\left(\left(\theta_\phi^2\eta_\phi^2\sigma_\phi^2\sigma_f^2 - \lambda\theta_\phi\eta_\phi\chi\right)\theta_e + \Sigma_f\left(\lambda\chi + \theta_\phi\eta_\phi\sigma_\phi^2\sigma_f^2\right)\eta_e\right)$ – the level of optimal effort choice. When the two effects sum up to a positive result, an increase in the effect of ESG effort on cash flows, θ_e, amplifies the increase in the firm's cash flows after the introduction of ESG reporting.

The firm's expected ESG performance is only affected by the cash-flow productivity of the joint ESG-cash-flow effort through its effect on the manager's optimal choice of the joint ESG-cash-flow effort. When this effort is higher, the firm's ESG performance increases because the ESG productivity of the joint effort, η_e, is positive. The manager chooses a higher joint effort with a higher cash flow productivity θ_e if and only if, as a result of introducing

ESG reporting, the ERC increases $\left(\psi_f^* - \psi_f^\dagger > 0\right)$. Therefore, an increase in θ_e amplifies the effect of introducing ESG reporting on the firm's expected ESG performance whenever the ERC increases after the introduction of ESG reporting. The condition in part 2 of Corollary 3 perfectly resembles the condition in Proposition 2 for the increase in ERC.

A.7 A model without exogenous noise in cash flows and ESG performance

In this section, we solve our model with σ_x^2 and σ_y^2 set to zero. Note that setting $e_x = e_y = 0$ is a straightforward special case of the analysis, and yields similar results because e_x and e_y have no effect on investor learning from reports.

With no exogenous noise in cash flows and ESG performance, the joint distribution of x, y, f, and r is:

$$\begin{pmatrix} \tilde{x} \\ \tilde{y} \\ \tilde{r} \\ \tilde{f} \end{pmatrix} \sim N\left(\begin{pmatrix} \theta\alpha_e + \theta_\phi\bar{\phi} + \alpha_x \\ \eta_e\alpha_e + \eta_\phi\bar{\phi} + \alpha_y \\ \eta_e\alpha_e + \eta_\phi\bar{\phi} + \alpha_y \\ \theta\alpha_e + \theta_\phi\bar{\phi} + \alpha_x \end{pmatrix}, \begin{pmatrix} \theta_\phi^2\sigma_\phi^2 & \theta_\phi\eta_\phi\sigma_\phi^2 & \theta_\phi\eta_\phi\sigma_\phi^2 & \theta_\phi^2\sigma_\phi^2 \\ . & \eta_\phi^2\sigma_\phi^2 & \eta_\phi^2\sigma_\phi^2 & \theta_\phi\eta_\phi\sigma_\phi^2 \\ . & . & \eta_\phi^2\sigma_\phi^2 + \sigma_r^2 & \theta_\phi\eta_\phi\sigma_\phi^2 \\ . & . & . & \theta_\phi^2\sigma_\phi^2 + \sigma_f^2 \end{pmatrix} \right)$$

Conditional means are given by

$$E\left[\begin{matrix}\tilde{x} \\ \tilde{y}\end{matrix}\middle| r, f\right] = \begin{bmatrix} \theta\alpha_e + \theta_\phi\bar{\phi} + \alpha_x \\ \eta_e\alpha_e + \eta_\phi\bar{\phi} + \alpha_y \end{bmatrix} + \begin{bmatrix} \theta_\phi\eta_\phi\sigma_\phi^2 & \theta_\phi^2\sigma_\phi^2 \\ \eta_\phi^2\sigma_\phi^2 & \theta_\phi\eta_\phi\sigma_\phi^2 \end{bmatrix} \begin{bmatrix} \eta_\phi^2\sigma_\phi^2 + \sigma_r^2 & \theta_\phi\eta_\phi\sigma_\phi^2 \\ \theta_\phi\eta_\phi\sigma_\phi^2 & \theta_\phi^2\sigma_\phi^2 + \sigma_f^2 \end{bmatrix}^{-1} \begin{bmatrix} r - (\eta_e\alpha_e + \eta_\phi\bar{\phi} + \alpha_y) \\ f - (\theta\alpha_e + \theta_\phi\bar{\phi} + \alpha_x) \end{bmatrix}$$

The response coefficients in the model without exogenous noises are

$$\psi_f^{*\prime} \equiv \frac{\partial p}{\partial f} = \frac{\theta_\phi^2\sigma_\phi^2\sigma_r^2 + \lambda\left(\theta_\phi\eta_\phi\sigma_\phi^2\sigma_r^2\right)}{\left(\eta_\phi^2\sigma_\phi^2 + \sigma_r^2\right)\left(\theta_\phi^2\sigma_\phi^2 + \sigma_f^2\right) - \theta_\phi^2\eta_\phi^2\sigma_\phi^4}$$

$$\psi_r^{*'} \equiv \frac{\partial p}{\partial r} = \frac{\theta_\phi \eta_\phi \sigma_\phi^2 \sigma_f^2 + \lambda\left(-\theta_\phi^2 \eta_\phi^2 \sigma_\phi^4 + \left(\theta_\phi^2 \sigma_\phi^2 + \sigma_f^2\right)\eta_\phi^2 \sigma_\phi^2\right)}{\left(\eta_\phi^2 \sigma_\phi^2 + \sigma_r^2\right)\left(\theta_\phi^2 \sigma_\phi^2 + \sigma_f^2\right) - \theta_\phi^2 \eta_\phi^2 \sigma_\phi^4}$$

The manager's problem (reduced to only controlled parts) is

$$\begin{aligned} \max_{e, e_x, e_y} \quad & \psi_r^{*'}\left(\eta_e e + \eta_\phi \phi + e_y\right) + \psi_f^{*'}\left(\theta_e e + \theta_\phi \phi + e_x\right) - \tfrac{c_e}{2} e^2 - \tfrac{c_x}{2} e_x^2 - \tfrac{c_y}{2} e_y^2 \\ \Rightarrow \quad & e^* = \tfrac{\psi_r^{*'} \eta_e + \psi_f^{*'} \theta_e}{c_e}, e_x^* = \tfrac{\psi_f^{*'}}{c_x}, e_y^* = \tfrac{\psi_r^{*'}}{c_y} \end{aligned}$$

The ERC in the case of only financial reporting is $\psi_f^{\dagger'} = \left(1 - \frac{\sigma_f^2}{\sigma_f^2 + \theta_\phi^2 \sigma_\phi^2}\right) + \lambda \frac{\theta_\phi \eta_\phi \sigma_\phi^2}{\sigma_f^2 + \theta_\phi^2 \sigma_\phi^2}$.

The condition for the ESG-RC being positive is

$$\psi_r^{*'} > 0 \iff \lambda > \frac{-\theta_\phi \eta_\phi \sigma_\phi^2 \sigma_f^2}{\sigma_y^2\left(\sigma_f^2 + \theta_\phi^2 \sigma_\phi^2\right) + \eta_\phi^2 \sigma_\phi^2 \sigma_f^2}$$

The change in the ERC is positive when

$$\psi_f^{*'} - \psi_f^{\dagger'} > 0 \iff$$
$$\frac{\theta_\phi^2 \sigma_\phi^2 \sigma_r^2 + \lambda\left(\theta_\phi \eta_\phi \sigma_\phi^2 \sigma_r^2\right)}{\left(\eta_\phi^2 \sigma_\phi^2 + \sigma_r^2\right)\left(\theta_\phi^2 \sigma_\phi^2 + \sigma_f^2\right) - \theta_\phi^2 \eta_\phi^2 \sigma_\phi^4} - \frac{\theta_\phi^2 \sigma_\phi^2 + \lambda \theta_\phi \eta_\phi \sigma_\phi^2}{\sigma_f^2 + \theta_\phi^2 \sigma_\phi^2}$$

This condition is the condition in Proposition 2 with $\sigma_x^2 \to 0$ and $\sigma_y^2 \to 0$:

$$\lambda \theta_\phi \eta_\phi < \frac{-\theta_\phi^2 \eta_\phi^2 \sigma_\phi^2 \sigma_f^2}{\sigma_y^2\left(\sigma_f^2 + \theta_\phi^2 \sigma_\phi^2\right) + \eta_\phi^2 \sigma_\phi^2 \sigma_f^2}$$

The condition for the change in ex-ante price being positive, similarly, is the condition in Proposition 3 with $\sigma_x^2 \to 0$ and $\sigma_y^2 \to 0$.

$$\Delta p > 0 \iff$$
$$\begin{aligned} (\theta_e + \lambda \eta_e) \Bigg[& \frac{\theta_e}{c_e} \times \theta_\phi \eta_\phi \sigma_\phi^2 \times \left(\theta_\phi \eta_\phi \sigma_\phi^2 \sigma_f^2 - \lambda\left(\sigma_y^2\left(\sigma_f^2 + \theta_\phi^2 \sigma_\phi^2\right) + \eta_\phi^2 \sigma_\phi^2 \sigma_f^2\right)\right) \\ & + \frac{\eta_e}{c_e} \times \left(\sigma_f^2 + \theta_\phi^2 \sigma_\phi^2\right) \times \left(\theta_\phi \eta_\phi \sigma_\phi^2 \sigma_f^2 + \lambda\left(\sigma_y^2\left(\sigma_f^2 + \theta_\phi^2 \sigma_\phi^2\right) + \eta_\phi^2 \sigma_\phi^2 \sigma_f^2\right)\right) \Bigg] \end{aligned}$$

$$+\frac{1}{c_x} \times \theta_\phi \eta_\phi \sigma_\phi^2 \times \left(\theta_\phi \eta_\phi \sigma_\phi^2 \sigma_f^2 - \lambda \left(\sigma_y^2 \left(\sigma_f^2 + \theta_\phi^2 \sigma_\phi^2\right) + \eta_\phi^2 \sigma_\phi^2 \sigma_f^2\right)\right)$$
$$+\frac{\lambda}{c_y} \times \left(\sigma_f^2 + \theta_\phi^2 \sigma_\phi^2\right) \times \left(\theta_\phi \eta_\phi \sigma_\phi^2 \sigma_f^2 + \lambda \left(\sigma_y^2 \left(\sigma_f^2 + \theta_\phi^2 \sigma_\phi^2\right) + \eta_\phi^2 \sigma_\phi^2 \sigma_f^2\right)\right) > 0.$$

This condition may not be satisfied for certain parameter values, so the ex-ante price might decrease after the introduction of ESG reporting.