The Pace of Change: Socially Responsible Investing in Private Markets*

Deeksha Gupta† Alexandr Kopytov‡ Jan Starmans§

November 29, 2022

Abstract

We study the pace at which socially responsible investors generate impact in private capital markets. Investors with broad pro-social preferences care about firm externalities independent of their ownership in the firm and hence value acquiring firms with high negative production externalities because they can reform these firms. The anticipation of trading gains for firms with high negative externalities decreases the incentive of current firm owners to reduce these externalities proactively, potentially causing delay in reform. Investment mandates through which investors can commit to paying a premium for firms with low negative externalities can incentivize reform in a timely manner.

Keywords: Socially responsible investing, sustainable investing, ESG, private markets.
JEL Classifications: G11, G23, G24, G32, G34, H41, M14.

*We would like to thank Aymeric Bellon, Philip Bond, Matthieu Bouvard, Alvin Chen, Darwin Choi (discussant), Hans Degryse (discussant), Robin Döttling, Vadim Elenev, Thomas Geelen, Mariassunta Giannetti, Stefano Giglio, Will Gornall, Daniel Green, Sebastian Gryglewicz, Denis Gromb (discussant), German Gutierrez, Chris Hrdlicka, Marcin Kacperczyk, Jon Karpoff, Lukas Kremens, Augustin Landier, Doron Levit, Ye Li, Nadya Malenko, Vincent Maurin, Marcus M. Opp, Dmitry Orlov, Lubos Pastor, Lasse Heje Pedersen, Sebastien Pouget, Uday Rajan, Magdalena Rola-Janicka (discussant), Joel Shapiro, Lin Shen, Michael Sockin, Per Strömberg, and Josef Zechner, seminar participants at the Indian School of Business, University of Calgary, NFN Young Scholars Finance Webinar Series, Stockholm School of Economics, Carnegie Mellon University, Johns Hopkins University, Federal Reserve Board of Governors, Mistra Center for Sustainable Markets, Toulouse School of Economics, Junior European Finance Seminar, Tilburg University, Erasmus University Rotterdam, and University of Washington, as well as conference participants at the 2021 Greater Bay Area Finance Conference, 2022 Conference in Sustainable Finance at the University of Luxembourg, 2022 University of Wisconsin-Madison Junior Finance Conference, 2022 EFA Annual Meeting, 2022 GRASFI Annual Conference, and 2022 MSUFCU Conference on Financial Institutions and Investments, for their helpful comments and suggestions.

†Carey Business School, Johns Hopkins University. Email: deeksha.gupta@jhu.edu.
‡University of Hong Kong. Email: akopytov@hku.hk.
§Stockholm School of Economics. Email: jan.starmans@hhs.se.

Over the past decade, there has been a dramatic increase in socially responsible investing (see, e.g., US SIF, 2020). The central question among academics and industry practitioners is how investors can induce firms to reduce negative externalities such as carbon emissions. While the current focus is on *how* socially responsible investors can generate impact, it largely misses the crucial aspect of *how quickly* the impact can be achieved. The issue of timely impact is particularly salient in light of climate change as scientists argue that unless greenhouse gas emissions are reduced quickly, the world faces potentially catastrophic consequences (see, e.g., IPCC, 2021).

In this paper, we study the question of how socially responsible investors can reduce negative firm externalities *in a timely manner*. To this end, we introduce pro-social preferences into an otherwise standard search-theoretic model of financial markets in which an entrepreneur meets financial and socially responsible investors repeatedly over time. Importantly, firm reform can happen at different points in time. The entrepreneur—the initial firm owner—can immediately reform a "dirty" firm and make it "green" by paying a cost to reduce negative production externalities. Alternatively, firm reform can happen in the future if a socially responsible investor acquires a dirty firm and subsequently reforms it.

The paper has four key insights. First, the presence of socially responsible investors can cause strategic delay in firm reform. Strategic delay arises when an entrepreneur does not reform the firm proactively in the presence of socially responsible investors, even if she would have done so in the absence of socially responsible investors. Second, a more pro-social financial market can exacerbate strategic delay. Third, if we allow investors to adopt investment mandates, socially responsible investors find it optimal to adopt a mandate through which they commit to paying a premium for green firms. Such a mandate eliminates all delay by incentivizing the entrepreneur to reform the firm. Fourth, if the market is expected to become more pro-social in the future, the incentive to strategically delay reform increases. Moreover, the entrepreneur may strategically delay the sale of a dirty firm to socially responsible investors until the market becomes pro-social, deferring reform even further.

Our paper highlights the unintended consequences of *active* investment strategies aimed at generating impact as they can disincentivize current firm owners to reform their firms proactively. In contrast, a *passive* investment strategy of acquiring green firms at a premium can generate incentives for timely reform. These insights are important given that academics and industry practitioners generally consider active investment strategies (e.g., voice) to be more effective than passive

strategies (e.g., exit).[1]

More specifically, we develop a dynamic search model with both financial and socially responsible investors who consider acquiring a firm initially owned by an entrepreneur. Every period, the firm generates a financial profit and a social cost. The firm is initially dirty and generates a high social cost each period, capturing the firm's externalities such as carbon emissions. All agents are risk-neutral and value the firm's profits equally. In addition, socially responsible investors incur a disutility from the social cost of production. The entrepreneur may also care about the social cost. Importantly, the pro-social preferences are broad in the sense that agents care about the social cost independent of whether they own the firm (see, e.g., Oehmke and Opp, 2022). For example, these preferences can capture agents' direct exposure to externalities or moral concern about the social costs incurred by other agents. The owner of the firm—entrepreneur or investor—can permanently reduce the social cost by paying a one-time reform cost. The reform decision can also be interpreted as innovating on a green technology, adopting a greener technology, or scaling a green technology. The key assumption in our model is that the entrepreneur is able to change or scale the firm's production technology in a way that reduces social costs (or generates social benefits) on her own. In each period, the entrepreneur meets an investor at random. Upon meeting, the entrepreneur can make a take-it-or-leave-it price offer to the investor for the firm's acquisition.

Our model applies well to impact investing in private capital markets. Socially responsible investors' preferences in our model best describe impact investors who state that their investments are guided by "intentionality" and "additionality"—the intention to improve firms' environmental and social outcomes over and above what would happen absent their investment (see, e.g., Born and Brest, 2013). Moreover, search frictions in private markets can be particularly severe with long wait times to raise capital (see, e.g., Cremades, 2019), and frequent deal terminations (see, e.g., Cain et al., 2015; Thomas and Sabater, 2022). Private markets account for a significant share of impact investing (GIIN, 2020) and are considered to be in a unique position to influence decarbonization efforts because of the large amount of capital private equity investors can deploy (Burack et al., 2022; Eccles et al., 2022; Sheth and Andrews, 2022).

We start our analysis by characterizing the entrepreneur's decision to turn the firm green in a benchmark case with only financial investors. Because both the entrepreneur and financial investors value profits equally and because the entrepreneur incurs the disutility from the firm's social

[1]See, for example, Hart and Zingales (2017), Krueger et al. (2020), UNPRI (2021), Berk and van Binsbergen (2022), Broccardo et al. (2022), Gollier and Pouget (2022), Jagannathan et al. (2022).

cost regardless of whether she owns the firm, there are no gains from trade. As a result, investors do not influence the entrepreneur's reform decision. Specifically, the entrepreneur turns the firm green if and only if her pro-social preferences are sufficiently strong.

Next, we consider the entrepreneur's decision to turn the firm green if socially responsible investors are also present in the financial market. Again, there are no gains from trade if the entrepreneur meets a financial investor. If the entrepreneur turns the firm green herself, there are also no gains from trade when she meets a socially responsible investor because the firm is already green and the disutility from the firm's social cost is incurred independent of ownership. In contrast, if the entrepreneur owns a dirty firm and meets a socially responsible investor, there can be gains from trade. In this case, the socially responsible investor values not only the firm's profits, but also the potential to reduce the social cost of production after acquiring the firm. Importantly, the investor internalizes the fact that the firm remains dirty absent an acquisition and is willing to pay to avoid this counterfactual. Therefore, the entrepreneur can realize gains from trade in the financial market if she owns a dirty firm but not if she owns a green firm. The anticipation of these trading gains increases the value of owning a dirty firm and may therefore reduce the entrepreneur's incentive to turn the firm green herself. Intuitively, the entrepreneur needs to leave room for impact to realize gains from trade.

A key insight of the model is that the presence of socially responsible investors in the financial market has an ambiguous effect on how quickly the firm is reformed. On the one hand, if the entrepreneur has weak pro-social preferences and would not turn the firm green in the absence of socially responsible investors, a socially responsible investor can acquire the firm and turn it green, thus speeding up firm reform. On the other hand, the trading gains the entrepreneur can capture if the firm is dirty causes an entrepreneur with moderate pro-social preferences to keep the firm dirty even if she would have turned it green in the absence of socially responsible investors. This decision causes a *strategic delay* in reform.

Making the financial market more pro-social can lessen or exacerbate the entrepreneur's incentive to strategically delay reform, depending on how the market becomes more pro-social. Stronger pro-social preferences of socially responsible investors increase their willingness to pay to acquire and reform a dirty firm. A higher price increases the expected value of staying dirty and consequently strengthens the entrepreneur's incentive to keep the firm dirty. In contrast, an increase in the share of socially responsible investors in the financial market can either increase or decrease the entrepreneur's incentive to strategically delay reform. On the one hand, the probability of meeting

a socially responsible investor increases, which raises the expected payoff from staying dirty and consequently strengthens the incentive to delay reform. On the other hand, it becomes less costly for any given socially responsible investor to pass up on acquiring a dirty firm as it is more likely that another socially responsible investor acquires and reforms the firm in the future. Socially responsible investors therefore have an incentive to free ride on each other. This free-rider problem can actually increase social welfare as it reduces trading gains and therefore the acquisition price of a dirty firm, which reduces the entrepreneur's incentive to strategically delay reform.

In recent years, many socially responsible funds have adopted investment mandates outlining a set of principles for their investments such as the United Nations' Principles for Responsible Investing (UN PRI, 2020) or specific impact terms in contracts between general and limited partners (Geczy et al., 2021). We therefore explore whether allowing socially responsible investors to commit to investment mandates ex ante can reduce delay and whether investors have incentives to adopt such mandates. Intuitively, strategic delay arises due to a hold-up problem because socially responsible investors cannot commit to not acquiring a dirty firm at a high price ex post. One would therefore expect that expanding the set of feasible contracts by introducing investment mandates through which socially responsible investors can commit to not acquiring dirty firms can eliminate delay in reform. We show that such an exclusionary mandate can indeed eliminate strategic delay by an entrepreneur with moderate pro-social preferences because it eliminates the hold-up problem. However, it cannot speed up reform by an entrepreneur with weak pro-social preferences. Intuitively, an entrepreneur with weak pro-social preferences does not reform the firm even absent socially responsible investors. Hence, adopting such a mandate keeps the firm dirty forever instead of allowing socially responsible investors to acquire and reform it.

In contrast to the exclusionary investment mandate, a mandate through which socially responsible investors commit to paying a premium for a green firm can eliminate any delay—strategic and non-strategic. Clearly, there always exists a price for a green firm that incentivizes the entrepreneur to reform the firm immediately. However, it is not clear that such an investment mandate would be adopted by investors because paying a high price for a green firm is costly. Nevertheless, we show that it is always individually rational for socially responsible investors to adopt such an investment mandate. Intuitively, socially responsible investors prefer to commit to a high price for a green firm ex ante to avoid the disutility from the delay in reform rather than paying for a dirty firm later and incurring the disutility until the firm is reformed. We also extend the model to two types of entrepreneurs with different pro-social preferences. In this case, socially responsible investors adopt

an investment mandate that incentivizes at least the entrepreneur with stronger pro-social preferences to reform the firm immediately but may not necessarily adopt a mandate that incentivizes both types of entrepreneurs to do so.

The starkly different predictions of the models with and without investment mandates highlight that the extent to which socially responsible investors can commit to investment strategies crucially determines their impact on the pace of firm reform. Notably, both aspects of the price-commitment mandate—acquiring green firms and paying a premium for impact—are observed in practice. For example, about $25 trillion of assets under management employ a "screening" mandate (UNPRI, 2020) and about 33% of impact investors adopt "below-market-rate" mandates through which they explicitly accept lower financial returns to achieve impact goals (GIIN, 2020). While screening and below-market-rate mandates are typically adopted separately by different types of funds, our analysis suggests that they should be adopted jointly. Interestingly, commitment is not an issue for an investor who receives a positive utility (a "warm glow") from investing in green firms. Such "naive" socially responsible investors do not internalize the broader impact of their actions and may therefore unintentionally create demand pressure and increase market prices for green firms, which can help support timely impact. However, the warm-glow premium will typically not lead to optimal firm reform because it simply reflects investors' taste for green firms and is not targeted to induce the entrepreneur to reform the firm proactively.

In an extension of the baseline model, we show that if socially responsible investors are expected to become more pro-social in the future, the incentive to strategically delay reform increases and a new type of perverse incentive—strategic delay in trade—can arise. Specifically, if socially responsible investors' willingness to pay for the firm increases substantially after the market becomes more pro-social, the entrepreneur has an incentive to strategically delay the sale of a dirty firm and wait until socially responsible investors become more pro-social. Importantly, strategic delay in trade can cause a substantial overall delay in reform even if search frictions are not too severe because it may take a long time for the market to become more pro-social.

Our paper has implications for the crucial question of how to define and measure "impact" in financial markets. Empirical analyses of socially responsible investing tend to focus on post-investment changes in firms' environmental and social performance (see, e.g., Dimson et al., 2015, 2021; Gantchev et al., 2022; Heath et al., 2022). In practice, impact funds also focus on post-investment improvements in firms (see, e.g., GIIN, 2020). In our paper, when socially responsible investors commit to acquiring a green firm at a premium, all of the measurable impact happens

before the investment rather than after. Focusing on post-investment changes therefore provides only a partial picture of impact. In addition, it is important to consider how socially responsible investors affect acquisition prices for green and dirty firms, which in turn determines the incentives of current owners to reform their firms. Furthermore, our analysis implies that active investment strategies by socially responsible investors can increase the price of dirty firms (i.e., reduce their cost of capital). This force may be important to consider when interpreting empirical estimates of the cost of capital effect of passive divestment strategies (Berk and van Binsbergen, 2022; Lindsey et al., 2022) because active strategies may be muting the effect of passive strategies.

We extend the baseline model in several ways and discuss a number of additional insights. Specifically, we show robustness of our main results to introducing generalized Nash bargaining and more severe search frictions. We also show that our results are robust to allowing financial investors to re-sell the firm after acquiring it. This extension highlights a possible intermediation role of financial investors in channelling dirty firms from the entrepreneur to socially responsible investors. We also discuss a number of additional insights the model can generate: the value of active and passive investing when investors provide growth capital and expertise; the effect of socially responsible investors on the innovation of green technologies; the weakening of environmental regulation in the presence of impact investing; the worsening of strategic delay if investors only obtain utility if they themselves reform the firm; the role of financial investors in freeing up socially responsible capital when it is limited; perverse incentives to make a firm dirty if technology is reversible; the design of socially responsible compensation for fund managers; and the political economy implications for climate regulation.

The remainder of the paper is organized as follows. Section 1 discusses the related literature. Section 2 presents an example that illustrates the reason for strategic delay in our model. Section 3 presents the baseline model and Section 4 analyzes this model. Section 5 studies the model with investment mandates. Section 6 introduces several extensions and discusses robustness. Section 7 discusses broader implications of our analysis. The last section concludes. The appendix contains all proofs and additional analyses.

1 Related Literature

Our paper contributes to the theoretical literature that studies whether and how socially responsible investors can impact firm production decisions (Heinkel et al., 2001; Hart and Zingales, 2017;

Davies and Van Wesep, 2018; Chowdhry et al., 2019; Morgan and Tumlinson, 2019; Landier and Lovo, 2020; Green and Roth, 2021; Matsusaka and Shu, 2021; Pastor et al., 2021; Roth, 2021; Barbalau and Zeni, 2022; Broccardo et al., 2022; De Angelis et al., 2022; Edmans et al., 2022; Geelen et al., 2022; Gollier and Pouget, 2022; Huang and Kopytov, 2022; Jagannathan et al., 2022; Levit et al., 2022; Moisson, 2022; Oehmke and Opp, 2022).[2] In contrast to the existing literature, we study the pace at which socially responsible investors can impact firm production decisions, an aspect that is crucially important given the current international efforts to rapidly reduce global emissions. Our dynamic model provides new perspectives on the role of impact investing in private markets, the effect of socially responsible investors on acquisition prices for green and dirty firms, the efficacy of active and passive investment strategies, and the limitations of current definitions of impact in financial markets.

Our paper is closest to Landier and Lovo (2020) who also study socially responsible investors in a financial market with search frictions. In their model, search frictions play a positive role by allowing a socially responsible investment fund to set emission targets for firms because non-complying firms face the risk of not receiving financing. In contrast, our model highlights that search frictions can generate potentially important social costs in a dynamic setting.

Our model differs from theories that consider atomistic investors who receive a "warm-glow" utility from investing in green firms and who can affect firm production decisions by reducing the cost of capital of green relative to dirty firms (see, e.g., Heinkel et al., 2001; Pastor et al., 2021). Instead, we consider investors with broad pro-social preferences who have size and therefore internalize the impact of their investment decisions.[3] The preferences we consider are similar to those in Oehmke and Opp (2022). In their model, financially constrained entrepreneurs raise capital from financial and socially responsible investors in a Holmström and Tirole (1997) style framework. Our market environment differs because we consider a dynamic model with search frictions and an entrepreneur who has the ability to reform her firm without investors. The papers' findings complement each other and highlight that optimal investment strategies of socially responsible investors can differ substantially depending on the market environment and the frictions faced by

[2]There are also theoretical papers that study asset pricing implications of socially responsible investing. These include Luo and Balvers (2017), Pastor et al. (2021), Pedersen et al. (2021), Baker et al. (2022), and Goldstein et al. (2022). In addition, a large empirical literature studies asset pricing implications of socially responsible investing (see, e.g., Bolton and Kacperczyk, 2022). Liang and Renneboog (2020) provide a review of this empirical literature.

[3]See Bénabou and Tirole (2006) and Besley and Ghatak (2018) for in-depth discussions of pro-social preferences. Related to our paper, some papers focus on how the entrepreneur's or the manager's pro-social preferences affect firm reform (Baron, 2007; Friedman and Heinle, 2021; De Angelis et al., 2022).

firms and investors.

There is a growing empirical literature studying socially responsible investing in private capital markets (Chava, 2014; Kovner and Lerner, 2015; Barber et al., 2021; Geczy et al., 2021; Bellon, 2022; Jeffers et al., 2022; Kacperczyk and Peydró, 2022). Our theoretical assumptions are in line with evidence in Geczy et al. (2021) that impact funds adopt investment mandates in which they contract ex ante on impact terms such as international ESG standards, and evidence in Barber et al. (2021) that investors in impact funds are willing to sacrifice return for non-pecuniary utility gains.

Finally, we contribute to the literature on decentralized financial markets by introducing pro-social preferences into an otherwise standard search-theoretic model of financial markets (see, e.g., Weill, 2020). Our model differs from standard models in which trading gains typically arise for exogenous reasons, such as differences in utility flows from holding an asset across buyers and sellers. In contrast, pro-social preferences can give rise to endogenous gains from trade and a free-rider problem between socially responsible investors.

2 Example

In this section, we present a two-period example to highlight the mechanism of strategic delay. In the next section, we introduce the infinite-horizon model.

Consider an entrepreneur who owns a "dirty" firm that generates a profit $\pi > 0$ and a social cost c_H at the end of each period $t \in \{0,1\}$. The entrepreneur can pay a one-time cost $\kappa > 0$ at the beginning of period $t = 0$ to make the firm "green" by reducing the social cost to $c_L < c_H$. The entrepreneur's per-period utility if she owns the firm is $\pi - \gamma c$, $c \in \{c_L, c_H\}$, where $\gamma \geq 0$ captures the entrepreneur's pro-social preferences. Pro-social preferences are broad in that the entrepreneur suffers the disutility from the social cost independent of ownership. That is, the entrepreneur's per-period utility if she does not own the firm is $-\gamma c$, $c \in \{c_L, c_H\}$. At the beginning of period $t = 1$, the entrepreneur meets an investor and can make a take-it-or-leave-it offer to sell the firm.[4] After the acquisition, the investor can reform the firm by paying the cost κ.

Table 1 shows the entrepreneur's and investor's utilities in the trading game with a financial investor who only values firm profits and therefore does not reform the firm. P_L and P_H are the endogenous prices quoted by the entrepreneur for a green and dirty firm, respectively. The highest

[4]To illustrate strategic delay as clearly as possible, we do not allow the entrepreneur to meet an investor in period $t = 0$. This assumption is not required to generate strategic delay if there are search frictions in the financial market. We discuss this assumption in more detail when describing the baseline model in Section 3.

price a financial investor is willing to pay for the firm—dirty or green—is simply equal to the firm's $t = 1$ profit, that is, $P_L = P_H = \pi$. At this price, the entrepreneur is indifferent between selling and not selling the firm. There are therefore no gains from trade because the entrepreneur and the investor value profits equally and because the entrepreneur's pro-social preferences are broad, implying that she cannot reduce her disutility from the social cost by simply selling the firm. In period $t = 0$, anticipating that she will not sell the firm to the financial investor in period $t = 1$, the entrepreneur decides whether to reform it. The entrepreneur reforms the firm if her utility from making the firm green, $2(\pi - \gamma c_L) - \kappa$, is higher than her utility from keeping it dirty, $2(\pi - \gamma c_H)$. She thus reforms the firm if and only if $\kappa \leq 2\gamma(c_H - c_L)$, that is, if the cost of reform is less than the reduction in her disutility from the social cost. Intuitively, the entrepreneur reforms the firm if her pro-social preferences are sufficiently strong.

Green Firm	Entrepreneur	Investor
Not Sell	$\pi - \gamma c_L$	0
Sell	$P_L - \gamma c_L$	$\pi - P_L$

Dirty Firm	Entrepreneur	Investor
Not Sell	$\pi - \gamma c_H$	0
Sell	$P_H - \gamma c_H$	$\pi - P_H$

Table 1: Trading Game with a Financial Investor

Table 2 shows the entrepreneur's and investor's utilities in the trading game with a socially responsible investor with pro-social preference parameter $\lambda > 0$, who reforms the firm post-acquisition in period $t = 1$, that is, $\lambda(c_H - c_L) > \kappa$. If the firm is already green, there are no gains from trade. Intuitively, the most the investor is willing to pay for the firm is its $t = 1$ profit because he cannot further reduce the social cost if he acquires the firm. If the firm is dirty, the highest price the socially responsible investor is willing to pay is given by

$$\pi - P_H - \kappa - \lambda c_L = -\lambda c_H \Leftrightarrow P_H = \pi + \lambda(c_H - c_L) - \kappa.$$

In particular, we have $P_H > \pi$. Intuitively, the investor values not only the firm's profits, but also the reduction in the social cost post-acquisition. The entrepreneur sells the firm because $P_H - \gamma c_L > \pi - \gamma c_H$. The entrepreneur benefits from the price, which exceeds the firm's profit, and from the anticipated reduction in the social cost by the socially responsible investor.

Green Firm	Entrepreneur	Investor
Not Sell	$\pi - \gamma c_L$	$-\lambda c_L$
Sell	$P_L - \gamma c_L$	$\pi - P_L - \lambda c_L$

Dirty Firm	Entrepreneur	Investor
Not Sell	$\pi - \gamma c_H$	$-\lambda c_H$
Sell	$P_H - \gamma c_L$	$\pi - P_H - \kappa - \lambda c_L$

Table 2: Trading Game with a Socially Responsible Investor

Importantly, when considering the reform decision in period $t = 0$, the entrepreneur anticipates that there are gains from trade in the next period if she owns a dirty firm but not if she owns a green firm. She reforms the firm in period $t = 0$ if and only if

$$2(\pi - \gamma c_L) - \kappa \geq \pi - \gamma c_H + P_H - \gamma c_L \Leftrightarrow \gamma \geq \lambda.$$

The key insight is that the anticipation of the trading gains when the entrepreneur owns a dirty firm can reduce her incentive to turn the firm green herself. Specifically, if $\frac{\kappa}{2(c_H - c_L)} \leq \gamma < \lambda$, the entrepreneur would reform the firm immediately in the absence of the socially responsible investor but *strategically* delays reform in the presence of the socially responsible investor. If $\gamma < \frac{\kappa}{2(c_H - c_L)}$, the entrepreneur does not reform the firm in the absence of the socially responsible investor, and so the presence of the socially responsible investor speeds up the firm's reform. Finally, if $\gamma \geq \lambda$, the entrepreneur reforms the firm herself even in the presence of the socially responsible investor.

In the next section, we introduce the infinite-horizon model. In addition to establishing strategic delay in a more general setting, the infinite-horizon model features important dynamic interactions between socially responsible investors such as a free-rider problem that affects gains from trade and therefore strategic delay. We also use this general framework to study investment mandates that are meant to address delay in reform and to study a number of extensions.

3 Model

Time is discrete and infinite: $t \in \mathbb{N}_0 := \{0, 1, \ldots\}$. There is a single deep-pocket risk-neutral entrepreneur (she/her) who owns a firm at the beginning of period $t = 0$, and $N \geq 1$ risk-neutral deep-pocket investors (he/him) who can acquire the firm from the entrepreneur. The entrepreneur and the investors have the same time-discount factor $\beta \in (0, 1)$. There are $N_f \geq 0$ financial investors and $N_s = N - N_f \geq 0$ socially responsible investors.

The firm generates a profit $\pi > 0$ and a social cost $c \in \{c_L, c_H\}$ at the end of each period $t \in \mathbb{N}_0$. Initially, the social cost is equal to c_H. In period $t = 0$, the entrepreneur can incur a one-time cost $\kappa > 0$ to reduce the social cost to $c_L < c_H$ for the current and all future periods.[5] We assume that the entrepreneur reforms the firm if she is indifferent between reforming and not reforming it.

[5] In Appendix B.1, we allow the owner of the firm—the entrepreneur or an investor—to reform the firm in any period $t \in \mathbb{N}_0$. The equilibrium we derive in Section 4 is also an equilibrium in this extended model.

Importantly, the entrepreneur has sufficient funds to pay the cost κ. Notably, our results remain unchanged if, instead of requiring the one-time cost κ, reducing the social cost would be associated with a permanent reduction in the per-period profit from π to $\pi - \kappa(1-\beta)$. In this case, even a financially-constrained entrepreneur would be able to reform the firm as long as $\pi > \kappa(1-\beta)$.

We allow c_H and c_L to be positive or negative and only require $c_H > c_L$. A positive social cost captures negative externalities arising from the firm's production such as greenhouse gas emissions, whereas a negative social cost captures positive externalities from the firm's production such as a social benefit. In particular, the reform decision can be interpreted as innovating on a green technology, adopting a greener technology, or scaling a green technology. For ease of exposition, we only use the term social cost throughout the paper.

We refer to a firm with a high social cost of production, $c = c_H$, as a "dirty" firm and a firm with a low social cost of production, $c = c_L$, as a "green" firm. The discounted social surplus generated by a firm that stays dirty forever is equal to $\frac{\pi - c_H}{1-\beta}$, and the discounted social surplus generated by a green firm is equal to $\frac{\pi - c_L}{1-\beta} - \kappa$. We assume that reforming the firm is socially optimal, that is, $\frac{c_H - c_L}{1-\beta} > \kappa$. In addition, we assume that it is not socially desirable to simply shut down a dirty firm, that is, $\pi > c_H$.

If the entrepreneur owns the firm, her per-period utility is given by $\pi - \gamma c$, where $c \in \{c_L, c_H\}$ is the social cost of production and $\gamma \geq 0$ captures her pro-social preferences. If the entrepreneur does not own the firm, her per-period utility is given by $-\gamma c$. A financial investor has a per-period utility of π if he owns the firm and zero otherwise. A socially responsible investor has a per-period utility of $\pi - \lambda c$ if he owns the firm and $-\lambda c$ otherwise, where $\lambda > 0$. While the two parameters γ and λ can be equal, they will generally differ across agents.[6] To ensure that the total per-period disutility from the social cost of production does not exceed the social cost, we require that $\gamma + \lambda N_s \leq 1$.

The pro-social preferences are "broad" in the sense that an agent incurs the disutility from the social cost of production independent of ownership. These preferences can capture agents' direct exposure to the social cost of production. For example, some investors may be located in the same area as the firm and therefore suffer directly from the firm's pollution. Alternatively, the pro-social preferences can capture moral concern about the social costs incurred by other agents.

[6]There is ample evidence that some economic agents, including investors in a financial market context, have pro-social preferences and that there is heterogeneity across agents (see, e.g., List, 2009; Riedl and Smeets, 2017; Bonnefon et al., 2022; Heeb et al., 2022). For example, λ may capture the average pro-social preferences of households investing in an impact fund, whereas γ may represent the pro-social preferences of a single company founder.

The financial market is subject to search frictions.[7] Specifically, at the beginning of each period $t \in \mathbb{N} := \{1,2,\ldots\}$, the entrepreneur meets a given investor with probability $\frac{1}{N}$. As a result, the probability of meeting a financial investor is equal to $\frac{N_f}{N}$, and the probability of meeting a socially responsible investor is equal to $\frac{N_s}{N}$. Note that our timing convention implies that if the entrepreneur does not reform the firm, then the minimum delay in reform is one period. We choose this convention for ease of exposition. In addition, this choice may capture an important source of delay in reality. The first period can capture a period in which the entrepreneur sets up the firm and gets ready to sell it to outside investors. As such, the first-period delay can be significantly longer compared with the delay arising between periods while trading in the financial market. Importantly, we could allow the entrepreneur to also meet an investor at the beginning of period $t = 0$. This alternative specification does not resolve delay in reform in our model unless $N_s = N$, that is, if there are no search frictions to meeting a socially responsible investor.

Upon meeting an investor, the entrepreneur can sell the firm by making a take-it-or-leave-it price offer to the investor. We assume that the entrepreneur does not sell the firm if she is indifferent between selling and not selling it. If the entrepreneur sells the firm to an investor, the investor owns the firm forever and there is no further change in ownership.

Directly following the acquisition of a dirty firm with a high social cost of production, $c = c_H$, an investor can reduce the social cost to $c_L < c_H$ for the current and all future periods by incurring the same one-time cost $\kappa > 0$ as the entrepreneur.[8] We assume that the investor reforms the firm if he is indifferent between reforming and not reforming it. Financial investors do not reform a dirty firm because they do not care about the social cost of production. If a socially responsible investor reforms a dirty firm, his discounted utility is given by $\frac{\pi-\lambda c_L}{1-\beta} - \kappa$, and if he does not reform it, his discounted utility is given by $\frac{\pi-\lambda c_H}{1-\beta}$. As a result, a socially responsible investor reforms a dirty firm if and only if

$$\frac{\pi - \lambda c_L}{1-\beta} - \kappa \geq \frac{\pi - \lambda c_H}{1-\beta} \Leftrightarrow \lambda \geq (1-\beta)\frac{\kappa}{c_H - c_L}.$$

Intuitively, a socially responsible investor reforms the firm if he cares sufficiently strongly about

[7] As emphasized in the literature, search frictions may arise for multiple reasons such as information frictions or coordination problems (see, e.g., Lagos, 2000; Rogerson et al., 2005). Search frictions in private markets can be particularly severe with long wait times to raise capital (see, e.g., Cremades, 2019), and frequent deal terminations (see, e.g., Cain et al., 2015; Thomas and Sabater, 2022).

[8] The economic forces we highlight in our analysis equally apply to acquiring a controlling stake in the firm or offering a subsidy to the entrepreneur to reform the firm herself ex post. What matters is that search frictions prevent direct bargaining or contracting between the entrepreneur and socially responsible investors in period $t = 0$.

the firm's social cost of production.[9] We assume that socially responsible investors are sufficiently pro-social such that such an investor reforms a dirty firm if he acquires it.

Assumption 1. $\lambda > \eta_1 := (1-\beta)\frac{\kappa}{c_H - c_L}$.

We study our baseline model in Section 4. In Section 5, we allow investors to adopt investment mandates before trading in the financial market. In Section 6, we introduce several extensions and discuss the robustness of our results. Specifically, we study extensions in which the market may become more pro-social in the future, the acquisition price is determined by generalized Nash bargaining, the market has more severe search frictions, and financial investors can re-sell the firm after acquiring it.

4 Equilibrium

In this section, we study the entrepreneur's reform decision and the subsequent trading between the entrepreneur and investors in the financial market. We consider symmetric equilibria in which the entrepreneur offers the same price to all investors of the same type and all investors of the same type behave identically. As a benchmark, we study a financial market with only financial investors in Section 4.1. Section 4.2 considers a financial market with both financial and socially responsible investors.

4.1 Benchmark with Only Financial Investors

In this section, we consider a financial market with only financial investors. Formally, we assume that $N_f = N$ such that $N_s = 0$. Denote the highest price a financial investor is willing to pay for a green firm by P_L^f and for a dirty firm by P_H^f.

Lemma 1. *Let $N_s = 0$. Then the highest prices a financial investor is willing to pay for a green firm and for a dirty firm are equal to the discounted profits. That is, $P_L^f = P_H^f = \frac{\pi}{1-\beta}$. The entrepreneur is indifferent between selling the firm to a financial investor and retaining ownership. There are no gains from trade when the entrepreneur meets a financial investor.*

[9] Note that because the utility from the profit and the disutility from the social cost of production are additively separable, we could introduce a different time-discount rate for the social cost akin to a social discount rate (see, e.g., Caplin and Leahy, 2004). In this case, the weight of the social cost in agents' decision making is determined jointly by the strength of pro-social preferences and the level of the discount rate applied to social costs.

Financial investors never reform the firm. Because the entrepreneur and financial investors value profits equally and the entrepreneur incurs the disutility from the social cost of production independent of ownership, there are no gains from trade when the entrepreneur meets a financial investor. This feature distinguishes our model from standard search-theoretic models of financial markets in which trading gains typically arise for exogenous reasons (see, e.g., Weill, 2020), such as differences in utility flows from holding an asset across buyers and sellers. Because the entrepreneur is indifferent between selling the firm to a financial investor and retaining ownership, introducing any exogenous gains from trade can induce trade between the entrepreneur and financial investors. As we will show in the next section, pro-social preferences can give rise to endogenous gains from trade. To show this key insight most clearly, we deliberately exclude any exogenous gains from trade.

When deciding whether to reduce the social cost of production, the entrepreneur compares her discounted utility from reforming the firm in period $t = 0$, $\frac{\pi-\gamma c_L}{1-\beta} - \kappa$, with her discounted utility from not reforming the firm, $\frac{\pi-\gamma c_H}{1-\beta}$, which directly implies the following result.

Lemma 2. *Let $N_s = 0$. Then the entrepreneur reforms the firm if and only if her pro-social preference parameter γ is sufficiently high. That is, the entrepreneur reforms the firm in period $t = 0$ if and only if $\gamma \geq \eta_1$, where $\eta_1 = (1-\beta)\frac{\kappa}{c_H - c_L}$ is defined in Assumption 1.*

Intuitively, the entrepreneur reforms the firm if she cares sufficiently strongly about the firm's social cost of production. Because the entrepreneur never sells the firm to a financial investor in equilibrium, the same result would obtain if the entrepreneur had no access to the financial market and therefore operated in autarky.

4.2 Financial Market with Socially Responsible Investors

In this section, we consider a financial market with socially responsible investors. Formally, we assume that $N_f < N$ such that $N_s > 0$. Denote the highest price a socially responsible investor is willing to pay for a green firm by P_L^s and for a dirty firm by P_H^s. Our goal is to understand whether and how the presence of socially responsible investors affects trading in the financial market and the entrepreneur's reform decision.

4.2.1 Gains from Trade in Financial Market

As was the case in the financial market with only financial investors (Lemma 1), there are no gains from trade between the entrepreneur and financial investors.

Lemma 3. *The highest prices a financial investor is willing to pay for a green firm and for a dirty firm are equal to the discounted profits. That is,* $P_L^f = P_H^f = \frac{\pi}{1-\beta}$. *There are no gains from trade when the entrepreneur meets a financial investor.*

The fact that the entrepreneur never sells the firm to a financial investor implies that our model is equivalent to a model without any financial investors—or a model without search frictions to meeting financial investors—in which the probability of meeting a socially responsible investor in a given period is equal to $\frac{N_s}{N}$.

Importantly, there are also no gains from trade when the entrepreneur who has reduced the social cost of production in period $t = 0$ and owns a green firm, $c = c_L$, meets a socially responsible investor.

Lemma 4. *The highest price a socially responsible investor is willing to pay for a green firm is equal to the discounted profits. That is,* $P_L^s = \frac{\pi}{1-\beta}$. *The entrepreneur is indifferent between selling a green firm to a socially responsible investor and retaining ownership. There are no gains from trade when the entrepreneur who owns a green firm meets a socially responsible investor.*

Because the firm is already green, an acquisition by a socially responsible investor would not affect the social cost of production, and consequently would not affect the disutility from the social cost of production that the entrepreneur and the socially responsible investor incur. As a result, there are no gains from trade.

Next, consider the case when the entrepreneur who does not reduce the social cost of production in period $t = 0$ and therefore owns a dirty firm, $c = c_H$, meets a socially responsible investor. Recall that Assumption 1 implies that if the investor acquires the firm, then he immediately reforms it. In the following, we will first determine the price for a dirty firm assuming that a symmetric equilibrium in which there are gains from trade when the entrepreneur meets a socially responsible investor exists. In the second step, we will determine the conditions under which such an equilibrium exists.

Lemma 5. *In a symmetric equilibrium in which there are gains from trade when the entrepreneur who owns a dirty firm meets a socially responsible investor, the highest price the investor is willing*

to pay is given by

$$P_H^s = \frac{\pi}{1-\beta} + \frac{\lambda(c_H - c_L)}{1-\beta\left(1-\frac{N_s-1}{N}\right)} - \kappa. \tag{1}$$

Lemma 5 shows that the higher the pro-social preference parameter of socially responsible investors λ, the higher the acquisition price P_H^s. Intuitively, a socially responsible investor who is more concerned about the social cost of production has a higher willingness to pay to acquire and reform a dirty firm.

The acquisition price also depends on the high social cost of production, c_H, even though the socially responsible investor immediately reforms the firm after an acquisition. This is because the socially responsible investor is concerned about the firm staying dirty if he does not acquire it. The higher the disutility of the socially responsible investor in this counterfactual, the higher the price he is willing to pay to avoid it.

The number of socially responsible investors in the financial market, N_s, also affects the acquisition price. If $N_s = 1$, then the highest price a socially responsible investor is willing to pay for a dirty firm is given by

$$P_H^s\big|_{N_s=1} = \frac{\pi}{1-\beta} + \frac{\lambda(c_H - c_L)}{1-\beta} - \kappa > \frac{\pi}{1-\beta}.$$

The latter inequality holds because $\frac{\lambda(c_H-c_L)}{1-\beta} > \kappa$ by Assumption 1. That is, a single socially responsible investor is willing to pay a premium for a dirty firm if and only if he is willing to reform it. Intuitively, the socially responsible investor values not only the firm's profits, but also the reduction in the social cost of production after the acquisition. The case of a single socially responsible investor is the natural extension of our example in Section 2 to a dynamic setting.

In addition to verifying our key results in a more general setting, our dynamic framework gives rise to an important new economic force—a free-rider problem—that reduces the price for a dirty firm, P_H^s, when the number of socially responsible investors increases. This novel result arises due to pro-social preferences and the dynamic interaction between socially responsible investors. Specifically, while the cost of reforming the firm is borne by the socially responsible investor who acquires the firm, the benefit accrues to all socially responsible investors who care about the social cost independent of ownership. Importantly, while the entrepreneur captures all gains from trade when she meets a given socially responsible investor, she cannot capture the utility gains that the acquisition generates for other socially responsible investors. Increasing the number of socially responsible investors therefore increases the expected discounted utility of a given socially

responsible investor when not owning the firm because the firm's reform by another socially responsible investor in the future becomes more likely. As a result, increasing the number of socially responsible investors reduces a given socially responsible investor's willingness to pay for a dirty firm.

Importantly, this free-rider problem arises due to the presence of pro-social preferences and is absent in standard search-theoretic models of financial markets. It may be an important force in private markets in which the same set of investors participate repeatedly over time and are aware of other investors' deal flows (see, e.g., Duff & Phelps, 2018).

Proposition 1. *There exists a symmetric equilibrium in the financial market if and only if*

$$\lambda > (\eta_1 - \gamma) \frac{1 - \beta \left(1 - \frac{N_s - 1}{N}\right)}{1 - \beta}, \tag{2}$$

where $\eta_1 = (1-\beta)\frac{\kappa}{c_H - c_L}$ *is defined in Assumption 1. If the condition in equation* (2) *is satisfied, then the symmetric equilibrium is unique, there are gains from trade when the entrepreneur who owns a dirty firm meets a socially responsible investor, the entrepreneur sells a dirty firm when she meets a socially responsible investor, and the acquisition price* P_H^s *is given by equation* (1).

Proposition 1 establishes the existence and uniqueness of a symmetric equilibrium in the financial market if the condition in equation (2) is satisfied. A symmetric equilibrium may not exist because of the free-rider problem.[10] In particular, if $N_s = 1$, the condition in equation (2) is always satisfied. As discussed above, an increase in N_s reduces socially responsible investors' willingness to pay to acquire a dirty firm due to the free-rider problem. If the free-rider problem reduces the willingness to pay sufficiently, a symmetric equilibrium ceases to exist. Henceforth, we make the following assumption.

Assumption 2. *The condition in equation* (2) *is satisfied.*

Proposition 1 further shows that if the condition in equation (2) is satisfied, there are gains from trade when the entrepreneur who owns a dirty firm meets a socially responsible investor. Importantly, gains from trade arise endogenously because socially responsible investors reform the firm after acquiring it.

[10] Recall that we study symmetric equilibria in which the entrepreneur offers the same price to all investors of the same type and all investors of the same type behave identically. If the condition in equation (2) does not hold, asymmetric equilibria in which a subset of socially responsible investors acquires a dirty firm upon meeting the entrepreneur can exist.

It is worth noting that if a socially responsible investor acquires a dirty firm, he incurs a financial loss in equilibrium. Specifically, the net present financial value of the acquisition by a socially responsible investor is given by

$$\frac{\pi}{1-\beta} - \kappa - P_H^s = -\frac{\lambda(c_H - c_L)}{1-\beta\left(1-\frac{N_s-1}{N}\right)} < 0. \tag{3}$$

However, socially responsible investors are willing to incur this financial loss because they obtain utility from reforming the firm.

4.2.2 Entrepreneur's Reform Decision

Given the trading behavior in the financial market, we can study whether the entrepreneur reduces the social cost of production in period $t = 0$.

Proposition 2. *The entrepreneur reforms the firm in period $t = 0$ if and only if*

$$\gamma \geq \eta_1 + \lambda \frac{\beta\frac{N_s}{N}}{1-\beta\left(1-\frac{N_s-1}{N}\right)} =: \eta_2, \tag{4}$$

where $\eta_1 = (1-\beta)\frac{\kappa}{c_H - c_L}$ is defined in Assumption 1.

The key insight from Proposition 2 is that the presence of socially responsible investors in the financial market can lead to a strategic delay in the reduction of the social cost of production. Recall from Section 4.1 that if the financial market is populated only by financial investors, the entrepreneur reduces the social cost of production if and only if $\gamma \geq \eta_1$. Proposition 2 implies that if $\eta_1 \leq \gamma < \eta_2$, the entrepreneur strategically delays the firm's reform in the sense that she does not reform the firm in the presence of socially responsible investors even though she would reform the firm in the absence of socially responsible investors. We therefore refer to the interval $[\eta_1, \eta_2)$ as the *strategic delay region*. Intuitively, the presence of socially responsible investors gives rise to gains from trade if the entrepreneur owns a dirty firm but not if she owns a green firm. These trading gains for a dirty firm, in turn, reduce the entrepreneur's incentive to reform the firm.

4.2.3 Determinants of Entrepreneur's Reform Decision

In this section, we study how the characteristics of socially responsible investors—their pro-social preference parameter λ and their number N_s—affect strategic delay.

Proposition 3. *Strengthening socially responsible investors' pro-social preferences increases the size of the strategic delay region. An increase in the number of socially responsible investors can increase or decrease the size of the strategic delay region. Specifically, the threshold η_1 does not depend on λ or N_s. The threshold η_2 increases in λ, increases in N_s if $N > \frac{\beta}{1-\beta}$, and decreases in N_s if $N < \frac{\beta}{1-\beta}$.*

Proposition 3 shows that the size of the strategic delay region $[\eta_1, \eta_2)$ unambiguously increases in the pro-social preference parameter of socially responsible investors, λ. Intuitively, a higher λ means that socially responsible investors gain more from reforming a dirty firm after an acquisition, which in turn increases the price in equation (1) they are willing to pay to acquire a dirty firm. In turn, this means that the entrepreneur has a weaker incentive to reduce the social cost of production herself.

Proposition 3 further establishes that the effect of the number of socially responsible investors, N_s, on the size of the strategic delay region is ambiguous. The reason is that an increase in the number of socially responsible investors has two opposing effects. First, a higher N_s increases the probability that the entrepreneur meets a socially responsible investor and therefore makes it more likely to sell a dirty firm. This force pushes η_2 up and increases the size of the strategic delay region. On the other hand, a higher N_s also intensifies the free-rider problem discussed in Section 4.2, which reduces the price in equation (1) a socially responsible investor is willing to pay for a dirty firm. This force pushes η_2 down and reduces the size of the strategic delay region. As such, the free-rider problem is in fact beneficial in the sense that it reduces strategic delay.

In addition to the size of the strategic delay region, the number of socially responsible investors, N_s, also affects the expected delay in the reduction of the social cost of production. Specifically, if the entrepreneur does not reform the firm, the expected delay in the reform of the firm is given by

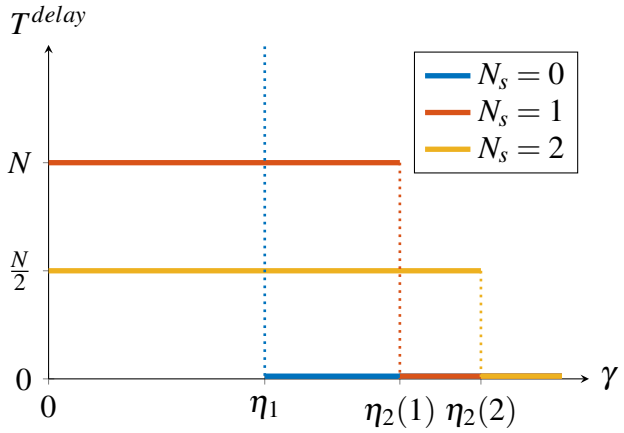
$$T^{delay} = \sum_{t=1}^{\infty} \left(1 - \frac{N_s}{N}\right)^{t-1} \frac{N_s}{N} t = \frac{N}{N_s}.$$

Conditional on the entrepreneur not reforming the firm, increasing the number of socially responsible investors N_s shortens the expected delay because it makes meeting a socially responsible investor more likely.

Figure 1 shows how the expected delay T^{delay} depends on the strength of the entrepreneur's pro-social preferences, γ, and the number of socially responsible investors, N_s. In the absence of socially responsible investors (i.e., $N_s = 0$), an entrepreneur with $\gamma \geq \eta_1$ reforms the firm (i.e,

$T^{delay} = 0$) but an entrepreneur with $\gamma < \eta_1$ does not reform the firm (i.e., $T^{delay} = \infty$). With a single socially responsible investor (i.e., $N_s = 1$), the dirty firm is eventually acquired by this investor. However, the presence of a socially responsible investor generates strategic delay for an entrepreneur with $\gamma \in [\eta_1, \eta_2(1))$, where $\eta_2(1)$ denotes the threshold in equation (4) when $N_s = 1$. If $\gamma < \eta_2(1)$, the expected delay is equal to N. Finally, if $N > \frac{\beta}{1-\beta}$, a further increase in N_s increases the strategic delay region but also shortens the expected delay in reform for an entrepreneur who chooses to not reform the firm herself.

Figure 1: Expected Delay T^{delay}



Notes: The figure plots the expected delay T^{delay} as a function of the entrepreneur's pro-social preference parameter γ for different numbers of socially responsible investors N_s for the case in which η_2 is increasing in N_s. The threshold η_1 is defined in Assumption 1 and $\eta_2(N_s)$ denotes the threshold in equation (4) from Proposition 2 as a function of the number of socially responsible investors N_s.

5 Investment Mandates

In this section, we analyze whether investment mandates through which socially responsible investors can commit to certain investment strategies can address the problem of delay in reform, and whether investors have incentives to adopt such mandates. In practice, many socially responsible funds have adopted investment mandates outlining a set of principles for their investments such as the United Nations' Principles for Responsible Investing (UN PRI, 2020) or specific impact terms in contracts between general and limited partners (Geczy et al., 2021).

In our baseline model, strategic delay arises due to a hold-up problem because socially responsible investors cannot commit to not acquiring a dirty firm ex post. One would therefore expect

that expanding the set of feasible contracts by introducing investment mandates through which socially responsible investors can commit to not acquiring dirty firms can eliminate delay in reform. We therefore first study an *exclusionary* investment mandate through which socially responsible investors can commit to not acquiring a firm as a function of its status—green or dirty. In practice, this corresponds to a mandate based on screening firms using criteria such as ESG ratings. We show that while such a mandate can indeed eliminate strategic delay by an entrepreneur with moderate pro-social preferences because it eliminates the hold-up problem, it cannot speed up reform by an entrepreneur with weak pro-social preferences. We therefore also study a *price-commitment* investment mandate through which socially responsible investors can commit to a price for the firm as a function of its status—green or dirty. We show that an investment mandate through which investors commit to paying a premium for green firms can eliminate all delay—strategic and non-strategic. In practice, such a mandate corresponds to a below-market-rate mandate with positive screening.

More specifically, we study whether there exists an investment mandate—exclusionary or price-commitment—that induces zero delay and that all socially responsible investors are willing to adopt ex ante before the entrepreneur takes any action in period $t = 0$. In other words, we require that the adoption of the investment mandate is individually rational ex ante in the sense that no socially responsible investor has an incentive to deviate to not adopting it.[11] A necessary condition for individual rationality is therefore our assumption that investors have size such that the deviation of an individual investor affects trading in the financial market. If a socially responsible investor does not adopt a proposed investment mandate, the entrepreneur can make a take-it-or-leave-it offer to this specific socially responsible investor if they meet in the financial market. In Section 5.3, we discuss the role of commitment and the implementation of investment mandates in practice.

5.1 Exclusionary Investment Mandate

In this section, we consider an exclusionary investment mandate through which socially responsible investors can commit to not trading with the entrepreneur as a function of the firm's status—green or dirty. For example, if socially responsible investors commit to not acquiring a dirty firm,

[11] To simplify the analysis, we restrict deviations to not adopting a proposed investment mandate. In particular, we do not allow a socially responsible investor to deviate to adopting an investment mandate that is different from the proposed one. Our main results hold if we allow for these more general deviations.

then the entrepreneur cannot sell a dirty firm to a socially responsible investor at any price if they meet in the financial market. Note that we assume a strong form of commitment in the sense that we rule out renegotiation between the entrepreneur and socially responsible investors ex post. As we show below, even with this strong form of commitment, an exclusionary investment mandate cannot always implement zero delay. If socially responsible investors were unable to commit to not renegotiating, then the exclusionary investment mandate would simply fail to work at all. Interestingly, as we show in Section 5.2, the price-commitment investment mandate requires a weaker form of commitment regarding renegotiation.

If $\gamma \geq \eta_2$, where η_2 is defined in Proposition 2, then the entrepreneur reforms the firm herself even in the presence of socially responsible investors and there is no need for an investment mandate to correct the entrepreneur's incentive. We therefore consider the case $\gamma < \eta_2$ below and seek to understand if an exclusionary investment mandate can induce the entrepreneur to reform the firm.

Proposition 4. *If $\gamma \in [0, \eta_1)$, there does not exist an exclusionary investment mandate that induces the entrepreneur to reform the firm in period $t = 0$, where η_1 is defined in Assumption 1. If $\gamma \in [\eta_1, \eta_2)$, there exists an individually-rational exclusionary investment mandate through which socially responsible investors commit to not acquiring a dirty firm that induces the entrepreneur to reform the firm in period $t = 0$, where η_2 is defined in Proposition 2.*

Proposition 4 establishes that if $\gamma \in [\eta_1, \eta_2)$, socially responsible investors adopt an investment mandate through which they commit to not acquiring a dirty firm. This result is intuitive. If $\gamma \in [\eta_1, \eta_2)$, the entrepreneur reduces the social cost herself in the absence of socially responsible investors. However, the presence of socially responsible investors induces her to keep the firm dirty and sell it to a socially responsible investor in the financial market to capture gains from trade. Therefore, if socially responsible investors commit to not acquiring a dirty firm, the entrepreneur behaves as if there were no socially responsible investors in the financial market and reforms the firm immediately. Thus, the exclusionary investment mandate can avoid the strategic delay caused by socially responsible investors.

However, an exclusionary investment mandate cannot reduce the delay in the reform of the firm if $\gamma \in [0, \eta_1)$. Without an exclusionary investment mandate, a dirty firm is eventually acquired by a socially responsible investor and reformed. Because the firm would not be reformed in the absence of an acquisition by a socially responsible investor, committing to not acquire a dirty firm would

in fact increase the delay in reforming the firm.

Finally, whether socially responsible investors commit to not acquiring a green firm does not affect our results because a green firm is never acquired in equilibrium even in the absence of investment mandates.

5.2 Price-Commitment Investment Mandate

In this section, we consider an investment mandate through which socially responsible investors can commit to offering a price as a function of the firm's status—green or dirty. Specifically, socially responsible investors can commit to a price $\tilde{P}_L$ for a green firm and/or a price $\tilde{P}_H$ for a dirty firm. In particular, socially responsible investors can choose to commit to a price only for a green or only for a dirty firm. When the entrepreneur meets a socially responsible investor, she can either accept the price $\tilde{P}_L$ for a green firm or $\tilde{P}_H$ for a dirty firm (if available), or reject it and revert back to the standard trading protocol in which she can make a take-it-or-leave-it offer to the socially responsible investor. Note that this assumption imposes a lower bound on the prices socially responsible investors can commit to: A socially responsible investor cannot commit to not considering a take-it-or-leave-it offer if the entrepreneur does not accept the pre-committed price. This implies, in particular, that investors cannot commit to paying a price for a dirty firm that is below the take-it-or-leave-it acquisition price derived in Section 4. Importantly, we show in Proposition 5 that even with this limited form of commitment, socially responsible investors adopt a price-commitment investment mandate that eliminates delay. Allowing investors to further commit to not trading at all if the pre-committed price is not accepted would further strengthen their incentive to adopt a price-commitment mandate because the entrepreneur could be induced to reform the firm at a lower pre-committed price for a green firm.

If $\gamma \geq \eta_2$, then the entrepreneur reforms the firm herself even in the presence of socially responsible investors and there is no need for an investment mandate. We therefore consider the case $\gamma < \eta_2$ below and seek to understand if an investment mandate with price commitment can induce the entrepreneur to reform the firm in period $t = 0$.

Proposition 5. *If $\gamma \in [0, \eta_2)$, then there exists an individually-rational price-commitment investment mandate through which socially responsible investors commit to paying the price*

$$\tilde{P}_L = \frac{\pi}{1-\beta} + \frac{c_H - c_L}{\beta \frac{N_s}{N}} (\eta_2 - \gamma) > \frac{\pi}{1-\beta}$$

for a green firm that induces the entrepreneur to reform the firm in period $t = 0$, where η_2 is defined in Proposition 2.

Proposition 5 establishes that if $\gamma \in [0, \eta_2)$, socially responsible investors adopt an investment mandate through which they commit to offering a price for a green firm that is higher than the discounted profits, that is, $\tilde{P}_L > \frac{\pi}{1-\beta}$. The investment mandate does not include a price offer for a dirty firm.[12] By Lemma 4, the price a socially responsible investor would be willing to pay for a green firm in the absence of an investment mandate is $\frac{\pi}{1-\beta}$, which is not sufficient to induce the entrepreneur with $\gamma \in [0, \eta_2)$ to reform the firm. In particular, if $\gamma \in [0, \eta_1)$, there is non-strategic delay because the entrepreneur's pro-social preferences are too weak, and if $\gamma \in [\eta_1, \eta_2)$, there is strategic delay. The problem of strategic delay arises because there are trading gains only if the entrepreneur owns a dirty firm but not if she owns a green firm. By offering to pay a premium for a green firm, socially responsible investors can correct the entrepreneur's incentive and induce the entrepreneur to reform the firm immediately. Importantly, in contrast to an exclusionary investment mandate, the investment mandate with price commitment can also induce an entrepreneur with weak pro-social preferences $\gamma \in [0, \eta_1)$ to reform the firm.

Although there exists a price for a green firm that induces the entrepreneur to reform the firm, it is not immediately clear that socially responsible investors are willing to adopt such an investment mandate because paying a premium for a green firm is costly for them. The price $\tilde{P}_L$ is chosen such that the entrepreneur is indifferent between reforming and not reforming the firm. In other words, $\tilde{P}_L$ is the minimum price for a green firm that socially responsible investors must commit to in order to induce the entrepreneur to reform the firm. Each individual socially responsible investor internalizes that if he deviates to not adopting the investment mandate, the entrepreneur switches to not reforming the firm and selling the dirty firm in the financial market. Even though offering a premium is costly, socially responsible investors find it individually rational to commit to the investment mandate because they incur an additional disutility in each period in which the firm is dirty. Intuitively, socially responsible investors prefer to commit to a high price for a green firm ex ante to avoid the disutility from the delay in reform rather than paying for a dirty firm later and incurring the disutility until the firm is reformed.

It is worth noting that if a socially responsible investor acquires a green firm under the price-

[12]Note that because the entrepreneur always has the option to reject the pre-committed price and revert to the standard trading protocol, this mandate with no price for a dirty firm is equivalent to an investment mandate with a sufficiently low price $\tilde{P}_H$ for a dirty firm.

commitment investment mandate from Proposition 5, then he incurs a financial loss in equilibrium. The net present financial value of the acquisition by a socially responsible investor is given by

$$\frac{\pi}{1-\beta} - \tilde{P}_L = -\frac{c_H - c_L}{\beta \frac{N_s}{N}} (\eta_2 - \gamma) < 0. \tag{5}$$

As follows from equation (3), a socially responsible investor also incurs a financial loss if he acquires a dirty firm and reforms it in the absence of investment mandates. The financial loss that socially responsible investors incur in the presence of investment mandates, given by equation (5), is lower than that in the absence of investment mandates, given by equation (3), if and only if $\gamma > \eta_1$. Intuitively, the stronger the entrepreneur's pro-social preferences, the less costly it is to correct the entrepreneur's incentive and induce her to reform the firm in period $t = 0$. Note that even though the financial loss is higher under the investment mandate with price commitment if $\gamma < \eta_1$, it also avoids the disutility from the delay in reform incurred by socially responsible investors. As implied by Proposition 5, this utility gain always exceeds the potentially higher financial loss.

5.3 Commitment and Implementation of Investment Mandates

Our results highlight that the extent to which socially responsible investors can commit to investment strategies determines their impact on the pace of firm reform. Notably, investment mandates are commonly adopted by impact funds. Geczy et al. (2021) show that the vast majority of impact funds outline and contract ex ante on impact terms, with 94% of funds including impact terms in their contracts between general and limited partners and 70% of funds contracting on impact terms with their portfolio companies. Commitment may be facilitated through such explicit contracts and through reputational concerns arising from, for example, the adoption of internationally-recognized socially responsible investing frameworks such as the United Nations' Principles for Responsible Investment. Indeed, deviating from such a framework ex post may result in exclusion from a signatory list which can be reputationally damaging for socially responsible investors. There are, of course, reasons that may limit the ability of some investors to commit in reality, which in turn limits the ability of these investors to induce reform in a timely manner. For example, commitment to paying a premium for a green firm may be limited by the fiduciary duty of investment funds (see, e.g., Eccles and Klimenko, 2019; GIIN, 2020).

The price-commitment investment mandate can be implemented through an investment mandate that is explicitly "below market rate" and engages in positive screening such as investing in

firms that already have high ESG scores. In practice, about $25 trillion of assets under management employ a "screening" mandate (UNPRI, 2020) and about 33% of impact funds are "below-market-rate" funds explicitly expecting lower financial returns to achieve impact goals (GIIN, 2020). As we noted above, the price-commitment mandate does not require a commitment to not renegotiate with the entrepreneur if it is optimal to do so ex post. Allowing investors to further commit to not renegotiating if the pre-committed price is not accepted would further strengthen their incentive to adopt a price-commitment mandate.

Interestingly, the price-commitment investment mandate adopted by socially responsible investors through which they acquire green firms at a premium is observationally similar to the investment strategy of investors who receive a positive utility (a "warm glow") from investing in green firms. Commitment is not an issue for such warm-glow investors. A somewhat surprising implication of our analysis is that such "naive" socially responsible investors, who do not internalize the broader impact of their actions, may unintentionally create demand pressure and increase market prices for green firms, which can help support timely impact. However, the warm-glow premium will typically not lead to optimal firm reform because it simply reflects investors' taste for green firms and is not targeted to induce the entrepreneur to reform the firm proactively.

While we do not explicitly model the entity that proposes the investment mandate, any of the socially responsible investors would be willing to propose it because we require that the investment mandate is individually rational. Alternatively, the problem of designing an investment mandate can be interpreted as the problem of a constrained social planner. Specifically, the social planner designs an investment mandate with the aim to minimize delay in the firm's reform. However, the planner cannot force individual socially responsible investors to adopt the investment mandate and hence has to satisfy their individual rationality constraints. For example, the United Nations' Principles for Responsible Investment is a set of standards for socially responsible investing designed by a United Nations-supported international network of investors. Individual investors can—but do not have to—adopt the United Nations' Principles for Responsible Investment. The design of such principles therefore has to take into account the willingness of individual investors to adopt these principles.

5.4 Price-Commitment Investment Mandate: Multiple Entrepreneur Types

Proposition 5 establishes that socially responsible investors always adopt an investment mandate with price commitment to incentivize the entrepreneur to reform the firm in period $t = 0$. This result arises when there is a single entrepreneur type with the pro-social preference parameter γ, and so the price can be chosen such that the entrepreneur is exactly indifferent between reforming and not reforming the firm. Intuitively, the investment mandate can be tailored to the specific entrepreneur type in this case. This tailoring in turn means that a deviation by a socially responsible investor makes the entrepreneur switch to not reforming the firm, which creates strong incentives for socially responsible investors to not deviate from the mandate.

In this section, we seek to understand the robustness of this strong result by studying whether socially responsible investors adopt a price-commitment investment mandate if there are multiple entrepreneur types. To address this question, we extend our analysis as follows: after an investment mandate is adopted (if any) but before the entrepreneur takes any action in period $t = 0$, the entrepreneur's type is drawn at random. In particular, with probability $w_0 \in (0,1)$ the entrepreneur is a low-γ type with the pro-social preference parameter $\gamma = 0$. With the complementary probability $1 - w_0$ she is a high-γ type with $\gamma = \gamma_h > 0$.[13] After the entrepreneur's type is drawn, it becomes public information and the model proceeds as discussed in Section 5.2.

The key novelty of the setting with multiple entrepreneur types is that socially responsible investors cannot commit to a price for a green firm that makes both types of entrepreneurs indifferent between reforming the firm and keeping it dirty. Specifically, socially responsible investors can commit to prices $\tilde{P}_L$ and $\tilde{P}_H$ for a green and a dirty firm, respectively, but cannot condition these prices on the entrepreneur's type $\gamma \in \{0, \gamma_h\}$.

Proposition 5 shows that the price that makes an entrepreneur with a pro-social preference parameter $\gamma < \eta_2$ indifferent between reforming and not reforming the firm is given by

$$\tilde{P}_L(\gamma) = \frac{\pi}{1-\beta} + \frac{c_H - c_L}{\beta \frac{N_s}{N}} (\eta_2 - \gamma). \tag{6}$$

However, socially responsible investors cannot set different prices for different entrepreneur types. Thus, if socially responsible investors commit to the price $\tilde{P}_L(\gamma_h)$ for a green firm, only the high-γ entrepreneur reforms the firm in period $t = 0$. If they commit to the price $\tilde{P}_L(0) > \tilde{P}_L(\gamma_h)$ for a green firm, then both types of entrepreneurs reform the firm in period $t = 0$. However, while the low-γ

[13] In this section, we assume that Assumption 2 holds for both entrepreneur types.

entrepreneur is indifferent between reforming the firm and keeping it dirty in this case, the high-γ entrepreneur strictly prefers to reform the firm. Put differently, socially responsible investors overpay the high-γ entrepreneur to reform the firm. In contrast to the low-γ entrepreneur, the high-γ entrepreneur values a reduction in the social cost of production associated with the firm's reform, and thus requires a lower price for a green firm to have a sufficient incentive to reform it.

Corollary 1. *If $\gamma_h \in [0, \eta_2)$, then there exists an individually-rational investment mandate with price commitment through which socially responsible investors commit to paying the price $\tilde{P}_L(\gamma_h)$ for a green firm, where $\tilde{P}_L(\gamma)$ is defined in equation* (6) *and η_2 is defined in Proposition 2, that induces only the high-γ entrepreneur to reform the firm in period $t = 0$.*

Corollary 1 follows from Proposition 5 and establishes that there always exists an investment mandate with price commitment that induces at least the high-γ entrepreneur to reform the firm. Socially responsible investors do not need to overpay to incentivize only the high-γ entrepreneur to reform the firm. Consequently, similar to Proposition 5, it is always individually rational to induce at least such an entrepreneur to reform the firm immediately.

Proposition 6. *Consider an investment mandate with price commitment through which socially responsible investors commit to paying the price $\tilde{P}_L(0)$ for a green firm, where $\tilde{P}_L(\gamma)$ is defined in equation* (6)*, that induces the entrepreneur to reform the firm in period $t = 0$ irrespective of her type. There exist two thresholds $\bar{\gamma} > 0$ and $\bar{w}_0 \in (0,1)$ (both defined in the proof) such that if $\gamma_h < \bar{\gamma}$, the proposed investment mandate is always individually rational, and if $\gamma_h \geq \bar{\gamma}$, it is individually rational if and only if $w_0 \geq \bar{w}_0$. If $\gamma_h \geq \bar{\gamma}$ and $w_0 < \bar{w}_0$, then there does not exist an individually-rational investment mandate with price commitment for a green firm that induces the entrepreneur to reform the firm in period $t = 0$ irrespective of her type.*

Proposition 6 characterizes when socially responsible investors adopt an investment mandate that induces both entrepreneur types to reform the firm and shows that such a mandate is not always individually rational. Whether socially responsible investors are willing to adopt the proposed investment mandate depends on the pro-social preference parameter of the high-γ entrepreneur, γ_h, and the probability of drawing the low-γ entrepreneur, w_0. Specifically, the proposed investment mandate is always individually rational if the high-γ entrepreneur is not too pro-social (i.e., if $\gamma_h < \bar{\gamma}$). If instead the high-γ entrepreneur is sufficiently pro-social (i.e., if $\gamma_h \geq \bar{\gamma}$), the proposed investment mandate is individually rational if and only if the probability of drawing the high-γ entrepreneur is sufficiently low (i.e., if $w_0 \geq \bar{w}_0$).

To understand the intuition for this result, consider a socially responsible investor who unilaterally deviates to not adopting the proposed investment mandate. Recall that the price $\tilde{P}_L(0)$ is chosen such that the low-γ entrepreneur is indifferent between reforming and not reforming the firm. As a result, the deviation induces the low-γ entrepreneur to switch to not reforming the firm. The key question is what happens to the high-γ entrepreneur. If the high-γ entrepreneur is not too pro-social (i.e., if $\gamma_h < \bar{\gamma}$), then she also switches to not reforming the firm. If both entrepreneur types switch to not reforming the firm, then the disutility for socially responsible investors is high, and the price-commitment investment mandate is always individually rational.

In contrast, if the high-γ entrepreneur is sufficiently pro-social (i.e., if $\gamma_h \geq \bar{\gamma}$), then the high-$\gamma$ entrepreneur still reforms the firm even if one socially responsible investor deviates from the proposed investment mandate, which introduces a trade-off. On the one hand, if the entrepreneur turns out to be the low-γ entrepreneur, then the deviation induces the entrepreneur to not reform the firm, which makes the deviation costly for the socially responsible investor due to the delay in reform. On the other hand, if the entrepreneur turns out to be the high-γ entrepreneur, then the deviation does not affect the entrepreneur's reform decision but implies that the deviating investor does not have to pay the premium if she meets the entrepreneur in the financial market. Which of these two effects dominates therefore depends on the probability of drawing the low-γ entrepreneur, w_0. If the probability of drawing the low-γ entrepreneur is high, incurring the disutility from delay due to the deviation outweighs the benefit of saving on paying the premium.

Finally, we discuss how the characteristics of socially responsible investors—their pro-social preference parameter λ and their number N_s—affect the adoption of the proposed investment mandate through the thresholds $\bar{\gamma}$ and $\bar{w}_0$ from Proposition 6.

Corollary 2. *$\bar{\gamma}$ increases in λ and decreases in N_s, and $\bar{w}_0$ decreases in both λ and N_s.*

The first key insight from Corollary 2 is that an increase in λ increases the set of parameter values in terms of γ_h and w_0 for which the proposed investment mandate that induces both entrepreneur types to reform the firm is individually rational. The reason is that a higher λ implies a higher disutility for socially responsible investors due to the delay in reform, which means that an individual socially responsible investor is less willing to deviate from the proposed investment mandate that eliminates the delay in reform. Interestingly, this result is in contrast to our result in Proposition 3, which shows that, in the absence of investment mandates, the problem of strategic delay in reform becomes more severe as λ increases. In that case, a higher λ increases the price

socially responsible investors are willing to pay to reform a dirty firm, which in turn reduces the incentive of the entrepreneur to reform the firm. In contrast, in the presence of investment mandates, a higher λ increases the willingness of socially responsible investors to commit to paying a premium for a green firm to avoid any delay in reform.

Corollary 2 further establishes that an increase in N_s has an ambiguous effect on the set of parameter values in terms of γ_h and w_0 for which the proposed investment mandate is individually rational. The reason is that the number of socially responsible investors N_s determines the probability of meeting a socially responsible investor in the financial market, which in turn affects the reservation utilities of both the entrepreneur and investors. This gives rise to two opposing effects.

First, recall that if $\gamma_h > \bar{\gamma}$, then the high-γ entrepreneur is willing to reform the firm even if one socially responsible investor deviates to not adopting the investment mandate. This in turn generates incentives for socially responsible investors to deviate to not adopting the investment mandate. As the number of socially responsible investors N_s increases, the impact that each individual socially responsible investor can have on the entrepreneur diminishes, which strengthens the incentive to deviate. In other words, as N_s increases, the free-rider problem in the adoption of the investment mandate intensifies.

At the same time, a higher N_s means that an individual socially responsible investor is less likely to pay the premium for the green firm. In addition, the premium for a green firm declines because the price for a green firm implied by the mandate, $\tilde{P}_L(0)$, decreases in N_s.[14] The reason is that a larger number of socially responsible investors have to commit to a lower price to generate the same incentive for the entrepreneur to reform the firm because the probability of meeting a socially responsible investor increases. This second effect reduces the incentive of an individual socially responsible investor to deviate, making the overall effect ambiguous.

6 Extensions and Robustness

In this section, we consider several extensions of the baseline model from Section 3. Section 6.1 studies an extension in which the market may become more pro-social in the future. Section 6.2 investigates how our results are affected if the acquisition price is determined by generalized Nash bargaining. Section 6.3 introduces a parameter that governs the severity of search frictions and

[14] By plugging η_2 from equation (4) into $\tilde{P}_L(\gamma)$ defined in equation (6), it is straightforward to show that $\tilde{P}_L(0)$ decreases in N_s.

explores how varying this parameter affects strategic delay. Finally, Section 6.4 shows that our results are robust to allowing financial investors to re-sell the firm after acquiring it and discusses how the model can be extended to allow for intermediation by financial investors between the entrepreneur and socially responsible investors.

6.1 More Pro-Social Investors in the Future

In this extension, we consider a model in which socially responsible investors may become more pro-social over time. We analyze the extended model in detail in Appendix B.2. Specifically, we assume that in period $t = 0$, the pro-social preference parameter of socially responsible investors is given by λ^0. With probability $1 - \varphi$ it remains the same next period, and with probability φ it increases to $\lambda^1 > \lambda^0$. If it increases to λ^1, it stays at this level forever. If $\varphi = 0$, we are back to the baseline model with $\lambda = \lambda^0$, and, as in the baseline model, we assume that λ^0 satisfies the condition in equation (2).[15] In what follows, we analyze how the results from the baseline model change when the increase in λ is possible, that is, when $\varphi > 0$. In reality, an increase in λ can be driven by growing social and environmental concerns of investors. For example, a report by Morgan Stanley (2019) documents such changes in preferences of investors, particularly young ones, over recent years.

Clearly, once the pro-social preference parameter of socially responsible investors has increased to λ^1, we are back to our baseline model with $\lambda = \lambda^1$. Therefore, if the entrepreneur's first meeting with a socially responsible investor occurs after the increase in λ, she sells a dirty firm. The key question in the extended model is whether the entrepreneur also sells a dirty firm if her first meeting with a socially responsible investor occurs before the market has become more pro-social. The main novel insight from the extended model is that the entrepreneur may choose to not trade with a socially responsible investor with $\lambda = \lambda^0$ and to wait for the market to become more pro-social before selling a dirty firm, even though she would sell a dirty firm to a socially responsible investor with $\lambda = \lambda^0$ in the baseline model. This strategic delay in trade further defers the reform of the firm.

We first show in Proposition 7 that strategic delay in trade does not necessarily arise if the probability of the market becoming more pro-social, φ, is small.

[15] The condition in equation (2) guarantees that a symmetric equilibrium exists in the baseline model with $\lambda = \lambda^0$.

Proposition 7. *For any given set of parameters, there exists a threshold $\bar{\varphi} > 0$ such that for all $\varphi < \bar{\varphi}$, there exists a unique symmetric equilibrium in the financial market in which the entrepreneur sells a dirty firm to the first socially responsible investor she meets. In this equilibrium, the entrepreneur reforms the firm in period $t = 0$ if and only if her pro-social preference parameter γ is sufficiently high, that is, if $\gamma \geq \eta_2^{\lambda}(\varphi)$, where $\eta_2^{\lambda}(\varphi) > \eta_1$ is defined in Appendix B.2. Furthermore, the size of the strategic delay region $\left[\eta_1, \eta_2^{\lambda}(\varphi)\right)$ increases as the probability that the market becomes more pro-social, φ, increases.*

If $\varphi = 0$, we are back to our baseline model with $\lambda = \lambda^0$. In this case, the entrepreneur sells a dirty firm to the first socially responsible investor she meets. Naturally, if φ is sufficiently small, the same result obtains. Furthermore, for such values of φ, strategic delay in the reform of the firm exacerbates if φ increases. Intuitively, if the entrepreneur expects that socially responsible investors will become more pro-social with a higher probability in each period going forward, the option to delay the reform of the firm becomes more valuable.

Proposition 8 shows that the potential increase in the pro-social preference parameter of socially responsible investors can induce the entrepreneur to delay selling a dirty firm until this increase realizes.

Proposition 8. *For any $\varphi > 0$, there exists a set of parameter values such that there exists a unique symmetric equilibrium in the financial market in which the entrepreneur sells a dirty firm only to socially responsible investors with pro-social preference parameter $\lambda = \lambda^1$. That is, the entrepreneur sells a dirty firm to socially responsible investors after but not before the market becomes more pro-social.*

The extended model therefore features a second type of strategic delay by the entrepreneur—strategic delay in trade—in addition to strategic delay in reform. Intuitively, the entrepreneur chooses to retain ownership of a dirty firm until the market becomes more pro-social if the price she can get from socially responsible investors with the high pro-social preference parameter $\lambda^1 > \lambda^0$ is substantially higher than the price she can get from socially responsible investors with the low pro-social preference parameter λ^0.[16]

[16] In the proof of Proposition 8 we characterize sufficient conditions under which the equilibrium of this proposition is the unique symmetric equilibrium. These conditions are, first, a sufficiently high λ^1 and, second, a sufficiently high N_s. Under these conditions, the entrepreneur expects to get a high price for a dirty firm quickly after the market becomes more pro-social. Furthermore, if N_s is high, a given socially responsible investors has a strong incentive to free ride, particularly when not acquiring and not reforming a dirty firm on his own is not too costly for him (i.e.,

Notably, the extended model has important additional implications for how socially responsible investors affect the pace of firm reform by an entrepreneur with weak pro-social preferences satisfying $\gamma \leq \eta_1$. In our baseline model, making the market more pro-social by introducing socially responsible investors with $\lambda = \lambda^0$ to the financial market speeds up reform for an entrepreneur with weak pro-social preferences (see Figure 1). However, in the extended model, the *expectation* of the market becoming more pro-social can increase delay in reform even for an entrepreneur with weak pro-social preferences. Anticipating the change in the financial market conditions in the future, such an entrepreneur has an incentive to strategically delay selling a dirty firm to socially responsible investors.

The expected delay in the reform of the firm in the equilibrium of Proposition 8 is given by

$$T^{delay} = \sum_{n=0}^{\infty} \left[(1-\varphi)^n \varphi \sum_{t=1}^{\infty} \left(1 - \frac{N_s}{N}\right)^{t-1} \frac{N_s}{N}(t+n) \right] = \frac{N}{N_s} + \frac{1-\varphi}{\varphi}.$$

Naturally, if the entrepreneur does not reform the firm and waits until the market becomes more pro-social before selling it, it takes longer for the reform to happen if the change in pro-social preferences is less likely, that is, if φ is smaller.

Taken together, the extended model can generate a novel type of strategic delay in addition to strategic delay in reform: strategic delay in trade. Strategic delay in reform causes a long delay in the firms' reform if search frictions in the financial market are severe because these frictions determine how long it takes for the entrepreneur to sell a dirty firm. Importantly, strategic delay in trade has the potential to cause a substantial delay even if search frictions are not too severe because the entrepreneur waits to sell the firm until the market becomes more pro-social.

6.2 Generalized Nash Bargaining

In this section, we study an extension in which the acquisition price is determined by generalized Nash bargaining, where $\theta \in [0,1]$ denotes the bargaining power of the entrepreneur. The baseline model in Section 3 is a special case of this extension with $\theta = 1$. We analyze the extended model in detail in Appendix B.3. As in the baseline model, we show that in a market with only financial investors, the entrepreneur reforms the firm if and only if $\gamma \geq \eta_1 = (1-\beta)\frac{\kappa}{c_H - c_L}$. In the presence of socially responsible investors, we obtain a strategic delay region, the size of which depends on

when $\lambda = \lambda^0$). Hence, the price for a dirty firm prior to the increase in λ is relatively low, and the entrepreneur delays selling a dirty firm until the increase realizes.

the entrepreneur's bargaining power θ.

Proposition 9. *The entrepreneur reforms the firm in period $t = 0$ if and only if*

$$\gamma \geq \eta_1 + \lambda \frac{\beta \theta \frac{N_s}{N}}{1 - \beta \left(1 - \frac{N_s - \theta}{N}\right)} =: \eta_2^{\theta},$$

where $\eta_1 = (1-\beta)\frac{\kappa}{c_H - c_L}$ is defined in Assumption 1.

As the entrepreneur's bargaining power, θ, increases, η_2^{θ} increases and so does the size of the strategic delay region. A higher θ means that the entrepreneur has more bargaining power. She therefore anticipates capturing a higher share of the gains from trade which increases her incentive to strategically delay reform. If $\theta = 0$, the entrepreneur never captures any gains from trade as investors have all the bargaining power. Consequently, there is no strategic delay in this case.

6.3 Severity of Search Frictions

In this extension, we introduce a parameter $\mu \in (0,1]$ governing the severity of search frictions. Specifically, the entrepreneur meets a given investor with probability $\mu \frac{1}{N}$ and does not meet any investor with probability $1 - \mu$. A lower value of μ implies more severe search frictions. In the baseline model we have $\mu = 1$. We analyze the extended model in detail in Appendix B.3. In particular, as in the baseline model, the entrepreneur reforms the firm if and only if $\gamma \geq \eta_1 = (1 - \beta)\frac{\kappa}{c_H - c_L}$ in the absence of socially responsible investors. In the presence of socially responsible investors, we obtain a strategic delay region, the size of which depends on the severity of search frictions μ.

Proposition 10. *Assume that $\lambda > (\eta_1 - \gamma)\frac{1-\beta\left(1-\mu\frac{N_s-1}{N}\right)}{1-\beta}$. Then the entrepreneur reforms the firm in period $t = 0$ if and only if*

$$\gamma \geq \eta_1 + \lambda \frac{\beta \mu \frac{N_s}{N}}{1 - \beta \left(1 - \mu \frac{N_s - 1}{N}\right)} =: \eta_2^{\mu},$$

where $\eta_1 = (1-\beta)\frac{\kappa}{c_H - c_L}$ is defined in Assumption 1.

As μ increases, search frictions become less severe, and η_2^{μ} increases. Intuitively, less severe search frictions imply that the entrepreneur with a dirty firm expects to capture the trading gains

sooner, making her option to delay more attractive. As search frictions become extremely severe (i.e., as $\mu \to 0$), meeting investors and capturing trading gains become vanishingly improbable, and the entrepreneur does not strategically delay reform.

In addition to the size of the strategic delay region, the severity of search frictions, μ, also affects the expected delay in reform. Specifically, if the entrepreneur does not reform the firm in period $t = 0$, that is, if $\gamma < \eta_2^{\mu}$, the expected delay in the reform of the firm is given by

$$T^{delay} = \sum_{t=1}^{\infty} \left(1 - \mu \frac{N_s}{N}\right)^{t-1} \mu \frac{N_s}{N} t = \frac{1}{\mu} \frac{N}{N_s}.$$

Not surprisingly, as μ declines and search frictions become more severe, meeting a socially responsible investor becomes less likely and the expected delay in reform increases.

6.4 Re-trading and Intermediation by Financial Investors

In our baseline model, there are no gains from trade when the entrepreneur meets a financial investor and the entrepreneur never sells the firm—green or dirty—to a financial investor. In this extension, we explore to what extent this result depends on our assumption that an investor owns the firm forever after an acquisition. We extend our baseline model by assuming that after an acquisition of a firm, a financial investor meets other investors repeatedly over time. Specifically, in a given period, the financial investor meets another investor with probability $\frac{1}{N}$. Upon meeting another investor, the financial investor can sell the firm by making a take-it-or-leave-it price offer. We analyze the extended model in detail in Appendix B.4.

Proposition 11. *Consider an entrepreneur who owns a dirty firm. There exists a unique symmetric equilibrium in which the entrepreneur sells the firm when she meets a socially responsible investor but not when she meets a financial investor. In equilibrium, the entrepreneur is indifferent between selling the firm to a financial investor and retaining ownership.*

Suppose that the entrepreneur sells a dirty firm to a financial investor. In this case, she can make a price offer that captures the price premium that the financial investor will obtain when selling the dirty firm to a socially responsible investor in the future. Alternatively, she can continue searching to sell the firm to a socially responsible investor herself. Because the financial investor does not have a superior search technology, a superior bargaining position, or any other advantage, the entrepreneur is indifferent between selling the firm to a financial investor and continuing to

search for a socially responsible investor herself. That is, there are no gains from trade between the entrepreneur and a financial investor. As such, the results in our baseline model are robust to allowing financial investors to sell the firm after an acquisition.

As discussed in Section 4.1, introducing any exogenous sources of gains from trade may induce the entrepreneur to sell a dirty firm to a financial investor, who would in turn sell the firm to a socially responsible investor. For example, the entrepreneur may have a higher holding cost compared with a financial investor or the financial investor may have a superior search technology. In this case, financial investors may act as intermediaries between the entrepreneur and socially responsible investors.

7 Discussion

In this section, we discuss several additional insights our analysis can generate if other features were added to the model.

Growth capital and investor expertise: We assume that the entrepreneur has enough funds and the ability to reform the firm herself. In practice, the entrepreneur may require capital or expertise from investors to adopt or scale green technologies. Our model does not preclude the scenario in which investor capital or expertise may be important for the firm to become greener. Of importance for the results is the assumption that there is some action that the entrepreneur can take to improve the firm proactively. For example, consider a modification of the two-period example from Section 2 in which the entrepreneur has capital A which she can spend to reduce the per-period social cost from c_H to $c_M < c_H$. To reduce the social cost to $c_L < c_M$, additional capital of $\kappa - A$ is needed, which only investors can provide. In this case, in a market with no socially responsible investors, the entrepreneur reduces the social cost of production to c_M if and only if $\gamma \geq \frac{A}{2(c_H - c_M)}$. When a socially responsible investor is present in the financial market, the highest price he is willing to pay for a dirty firm is $P_H = \pi + \lambda(c_H - c_L) - \kappa$ and for a partially reformed firm is $P_M = \pi + \lambda(c_M - c_L) - (\kappa - A)$. When $\lambda(c_H - c_M) > A$, the price for a dirty firm is higher than that for a partially reformed firm. The entrepreneur prefers to keep the firm dirty rather than partially reform it when her utility from delaying reform is greater than her utility from partially reforming the firm, that is, when $\pi - \gamma c_H + P_H - \gamma c_L > \pi - \gamma c_M - A + P_M - \gamma c_L$, which is equivalent to $\gamma < \lambda$. Therefore the entrepreneur strategically delays partial reform when $\lambda > \gamma \geq \frac{A}{2(c_H - c_M)}$. In such a case, socially responsible investors would want to adopt an investment mandate and commit

to paying a premium for firms that have been partially reformed by the entrepreneur. Socially responsible investors also benefit from actively reforming the firm further after an acquisition by reducing the social cost to c_L. Optimal impact can therefore require a mix of passive and active investment strategies.

Innovation and entrepreneur expertise: In our model, the reform decision can be interpreted as innovating on a green technology, where κ is the cost of innovation. Under this interpretation, the presence of socially responsible investors causes a strategic delay in the innovation of a green technology.

Alternatively, in some cases, the entrepreneur alone may have the skill to innovate on a green technology but following an innovation, the entrepreneur or investors can adopt the green technology. Our model can be extended to capture this feature by assuming that before any action is taken in period $t = 0$, the entrepreneur can choose to pay an innovation cost $\delta > 0$ to discover a green technology. This green technology can subsequently be adopted by the entrepreneur or an investor by paying the one-time cost κ. Put differently, paying the cost δ unlocks the potential to reform the firm and only the entrepreneur has the expertise to unlock this potential. At the same time, socially responsible investors can adopt the green technology but do not have the skill to discover it. As a result, if the entrepreneur does not innovate, the firm stays dirty forever.

If the entrepreneur does not innovate, there are no gains from trade in the financial market because all agents value profits equally, pro-social preferences are broad, and socially responsible investors are not able to discover the green technology to subsequently reform the firm. If the entrepreneur decides to innovate, the model proceeds as in our baseline model from Section 3. In particular, the presence of socially responsible can cause a strategic delay in the adoption of the green technology because there are gains from trade only if the entrepreneur owns a firm with a green technology that has not been adopted yet. Importantly, the trading gains arise only if the entrepreneur discovers the green technology thereby increasing the entrepreneur's incentive to innovate. The presence of socially responsible investors can therefore increase the entrepreneur's incentive to innovate even though their presence reduces her incentive to subsequently adopt the green technology.

Warm-glow preferences: Our model has implications for the potential role of warm-glow investors in supporting impact investors. Warm-glow investors, often considered "naive" socially responsible investors, are investors who simply like owning green firms. They are typically small investors who do not internalize the broader impact of their actions. Some researchers have raised

concerns that warm-glow investors employing "narrow" strategies of investing in green firms may be inferior to a "broad" strategy of investing in dirty firms and turning them green (see, e.g., Green and Roth, 2021; Oehmke and Opp, 2022). While such a "narrow" strategy is a concern in their settings, in our model this strategy is optimal for investors who care about broad impact because it can incentivize current owners to turn their firms green quickly. Interestingly, warm-glow investors naturally want to pay a premium for green firms and do not require a commitment device to do so, unlike investors with broad pro-social preferences. They may therefore help support timely impact by creating demand pressure and increasing market prices for green firms. It is important to note that the warm-glow premium alone will typically not lead to optimal firm reform because this premium simply depends on investor preferences—the extent of the warm glow they receive from investing in green firms. Such a premium will generally be different from the premium chosen by investors with broad pro-social preferences, which is tailored to induce the entrepreneur to reform the firm proactively.

Interaction between environmental regulation and impact investing: An interesting implication of our model is that impact investing can weaken the effect of environmental regulation.[17] We can model environmental regulation (e.g., carbon taxes) as a reduction in profits of a dirty firm relative to a green firm, which makes operating a dirty firm relatively more expensive. To illustrate this idea, consider a modification of the two-period example from Section 2 in which the dirty firm has a lower per-period profit compared with the green firm, that is, $\pi_H < \pi_L$. In the absence of a socially responsible investor, the entrepreneur reforms the firm if her utility from owning a green firm, $2(\pi_L - \gamma c_L) - \kappa$, is greater than her utility from owning a dirty firm, $2(\pi_H - \gamma c_H)$. In particular, the entrepreneur reforms the firm if her pro-social preferences are strong enough or if environmental regulation is strong enough, that is, if $\gamma + \frac{\pi_L - \pi_H}{c_H - c_L} \geq \frac{\kappa}{2(c_H - c_L)}$. Note that because $\pi_L > \pi_H$, even if the entrepreneur is not pro-social and $\gamma = 0$, she may still reform the firm due to environmental regulation.

If a socially responsible investor is present in the financial market, the highest price the investor is willing to pay for a dirty firm is $P_H = \pi_L + \lambda(c_H - c_L) - \kappa$. The entrepreneur prefers to keep the firm dirty rather than reform it if her utility from delaying reform is greater than her utility from reforming the firm, that is, if $\pi_H - \gamma c_H + P_H - \gamma c_L > 2(\pi_L - \gamma c_L) - \kappa$. As a result, the entrepreneur strategically delays reform when $\lambda - \frac{\pi_L - \pi_H}{c_H - c_L} > \gamma \geq \frac{\kappa}{2(c_H - c_L)} - \frac{\pi_L - \pi_H}{c_H - c_L}$. An interesting implication

[17] Related to this insight, a recent paper by Huang and Kopytov (2022) shows that environmental regulation can have unintended consequences in a setting with warm-glow investors.

is that impact investing can dampen the effectiveness of environmental regulation. In particular, even if environmental regulation is strong in the sense that an entrepreneur without pro-social preferences (i.e., $\gamma = 0$) would reform the firm in the absence of socially responsible investors, the presence of socially responsible investors can lead to strategic delay in firm reform and therefore reduce the effectiveness of environmental regulation.

Utility from impact: In our model, socially responsible investors have broad pro-social preferences and care about externalities independent of ownership. Alternatively, some socially responsible investors may obtain utility from generating impact and reforming a dirty firm but only when they own the firm. In our two-period example from Section 2, such preferences can be modeled as a socially responsible investor having a utility of $\pi + \lambda(c_H - c_L) - \kappa$ if they acquire a dirty firm and reform it and having a utility of zero if they do not acquire the firm. Such a preference for impact will lead to a similar strategic delay compared to when socially responsible investors have broad pro-social preferences. However, it would no longer be individually rational for socially responsible investors to adopt an investment mandate in which they commit to paying a premium for green firms, which limits their ability to speed up firm reform. Moreover, in a dynamic setting such as the one in our baseline model, these preferences would not give rise to the free-rider problem between socially responsible investors, thereby worsening strategic delay. Intuitively, a given socially responsible investor who receives utility only from reforming a firm herself does not value reform by others.

Limited socially responsible capital: We model socially responsible investors as having unlimited capital. Socially responsible investors are therefore unconstrained in their ability to acquire, reform, and hold on to firms. If socially responsible capital was limited, socially responsible investors may benefit from selling firms to financial investors to free up their capital to acquire more firms. Financial investors can therefore play an important role in freeing up socially responsible capital and supporting impact, even though they themselves do not have pro-social preferences.

Reversible technology: If technology was reversible and green firms could be made dirty, our model suggests that entrepreneurs and financial investors can have incentives to strategically make firms dirty to earn a higher premium in acquisitions by socially responsible investors. In particular, an entrepreneur with weaker pro-social preferences γ has a stronger incentive to reverse green technology. Such reversible technology should make the case for investment mandates stronger as mandates can incentivize the entrepreneur to proactively reform the firm, while without mandates, the entrepreneur has an incentive to make the firm dirty. Notably, Schneider (2011) provides evi-

dence that firms increased their emissions when incentivized with emission credits which required showing "real, measurable and additional" emission reductions.

Socially responsible compensation for fund managers: Our model has implications for the design of compensation for the managers of socially responsible funds. Geczy et al. (2021) find that impact funds generally do not tie compensation to impact. Our analysis suggests that such a contract may in fact be able to reduce strategic delay. Specifically, if compensation is tied to impact and fund managers are incentivized to generate post-investment impact, initial firm owners may strategically delay firm reform. Therefore, when designing compensation contracts for fund managers, socially responsible limited partners may benefit from weakening the relationship between compensation and post-investment impact.

Political economy of climate regulation: Our model has interesting implications for the political economy of climate regulation. In particular, if socially responsible investors are present in the financial market, entrepreneurs expect trading gains when they own a dirty firm. The anticipation of these trading gains can lead to the owners of dirty firms lobbying against regulation that forces them to reform proactively, even if they are pro-social. Conversely, pro-social investors may lobby for such regulation because it saves them paying for firm reform. Agents with pro-social preferences may therefore lobby and vote in opposite directions depending on whether they are investors or entrepreneurs in financial markets.

8 Concluding Remarks

The speed at which firms reduce negative externalities is crucially important in light of climate change. Motivated by the urgency of this issue, we study the pace at which socially responsible investors can induce firms to reduce negative externalities. Our framework generates rich implications for how socially responsible investors can affect the speed of firm reform. The key insight is that socially responsible investors do not always speed up firm reform and can in fact induce strategic delay in firm reform by the initial owners of firms. The adoption of investment mandates by socially responsible investors ex ante can avoid delay in reform. As we highlight in our discussion in Section 7, our analysis can generate a number of additional effects that the presence of socially responsible investors can have in financial markets that may be interesting to explore further in future research.

References

Baker, Steven D., Burton Hollifield, and Emilio Osambela, 2022, Asset Prices and Portfolios with Externalities, Working Paper.

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

Barber, Brad M., Adair Morse, and Ayako Yasuda, 2021, Impact Investing, *Journal of Financial Economics* 139, 162–185.

Baron, David P., 2007, Corporate Social Responsibility and Social Entrepreneurship, *Journal of Economics and Management Strategy* 16, 683–717.

Bellon, Aymeric, 2022, Does Private Equity Ownership Make Firms Cleaner? The Role of Environmental Liability Risks, Working Paper.

Bénabou, Roland, and Jean Tirole, 2006, Incentives and Prosocial Behavior, *American Economic Review* 96, 1652–1678.

Berk, Jonathon, and Jules van Binsbergen, 2022, The Impact of Impact Investing, Working Paper.

Besley, Timothy, and Maitreesh Ghatak, 2018, Prosocial Motivation and Incentives, *Annual Review of Economics* 10, 411–438.

Bolton, Patrick, and Marcin Kacperczyk, 2022, Global Pricing of Carbon-Transition Risk, Working Paper.

Bonnefon, Jean-Francois, Augustin Landier, Parinitha Sastry, and David Thesmar, 2022, Do Investors Care About Corporate Externalities? Experimental Evidence, Working Paper.

Born, Kelly, and Paul Brest, 2013, Unpacking the Impact in Impact Investing, *Stanford Social Innovation Review* 11, 22–31.

Broccardo, Eleonora, Oliver D. Hart, and Luigi Zingales, 2022, Exit vs. Voice, *Journal of Political Economy,* forthcoming.

Burack, Rebecca, François Faelli, Christophe De Vusser, Kiki Yang, Andrew Tymms, Hannah Morrill, Debra McCoy, and Marc Lino, 2022, Decarbonization: How Private Equity Can Make It Work, Bain and Company Brief.

Cain, Matthew, Antonio Macias, and Steven Davidoff Solomon, 2015, Broken Promises: The Role of Reputation in Private Equity Contracting and Strategic Default, *Journal of Corporation Law* 40, 565–598.

Caplin, Andrew, and John Leahy, 2004, The Social Discount Rate, *Journal of Political Economy* 112, 1257–1268.

Chava, Sudheer, 2014, Environmental Externalities and Cost of Capital, *Management Science* 60, 2223–2247.

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

Cremades, Alejandro, 2019, How Long It Takes to Raise Capital for a Startup, Forbes.

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

De Angelis, Tiziano, Peter Tankov, and Olivier David Zerbib, 2022, Climate Impact Investing, *Management Science,* forthcoming.

Dimson, Elroy, Oğuzhan Karakaş, and Xi Li, 2015, Active Ownership, *Review of Financial Studies* 28, 3225–3268.

Dimson, Elroy, Oğuzhan Karakaş, and Xi Li, 2021, Coordinated Engagements, Working Paper.

Duff & Phelps, 2018, Global Regulatory Outlook 2018, Duff & Phelps LLC.

Eccles, Robert G., and Svetlana Klimenko, 2019, The Investor Revolution, Harvard Business Review.

Eccles, Robert G., Vinay Shandal, David Young, and Benedicte Montgomery, 2022, Private Equity Should Take the Lead in Sustainability, Harvard Business Review.

Edmans, Alex, Doron Levit, and Jan Schneemeier, 2022, Socially Responsible Divestment, Working Paper.

Friedman, Henry L., and Mirko S. Heinle, 2021, Interested Investors and Intermediaries: When do ESG Concerns Lead to ESG Performance?, Working Paper.

Gantchev, Nickolay, Mariassunta Giannetti, and Rachel Li, 2022, Does Money Talk? Divestitures and Corporate Environmental and Social Policies, *Review of Finance,* forthcoming.

Geczy, Christopher, Jessica S. Jeffers, David K. Musto, and Anne M. Tucker, 2021, Contracts with (Social) Benefits: The Implementation of Impact Investing, *Journal of Financial Economics* 142, 697–718.

Geelen, Thomas, Jakub Hajda, and Jan Starmans, 2022, Sustainable Organizations, Working Paper.

GIIN, 2020, Annual Impact Investor Survey (10th Edition), Global Impact Investment Network.

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

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

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

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

Heath, Davidson, Daniele Macciocchi, Roni Michaely, and Matthew C. Ringgenberg, 2022, Does Socially Responsible Investing Change Firm Behavior?, Working Paper.

Heeb, Florian, Julian Kölbel, Falko Paetzold, and Stefan Zeisberger, 2022, Do Investors Care About Impact?, *Review of Financial Studies,* forthcoming.

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

Holmström, Bengt, and Jean Tirole, 1997, Financial Intermediation, Loanable Funds, and the Real Sector, *Quarterly Journal of Economics* 112, 663–691.

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

IPCC, 2021, Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Intergovernmental Panel on Climate Change.

Jagannathan, Ravi, Soohun Kim, Robert McDonald, and Shixiang Xia, 2022, Environmental Activism, Endogenous Risk, and Stock Prices, Working Paper.

Jeffers, Jessica, Tianshu Lyu, and Kelly Posenau, 2022, The Risk and Return of Impact Investing Funds, Working Paper.

Kacperczyk, Marcin T., and José-Luis Peydró, 2022, Carbon Emissions and the Bank-Lending Channel, Working Paper.

Kovner, Anna, and Josh Lerner, 2015, Doing Well by Doing Good? Community Development Venture Capital, *Journal of Economics and Management Strategy* 24, 643–663.

Krueger, Philipp, Zacharias Sautner, and Laura T. Starks, 2020, The Importance of Climate Risks for Institutional Investors, *Review of Financial Studies* 33, 1067–1111.

Lagos, Ricardo, 2000, An Alternative Approach to Search Frictions, *Journal of Political Economy* 108, 851–873.

Landier, Augustin, and Stefano Lovo, 2020, ESG Investing: How to Optimize Impact?, Working Paper.

Levit, Doron, Nadya Malenko, and Ernst G. Maug, 2022, Trading and Shareholder Democracy, *Journal of Finance,* forthcoming.

Liang, Hao, and Luc Renneboog, 2020, Corporate Social Responsibility and Sustainable Finance: A Review of the Literature, Working Paper.

Lindsey, Laura Anne, Seth Pruitt, and Christoph Schiller, 2022, The Cost of ESG Investing, Working Paper.

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

Luo, H. Arthur, and Ronald J. Balvers, 2017, Social Screens and Systematic Investor Boycott Risk, *Journal of Financial and Quantitative Analysis* 52, 365–399.

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

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

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

Morgan Stanley, 2019, Sustainable Signals: Individual Investor Interest Driven by Impact, Conviction and Choice, Report.

Oehmke, Martin, and Marcus M. Opp, 2022, A Theory of Socially Responsible Investment, Working Paper.

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

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

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

Rogerson, Richard, Robert Shimer, and Randall Wright, 2005, Search-Theoretic Models of the Labor Market: A Survey, *Journal of Economic Literature* 43, 959–988.

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

Schneider, Lambert Richard, 2011, Perverse Incentives under the CDM: An Evaluation of Hfc-23 Destruction Projects, *Climate Policy* 11, 851–864.

Sheth, Shrinal, and Meagan Andrews, 2022, Transforming High-Emitting Assets Is Hard, but Private Equity Could Help, World Economic Forum.

Thomas, Dylan, and Annie Sabater, 2022, Private Equity's Share of Terminated M&A Deals Climbs, S&P Global Market Intelligence.

UN PRI, 2020, Annual Report 2020, United Nations Principles for Responsible Investing.

UNPRI, 2020, An Introduction to Responsible Investment: Screening, United Nations Principles for Responsible Investing.

UNPRI, 2021, Discussing Divestment: Developing an Approach When Pursuing Sustainability Outcomes in Listed Equities, United Nations Principles for Responsible Investing.

US SIF, 2020, Report on US Sustainable and Impact Investing Trends 2020, The Forum for Sustainable and Responsible Investment.

Weill, Pierre-Olivier, 2020, The Search Theory of Over-the-Counter Markets, *Annual Review of Economics* 12, 747–773.

A Proofs

Denote the entrepreneur's expected discounted utility when she owns a dirty firm by E_H^1 and when she owns a green firm by E_L^1. We further denote the entrepreneur's expected discounted utility when a financial investor owns the firm by $E_j^{0,f}$, where $j \in \{L,H\}$, and when a socially responsible investor owns the firm by $E_L^{0,s}$ because socially responsible investors reform the firm. We define $\Delta E_j^f := E_j^1 - E_j^{0,f}$, $j \in \{L,H\}$, $\Delta E_L^s := E_L^1 - E_L^{0,s}$, and $\Delta E_H^s := E_H^1 - E_L^{0,s}$. The expected discounted utilities for financial investors and socially responsible investors are similarly defined using the letters F and S, respectively. For ease of exposition, we omit the superscript e if the entrepreneur owns the firm. In what follows, when we consider the expected discounted utilities S_j^0 and F_j^0, we imply that the entrepreneur owns the firm.

A.1 Baseline Model

Proof of Lemma 1. Assume to the contrary that there are gains from trade. Note that because financial investors do not care about the social cost of production and because the entrepreneur makes a take-it-or-leave-it price offer, we have $F_j^0 = 0$. We thus get the acquisition price $P_j^f = F_j^1 - F_j^0 = \frac{\pi}{1-\beta}$. Given the acquisition price P_j^f, the entrepreneur's expected discounted utility E_j^1 solves

$$E_j^1 = \pi - \gamma c_j + \beta \max\left\{E_j^{0,f} + P_j^f, E_j^1\right\},$$

which can be rewritten as

$$E_j^1 = \frac{\pi - \gamma c_j}{1-\beta} + \frac{\beta}{1-\beta}\max\left\{0, P_j^f - \Delta E_j^f\right\}. \tag{7}$$

Note that (7) implies that $E_j^1 \geq \frac{\pi-\gamma c_j}{1-\beta}$. Because $E_j^{0,f} = -\frac{\gamma c_j}{1-\beta}$, we have $\Delta E_j^f \geq \frac{\pi}{1-\beta} = P_j^f$. That is, there are no gains from trade when the entrepreneur meets a financial investor. In particular, the entrepreneur's expected discounted utility of owning a type-j firm is given by $E_j^1 = \frac{\pi-\gamma c_j}{1-\beta}$ such that $E_j^{0,f} + P_j^f = E_j^1$, that is, the entrepreneur is indifferent between selling and not selling the firm to a financial investor. ■

Proof of Lemma 3. Given the acquisition prices P_j^f and P_j^s, the entrepreneur's expected discounted

utility E_j^1 solves

$$E_j^1 = \pi - \gamma c_j + \beta \left(\frac{N_f}{N} \max \left\{ E_j^{0,f} + P_j^f, E_j^1 \right\} + \frac{N_s}{N} \max \left\{ E_L^{0,s} + P_j^s, E_j^1 \right\} \right),$$

which can be rewritten as

$$E_j^1 = \frac{\pi - \gamma c_j}{1-\beta} + \frac{\beta}{1-\beta} \left(\frac{N_f}{N} \max \left\{ 0, P_j^f - \Delta E_j^f \right\} + \frac{N_s}{N} \max \left\{ 0, P_j^s - \Delta E_j^s \right\} \right). \tag{8}$$

Given the acquisition prices P_j^f and P_j^s, the financial investor's expected discounted utility F_j^0 solves

$$F_j^0 = \beta \left(\frac{1}{N} \max \left\{ F_j^1 - P_j^f, F_j^0 \right\} + \left(\frac{N_f - 1}{N} \mathbb{1}_{\left\{ P_j^f \leq \Delta E_j^f \right\}} + \frac{N_s}{N} \mathbb{1}_{\left\{ P_j^s \leq \Delta E_j^s \right\}} \right) F_j^0 \right). \tag{9}$$

Using the fact that the entrepreneur makes a take-it-or-leave-it price offer such that $F_j^1 - P_j^f = F_j^0$, (9) implies $F_j^0 = 0$. As a result, we have $P_j^f = F_j^1 - F_j^0 = \frac{\pi}{1-\beta}$. In addition, (8) and the fact that $E_j^{0,f} = -\frac{\gamma c_j}{1-\beta}$ implies that $\Delta E_j^f = E_j^1 - E_j^{0,f} \geq \frac{\pi}{1-\beta}$. Taken together, this implies that $P_j^f \leq \Delta E_j^f$. That is, there are no gains from trade when the entrepreneur meets a financial investor and the entrepreneur therefore never sells the firm to a financial investor irrespective of its status. ■

Proof of Lemma 4. Anticipating that the entrepreneur does not sell the firm to a financial investor, the entrepreneur's expected discounted utility E_L^1 solves

$$E_L^1 = \pi - \gamma c_L + \beta \left(\frac{N_f}{N} E_L^1 + \frac{N_s}{N} \max \left\{ E_L^{0,s} + P_L^s, E_L^1 \right\} \right),$$

which can be rewritten as

$$E_L^1 = \frac{\pi - \gamma c_L}{1-\beta} + \frac{\beta}{1-\beta} \frac{N_s}{N} \max \left\{ 0, P_L^s - \Delta E_L^s \right\}.$$

The entrepreneur's discounted utility when a socially responsible investor owns the firm is given by $E_L^{0,s} = -\frac{\gamma c_L}{1-\beta}$. Because $E_L^1 \geq \frac{\pi - \gamma c_L}{1-\beta}$, we get

$$\Delta E_L^s = E_L^1 - E_L^{0,s} \geq \frac{\pi - \gamma c_L}{1-\beta} + \frac{\gamma c_L}{1-\beta} = \frac{\pi}{1-\beta}.$$

The discounted utility of a socially responsible investor when he acquires the firm is given by

$S_L^1 = \frac{\pi - \lambda c_L}{1-\beta}$. Because the per-period utility of a socially responsible investor when the entrepreneur owns the firm is equal to $-\lambda c_L$, we get $S_L^0 \geq -\frac{\lambda c_L}{1-\beta}$. As a result, we get $\Delta S_L = S_L^1 - S_L^0 \leq \frac{\pi}{1-\beta}$, that is, a socially responsible investor will at most pay a price equal to the discounted profits to acquire the firm. Taken together, this implies that the trading surplus $\Delta S_L - \Delta E_L^s$ is nonpositive, that is, there are no gains from trade and the entrepreneur does not sell the firm if she meets a socially responsible investor.

Given that there are no gains from trade, we have $E_L^1 = \frac{\pi - \gamma c_L}{1-\beta}$. The entrepreneur is indifferent between selling and not selling the firm because

$$E_L^{0,s} + P_L^s = -\frac{\lambda c_L}{1-\beta} + \frac{\pi}{1-\beta} = E_L^1,$$

which completes the proof. ■

Proof of Lemma 5. The entrepreneur's expected discounted utility when she owns a dirty firm, E_H^1, solves

$$E_H^1 = \frac{\pi - \gamma c_H}{1-\beta} + \frac{\beta}{1-\beta}\frac{N_s}{N}\max\left\{0, P_H^s - \Delta E_H^s\right\}. \tag{10}$$

Because a socially responsible investor reforms the dirty firm if he acquires it, the entrepreneur's discounted utility when a socially responsible investor owns the firm is given by $E_L^{0,s} = -\frac{\gamma c_L}{1-\beta}$. Taken together, we get

$$\Delta E_H^s = \frac{\pi}{1-\beta} - \frac{\gamma(c_H - c_L)}{1-\beta} + \frac{\beta}{1-\beta}\frac{N_s}{N}\max\left\{0, P_H^s - \Delta E_H^s\right\}. \tag{11}$$

Suppose that there are gains from trade when the entrepreneur meets a socially responsible investor. Using the fact that the entrepreneur makes a take-it-or-leave-it price offer such that $S_H^1 - P_H^s = S_H^0$, the expected discounted utility of a given socially responsible investor when he does not own the firm satisfies

$$S_H^0 = -\lambda c_H + \beta\left(\frac{1}{N}S_H^0 - \frac{N_s - 1}{N}\frac{\lambda c_L}{1-\beta} + \frac{N_f}{N}S_H^0\right),$$

which yields

$$S_H^0 = -\frac{\lambda c_L}{1-\beta} - \frac{\lambda(c_H - c_L)}{1 - \beta\left(1 - \frac{N_s - 1}{N}\right)}. \tag{12}$$

Using $S_H^1 = \frac{\pi - \lambda c_L}{1-\beta} - \kappa$, we get

$$P_H^s = \Delta S_H = S_H^1 - S_H^0 = \frac{\pi}{1-\beta} + \frac{\lambda(c_H - c_L)}{1-\beta\left(1 - \frac{N_s-1}{N}\right)} - \kappa,$$

which completest the proof. ■

Proof of Proposition 1. Using the fact that the entrepreneur makes a take-it-or-leave-it price offer such that $S_H^1 - P_H^s = S_H^0$, the socially responsible investor's expected discounted utility S_H^0 solves

$$S_H^0 = -\lambda c_H + \beta\left(\frac{1}{N}S_H^0 - \frac{N_s-1}{N}\mathbb{1}_{\{P_H^s > \Delta E_H^s\}}\frac{\lambda c_L}{1-\beta} + \left(\frac{N_s-1}{N}\mathbb{1}_{\{P_H^s \leq \Delta E_H^s\}} + \frac{N_f}{N}\right)S_H^0\right), \quad (13)$$

where ΔE_H^s solves (11). Solving (13) for S_H^0, we get

$$S_H^0 = \frac{1}{1-\beta\left(1 - \frac{N_s-1}{N}\mathbb{1}_{\{P_H^s > \Delta E_H^s\}}\right)}\left(-\lambda c_H - \frac{N_s-1}{N}\mathbb{1}_{\{P_H^s > \Delta E_H^s\}}\frac{\beta\lambda c_L}{1-\beta}\right).$$

Using $S_H^1 = \frac{\pi - \lambda c_L}{1-\beta} - \kappa$, we get

$$P_H^s = \Delta S_H = S_H^1 - S_H^0 = \frac{\pi}{1-\beta} + \frac{\lambda(c_H - c_L)}{1-\beta\left(1 - \frac{N_s-1}{N}\mathbb{1}_{\{P_H^s > \Delta E_H^s\}}\right)} - \kappa. \quad (14)$$

Note that a symmetric equilibrium exists if there exist values P_H^s and ΔE_H^s that satisfy (11) and (14). We first show that there does not exist a solution to (11) and (14) satisfying $P_H^s \leq \Delta E_H^s$. Assume instead that there exists a solution satisfying $P_H^s \leq \Delta E_H^s$. Then we get

$$P_H^s = \frac{\pi}{1-\beta} + \frac{\lambda(c_H - c_L)}{1-\beta} - \kappa, \quad (15)$$

and

$$\Delta E_H^s = \frac{\pi}{1-\beta} - \frac{\gamma(c_H - c_L)}{1-\beta}. \quad (16)$$

Equations (15) and (16) imply that $P_H^s \leq \Delta E_H^s \Leftrightarrow \lambda \leq \eta_1 - \gamma$, contradicting Assumption 1.

We next show that there exists a solution to (11) and (14) satisfying $P_H^s > \Delta E_H^s$ if and only if condition (2) holds. Assume there exists a solution to (11) and (14) satisfying $P_H^s > \Delta E_H^s$. That is,

there exist values P_H^s and ΔE_H^s satisfying

$$P_H^s = \frac{\pi}{1-\beta} + \frac{\lambda(c_H - c_L)}{1-\beta\left(1-\frac{N_s-1}{N}\right)} - \kappa, \tag{17}$$

and

$$\Delta E_H^s = \frac{\pi}{1-\beta} - \frac{\gamma(c_H - c_L)}{1-\beta} + \frac{\beta}{1-\beta}\frac{N_s}{N}(P_H^s - \Delta E_H^s), \tag{18}$$

and $P_H^s > \Delta E_H^s$. Because (17) and (18) are two linear equations in P_H^s and ΔE_H^s, we can solve for P_H^s and ΔE_H^s. Simple algebra implies that $P_H^s > \Delta E_H^s$ if and only if (2) holds. ■

Proof of Proposition 2. By Lemma 4, $E_L^1 - \kappa = \frac{\pi - \gamma c_L}{1-\beta} - \kappa$. Using (17) and (18) from the proof of Proposition 1, we can derive E_H^1 from (10). Then it is straightforward to derive that $E_H^1 \leq E_L^1$ is equivalent to (4). ■

Proof of Proposition 3. Differentiating η_2, given by (4), with respect to λ, we obtain

$$\frac{\partial \eta_2}{\partial \lambda} = \frac{\beta\frac{N_s}{N}}{1-\beta\left(1-\frac{N_s-1}{N}\right)} > 0.$$

Differentiating η_2 with respect to N_s, we obtain

$$\frac{\partial \eta_2}{\partial N_s} = \lambda\beta\frac{1}{N}\frac{1-\beta\left(1+\frac{1}{N}\right)}{\left(1-\beta\left(1-\frac{N_s-1}{N}\right)\right)^2}.$$

Then for any natural numbers $\hat{N}_s > \tilde{N}_s > 0$, we have

$$\eta_2(\hat{N}_s) > \eta_2(\tilde{N}_s) \Leftrightarrow 1-\beta\left(1+\frac{1}{N}\right) > 0 \Leftrightarrow N > \frac{\beta}{1-\beta},$$

which completes the proof. ■

Proof of Proposition 4. Note first that whether socially responsible investors commit to not acquiring a green firm does not affect equilibrium because a green firm is never acquired even in the absence of investment mandates.

Consider first the case in which $\gamma \in [0, \eta_1)$. If socially responsible investors adopt an investment mandate through which they commit to not acquiring a dirty firm, then the entrepreneur does not reduce the social cost of production and owns a dirty firm forever.

Consider next the case in which $\gamma \in [\eta_1, \eta_2)$. If socially responsible investors adopt an exclusionary investment mandate through which they commit to not acquiring a dirty firm, then the entrepreneur reforms the firm in period $t = 0$. The discounted utility of a socially responsible investor is then given by $-\frac{\lambda c_L}{1-\beta}$. Consider a given socially responsible investor who deviates from the investment mandate ex ante. Because the other socially responsible investors are committed to the investment mandate under this deviation, the financial market for a dirty firm has a single socially responsible investor. The entrepreneur does not reform the firm if $\gamma \in [\eta_1, \bar{\eta}_2)$, where $\bar{\eta}_2$ is the threshold (4) for $\bar{N}_s = 1$ and $\bar{N} = N_f + 1$. Note that condition (2) is always satisfied in this case because $\bar{N}_s = 1$. Using (17), the expected discounted utility of the deviating socially responsible investor is given by

$$S_H^0 = S_H^1 - \Delta S_H = \frac{\pi - \lambda c_L}{1-\beta} - \kappa - P_H^s\big|_{N_s=1} = -\frac{\lambda c_H}{1-\beta}.$$

As a result, the socially responsible investor does not deviate. If $\gamma \geq \bar{\eta}_2$, then the entrepreneur reforms the firm in period $t = 0$ irrespective of whether the socially responsible investor deviates or not. Thus, the socially responsible investor has no incentive to deviate. ■

Proof of Proposition 5. The proof proceeds in three steps. First, we show that the entrepreneur owning a green firm accepts a pre-bargaining offer P_L from socially responsible investors if and only if $P_L > \frac{\pi}{1-\beta}$. Second, we determine the minimum pre-bargaining price such that the entrepreneur reforms the firm in period $t = 0$ and accepts this price for the green firm in equilibrium. We denote this price by $\tilde{P}_L$. Third, we show that an investment mandate with a price commitment $\tilde{P}_L$ for a green firm is individually rational for socially responsible investors.

Step 1 Note that if $P_L \leq \frac{\pi}{1-\beta}$, the entrepreneur owning a green firm never accepts a pre-bargaining offer. Indeed, if she accepts the offer, her discounted utility is $P_L - \frac{\gamma c_L}{1-\beta}$. If she does not accept the offer, her expected discounted utility is larger than or equal to the discounted utility from owning the green firm forever, $\frac{\pi - \gamma c_L}{1-\beta}$, which is larger than or equal to $P_L - \frac{\gamma c_L}{1-\beta}$ if $P_L \leq \frac{\pi}{1-\beta}$.

Consider a pre-bargaining offer for a green firm $P_L > \frac{\pi}{1-\beta}$. Each period, if the entrepreneur meets a socially responsible investor, she can accept the pre-bargaining offer P_L. If she does, her discounted utility is $P_L - \frac{\gamma c_L}{1-\beta}$. If she does not, she can make a take-it-or-leave-it offer to a socially responsible investor. If this offer is accepted, her discounted utility is $P_{sg} - \frac{\gamma c_L}{1-\beta}$, where P_{sg} denotes the take-it-or-leave-it price offer. If the take-it-or-leave-it offer is rejected, or if the entrepreneur

does not meet a socially responsible investor, her per-period utility is $\pi - \gamma c_L$. Overall, the expected discounted utility of the entrepreneur owning a green firm is given by

$$\hat{E}^1 = \pi - \gamma c_L + \beta \left(\frac{N_s}{N} \mathbb{1}_{\left\{P_L - \frac{\gamma c_L}{1-\beta} > E^b\right\}} \left(P_L - \frac{\gamma c_L}{1-\beta} \right) + \frac{N_s}{N} \mathbb{1}_{\left\{P_L - \frac{\gamma c_L}{1-\beta} \leq E^b\right\}} E^b + \left(1 - \frac{N_s}{N}\right) \hat{E}^1 \right), \quad (19)$$

where

$$E^b = \max \left\{ \hat{E}^1, P_{sg} - \frac{\gamma c_L}{1-\beta} \right\}.$$

Two cases are possible.

Case 1: $P_L - \frac{\gamma c_L}{1-\beta} \leq E^b$ In this case, the pre-bargaining offer P_L is never accepted in equilibrium. This is essentially our baseline model. By Lemma 4, there are no gains from trade if the entrepreneur meets a socially responsible investor such that $E^b = \hat{E}^1$. Plugging this into (19), we obtain $\hat{E}^1 = \frac{\pi - \gamma c_L}{1-\beta}$. Hence, the condition for this case is $P_L - \frac{\gamma c_L}{1-\beta} \leq E^b \Leftrightarrow P_L \leq \frac{\pi}{1-\beta}$, which contradicts our premise that $P_L > \frac{\pi}{1-\beta}$.

Case 2: $P_L - \frac{\gamma c_L}{1-\beta} > E^b$ In this case, (19) simplifies to

$$\hat{E}^1 = \pi - \gamma c_L + \beta \left(\frac{N_s}{N} \left(P_L - \frac{\gamma c_L}{1-\beta} \right) + \left(1 - \frac{N_s}{N}\right) \hat{E}^1 \right). \quad (20)$$

To check whether the condition of this case is satisfied, we need to determine E^b. To do so, we need to determine the take-it-or-leave-it price offer P_{sg}. Note that the expected discounted utility of a socially responsible investor who does not own the firm is given by

$$\hat{S}^0 = -\lambda c_L + \beta \left(\frac{1}{N} \left(-P_L + \frac{\pi - \lambda c_L}{1-\beta} \right) + \frac{N_s - 1}{N} \left(-\frac{\lambda c_L}{1-\beta} \right) + \left(1 - \frac{N_s}{N}\right) \hat{S}^0 \right). \quad (21)$$

The entrepreneur makes a take-it-or-leave-it offer and it is accepted in equilibrium if only if

$$\hat{E}^1 < P_{sg} - \frac{\gamma c_L}{1-\beta}, \text{ where } P_{sg} = \frac{\pi - \lambda c_L}{1-\beta} - \hat{S}^0.$$

Plugging (20) and (21) in the above expression, it is straightforward to verify that it implies $P_L < \frac{\pi}{1-\beta}$, which contradicts our premise. Therefore, there are no gains from trade if the entrepreneur

makes a take-it-or-leave-it offer to a socially responsible investor. As a result, $E^b = \hat{E}^1$. Under (20), the condition of this case becomes $P_L - \frac{\gamma c_L}{1-\beta} > \hat{E}^1 \Leftrightarrow P_L > \frac{\pi}{1-\beta}$.

Step 2 In the second step, we use the results from Step 1 to derive the smallest price P_L such that the entrepreneur is willing to reform the firm in period $t = 0$. We denote this price by $\tilde{P}_L$.

Consider an entrepreneur with $\gamma \in [0, \eta_2)$. If the entrepreneur does not reform the firm, her expected discounted utility is equal to E_H^1, which can be derived from (10) using (17) and (18). If the entrepreneur reforms the firm in period $t = 0$, she accepts the price $P_L > \frac{\pi}{1-\beta}$ when she meets a socially responsible investor. Her expected discounted utility before incurring the one-time cost κ is $\hat{E}^1$ given by (20). Therefore, the entrepreneur reforms the firm in period $t = 0$ if and only if $\hat{E}^1 - \kappa \geq E_H^1$, which can be simplified to

$$P_L \geq \tilde{P}_L := \frac{\pi}{1-\beta} + \frac{c_H - c_L}{\beta \frac{N_s}{N}} (\eta_2 - \gamma).$$

Because $\gamma < \eta_2$, $\tilde{P}_L > \frac{\pi}{1-\beta}$, and so the entrepreneur reforms the firm and sells the firm to the first socially responsible investor she meets at the pre-committed price $\tilde{P}_L$.

Step 3 Finally, we verify that the investment mandate is individually rational for socially responsible investors. Consider a given socially responsible investor who deviates to not adopting the proposed investment mandate. Because $\tilde{P}_L$ is chosen such that the entrepreneur with $\gamma < \eta_2$ is indifferent between reforming and not reforming the firm in period $t = 0$, such a deviation induces the entrepreneur to not reform the firm. Following such a deviation, the expected discounted utility of a socially responsible investor is S_H^0 given by (12). If instead none of the socially responsible investors deviates, then the expected discounted utility of a given socially responsible investor is $\hat{S}^0$ given by (21) evaluated at $P_L = \tilde{P}_L$. Thus, an individual socially responsible investor does not deviate if $\hat{S}^0 \geq S_H^0$, which can be simplified to $\lambda N_s + \gamma - \eta_1 \geq 0$. This inequality always holds by Assumption 1. Therefore, it is not profitable for any socially responsible investor to deviate. ■

Proof of Corollary 1. The price $\tilde{P}_L(\gamma_h)$ is chosen such that the high-γ entrepreneur is indifferent between reforming and not reforming the firm in period $t = 0$. Therefore, if socially responsible investors commit to such a price for a green firm, only the high-γ entrepreneur reforms the firm in period $t = 0$. If a given socially responsible investor deviates to not adopting the proposed investment mandate, then the high-γ entrepreneur switches to not reforming the firm and the low-γ

entrepreneur's decision to not reform the firm is unaffected. However, from our proof of Proposition 5 it follows that such a deviation is not profitable. ■

Proof of Proposition 6. The price $\tilde{P}_L(0)$ is chosen such that the low-γ entrepreneur is indifferent between reforming and not reforming the firm in period $t=0$. Therefore, if socially responsible investors commit to the price $\tilde{P}_L(0)$ for a green firm, then the entrepreneur reforms the firm in period $t=0$ irrespective of her type and sells the firm to the first socially responsible investor she meets at this pre-committed price. Below, we derive the conditions under which this investment mandate is individually rational.

Case 1: Deviation does not induce the high-γ entrepreneur to not reform the firm Suppose that an individual socially responsible investor does not induce the high-γ entrepreneur to not reform the firm by deviating to not adopting the proposed investment mandate. This is the case if

$$\hat{E}^1\left(N_s-1,\tilde{P}_L(0),\gamma_h\right)-\kappa\geq E^1\left(N_s,\gamma_h\right), \tag{22}$$

where $\hat{E}^1\left(N_s,P_L,\gamma_h\right)$ is the expected discounted utility of the high-γ entrepreneur who reforms the firm in period $t=0$ and expects to get P_L for the reformed firm when matched with any of the N_s socially responsible investors. It is implicitly given by (20). $E^1\left(N_s,\gamma_h\right)$, defined in (10), is the expected discounted utility that the high-γ entrepreneur gets from selling a dirty firm in the financial market populated by N_s socially responsible investors.

Using (20), we obtain

$$\hat{E}^1\left(N_s-1,\tilde{P}_L(0),\gamma_h\right)-\kappa=\frac{\pi-\gamma_h c_L}{1-\beta}+\frac{N_s-1}{N_s}\frac{c_H-c_L}{1-\beta\left(1-\frac{N_s-1}{N}\right)}\eta_2-\frac{\eta_1\left(c_H-c_L\right)}{1-\beta},$$

where κ is expressed using the definition of η_1 given in Assumption 1. Plugging (17) and (18) in (10), we obtain

$$E^1\left(N_s,\gamma_h\right)=\frac{\pi-\gamma_h c_H}{1-\beta}+\frac{\beta\frac{N_s}{N}}{1-\beta}\frac{c_H-c_L}{1-\beta\left(1-\frac{N_s}{N}\right)}\left(\gamma_h-\eta_1+\lambda\frac{1-\beta}{1-\beta\left(1-\frac{N_s-1}{N}\right)}\right).$$

Using the two expressions above, the inequality (22) can be rewritten as

$$\gamma_h \geq \bar{\gamma} := \frac{1}{N_s} \frac{1-\beta}{1-\beta\left(1-\frac{N_s-1}{N}\right)} \eta_2. \tag{23}$$

An individual socially responsible investor is not willing to deviate from committing to pay $\tilde{P}_L(0)$ for a green firm if

$$w_0 S_H^0 + (1-w_0)\left(-\frac{\lambda c_L}{1-\beta}\right) \leq \hat{S}^0\left(\tilde{P}_L(0)\right). \tag{24}$$

If the entrepreneur is a low-γ type, which happens with probability w_0, the deviation by an individual socially responsible investor induces the entrepreneur to keep the firm dirty and sell it in the financial market. In this case, the expected discounted utility of an individual socially responsible investor is S_H^0 given by (12). If the entrepreneur is a high-γ type, which happens with probability $1-w_0$, a deviating investor's discounted utility is equal to $-\frac{\lambda c_L}{1-\beta}$ because the entrepreneur is still willing to reform the firm in period $t=0$ in expectation of getting the price $\tilde{P}_L(0)$ for the green firm from N_s-1 socially responsible investors. The right-hand side of (24) is the expected discounted utility of each socially responsible investor if they all adopt the proposed investment mandate. $\hat{S}^0\left(\tilde{P}_L\right)$ is implicitly defined by (21). Using the definitions of S_H^0 and $\hat{S}^0\left(\tilde{P}_L\right)$, we can simplify (24) to

$$w_0 \geq \bar{w}_0 := \frac{\beta\frac{1}{N}}{1-\beta\left(1-\frac{N_s}{N}\right)} + \frac{1}{N_s}\frac{1-\beta\left(1-\frac{N_s-1}{N}\right)}{1-\beta\left(1-\frac{N_s}{N}\right)}\frac{1}{\lambda}\eta_1. \tag{25}$$

Because $\lambda > \eta_1$ by Assumption 1, we have $\bar{w}_0 \in (0,1)$.

Case 2: Deviation induces the high-γ entrepreneur to not reform the firm Suppose now that the deviation by an individual socially responsible investor induces the high-γ entrepreneur to not reform the firm. This is case if $\gamma_h < \bar{\gamma}$, where $\bar{\gamma}$ is defined in (23). Following the deviation, the entrepreneur does not reform the firm in period $t=0$ irrespective of her type. The deviation is not individually rational for a socially responsible investor if $S_H^0 \leq \hat{S}^0\left(\tilde{P}_L(0)\right)$, which simplifies to $\lambda \geq \frac{1}{N_s}\eta_1$. By Assumption 1, this inequality holds.

Existence of individually-rational investment mandate if $\gamma_h \geq \bar{\gamma}$ and $w_0 < \bar{w}_0$ Finally, we show that there does not exist an investment mandate with price commitment for a green firm that induces the entrepreneur to reform the firm in period $t = 0$ irrespective of her type if $\gamma_h \geq \bar{\gamma}$ and $w_0 < \bar{w}_0$.

Clearly, if socially responsible investors commit to paying $P_L < \tilde{P}_L(0)$ for a green firm, then the low-γ entrepreneur does not reform the firm in period $t = 0$. Suppose that socially responsible investors commit to paying $P_L \geq \tilde{P}_L(0)$ for a green firm. In this case, (22) becomes

$$\hat{E}^1\left(N_s - 1, P_L, \gamma_h\right) - \kappa \geq E^1\left(N_s, \gamma_h\right).$$

This inequality can be rewritten as $\gamma_h \geq \bar{\gamma}(P_L)$, where $\bar{\gamma}(P_L)$ is decreasing in P_L and $\bar{\gamma}\left(\tilde{P}_L(0)\right) = \bar{\gamma}$ is defined by (23). Therefore, if $\gamma_h \geq \bar{\gamma}$, a deviation by an individual socially responsible investor does not induce the high-γ entrepreneur to not reform the firm.

If a deviation by an individual socially responsible investor cannot induce the low-γ entrepreneur to not reform the firm, then an individual socially responsible investor surely has an incentive to deviate to not adopting this investment mandate with price commitment. If a deviation by an individual socially responsible investor induces the low-γ entrepreneur to not reform the firm, then (24) becomes

$$w_0 S_H^0 + (1 - w_0)\left(-\frac{\lambda c_L}{1-\beta}\right) \leq \hat{S}^0\left(P_L\right).$$

This inequality can be rewritten as $w_0 \geq \bar{w}_0\left(P_L\right)$, where $\bar{w}_0(P_L)$ is increasing in P_L and $\bar{w}_0\left(\tilde{P}_L(0)\right) = \bar{w}_0$ is defined by (25). Therefore, if $w_0 < \bar{w}_0$, an individual socially responsible investor has an incentive to deviate to not adopting this investment mandate with price commitment. ■

Proof of Corollary 2. The threshold $\bar{\gamma}$ is given by (23). Plugging in η_2 defined by (4), we obtain

$$\bar{\gamma}(\lambda, N_s) = \eta_1 \frac{1}{N_s} \frac{1-\beta}{1-\beta\left(1-\frac{N_s-1}{N}\right)} + \lambda \frac{\beta\frac{1}{N}}{1-\beta\left(1-\frac{N_s-1}{N}\right)} \frac{1-\beta}{1-\beta\left(1-\frac{N_s-1}{N}\right)}.$$

Clearly, $\bar{\gamma}(\lambda, N_s)$ increases in λ and decreases in N_s.

The threshold $\bar{w}_0$ is given by (25). Clearly, it decreases in λ. Differentiating with respect to N_s,

we obtain

$$\frac{\partial \bar{w}_0}{\partial N_s} = -\left[\frac{\beta \frac{1}{N}}{1-\beta\left(1-\frac{N_s}{N}\right)}\right]^2 \frac{1}{\lambda}\frac{1}{N_s}\left(\lambda N_s - \eta_1\right) - \frac{1}{\lambda}\frac{1}{N_s^2}\eta_1 \frac{1-\beta\left(1-\frac{N_s-1}{N}\right)}{1-\beta\left(1-\frac{N_s}{N}\right)}.$$

By Assumption 1, $\lambda > \eta_1$, and therefore $\frac{\partial \bar{w}_0}{\partial N_s} < 0$. ■

B Model Extensions

B.1 Recurring Reform Option

We consider a version of the model in which the current firm owner—entrepreneur or investor—has the ability to reform the firm in any period $t \in \mathbb{N}_0$. As in the baseline model, we assume that Assumption 2 is satisfied. Recall that if an investor acquires the firm, he owns it indefinitely. Therefore, as in the main model, if a socially responsible investor acquires a dirty firm, he finds it optimal to reform it immediately. If a financial investor acquires a dirty firm, he never reforms it. Consequently, there are no gains from trade if the entrepreneur meets a financial investor and therefore never sells the firm to a financial investor.

As in the main model, if the entrepreneur owns a green firm, there are no gains from trade if the entrepreneur meets a socially responsible investor. Therefore, if the entrepreneur owns a green firm, her discounted utility is given by $\frac{\pi-\gamma c_L}{1-\beta}$.

The entrepreneur's expected discounted utility of owning a dirty firm after entrepreneur-investor meetings is given by

$$E_H^1 = \max\left\{\frac{\pi-\gamma c_L}{1-\beta} - \kappa, \pi - \gamma c_H + \beta E_H^{1,pre}\right\}. \tag{26}$$

That is, the entrepreneur chooses between reforming the firm, in which case her discounted utility is $\frac{\pi-\gamma c_L}{1-\beta} - \kappa$, and not reforming the firm and potentially receiving trading gains in the future. $E_H^{1,pre}$ is given by

$$E_H^{1,pre} = \frac{N_s}{N}\max\left\{-\frac{\gamma c_L}{1-\beta} + P_H^s, E_H^1\right\} + \left(1-\frac{N_s}{N}\right)E_H^1. \tag{27}$$

If the entrepreneur meets a socially responsible investor, she sells a dirty firm for the price P_H^s, anticipating that it will be reformed immediately, if and only if this generates a higher expected discounted utility than E_H^1.

We consider two cases.

Case 1: $\frac{\pi-\gamma c_L}{1-\beta} - \kappa \geq \pi - \gamma c_H + \beta E_H^{1,pre}$ In this case, the entrepreneur's expected discounted utility from owning a dirty firm after entrepreneur-investor meetings, given (26), yields

$$E_H^1 = \frac{\pi - \gamma c_L}{1-\beta} - \kappa.$$

If the entrepreneur meets a socially responsible investor, she sells the firm if and only if

$$-\frac{\gamma c_L}{1-\beta} + P_H^s > E_H^1 \Leftrightarrow P_H^s > \frac{\pi}{1-\beta} - \kappa. \tag{28}$$

Suppose that the entrepreneur sells the firm to a socially responsible investor. For a socially responsible investor who does not own the firm, the expected discounted utility right before a potential meeting with the entrepreneur is given by

$$S_H^{0,pre} = \frac{1}{N}\left(\frac{\pi - \lambda c_L}{1-\beta} - \kappa - P_H^s\right) + \frac{N_s - 1}{N}\left(-\frac{\lambda c_L}{1-\beta}\right) + \left(1 - \frac{N_s}{N}\right) S_H^0.$$

Because a socially responsible investor anticipates that the entrepreneur will reform the firm if she does not meet any socially responsible investor, the socially responsible investor's expected discounted utility in this case is given by

$$S_H^0 = -\lambda c_L + \beta S_H^0.$$

A socially responsible investor acquires a dirty firm if and only if

$$\frac{\pi - \lambda c_L}{1-\beta} - \kappa - P_H^s \geq S_H^0 \Leftrightarrow P_H^s \leq \frac{\pi}{1-\beta} - \kappa,$$

which contradicts (28). Therefore, there are no grains from trade if a socially responsible investor meets the entrepreneur with a dirty firm. As a result, (27) yields

$$E_H^{1,pre} = \frac{N_s}{N} E_H^1 + \left(1 - \frac{N_s}{N}\right) E_H^1 = E_H^1 = \frac{\pi - \gamma c_L}{1-\beta} - \kappa.$$

Finally, we need to verify when the condition of this case is satisfied, that is,

$$\frac{\pi-\gamma c_L}{1-\beta}-\kappa \geq \pi-\gamma c_H+\beta E_H^{1,pre} \Leftrightarrow \frac{\gamma(c_H-c_L)}{1-\beta} \geq \kappa \Leftrightarrow \gamma \geq \eta_1.$$

Case 2: $\frac{\pi-\gamma c_L}{1-\beta}-\kappa < \pi-\gamma c_H+\beta E_H^{1,pre}$ In this case, the expected discounted utility of the entrepreneur owning a dirty firm after entrepreneur-investor meetings, given by (26), yields

$$E_H^1=\pi-\gamma c_H+\beta\left(\frac{N_s}{N}\max\left\{-\frac{\gamma c_L}{1-\beta}+P_H^s,E_H^1\right\}+\left(1-\frac{N_s}{N}\right)E_H^1\right).$$

For a socially responsible investor who does not own the firm, the expected discounted utility right before a potential meeting with the entrepreneur owning a dirty firm is given by

$$\begin{aligned}S_H^{0,pre}=\frac{1}{N}\max\left\{\frac{\pi-\lambda c_L}{1-\beta}-\kappa-P_H^s,S_H^0\right\}\\ -\frac{N_s-1}{N}\mathbb{1}_{\left\{-\frac{\gamma c_L}{1-\beta}+P_H^s>E_H^1\right\}}\frac{\lambda c_L}{1-\beta}+\left(\frac{N_f}{N}+\frac{N_s-1}{N}\mathbb{1}_{\left\{-\frac{\gamma c_L}{1-\beta}+P_H^s\leq E_H^1\right\}}\right)S_H^0.\end{aligned}$$

Because a socially responsible investor anticipates that the entrepreneur will not reform the firm if she does not meet any socially responsible investor or if there are no positive trading gains, the socially responsible investor's expected discounted utility in these cases is given by

$$S_H^0=-\lambda c_H+\beta S_H^{0,pre}.$$

Note that this case is equivalent to the one considered in Section 4.2 of the main text.

To summarize, if the current firm owner—entrepreneur or investor—has the ability to reform the firm in any period, the results are as follows. If $\gamma<\eta_1$, there exists a symmetric equilibrium in which the entrepreneur does not reform the firm and sells a dirty firm to a socially responsible investor in the financial market. If $\gamma \geq \eta_2$, there exists a symmetric equilibrium in which the entrepreneur reforms the firm in period $t=0$ and does not sell it in the financial market. If $\gamma \in [\eta_1,\eta_2)$ there exist two symmetric equilibria, one in which the entrepreneur reforms the firm in period $t=0$ and does not sell it in the financial market, and one in which the entrepreneur does not reform the firm and sells a dirty firm to a socially responsible investor in the financial market.

B.2 More Pro-Social Market in the Future

In this extension, we use slightly different notation compared with the baseline model. Suppose that the pro-social preference parameter of socially responsible investors is given by $\lambda \in \{\lambda^0, \lambda^1\}$. For a given λ, we denote the expected discounted utility of the entrepreneur if she owns a dirty firm by E^1_λ and if she does not own the firm by E^0. Because we focus on the case in which the entrepreneur sells a dirty firm to a socially responsible investor who reforms the firm after the acquisition, we have $E^0 = -\frac{\gamma c_L}{1-\beta}$. Analogously, we denote the expected discounted utility of a socially responsible investor if he owns a dirty firm by S^1_λ, if the entrepreneur owns a dirty firm by S^0_λ, and if another socially responsible investor owns a dirty firm by $S^{0,s}_\lambda$. Finally, the price of a dirty firm is denoted by P_λ.

If λ has already increased to λ^1, it stays at this level forever. Therefore, the model after the increase in λ reduces to our baseline model with a fixed $\lambda = \lambda^1$. Using the expressions derived in the proof of Proposition 1, we get

$$E^1_{\lambda^1} = \frac{\pi - \gamma c_H}{1-\beta} + \frac{\beta \frac{N_s}{N}}{1-\beta} \frac{(c_H - c_L)}{1-\beta\left(1-\frac{N_s}{N}\right)} \left(\frac{1-\beta}{1-\beta\left(1-\frac{N_s-1}{N}\right)} \lambda^1 + \gamma - \eta_1 \right),$$

$$S^0_{\lambda^1} = -\frac{\lambda^1 c_H}{1-\beta\left(1-\frac{N_s-1}{N}\right)} - \frac{\beta \frac{N_s-1}{N}}{1-\beta\left(1-\frac{N_s-1}{N}\right)} \frac{\lambda^1 c_L}{1-\beta},$$

$$S^1_{\lambda^1} = \frac{\pi - \lambda^1 c_L}{1-\beta} - \kappa,$$

$$P_{\lambda^1} = \frac{\pi}{1-\beta} + \frac{\lambda^1 (c_H - c_L)}{1-\beta\left(1-\frac{N_s-1}{N}\right)} - \kappa,$$

where η_1 is defined in Assumption 1.

Next, consider the case in which $\lambda = \lambda^0$. If a socially responsible investor with λ^0 owns a green firm, his expected discounted utility is given by

$$S^{1,post}_{\lambda^0} = \pi - \lambda^0 c_L + \beta \left(\varphi \left(\frac{\pi - \lambda^1 c_L}{1-\beta} \right) + (1-\varphi) S^{1,post}_{\lambda^0} \right),$$

where, with probability φ, the pro-social preference parameter λ increases from λ^0 to λ^1 in the next period, and with probability $1-\varphi$, it remains unchanged. Solving the above equation for $S^{1,post}_{\lambda^0}$, we find that the expected discounted utility of a socially responsible investor upon acquiring

a dirty firm is given by

$$S^1_{\lambda^0} = S^{1,post}_{\lambda^0} - \kappa = \frac{\pi}{1-\beta} - \left(\frac{1-\beta}{1-\beta(1-\varphi)} \lambda^0 + \frac{\beta\varphi}{1-\beta(1-\varphi)} \lambda^1 \right) \frac{c_L}{1-\beta} - \kappa.$$

Furthermore, if a given socially responsible investor with $\lambda = \lambda^0$ does not own the firm but a different socially responsible investor has already acquired and reformed it, the expected discounted utility of this investor is given by

$$\begin{aligned} S^{0,s}_{\lambda^0} &= -\lambda^0 c_L + \beta \left(\varphi \left(-\frac{\lambda^1 c_L}{1-\beta} \right) + (1-\varphi) S^{0,s}_{\lambda^0} \right) \Leftrightarrow \\ S^{0,s}_{\lambda^0} &= - \left(\frac{1-\beta}{1-\beta(1-\varphi)} \lambda^0 + \frac{\beta\varphi}{1-\beta(1-\varphi)} \lambda^1 \right) \frac{c_L}{1-\beta}. \end{aligned}$$

If the entrepreneur owns a dirty firm, the expected discounted utility of a socially responsible investor with $\lambda = \lambda^0$ is given by

$$\begin{aligned} S^0_{\lambda^0} = -\lambda^0 c_H + \beta \Bigg(& \varphi \left(\frac{1}{N} S^0_{\lambda^1} + \frac{N_s - 1}{N} \left(-\frac{\lambda^1 c_L}{1-\beta} \right) + \left(1 - \frac{N_s}{N} \right) S^0_{\lambda^1} \right) \\ & + (1-\varphi) \left(\mathbb{1}_{\{P_{\lambda^0} > \Delta E_{\lambda^0}\}} \left(\frac{1}{N} S^0_{\lambda^0} + \frac{N_s - 1}{N} S^{0,s}_{\lambda^0} + \left(1 - \frac{N_s}{N} \right) S^0_{\lambda^0} \right) + \mathbb{1}_{\{P_{\lambda^0} \leq \Delta E_{\lambda^0}\}} S^0_{\lambda^0} \right) \Bigg), \end{aligned} \quad (29)$$

where the price P_{λ^0} is determined by the gain in the expected discounted utility of a socially responsible investor due to the acquisition of a dirty firm, that is, $P_{\lambda^0} = S^1_{\lambda^0} - S^0_{\lambda_0}$. The indicator function $\mathbb{1}_{\{P_{\lambda^0} > \Delta E_{\lambda^0}\}}$ identifies if there are gains from trade when the entrepreneur with a dirty firm meets a socially responsible investor with $\lambda = \lambda^0$. There are gains from trade if the acquisition price P_{λ^0} exceeds $\Delta E_{\lambda^0} = E^1_{\lambda^0} - E^0$, where the expected discounted utility of the entrepreneur owning a dirty firm, $E^1_{\lambda^0}$, is given by

$$\begin{aligned} E^1_{\lambda^0} = \pi - \gamma c_H + \beta \Bigg(& \varphi \left(\frac{N_s}{N} \left(P_{\lambda^1} + E^0 \right) + \left(1 - \frac{N_s}{N} \right) E^1_{\lambda^1} \right) \\ & + (1-\varphi) \left(\mathbb{1}_{\{P_{\lambda^0} > \Delta E_{\lambda^0}\}} \left(\frac{N_s}{N} \left(P_{\lambda^0} + E^0 \right) + \left(1 - \frac{N_s}{N} \right) E^1_{\lambda^0} \right) + \mathbb{1}_{\{P_{\lambda^0} \leq \Delta E_{\lambda^0}\}} E^1_{\lambda^0} \right) \Bigg). \end{aligned} \quad (30)$$

There are two candidates for a symmetric equilibrium. In the first one, there are gains from trade when the entrepreneur with a dirty firm meets a socially responsible investor with $\lambda = \lambda^0$, that is, $P_{\lambda^0} > \Delta E_{\lambda^0}$. In the second one, there are no gains from trade when the entrepreneur with a dirty firm meets a socially responsible investor with $\lambda = \lambda^0$, that is, $P_{\lambda^0} \leq \Delta E_{\lambda^0}$.

Consider the first candidate symmetric equilibrium. Setting $\mathbb{1}_{\{P_{\lambda^0} > \Delta E_{\lambda^0}\}} = 1$ in (29) and (30) and using the expressions above to solve for P_{λ^0} and ΔE_{λ^0}, we can rewrite $P_{\lambda^0} > \Delta E_{\lambda^0}$ in terms of the parameters as

$$\lambda^0 > \frac{1-(1-\varphi)\beta\left(1-\frac{N_s-1}{N}\right)}{1-\beta(1-\varphi)}\left[(\eta_1-\gamma)\frac{1-\beta(1-\varphi)\left(1-\frac{N_s}{N}\right)}{1-\beta+\beta\frac{N_s}{N}}+\right.$$
$$\left.\frac{\varphi\beta}{1-\beta+\beta\frac{N_s-1}{N}}\lambda^1\left(\frac{\frac{N_s}{N}}{1-\beta+\beta\frac{N_s}{N}}-\frac{(1-\beta(1-\varphi))\left(1-\frac{N_s-1}{N}\right)}{1-(1-\varphi)\beta\left(1-\frac{N_s-1}{N}\right)}\right)\right]. \quad (31)$$

Consider the second candidate symmetric equilibrium. Setting $\mathbb{1}_{\{P_{\lambda^0} > \Delta E_{\lambda^0}\}} = 0$ in (29) and (30) and using the expressions above to solve for P_{λ^0} and ΔE_{λ^0}, we can rewrite $P_{\lambda^0} \leq \Delta E_{\lambda^0}$ in terms of the parameters as

$$\lambda^0 \leq (\eta_1-\gamma)\frac{1-\beta(1-\varphi)\left(1-\frac{N_s}{N}\right)}{1-\beta+\beta\frac{N_s}{N}}+\frac{\varphi\beta}{1-\beta+\beta\frac{N_s-1}{N}}\lambda^1\left(\frac{N_s-1}{N}-\frac{(1-\beta)\left(1-\frac{N_s}{N}\right)}{1-\beta+\beta\frac{N_s}{N}}\right). \quad (32)$$

In what follows, we establish sufficient conditions under which each of the two symmetric equilibria exists.

Proof of Proposition 7. Denote the right-hand side of inequality (31) by $A^+(\varphi)$ and the right-hand side of inequality (32) by $A^-(\varphi)$. Note that $A^+(0) = (\eta_1-\gamma)\frac{1-\beta\left(1-\frac{N_s-1}{N}\right)}{1-\beta}$ and $A^-(0) = \eta_1-\gamma$. Because condition (2) holds for $\lambda = \lambda^0$, (31) is satisfied and (32) is not satisfied when $\varphi = 0$. By continuity, there exists a $\bar{\varphi} > 0$ such that $\lambda^0 > A^+(\varphi)$ and $\lambda^0 > A^-(\varphi)$ for all $\varphi < \bar{\varphi}$. It means that for such values of φ, there exists a unique symmetric equilibrium in which the entrepreneur owning a dirty firm sells it to the first socially responsible investor she meets in the financial market.

In this equilibrium, the entrepreneur reforms the firm in period $t = 0$ if and only if $E^1_{\lambda^0} \leq \frac{\pi-\gamma c_L}{1-\beta} - \kappa$, which is equivalent to

$$\gamma \geq \eta_1 + \frac{\beta\frac{N_s}{N}}{1-\beta+\beta\frac{N_s-1}{N}}\left[\lambda^0+\left(\lambda^1-\lambda^0\right)\left(1-\frac{1-\beta+\beta\frac{N_s}{N}}{1-(1-\varphi)\beta\left(1-\frac{N_s}{N}\right)}\frac{(1-\varphi)\left(1-\beta+\beta\frac{N_s-1}{N}\right)}{1-(1-\varphi)\beta\left(1-\frac{N_s-1}{N}\right)}\right)\right].$$

Denote the right-hand side of the expression above by $\eta^\lambda_2(\varphi)$. It is straightforward to verify that $\eta^\lambda(\varphi)$ is an increasing function. ■

Proof of Proposition 8. We are going to prove that if $N > 1$, then there exist two thresholds $\bar{\lambda}$ and $\bar{N}_s \leq N$ such that (31) does not hold and (32) holds if $\lambda^1 \geq \bar{\lambda}$ and $N_s \geq \bar{N}_s$.

Consider inequality (31). Denote

$$Q^+(N_s) = \frac{\frac{N_s}{N}}{1-\beta+\beta\frac{N_s}{N}} - \frac{(1-\beta(1-\varphi))\left(1-\frac{N_s-1}{N}\right)}{1-(1-\varphi)\beta\left(1-\frac{N_s-1}{N}\right)}.$$

It is straightforward to verify that $\frac{\partial Q^+}{\partial N_s} > 0$ and $Q^+(N) > 0$. Therefore, there exists a threshold $\bar{N}_s^+ \leq N$ such that the right-hand side of (31) is an increasing function of λ^1 if $N_s \geq \bar{N}_s^+$. Consequently, there exists a threshold $\bar{\lambda}^+$ such that (31) does not hold if $\lambda^1 \geq \bar{\lambda}^+$ and $N_s \geq \bar{N}_s^+$.

Consider inequality (32). Denote

$$Q^-(N_s) = \frac{N_s-1}{N} - \frac{(1-\beta)\left(1-\frac{N_s}{N}\right)}{1-\beta+\beta\frac{N_s}{N}}.$$

It is straightforward to verify that $\frac{\partial Q^-}{\partial N_s} > 0$ and $Q^-(N) > 0$. Therefore, there exists a threshold $\bar{N}_s^- \leq N$ such that the right-hand side of (32) is an increasing function of λ^1 if $N_s \geq \bar{N}_s^-$. Consequently, there exists a threshold $\bar{\lambda}^-$ such that (32) holds if $\lambda^1 \geq \bar{\lambda}^-$ and $N_s \geq \bar{N}_s^-$.

To complete the proof, define $\bar{\lambda} = \max\{\bar{\lambda}^-, \bar{\lambda}^+, \lambda^0\}$ and $\bar{N}_s = \max\{\bar{N}_s^-, \bar{N}_s^+\}$. ■

B.3 Generalized Nash Bargaining and Severity of Search Frictions

In this appendix, we study an extension in which the acquisition price is determined by generalized Nash bargaining, where $\theta \in (0,1]$ denotes the bargaining power of the entrepreneur. Furthermore, we introduce a parameter governing the severity of search frictions. That is, the entrepreneur meets a given investor with probability $\frac{\mu}{N}$, where $\mu \in (0,1]$. The baseline model is a special case of this extended model with $\theta = 1$ and $\mu = 1$.

We use the same notation as in the baseline model. Specifically, denote the entrepreneur's expected discounted utility when she owns a dirty firm by E_H^1 and when she owns a green firm by E_L^1. We further denote the entrepreneur's expected discounted utility when a financial investor owns the firm by $E_j^{0,f}$, where $j \in \{L,H\}$, and when a socially responsible investor owns the firm by $E_L^{0,s}$ because socially responsible investors reform the firm. We define $\Delta E_j^f := E_j^1 - E_j^{0,f}$, $j \in \{L,H\}$, $\Delta E_L^s := E_L^1 - E_L^{0,s}$, and $\Delta E_H^s := E_H^1 - E_L^{0,s}$. The expected discounted utilities for financial investors

and socially responsible investors are similarly defined using the letters F and S, respectively. For ease of exposition, we omit superscript e if the entrepreneur owns the firm. In what follows, when we consider the expected discounted utilities S_j^0 and F_j^0, we imply that the entrepreneur owns the firm.

B.3.1 Price Setting

When the entrepreneur who owns a firm with a social cost of production c_j, $j \in \{L,H\}$, meets a type $k \in \{f,s\}$ investor in the financial market, the price P_j^k solves

$$P_j^k \in \arg\max_P \left(E_j^{0,k} + P - E_j^1\right)^\theta \left(V_j^1 - P - V_j^0\right)^{1-\theta},$$

subject to

$$\Delta E_j^k \leq P \leq \Delta V_j.$$

Here $V_j^1 = F_j^1$, $V_j^0 = F_j^0$, and $\Delta V_j = \Delta F_j$ if the entrepreneur meets a financial investor, and $V_j^1 = S_j^1$, $V_j^0 = S_j^0$, and $\Delta V_j = \Delta S_j$ if the entrepreneur meets a socially responsible investor. Thus, if $\Delta E_j^k < \Delta V_j$, there are gains from trade and the acquisition price is given by

$$P_j^k = (1-\theta)\Delta E_j^k + \theta \Delta V_j = \Delta E_j^k + \theta X_j^k,$$

where $X_j^k := \Delta V_j - \Delta E_j^k$ denotes the trading surplus. If $\Delta E_j^k \geq \Delta V_j$, then there are no gains from trade and the entrepreneur does not sell the firm to the investor.

B.3.2 Benchmark with Only Financial Investors

We first consider the case in which there are no socially responsible investors in the financial market, that is, $N_s = 0$.

Lemma B.1. *Let $N_s = 0$. There are no gains from trade when the entrepreneur meets a financial investor. Therefore, the entrepreneur reforms the firm in period $t = 0$ if and only if $\gamma \geq \eta_1$, where $\eta_1 = (1-\beta)\frac{\kappa}{c_H - c_L}$ is defined in Assumption 1.*

Proof. Given the acquisition price P_j^f, the entrepreneur's expected discounted utility E_j^1 solves

$$E_j^1 = \pi - \gamma c_j + \beta\left(\mu \max\left\{E_j^{0,f} + P_j^f, E_j^1\right\} + (1-\mu)E_j^1\right),$$

which can be rewritten as

$$E_j^1 = \frac{\pi - \gamma c_j}{1-\beta} + \frac{\beta}{1-\beta}\mu\theta \max\left\{0, X_j^f\right\}. \tag{33}$$

Because the per-period utility of a financial investor when the entrepreneur owns the firm is equal to zero, we get $F_j^0 \geq 0$. Furthermore, $F_j^1 = \frac{\pi}{1-\beta}$ and therefore $\Delta F_j \leq \frac{\pi}{1-\beta}$. In addition, (33) and the fact that $E_j^{0,f} = -\frac{\gamma c_j}{1-\beta}$ imply that $\Delta E_j^f = E_j^1 - E_j^{0,f} \geq \frac{\pi}{1-\beta}$. Consequently, $X_j^f \leq 0$.

The entrepreneur reforms the firm in period $t = 0$ if and only if her discounted utility from reforming the firm, $\frac{\pi - \gamma c_L}{1-\beta} - \kappa$, is equal to or larger than her discounted utility from not reforming the firm, $\frac{\pi - \gamma c_H}{1-\beta}$, which is equivalent to $\gamma \geq (1-\beta)\frac{\kappa}{c_H - c_L}$. ■

B.3.3 Financial Market with Socially Responsible Investors

Suppose now that socially responsible investors are present in the financial market, that is, $N_s > 0$.

Gains from Trade in Financial Market

Lemma B.2. *There are no gains from trade when the entrepreneur meets a financial investor.*

Proof. Given the acquisition prices P_j^f and P_j^s, the entrepreneur's expected discounted utility E_j^1 solves

$$E_j^1 = \pi - \gamma c_j + \beta\left(\mu\frac{N_f}{N}\max\left\{E_j^{0,f} + P_j^f, E_j^1\right\} + \mu\frac{N_s}{N}\max\left\{E_L^{0,s} + P_j^s, E_j^1\right\} + (1-\mu)E_j^1\right),$$

which can be rewritten as

$$E_j^1 = \frac{\pi - \gamma c_j}{1-\beta} + \frac{\beta}{1-\beta}\left(\mu\frac{N_f}{N}\theta\max\left\{0, X_j^f\right\} + \mu\frac{N_s}{N}\theta\max\left\{0, X_j^s\right\}\right). \tag{34}$$

Because the per-period utility of a financial investor when the entrepreneur owns the firm is equal to zero, we get $F_j^0 \geq 0$. Furthermore, $F_j^1 = \frac{\pi}{1-\beta}$ and therefore $\Delta F_j \leq \frac{\pi}{1-\beta}$. In addition, (34) and the fact that $E_j^{0,f} = -\frac{\gamma c_j}{1-\beta}$ imply that $\Delta E_j^f = E_j^1 - E_j^{0,f} \geq \frac{\pi}{1-\beta}$. Consequently, $X_j^f \leq 0$. ■

Additionally, there are also no gains from trade when the entrepreneur owning a green firm meets a socially responsible investor.

Lemma B.3. *There are no gains from trade when the entrepreneur owning a green firm meets a socially responsible investor.*

Proof. Anticipating that the entrepreneur does not sell the firm to a financial investor, the entrepreneur's expected discounted utility E_L^1 solves

$$E_L^1 = \pi - \gamma c_L + \beta \left(\mu \frac{N_f}{N} E_L^1 + \mu \frac{N_s}{N} \max \left\{ E_L^{0,s} + P_L^s, E_L^1 \right\} + (1-\mu) E_L^1 \right),$$

which can be rewritten as

$$E_L^1 = \frac{\pi - \gamma c_L}{1-\beta} + \frac{\beta}{1-\beta} \mu \frac{N_s}{N} \theta \max \left\{ 0, X_L^s \right\}.$$

The entrepreneur's discounted utility when a socially responsible investor owns the firm is given by $E_L^{0,s} = -\frac{\gamma c_L}{1-\beta}$. Because $E_L^1 \geq \frac{\pi - \gamma c_L}{1-\beta}$, we have $\Delta E_L^s \geq \frac{\pi}{1-\beta}$.

The discounted utility of a socially responsible investor when he acquires the firm is given by $S_L^1 = \frac{\pi - \lambda c_L}{1-\beta}$. Because the per-period utility of a socially responsible investor when the entrepreneur owns the firm is equal to $-\lambda c_L$, we get $S_L^0 \geq -\frac{\lambda c_L}{1-\beta}$. As a result, we get $\Delta S_L \leq \frac{\pi}{1-\beta}$. Consequently, $X_L^s \leq 0$. ■

Suppose now that the entrepreneur does not reduce the social cost of production and therefore owns a dirty firm. Then there may exist trading gains when the entrepreneur meets a socially responsible investor.

Proposition B.1. *There exists a symmetric equilibrium in the financial market if and only if*

$$\lambda > (\eta_1 - \gamma) \frac{1 - \beta \left(1 - \mu \frac{N_s - 1}{N} \right)}{1 - \beta}, \tag{35}$$

where $\eta_1 = (1-\beta) \frac{\kappa}{c_H - c_L}$ *is defined in Assumption 1. If condition* (35) *is satisfied, then the trading surplus when the entrepreneur with a dirty firm meets a socially responsible investor,* X_H^s*, is positive and the entrepreneur sells the firm when she meets a socially responsible investor.*

Proof. Following the same steps as in proof of Lemma B.3, we can derive the entrepreneur's expected discounted utility if she owns a dirty firm, which is given by

$$E_H^1 = \frac{\pi - \gamma c_H}{1-\beta} + \frac{\beta}{1-\beta} \mu \frac{N_s}{N} \theta \max \left\{ 0, X_H^s \right\}. \tag{36}$$

Furthermore, if the entrepreneur sells the firm to a socially responsible investor, her expected discounted utility is $E_L^{0,s} = -\frac{\gamma c_L}{1-\beta}$.

The expected discounted utility of a socially responsible investor who does not own the firm is

$$S_H^0 = -\lambda c_H + \beta\left(\mu\frac{1}{N}S_H^0 + \mu\frac{1}{N}(1-\theta)\max\{0,X_H^s\} - \mu\frac{N_s-1}{N}\mathbb{1}_{\{X_H^s>0\}}\frac{\lambda c_L}{1-\beta} + \left(1-\mu\frac{1}{N}-\mu\frac{N_s-1}{N}\mathbb{1}_{\{X_H^s>0\}}\right)S_H^0\right),$$

which can be rewritten as

$$S_H^0 = \frac{1}{1-\beta\left(1-\mu\frac{N_s-1}{N}\mathbb{1}_{\{X_H^s>0\}}\right)}\left(-\lambda c_H + \beta\mu\frac{1}{N}(1-\theta)\max\{0,X_H^s\} - \beta\mu\frac{N_s-1}{N}\mathbb{1}_{\{X_H^s>0\}}\frac{\lambda c_L}{1-\beta}\right).$$

Recall that $S_H^1 = \frac{\pi-\lambda c_L}{1-\beta} - \kappa$. Then

$$\Delta S_H = S_H^1 - S_H^0 = \frac{\pi}{1-\beta} - \frac{\beta\mu\frac{1}{N}}{1-\beta\left(1-\mu\frac{N_s-1}{N}\mathbb{1}_{\{X_H^s>0\}}\right)}(1-\theta)\max\{0,X_H^s\} + \frac{1}{1-\beta\left(1-\mu\frac{N_s-1}{N}\mathbb{1}_{\{X_H^s>0\}}\right)}\lambda(c_H-c_L) - \kappa.$$

Using the expressions above, we can write the trading surplus $X_H^s = \Delta S_H - \Delta E_H^s$ as

$$X_H^s = -\left(\frac{\beta}{1-\beta\left(1-\mu\frac{N_s-1}{N}\mathbb{1}_{\{X_H^s>0\}}\right)}\mu\frac{1}{N}(1-\theta) + \frac{\beta}{1-\beta}\mu\frac{N_s}{N}\theta\right)\max\{0,X_H^s\} + \left(\frac{\lambda}{1-\beta\left(1-\mu\frac{N_s-1}{N}\mathbb{1}_{\{X_H^s>0\}}\right)} + \frac{\gamma}{1-\beta}\right)(c_H-c_L) - \kappa. \quad (37)$$

We first show that there does not exist a solution to (37) satisfying $X_H^s \leq 0$. Assume instead that there exists a solution satisfying $X_H^s \leq 0$. Then we get $X_H^s = \frac{\lambda+\gamma}{1-\beta}(c_H-c_L) - \kappa$. Therefore, $X_H^s \leq 0 \Leftrightarrow \lambda \leq \eta_1 - \gamma$, which contradicts Assumption 1.

We next show that there exists a solution to (37) satisfying $X_H^s > 0$ if and only if condition (35)

holds. Assume that there exists a solution to (37) satisfying $X_H^s > 0$, that is

$$X_H^s = -\left(\frac{\beta}{1-\beta\left(1-\mu\frac{N_s-1}{N}\right)}\mu\frac{1}{N}(1-\theta)+\frac{\beta}{1-\beta}\mu\frac{N_s}{N}\theta\right)X_H^s + \left(\frac{\lambda}{1-\beta\left(1-\mu\frac{N_s-1}{N}\right)}+\frac{\gamma}{1-\beta}\right)(c_H-c_L)-\kappa,$$

which implies

$$X_H^s = \frac{(c_H-c_L)\left(\frac{\lambda}{1-\beta\left(1-\mu\frac{N_s-1}{N}\right)}+\frac{\gamma}{1-\beta}\right)-\kappa}{1+\frac{\beta}{1-\beta\left(1-\mu\frac{N_s-1}{N}\right)}\mu\frac{1}{N}(1-\theta)+\frac{\beta}{1-\beta}\mu\frac{N_s}{N}\theta}. \tag{38}$$

It is straightforward to derive that $X_H^s > 0$ if and only if (35) holds. ■

Entrepreneur's Reform Decision The entrepreneur reduces the social cost of production in period $t = 0$ if and only if

$$\frac{\pi-\gamma c_L}{1-\beta}-\kappa \geq \frac{\pi-\gamma c_H}{1-\beta}+\frac{\beta}{1-\beta}\mu\frac{N_s}{N}\theta X_H^s, \tag{39}$$

where the right-hand-side of the inequality is derived from equation (36) using $X_H^s > 0$.

Proposition B.2. *Assume that condition* (35) *holds. Then the entrepreneur reforms the firm in period* $t = 0$ *if and only if*

$$\gamma \geq \eta_1 + \lambda\frac{\beta\theta\mu\frac{N_s}{N}}{1-\beta\left(1-\mu\frac{N_s-\theta}{N}\right)} =: \eta_2, \tag{40}$$

where $\eta_1 = (1-\beta)\frac{\kappa}{c_H-c_L}$ *is defined in Assumption 1.*

Proof. Using (38), it is straightforward to derive that (39) is equivalent to (40). ■

As a result, we obtain the strategic delay region $[\eta_1, \eta_2)$ in which the entrepreneur does not reform the firm in the presence of socially responsible investors even though she would reform the firm in the absence of socially responsible investors. Clearly, $\frac{\partial\eta_2}{\partial\theta} > 0$ and $\frac{\partial\eta_2}{\partial\mu} > 0$.

Notice that Propositions 9 and 10 from the main text are special cases of Proposition B.2 with $\mu = 1$ and $\theta = 1$, respectively.

B.4 Re-trading and Intermediation by Financial Investors

In this extension, we use the superscript e for the expected discounted utilities of investors who do not own the firm to mark that the entrepreneur owns the firm.

Proof of Proposition 11. Consider a financial market in which a financial investor owns a dirty firm. Note first that the financial investor never sells the firm to another financial investor because there are no gains from trade between investors of the same type. As a result, this case is isomorphic to trading between an entrepreneur with $\gamma = 0$ and socially responsible investors, and Proposition 1 with $\gamma = 0$ applies. In particular, the result determines the expected discounted utilities F_H^1 and S_H^1.

Turning to the entrepreneur, following the same arguments as in the baseline model, it is straightforward to show that there are no gains from trade with either financial investors or socially responsible investors if the entrepreneur owns a green firm.

Next, consider the case in which the entrepreneur owns a dirty firm. The acquisition prices are given by $P_H^{e\to s} = S_H^1 - S_H^{0,e}$ if the firm is sold to a socially responsible investor, and $P_H^{e\to f} = F_H^1 - F_H^{0,e}$ if the firm is sold to a financial investor. The entrepreneur's expected discounted utility E_H^1 satisfies

$$E_H^1 = \pi - \gamma c_H + \beta \left(\frac{N_f}{N} \max \left\{ E_H^{0,f} + P_H^{e\to f}, E_H^1 \right\} + \frac{N_s}{N} \max \left\{ E_L^{0,s} + P_H^{e\to s}, E_H^1 \right\} \right).$$

Because a financial investor sells a dirty firm to a socially responsible investor, we get

$$E_H^{0,f} = -\gamma c_H + \beta \left(\frac{N_f}{N} E_H^{0,f} - \frac{N_s}{N} \frac{\gamma c_L}{1-\beta} \right).$$

We further have $E_L^{0,s} = -\frac{\gamma c_L}{1-\beta}$, which yields

$$E_H^1 = \pi - \gamma c_H + \beta \left(\frac{N_f}{N} \max \left\{ E_H^{0,f} + F_H^1 - F_H^{0,e}, E_H^1 \right\} + \frac{N_s}{N} \max \left\{ -\frac{\gamma c_L}{1-\beta} + S_H^1 - S_H^{0,e}, E_H^1 \right\} \right).$$

Because the entrepreneur makes a take-it-or-leave-it offer to a financial investor, we get $F_H^{0,e} = 0$. Further, because the entrepreneur makes a take-it-or-leave-it offer to a socially responsible

investor, the socially responsible investor's expected discounted utility $S_H^{0,e}$ satisfies

$$S_H^{0,e} = -\lambda c_H + \beta\left(\frac{1}{N}S_H^{0,e} + \frac{N_f}{N}\left(\mathbb{1}_{\{e\to f\}}S_H^{0,f} + \mathbb{1}_{\{e\not\to f\}}S_H^{0,e}\right) + \frac{N_s-1}{N}\left(\mathbb{1}_{\{e\to s\}}\left(-\frac{\lambda c_L}{1-\beta}\right) + \mathbb{1}_{\{e\not\to s\}}S_H^{0,e}\right)\right),$$

where the indicator function denotes trade or no trade between the respective parties.

Consider a symmetric equilibrium in which the entrepreneur sells the dirty firm to a financial investor and to a socially responsible investor. We need to determine the values E_H^1, $S_H^{0,e}$, and $S_H^{0,f}$ that satisfy

$$E_H^1 = \pi - \gamma c_H + \beta\left(\frac{N_f}{N}\left(E_H^{0,f} + F_H^1\right) + \frac{N_s}{N}\left(-\frac{\gamma c_L}{1-\beta} + S_H^1 - S_H^{0,e}\right)\right),$$

$$S_H^{0,f} = -\lambda c_H + \beta\left(\frac{N_f+1}{N}S_H^{0,f} + \frac{N_s-1}{N}\left(-\frac{\lambda c_L}{1-\beta}\right)\right),$$

and

$$S_H^{0,e} = -\lambda c_H + \beta\left(\frac{1}{N}S_H^{0,e} + \frac{N_f}{N}S_H^{0,f} + \frac{N_s-1}{N}\left(-\frac{\lambda c_L}{1-\beta}\right)\right),$$

subject to $E_H^{0,f} + P_H^{e\to f} > E_H^1$ and $E_L^{0,s} + P_H^{e\to s} > E_H^1$. The unique solution to the equations implies $E_H^{0,f} + P_H^{e\to f} = E_H^1$. Thus, a symmetric equilibrium in which the entrepreneur sells the firm to both investor types does not exist.

Consider an equilibrium in which the entrepreneur sells the dirty firm only to socially responsible investors as in the baseline model. We need to determine the values E_H^1 and $S_H^{0,e}$ that satisfy

$$E_H^1 = \pi - \gamma c_H + \beta\left(\frac{N_f}{N}E_H^1 + \frac{N_s}{N}\left(-\frac{\gamma c_L}{1-\beta} + S_H^1 - S_H^{0,e}\right)\right),$$

and

$$S_H^{0,e} = -\lambda c_H + \beta\left(\frac{N_f+1}{N}S_H^{0,e} + \frac{N_s-1}{N}\left(-\frac{\lambda c_L}{1-\beta}\right)\right),$$

subject to $E_H^{0,f} + P_H^{e\to f} \leq E_H^1$ and $E_L^{0,s} + P_H^{e\to s} > E_H^1$. The unique solution to the equations satisfies $E_H^{0,f} + P_H^{e\to f} = E_H^1$ and $E_L^{0,s} + P_H^{e\to s} > E_H^1 \Leftrightarrow \lambda > (\eta_1 - \gamma)\frac{1-\beta\left(1-\frac{N_s-1}{N}\right)}{1-\beta}$, which is condition (2). ■