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

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Abstract

We study the pace at which socially responsible investors can generate impact. Investors with broad 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 externalities, causing a potential 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.

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1 Introduction

Over the past decade, there has been a dramatic increase in socially responsible investing (see, e.g., US SIF, 2020). Despite this tremendous increase, there is little consensus among practitioners and academics on the optimal way for socially responsible investors to generate impact. For example, many investors focus on screening their investments based on criteria such as ESG scores. However, such passive screening is not generally considered to be "impact investing," which requires the creation of measurable and positive change (GIIN, 2020).

While the current debate focuses on how socially responsible investors can generate impact, it misses the crucial aspect of how quickly the impact is achieved. For example, to generate timely impact, should socially responsible investors passively invest in "green" firms that have already reduced their externalities such as greenhouse gas emissions? Or should they target "dirty" firms that are lagging behind and push these firms to reform? 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 questions of whether and 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 model of dynamic search in financial markets. Our framework best applies to private capital markets, which account for a significant share of impact investing.[1] In the model, an entrepreneur initially owns a dirty firm and can sell the firm to an investor. An important feature of our model is that socially responsible investors as well as the entrepreneur—the initial firm owner—can reform the firm by reducing negative production externalities. Our model therefore allows us to study the timeliness of reform as the entrepreneur can immediately reform the firm herself or search for a socially responsible investor who may acquire the firm and reform it in the future. Our goal is to understand whether the entrepreneur has incentives to reform the firm herself in the presence of socially responsible investors.

We show that socially responsible investors can cause a delay in the reduction of negative firm externalities. We consider investors with broad preferences who care about firm externalities

[1] In 2019, private equity accounted for 16% and private debt for 37% of impact investing (GIIN, 2020).

independent of their ownership in the firm (as in, e.g., Oehmke and Opp, 2020).[2] Investors with these preferences value acquiring firms with high negative production externalities ("dirty" firms) because they can reform these firms. Therefore, there are trading gains when an entrepreneur who owns a dirty firm meets a socially responsible investor. These trading gains can increase the value of owning a dirty firm and reduce the incentive of the entrepreneur to reform the firm, which can cause a delay in firm reform. We further show that investment mandates through which socially responsible investors commit to paying a premium for firms with low negative production externalities ("green" firms) can eliminate delay and incentivize the entrepreneur to reform the firm in a timely manner.

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. The social cost captures externalities such as the firm's 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, where stronger pro-social preferences imply a greater disutility from the social cost. 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.

The owner of the firm—entrepreneur or investor—can reduce the social cost forever by paying a one-time reform cost. We assume that each agent has enough funds to pay the reform cost. Each period, the entrepreneur meets an investor at random. In the baseline model, upon meeting, the entrepreneur can make a take-it-or-leave-it price offer to the investor for the acquisition of the firm.[3] While we discuss a reduction in the social cost as turning a dirty firm green, the reform decision can be interpreted more broadly as picking between different green technologies or scaling a green technology. The key assumption for our results is that the entrepreneur has enough funds to change or scale the firm's production technology without the need for capital from investors.

[2]These broad pro-social 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, they can capture moral concern about the social costs incurred by others.

[3]In Appendix C, we study an extension in which the acquisition price is determined by Nash bargaining. Our main results hold in this generalized setting.

We start our analysis by characterizing the entrepreneur's decision to turn the firm green in a benchmark case in which there are no socially responsible investors. Since both the entrepreneur and financial investors value profits equally and since the entrepreneur incurs the disutility from the firm's social cost regardless of whether she owns the firm, there are no gains from trade. As a result, the entrepreneur's decision to pay the one-time cost to turn the firm green depends only on her pro-social preferences. 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 present in the financial market. As discussed above, there are no gains from trade if the entrepreneur meets a financial investor. Furthermore, if the entrepreneur turns the firm green herself, there are also no gains from trade if she meets a socially responsible investor. Since the firm is already green, such an investor cannot further reduce the social cost after acquiring the firm and as a result only values the firm's profits. In contrast, if the entrepreneur owns a dirty firm and meets a socially responsible investor, there can be gains from trade. In such a 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. 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.

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, the firm can be acquired by a socially responsible investor and turned green. 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 turning the firm green.

Making the financial market more pro-social can lessen or exacerbate the entrepreneur's incentive to strategically delay reform. Interestingly, the way in which the financial market becomes

more pro-social—either by increasing the strength of investors' pro-social preferences or by increasing the share of socially responsible investors in the financial market—matters for whether the entrepreneur's incentive to strategically delay reform strengthens or weakens. 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. An increase in the share of socially responsible investors in the financial market has a more nuanced effect and 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 is less costly for any given socially responsible investor who meets the entrepreneur to pass up on acquiring the firm as he expects another socially responsible investor to acquire and reform the firm in the future. Socially responsible investors therefore have an incentive to free ride on each other. This effect reduces trading gains, which reduces the incentive to strategically delay reform.

In recent years, many socially responsible funds have adopted investment mandates outlining a set of principles for their investments.[4] We therefore additionally 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. Correcting the entrepreneur's incentive to reform the firm requires a mechanism that allows socially responsible investors to alter their trading behavior as a function of the firm's status—green or dirty. As such, we focus on two types of mandates—a commitment to not acquiring a firm depending on its status, and a commitment to paying a pre-specified price for a firm depending on its status.

A mandate through which socially responsible investors commit to not investing in dirty firms can eliminate strategic delay by an entrepreneur with moderate pro-social preferences but cannot speed up reform by an entrepreneur with weak pro-social preferences. Intuitively, since an entrepreneur with moderate pro-social preferences no longer expects to realize trading gains from

[4]For example, the number of investor signatories to the United Nations' Principles for Responsible Investing increased by 29% between 2019 and 2020, from 2092 signatories to 2701 signatories. Their combined assets under management increased by 20% over the same period from $86.3 trillion to $103.4 trillion (UN PRI, 2020). Also see Geczy et al. (2021) who 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.

owning a dirty firm, she has no incentive to strategically delay reform and therefore reforms the firm immediately. In contrast, if the entrepreneur has weak pro-social preferences such that she would keep the firm dirty absent socially responsible investors, adopting such a mandate keeps the firm dirty forever instead of allowing socially responsible investors to acquire and reform it.

A mandate through which socially responsible investors commit to paying a premium for a green firm can eliminate any delay—strategic or non-strategic. Clearly, there always exists a price for a green firm that can incentivize the entrepreneur to reform the firm immediately. Although the price exists, it is not immediately clear that such an investment mandate would be adopted because paying a high price for a green firm is costly for socially responsible investors. However, 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 cost of delay in reform rather than paying for a dirty firm later and incurring the cost of delay. We also extend the model to the case of 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 incentivize both types of entrepreneurs to do so.

In practice, the optimal investment strategy of buying green firms at a premium 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.[5] Interestingly, this investment mandate is observationally similar to the investment strategy of an investor who receives a positive utility (a "warm glow") from investing in green firms. Some researchers have raised concerns that this type of "narrow" strategy 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, 2020; Oehmke and Opp, 2020). While such a "narrow" strategy is a concern in their setting, 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. An interesting implication is that "naive" socially responsible investors, who receive a warm glow from investing in green firms but do not internalize the broader impact of their actions, may unintentionally create demand pressure and increase

[5] In practice, about 33% of impact investors are "below-market-rate" investors who explicitly expect lower financial returns to achieve impact goals (GIIN, 2020).

market prices for green assets, which may help support timely impact.

Our paper has implications for the appropriate definition and measurement of "impact" in financial markets. In particular, socially responsible investors who employ positive or negative screening when choosing which firms to invest in but who do not try to create additional positive change post investment are typically not considered "impact investors" (GIIN, 2020). Our research suggests that only focusing on impact post investment can in fact generate a delay in firm reform. In our paper, the best and quickest way for socially responsible investors to have impact is to commit to acquiring firms that are already green at a premium. This investment strategy incentivizes current owners to make their firms green before they are acquired by socially responsible investors. All of the measurable impact will therefore happen before the investment rather than after. Our results imply that focusing on post-transaction impact only provides a partial picture of the impact socially responsible investors can generate. In addition, it is important to consider how socially responsible investors affect market prices for green and dirty firms because market prices in turn affect the incentives of current owners to reform their firms.

Related Literature Our paper contributes to the theoretical literature studying whether and how socially responsible investors can impact firm production decisions (Heinkel, Kraus, and Zechner, 2001; Gollier and Pouget, 2014; Hart and Zingales, 2017; Chowdhry, Davies, and Waters, 2019; Morgan and Tumlinson, 2019; Broccardo, Hart, and Zingales, 2020; Green and Roth, 2020; Landier and Lovo, 2020; Oehmke and Opp, 2020; Pastor, Stambaugh, and Taylor, 2020; Roth, 2020; Moisson, 2021).[6] To the best of our knowledge, we are the first to study the pace at which socially responsible investors can induce firms to change their production technology—an aspect that is crucially important due to the urgency of climate change.

Our paper is closest to Landier and Lovo (2020) who also consider how socially responsible investors can impact firm production decisions in a financial market that is subject to 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

[6]There are also theoretical papers that study asset pricing implications of socially responsible investing. These include Luo and Balvers (2017), Baker et al. (2019), Pastor, Stambaugh, and Taylor (2020), Pedersen et al. (2020), and Goldstein et al. (2021). In addition, a large empirical literature studies asset pricing implications of socially responsible investing (see, e.g., Bolton and Kacperczyk, 2020). Liang and Renneboog (2020) provide a review of this empirical literature.

financing. In contrast to Landier and Lovo (2020), our model is dynamic, which allows us to study the pace at which firms change their production technology and to highlight potentially important costs that arise in the presence of search frictions. Specifically, we show that socially responsible investors can induce a strategic delay in the reduction of firms' production externalities in the presence of search frictions and study how the adoption of investment mandates can address the problem of delay.

Our model differs from theories that consider atomistic investors who receive a positive utility (a "warm glow") from investing in green firms and who can affect firm production decisions by reducing the cost of capital of green firms (see, e.g., Heinkel et al., 2001; Pastor et al., 2020). Instead, we consider investors with broad preferences who have size and therefore internalize the impact of their investment decisions.[7] The preferences we consider are similar to those in Oehmke and Opp (2020). 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 the entrepreneur in our framework has enough funds to reform her firm without investors. Jointly, the papers' findings complement each other and highlight that the investment strategies of socially responsible investors can differ substantially depending on the market environment and the financial constraints faced by firms.

There is a growing empirical literature studying socially responsible investing in private capital markets (Chava, 2014; Kovner and Lerner, 2015; Bellon, 2020; Barber et al., 2021; Geczy et al., 2021; Jeffers et al., 2021; Kacperczyk and Peydró, 2021). 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 model of financial markets (see, e.g., Weill, 2020). Our model differs from standard models in which trading gains typically arise due to differ-

[7] 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; Davies and Van Wesep, 2018; Friedman and Heinle, 2021; De Angelis, Zerbib, and Ensae, 2021).

ences in utility flows of holding an asset across different agents. Introducing pro-social preferences makes our setting different because agents incur the disutility from the firm's social cost independent of whether they own the firm. There are therefore no inherent gains from trade in our setting. Instead, pro-social preferences can give rise to gains from trade because socially responsible investors can reduce a firm's social cost after acquiring the firm.

The remainder of the paper is organized as follows. Section 2 presents an example that captures the source of strategic delay in our model. Section 3 presents the model. Section 4 studies the model without investment mandates. Section 5 studies the model with investment mandates. The last section concludes. The appendix contains all proofs and additional analyses.

2 Example

Consider a two-period environment without time discounting. An entrepreneur (she/her) owns a firm that generates a profit $\pi > 0$ and a social cost $c \in \{c_L, c_H\}$ at the end of each period $t \in \{0, 1\}$. Initially, the firm is "dirty" and generates a high social cost equal to c_H. In period $t = 0$, the entrepreneur can incur a one-time cost $\kappa > 0$ to make the firm "green" by reducing the social cost to $c_L < c_H$ for the current and the future period, that is, for both periods $t = 0$ and $t = 1$.

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—a social benefit—captures positive externalities from the firm's production such as a positive social impact. For ease of exposition, we only use the term social cost throughout the paper.

The entrepreneur has a per-period utility of $\pi - \gamma c$ when she owns the firm, where $c \in \{c_L, c_H\}$ is the social cost of production and $\gamma \geq 0$ captures the entrepreneur's pro-social preferences. If the entrepreneur does not own the firm, her per-period utility is given by $-\gamma c$. That is, if $\gamma > 0$, the entrepreneur has broad pro-social preferences and cares about the social cost of production independent of her ownership in the firm.

The pro-social preferences are "broad" in the sense that an agent incurs the disutility from the social cost of production independent of whether he or she owns the firm (see, e.g., Oehmke and

Opp, 2020). The pro-social 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.[8]

There is one investor (he/him) who can acquire the firm from the entrepreneur at the beginning of period $t = 1$. If he acquires a dirty firm, the investor can immediately reform the firm and reduce its social cost to c_L by paying the same one-time cost $\kappa > 0$. We consider a financial investor and a socially responsible investor and seek to understand when the entrepreneur reduces the social cost of production in the presence of these different types of investors. A financial investor cares only about profits. In contrast, a socially responsible investor has broad pro-social preferences like the entrepreneur with the pro-social preference parameter $\lambda > 0$. The entrepreneur can sell the firm by making a take-it-or-leave-it price offer to the investor and we assume that she does not sell the firm if she is indifferent between selling and not selling the firm.

Intuitively, the parameters γ and λ represent the shares of the social cost of production internalized by the entrepreneur and the socially responsible investor, respectively. To ensure that the total per-period disutility from the social cost of production does not exceed the social cost, we require that $\gamma + \lambda \leq 1$.[9]

We assume that it is socially optimal for an investor to adopt the green production technology at $t = 1$, that is, we assume that $c_H - c_L > \kappa$. Clearly, it is more socially efficient for the entrepreneur to adopt the green production technology in period $t = 0$ than for an investor to do so in period $t = 1$. In addition, we assume that the dirty production technology generates a positive social surplus such that it is not socially desirable to simply shut down the dirty production technology.

This two-period example can be solved by backward induction. We first determine the outcome of the trading game at $t = 1$ and then study the entrepreneur's decision to reform the firm at $t = 0$. To focus on the interesting case, we assume that the socially responsible investor has incentives to

[8] A literature in economics explores the consequences of pro-social preferences in other contexts (see, e.g., Besley and Ghatak, 2018). There is ample evidence that some economic agents have pro-social preferences and that there is heterogeneity across agents (see, e.g., List, 2009). For evidence in a financial market context, see, for example, Riedl and Smeets (2017) and Bonnefon et al. (2019).

[9] The share of the social cost of production that a given entrepreneur or investor internalizes may be relatively small in reality. If $\gamma + \lambda < 1$, then the remainder of the social cost may be borne by other agents in the economy such as households, which are not explicitly accounted for in our framework.

reform a dirty firm in period $t = 1$. Note that if the socially responsible investor acquires a dirty firm, then reforming the firm gives the investor a utility of $\pi - \lambda c_L - \kappa$, and a utility of $\pi - \lambda c_H$ if he does not reform the firm. The socially responsible investor reforms the firm after acquiring it if and only if

$$\pi - \lambda c_L - \kappa \geq \pi - \lambda c_H \Leftrightarrow \lambda \geq \frac{\kappa}{c_H - c_L}.$$

We therefore assume that $\lambda > \frac{\kappa}{c_H - c_L}$.

Trading with a financial investor Consider first the case in which the investor is a financial investor. Since a financial investor does not care about the social cost of production, he will not reform a dirty firm after an acquisition. Moreover, the highest price P_f the financial investor is willing to pay for the firm—green or dirty—is simply equal to the period $t = 1$ profit, π. As a result, if the entrepreneur sells the firm, her utility is given by $P_f - \gamma c = \pi - \gamma c$, where $c \in \{c_L, c_H\}$ is the pre-acquisition social cost. If the entrepreneur does not sell the firm, her utility is given by $\pi - \gamma c$. As a result, there are no gains from trade independent of whether the firm is green or dirty. Hence, the entrepreneur does not sell the firm. The reason is that the entrepreneur and the investor value firm profits equally and the entrepreneur's pro-social preferences are broad such that she suffers from the social cost of production independent of her ownership in the firm.

Reform decision with a financial investor In period $t = 0$, anticipating that she will not sell the firm to the financial investor at the beginning of period $t = 1$, the entrepreneur decides whether or not to reduce the social cost of production. If she reforms the firm, her utility is equal to $2(\pi - \gamma c_L) - \kappa$. If she does not reform the firm, her utility is equal to $2(\pi - \gamma c_H)$. She therefore reforms the firm in period $t = 0$ if and only if

$$2(\pi - \gamma c_L) - \kappa \geq 2(\pi - \gamma c_H) \Leftrightarrow \gamma \geq \frac{\kappa}{2(c_H - c_L)}.$$

Intuitively, the entrepreneur reforms the firm if her pro-social preferences are strong enough.

Trading with a socially responsible investor Consider next the case in which the investor is a socially responsible investor. Assume first that the entrepreneur reforms the firm in period $t = 0$

and therefore owns a green firm. If the socially responsible investor acquires the firm at price P_s, then his utility is given by $\pi - \lambda c_L - P_s$. If he does not acquire the firm, he still incurs the disutility from the social cost of production, which gives him a utility of $-\lambda c_L$. Thus, the highest price the socially responsible investor is willing to pay for the firm in period $t = 1$ makes him indifferent between acquiring and not acquiring the firm, and is given by $\pi - \lambda c_L - P_s = -\lambda c_L \Leftrightarrow P_s = \pi$. Intuitively, since the firm is already green, a socially responsible investor cannot further reduce the social cost if he acquires the firm. Since he incurs the disutility from the social cost of production independent of whether he owns the firm, the socially responsible investor values only the firm's profits. Similar to the case when the entrepreneur meets a financial investor, there are no gains from trade and the entrepreneur does not sell a green firm to the socially responsible investor.

Assume next that the entrepreneur does not reform the firm in period $t = 0$. Since $\lambda > \frac{\kappa}{c_H - c_L}$, the socially responsible investor reforms the firm if he acquires it. In this case, his utility is given by $\pi - \lambda c_L - \kappa - P_s$. If he does not acquire the firm, the firm stays dirty, and his utility is given by $-\lambda c_H$. The highest price the socially responsible investor is willing to pay for the firm is therefore given by

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

In particular, we have $P_s > \pi$. Intuitively, 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. The entrepreneur sells the firm because $P_s - \gamma c_L > \pi - \gamma c_H$. Therefore, there are gains from trade if the entrepreneur owns a dirty firm but not if she owns a green firm.

Reform decision with a socially responsible investor In the presence of the socially responsible investor, if the entrepreneur reforms the firm at $t = 0$, her utility is equal to $2(\pi - \gamma c_L) - \kappa$. If she does not reform the firm, her utility is equal to $\pi - \gamma c_H + P_s - \gamma c_L$. She therefore reforms the firm in period $t = 0$ if and only if

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

Summary The anticipation of the trading gains when the entrepreneur owns a dirty firm increases the value of owning a dirty firm and can therefore reduce the entrepreneur's incentive to

turn the firm green herself. Specifically, if $\frac{\kappa}{2(c_H-c_L)} \leq \gamma < \lambda$, then the entrepreneur would reform the firm immediately in the absence of the socially responsible investor but strategically delays the firm's reform in the presence of the socially responsible investor. If $\gamma < \frac{\kappa}{2(c_H-c_L)}$, then the entrepreneur does not reform the firm independent of whether the socially responsible investor is present in the financial market. In this case, the socially responsible investor speeds up the firm's reform as he acquires and reforms the firm in period $t = 1$. Finally, if $\gamma \geq \lambda$, then 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 with both financial and socially responsible investors and seek to understand when the entrepreneur reduces the social cost of production in the presence of socially responsible investors in this more general setting.

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.[10] The entrepreneur has sufficient funds to pay the cost κ to reduce the social cost of production, and we assume that she reforms the firm if she is indifferent between reforming and not reforming it.

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. Given the model assumptions, 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 a green firm generates a higher discounted social surplus such that reforming the firm is socially optimal,

[10] In Appendix B, 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.

that is, we assume that $\frac{c_H - c_L}{1-\beta} > \kappa$. In addition, we assume that a dirty firm generates a positive social surplus such that it is not socially desirable to simply shut down a dirty firm.

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 $\gamma \geq 0$. That is, $-\gamma c$ captures the entrepreneur's per-period disutility from the social cost of production. In particular, if $\gamma > 0$, the entrepreneur has pro-social preferences and cares about the social cost of production. 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 $\lambda > 0$. 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 financial market is subject to search frictions. 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 $\frac{N_s}{N}$. 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 the firm. If the entrepreneur sells the firm to an investor, the investor owns the firm forever and there is no further change in ownership. In Appendix C, we show that the results from Section 4 are robust to extending the framework to generalized Nash bargaining with a positive bargaining power of investors.

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. We assume that if the investor is indifferent between reforming and not reforming the firm, he reforms it. If a financial investor acquires a dirty firm, he does not reform the firm because financial investors 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 the firm's social cost of production. We assume that socially responsible investors are pro-social enough such that they reform a dirty firm if they own it:

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

In Section 4, we study the financial market as described above. In Section 5, we introduce and study an extension of the model in which investors can adopt investment mandates before entering the financial market.

4 Equilibrium

In this section we define and derive conditions for a symmetric equilibrium in which the entrepreneur offers the same price to all investors of the same type and all investors of the same type behave identically. We then solve for equilibrium allocations and prices with and without socially responsible investors in the financial market.

4.1 Definition

Denote the entrepreneur's expected discounted utility excluding the reform cost κ when she owns a firm with social cost of production $c \in \{c_L, c_H\}$ by $V^1(c)$. All expected discounted utilities are determined during the period after a potential meeting in the financial market, which happens at the beginning of the period. The profit and social cost realize at the end of the period. Note that $V^1(c_H)$ does not include the reform cost κ. Denote the entrepreneur's expected discounted utility when a financial investor owns the firm by $V_f^0(c)$, and when a socially responsible investor owns the firm by $V_s^0(c)$. Since a financial investor does not reform a dirty firm, we have $V_f^0(c) = -\frac{\gamma c}{1-\beta}$. In contrast, a socially responsible investor reforms a dirty firm and we therefore have $V_s^0(c) = V_s^0 := -\frac{\gamma c_L}{1-\beta}$.

Denote a financial investor's expected discounted utility when the entrepreneur owns a firm with social cost of production $c \in \{c_L, c_H\}$ by $Z_f^0(c)$, and when he acquires the firm by $Z_f^1(c)$. Note that $Z_f^1(c)$ includes the reform cost κ but does not include the acquisition price $P_f(c)$. Since a financial investor does not care about the social cost of production, we have $Z_f^1(c) = Z_f^1 := \frac{\pi}{1-\beta}$.

Denote a socially responsible investor's expected discounted utility when the entrepreneur owns the firm by $Z_s^0(c)$, and when he acquires the firm by $Z_s^1(c)$. Since a socially responsible reforms a dirty firm, we have $Z_s^1(c_L) = \frac{\pi - \lambda c_L}{1-\beta}$ and $Z_s^1(c_H) = \frac{\pi - \lambda c_L}{1-\beta} - \kappa$.

Denote by $P_f(c)$ and $P_s(c)$ the acquisition prices of a firm with social cost of production $c \in \{c_L, c_H\}$ when the entrepreneur meets a financial investor and when she meets a socially responsible investor, respectively. The entrepreneur makes a take-it-or-leave-it price offer to sell the firm to an investor. The acquisition price $P_f(c)$ therefore solves

$$Z_f^1 - P_f(c) = Z_f^0(c) \Leftrightarrow P_f(c) = \Delta Z_f(c) := Z_f^1 - Z_f^0(c). \tag{1}$$

The acquisition price $P_s(c)$ solves

$$Z_s^1(c) - P_s(c) = Z_s^0(c) \Leftrightarrow P_s(c) = \Delta Z_s(c) := Z_s^1(c) - Z_s^0(c). \tag{2}$$

Given the acquisition prices $P_f(c)$ and $P_s(c)$, the entrepreneur's expected discounted utility $V^1(c)$ solves

$$V^1(c) = \pi - \gamma c + \beta \left(\frac{N_f}{N} \max \left\{ V_f^0(c) + P_f(c), V^1(c) \right\} + \frac{N_s}{N} \max \left\{ V_s^0 + P_s(c), V^1(c) \right\} \right),$$

which can be rewritten as

$$V^1(c) = \underbrace{\frac{\pi - \gamma c}{1-\beta}}_{\substack{\text{Entrepreneur} \\ \text{owns the firm}}} + \frac{\beta}{1-\beta} \left(\underbrace{\frac{N_f}{N} \max \left\{ 0, P_f(c) - \Delta V_f(c) \right\}}_{\substack{\text{Entrepreneur meets a} \\ \text{financial investor}}} + \underbrace{\frac{N_s}{N} \max \left\{ 0, P_s(c) - \Delta V_s(c) \right\}}_{\substack{\text{Entrepreneur} \\ \text{meets a socially} \\ \text{responsible investor}}} \right), \tag{3}$$

where $\Delta V_f(c) := V^1(c) - V_f^0(c)$ and $\Delta V_s(c) := V^1(c) - V_s^0$. The first summand in (3) is the entrepreneur's discounted utility from owning the firm, capturing the firm's profit and the disutility from the social cost of production $c \in \{c_L, c_H\}$. The first summand in the bracket captures the entrepreneur's expected discounted utility from meeting a financial investor in the next period. In this case, the entrepreneur either sells the firm to the financial investor or retains ownership of the firm. The second summand in the bracket captures the entrepreneur's expected discounted utility

from meeting a socially responsible investor.

Given the acquisition prices $P_f(c)$ and $P_s(c)$, the financial investor's expected discounted utility $Z_f^0(c)$ solves

$$Z_f^0(c) = \beta \Bigg(\underbrace{\frac{1}{N} \max \left\{ Z_f^1 - P_f(c), Z_f^0(c) \right\}}_{\substack{\text{Given financial investor} \\ \text{meets the entrepreneur}}} + \Bigg(\underbrace{\frac{N_f - 1}{N} \mathbb{1}_{\{P_f(c) \leq \Delta V_f(c)\}}}_{\substack{\text{Other financial investor} \\ \text{meets the entrepreneur}}} + \underbrace{\frac{N_s}{N} \mathbb{1}_{\{P_s(c) \leq \Delta V_s(c)\}}}_{\substack{\text{Socially responsible} \\ \text{investor meets} \\ \text{the entrepreneur}}} \Bigg) Z_f^0(c) \Bigg). \quad (4)$$

Using the fact that the entrepreneur makes a take-it-or-leave-it price offer such that $Z_f^1 - P_f(c) = Z_f^0(c)$, (4) implies $Z_f^0(c) = 0$. As a result, we have $P_f(c) = Z_f^1 - Z_f^0(c) = \frac{\pi}{1-\beta}$. In addition, (3) implies that $\Delta V_f(c) = V^1(c) - V_f^0(c) \geq \frac{\pi}{1-\beta}$. Taken together, this implies that $P_f(c) \leq \Delta V_f(c)$. That is, there are no gains from trade if the entrepreneur meets a financial investor and the entrepreneur therefore never sells the firm to a financial investor irrespective of its status.

To understand why there are no gains from trade if the entrepreneur meets a financial investor, note that there are two potential sources of gains from trade: profits and social costs. First, the entrepreneur and financial investors value profits equally. As a result, there are no gains from trade in terms of the firm's profits. Second, the entrepreneur incurs the disutility from the social cost of production independent of whether she owns the firm. In addition, financial investors do not reduce the social cost of production. Therefore, the entrepreneur cannot reduce her disutility from the social cost of production by selling the firm to a financial investor.

Anticipating that the entrepreneur does not sell the firm to a financial investor, (3) can be rewritten as

$$V^1(c) = \frac{\pi - \gamma c}{1 - \beta} + \frac{\beta}{1 - \beta} \frac{N_s}{N} \max \left\{ 0, P_s(c) - \Delta V_s(c) \right\}, \quad (5)$$

and the socially responsible investor's expected discounted utility $Z_s^0(c)$ solves

$$Z_s^0(c) = -\lambda c + \beta \Bigg(\underbrace{\frac{1}{N} \max\left\{Z_s^1(c) - P_s(c), Z_s^0(c)\right\}}_{\substack{\text{Given socially responsible} \\ \text{investor meets} \\ \text{the entrepreneur}}} - \underbrace{\frac{N_s - 1}{N} \mathbb{1}_{\{P_s(c) > \Delta V_s(c)\}} \frac{\lambda c_L}{1-\beta}}_{\substack{\text{Other socially responsible} \\ \text{investor meets} \\ \text{the entrepreneur}}} + \Bigg(\underbrace{\frac{N_s - 1}{N} \mathbb{1}_{\{P_s(c) \leq \Delta V_s(c)\}}}_{\substack{\text{Other socially responsible} \\ \text{investor meets} \\ \text{the entrepreneur}}} + \underbrace{\frac{N_f}{N}}_{\substack{\text{Financial investor} \\ \text{meets the entrepreneur}}} \Bigg) Z_s^0(c) \Bigg). \quad (6)$$

Note that since the entrepreneur makes a take-it-or-leave-it price offer such that $Z_s^1(c) - P_s(c) = Z_s^0(c)$, we can substitute $\max\left\{Z_s^1(c) - P_s(c), Z_s^0(c)\right\} = Z_s^0(c)$ in (6).

Definition 1. *An equilibrium is a collection of values* $V_f^0(c_L) = -\frac{\gamma c_L}{1-\beta}$, $V_f^0(c_H) = -\frac{\gamma c_H}{1-\beta}$, $V_s^0 = -\frac{\gamma c_L}{1-\beta}$, $V^1(c_L)$, $V^1(c_H)$, $Z_f^0(c_L) = 0$, $Z_f^0(c_H) = 0$, $Z_f^1 = \frac{\pi}{1-\beta}$, $Z_s^0(c_L)$, $Z_s^0(c_H)$, $Z_s^1(c_L) = \frac{\pi - \lambda c_L}{1-\beta}$, *and* $Z_s^1(c_H) = \frac{\pi - \lambda c_L}{1-\beta} - \kappa$, *and acquisition prices* $P_f(c_L) = \frac{\pi}{1-\beta}$, $P_f(c_H) = \frac{\pi}{1-\beta}$, $P_s(c_L)$, *and* $P_s(c_H)$, *satisfying* (1), (2), (4), (5), *and* (6), *and a reform decision* $c \in \{c_L, c_H\}$ *satisfying*

$$c \in \underset{\tilde{c} \in \{c_L, c_H\}}{\arg\max} \left(V^1(\tilde{c}) - \mathbb{1}_{\{\tilde{c} = c_L\}} \kappa \right).$$

4.2 Financial Market with Only Financial Investors

In this section, we consider a financial market that is populated only by financial investors. Formally, we assume that $N_f = N$ such that $N_s = 0$. Recall from Section 4.1 that there are no gains from trade if the entrepreneur meets a financial investor. As a result, the entrepreneur never sells the firm to a financial investor irrespective of its status and the entrepreneur's discounted utility from owning a green and from owning a dirty firm are given by

$$V^1(c_L) = \frac{\pi - \gamma c_L}{1-\beta} \text{ and } V^1(c_H) = \frac{\pi - \gamma c_H}{1-\beta}.$$

The fact that there are no gains from trade when the entrepreneur meets a financial investor distinguishes our model from standard models of over-the-counter markets in which trading gains typically arise due to differences in utility flows of holding an asset across different agents. While

agents in our model have different utility flows from holding an asset, this difference does not give rise to trading gains because agents incur the disutility independent of whether they own the firm.

In deciding whether to reduce the social cost of production, the entrepreneur compares her discounted utility from reforming the firm in period $t = 0$, $V^1(c_L) - \kappa = \frac{\pi - \gamma c_L}{1-\beta} - \kappa$, with her discounted utility from not reforming the firm, $V^1(c_H) = \frac{\pi - \gamma c_H}{1-\beta}$, which directly implies the following result.[11]

Lemma 1. *If $N_s = 0$, 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 and only if her pro-social preferences are sufficiently strong.

4.3 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 $N_s > 0$. We seek to understand when the entrepreneur reduces the social cost of production in the presence of socially responsible investors. In Section 4.3.1, we study trading in the financial market if the entrepreneur reforms the firm. In Section 4.3.2, we study trading in the financial market if the entrepreneur does not reform the firm. In Section 4.3.3, we study the entrepreneur's decision to reform the firm, anticipating trading behavior in the financial market. In Section 4.3.4, we discuss the determinants of the entrepreneur's decision to reform the firm.

4.3.1 Entrepreneur with a Green Firm

Assume that the entrepreneur reduces the social cost of production and therefore owns a green firm. As discussed in Section 4.1, the entrepreneur's expected discounted utility when she owns the firm, $V^1(c_L)$, solves (5), that is,

$$V^1(c_L) = \frac{\pi - \gamma c_L}{1-\beta} + \frac{\beta}{1-\beta}\frac{N_s}{N}\max\left\{0, P_s(c_L) - \Delta V_s(c_L)\right\}.$$

[11] Note that the same outcome obtains if the entrepreneur has no access to the financial market.

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

$$\Delta V_s(c_L) = V^1(c_L) - V_s^0 \geq \frac{\pi - \gamma c_L}{1-\beta} + \frac{\gamma c_L}{1-\beta} = \frac{\pi}{1-\beta}.$$

The change in the entrepreneur's expected discounted utility from giving up ownership of the firm is larger than or equal to the discounted profits because the social cost of production is unaffected by a transfer of ownership.

The discounted utility of a socially responsible investor when he acquires the firm is given by $Z_s^1(c_L) = \frac{\pi-\lambda c_L}{1-\beta}$. Since the per-period utility of a socially responsible investor when the entrepreneur owns the firm is equal to $-\lambda c_L$, (6) implies that $Z_s^0(c_L) \geq -\frac{\lambda c_L}{1-\beta}$. As a result, we get $\Delta Z_s(c_L) = Z_s^1(c_L) - Z_s^0(c_L) \leq \frac{\pi}{1-\beta}$, that is, a socially responsible investor will at most pay a price equal to the discounted profits to acquire the firm. Since $\Delta V_s(c_L) \geq \frac{\pi}{1-\beta}$, this implies that the trading surplus $\Delta Z_s(c_L) - \Delta V_s(c_L)$ is nonpositive. As a result, there are no gains from trade and the entrepreneur does not sell the firm if she meets a socially responsible investor.

Intuitively, there are no gains from trade if the entrepreneur with a green firm meets a socially responsible investor because the entrepreneur and the socially responsible investor value profits equally and incur the disutility from the social cost of production regardless of ownership. Importantly, since the firm is already green, a socially responsible investor does not affect the social cost of production when acquiring the firm.

Anticipating that she is not going to sell the firm to a financial investor or to a socially responsible investor if she reforms the firm in period $t = 0$, the entrepreneur's discounted utility from reforming the firm is given by $V^1(c_L) - \kappa = \frac{\pi-\gamma c_L}{1-\beta} - \kappa$.

4.3.2 Entrepreneur with a Dirty Firm

Assume that the entrepreneur does not reduce the social cost of production and therefore owns a dirty firm. As discussed in Section 4.1, the entrepreneur's expected discounted utility when she

owns the firm, $V^1(c_H)$, solves (5), that is,

$$V^1(c_H) = \frac{\pi - \gamma c_H}{1-\beta} + \frac{\beta}{1-\beta}\frac{N_s}{N}\max\left\{0, P_s(c_H) - \Delta V_s(c_H)\right\}.$$

Recall that since 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 $V_s^0 = -\frac{\gamma c_L}{1-\beta}$. In Section 4.3.1, the entrepreneur reforms the firm herself and a change in ownership therefore does not affect the social cost of production. In contrast, if the entrepreneur does not reform the firm, then a change in ownership reduces the social cost of production if a socially responsible investor acquires the firm. Therefore, if $\gamma > 0$, the acquisition by a socially responsible investor reduces the entrepreneur's disutility due to the social cost. Taken together, we get

$$\Delta V_s(c_H) = \frac{\pi}{1-\beta} - \frac{\gamma(c_H - c_L)}{1-\beta} + \frac{\beta}{1-\beta}\frac{N_s}{N}\max\left\{0, P_s(c_H) - \Delta V_s(c_H)\right\}. \tag{7}$$

Suppose that there are positive 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 $Z_s^1(c_H) - P_s(c_H) = Z_s^0(c_H)$, the expected discounted utility of a given socially responsible investor when he does not own the firm, given by (6), can then be written as

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

which yields

$$Z_s^0(c_H) = -\frac{\lambda c_L}{1-\beta} - \frac{\lambda(c_H - c_L)}{1-\beta\left(1 - \frac{N_s - 1}{N}\right)}. \tag{8}$$

If $N_s = 1$, there is only one socially responsible investor who can acquire the firm and reform it. Since the entrepreneur makes a take-it-or-leave-it offer to the investor and therefore captures the whole trading surplus, that investor's expected discounted utility when the entrepreneur owns the firm is given by $Z_s^0(c_H) = -\frac{\lambda c_H}{1-\beta}$. If $N_s > 1$, then the expected discounted utility of a given socially responsible investor when the entrepreneur owns the firm increases such that $Z_s^0(c_H) > -\frac{\lambda c_H}{1-\beta}$. The reason is that even if a given socially responsible investor does not acquire and reform the firm, another socially responsible investor will, which benefits all socially responsible investors.

Using $Z_s^1(c_H) = \frac{\pi - \lambda c_L}{1-\beta} - \kappa$, we get

$$P_s(c_H) = \Delta Z_s(c_H) = Z_s^1(c_H) - Z_s^0(c_H) = \frac{\pi}{1-\beta} + \frac{\lambda(c_H - c_L)}{1-\beta\left(1 - \frac{N_s - 1}{N}\right)} - \kappa. \tag{9}$$

We can show that the trading surplus when the entrepreneur meets a socially responsible investor is positive if the pro-social preference parameter of socially responsible investors, λ, is sufficiently high. Formally, we establish the following proposition.

Proposition 1. *There exist values $V^1(c_H)$ and $Z_s^0(c_H)$ and an acquisition price $P_s(c_H)$ satisfying the equilibrium conditions* (2)*,* (5)*, and* (6) *if and only if*

$$\lambda > (\eta_1 - \gamma)\frac{1-\beta\left(1 - \frac{N_s - 1}{N}\right)}{1-\beta}, \tag{10}$$

where $\eta_1 = (1-\beta)\frac{\kappa}{c_H - c_L}$ is defined in Assumption 1. If condition (10) *is satisfied, then the trading surplus when the entrepreneur with a dirty firm meets a socially responsible investor, $\Delta Z_s(c_H) - \Delta V_s(c_H)$, is positive, the entrepreneur sells the firm when she meets a socially responsible investor, and the acquisition price $P_s(c_H)$ is given by* (9)*.*

Proposition 1 establishes that equilibrium values $V^1(c_H)$ and $Z_s^0(c_H)$ and an acquisition price $P_s(c_H)$ exist if condition (10) is satisfied.[12] If $\gamma \geq \eta_1$, then condition (10) is always satisfied. If $\gamma < \eta_1$, then condition (10) is satisfied as long as the pro-social preference parameter of socially responsible investors, λ, is sufficiently high. Henceforth, we make the following assumption:

Assumption 2. *Condition* (10) *is satisfied.*

Proposition 1 further shows that if condition (10) is satisfied, there are gains from trade when the entrepreneur meets a socially responsible investor. As in Section 4.3.1, there are no gains from trade in terms of agents' valuation of profits. However, in contrast to Section 4.3.1, the entrepreneur has not reduced the social cost of production. Therefore, there are gains from trade because socially responsible investors reduce the social cost of production after acquiring the firm.

[12] 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 condition (10) does not hold, asymmetric equilibria in which a subset of socially responsible investors acquire a dirty firm upon meeting the entrepreneur can exist.

In particular, the higher the pro-social preference parameter of socially responsible investors λ, the higher the acquisition price $P_s(c_H)$. Intuitively, a socially responsible investor who is more concerned about the social cost of production has a higher willingness to pay to acquire the firm to reform it.

The acquisition price $P_s(c_H)$ is decreasing in the number of socially responsible investors N_s (and hence in the proportion of socially responsible investors in the financial market) because of a free-rider problem between socially responsible investors. 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. Increasing the number of socially responsible investors increases the likelihood that another socially responsible investor acquires the firm and pays the reform cost. This increases the expected discounted utility of any socially responsible investor when not owning the firm, which in turn reduces the willingness to pay for a dirty firm when meeting the entrepreneur. 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.

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

$$\frac{\pi}{1-\beta} - \kappa - P_s(c_H) = -\frac{\lambda(c_H - c_L)}{1-\beta\left(1-\frac{N_s-1}{N}\right)} < 0. \tag{11}$$

Anticipating that she is going to sell the firm only to a socially responsible investor if she does not reform the firm, the entrepreneur's expected discounted utility from not reforming the firm is given by

$$V^1(c_H) = \frac{\pi - \gamma c_H}{1-\beta} + \frac{\beta}{1-\beta}\frac{N_s}{N}\left(P_s(c_H) - \Delta V_s(c_H)\right). \tag{12}$$

4.3.3 Entrepreneur's Choice of the Social Cost of Production

Given the trading behavior in the financial market, we can study whether the entrepreneur reduces the social cost of production. Section 4.3.1 shows that if the entrepreneur reforms the firm, there are no gains from trade, the entrepreneur does not sell the firm to an investor—financial or socially

responsible—and her discounted utility is given by $V^1(c_L) - \kappa = \frac{\pi - \gamma c_L}{1-\beta} - \kappa$. Section 4.3.2 shows that if the entrepreneur does not reform the firm, then there are gains from trade in the financial market when the entrepreneur meets a socially responsible investor. In this case, the entrepreneur's expected discounted utility is given by (12). Thus, the entrepreneur reduces the social cost of production in period $t = 0$ if and only if $V^1(c_L) - \kappa \geq V^1(c_H)$, that is, if and only if

$$\frac{\pi - \gamma c_L}{1-\beta} - \kappa \geq \frac{\pi - \gamma c_H}{1-\beta} + \frac{\beta}{1-\beta} \frac{N_s}{N} \left(P_s(c_H) - \Delta V_s(c_H) \right). \tag{13}$$

In particular, the entrepreneur's decision to reform the firm depends on the trading surplus $P_s(c_H) - \Delta V_s(c_H) = \Delta Z_s(c_H) - \Delta V_s(c_H)$, which arises endogenously in the financial market.

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

$$\gamma \geq \eta_1 + \lambda \frac{\beta \frac{N_s}{N}}{1 - \beta \left(1 - \frac{N_s - 1}{N} \right)} =: \eta_2, \tag{14}$$

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

The main takeaway from Proposition 2 is that the presence of socially responsible investors in the financial market can lead to a delay in the reduction of the social cost of production. Specifically, the entrepreneur reforms the firm if and only if condition (14) is satisfied. Recall from Section 4.2 that if the financial market is populated only by financial investors, the entrepreneur reduces the social cost of production if and only if $\gamma \geq \eta_1$. This 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 $[\eta_1, \eta_2)$ 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 and meets a socially responsible investor. Importantly, these trading gains arise only 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 incentives to reform the firm.

To generate strategic delay in reform by the entrepreneur in the two-period example from Section 2, we require that γ is lower than λ. In the infinite horizon model, strategic delay can arise

even if γ is larger than λ. The reason is that, with an infinite horizon, the entrepreneur will meet another socially responsible investor in the future if she does not trade with a socially responsible investor in a given period. Thus, even if $\gamma = \lambda$, the entrepreneur has a higher continuation value compared with that of a socially responsible investor, who owns the firm forever once he acquires it and therefore has no option to sell it in the future.

4.3.4 Determinants of the Entrepreneur's Choice of the Social Cost of Production

In this section, we study how the characteristics of socially responsible investors—their pro-social preference parameter λ and their number N_s—affect the size of the strategic delay region $[\eta_1, \eta_2)$.

Corollary 1. *The threshold η_1 does not depend on λ or N_s. The threshold η_2 increases in λ, and increases in N_s if and only if $N > \frac{\beta}{1-\beta}$.*

Surprisingly, Corollary 1 implies that making the financial market more pro-social can actually increase the strategic delay region. Interestingly, while the effect of making a given set of socially responsible investors more socially responsible by increasing λ always increases the strategic delay region, increasing the number of socially responsible investors while keeping the strength of their pro-social preferences fixed may increase or decrease the strategic delay region.

More specifically, Corollary 1 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 the firm after an acquisition, which allows the entrepreneur to extract more value from socially responsible investors if she keeps the firm dirty. In turn, this means that the entrepreneur has weaker incentives to reduce the social cost of production herself.

Corollary 1 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 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. On the one hand, 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 4.3.2. From the perspective of a given socially responsible investor, a higher N_s makes it more likely that another socially responsible investor will acquire the firm and incur the cost of reforming it. As a result, a given socially responsible investor is less willing to acquire the firm himself, which reduces the price he is willing to pay for a dirty firm. This force pushes η_2 down and reduces the size of the strategic delay region.

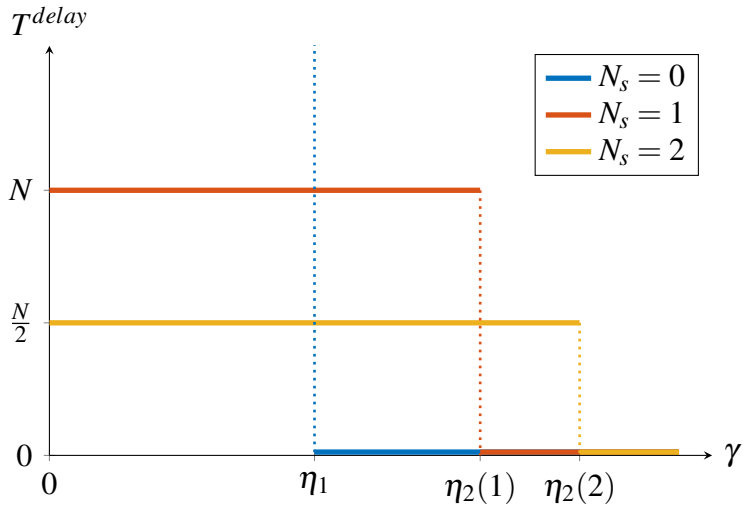
In addition to the size of the strategic delay region, the number of socially responsible investors, N_s, also affects the expected delay in the reduction of the social cost of production. Specifically, if the entrepreneur does not reform the firm, the expected delay in the reform of the firm is given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

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

Note that the minimum delay is one period if $N_s = N$. In this case, the entrepreneur meets a socially responsible investor in period $t = 1$ with probability 1. Not surprisingly, 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, for three values of N_s. In the absence of socially responsible investors ($N_s = 0$), an entrepreneur with $\gamma \geq \eta_1$ reduces the social cost of production in period $t = 0$. However, an entrepreneur with $\gamma < \eta_1$ never reduces the social cost of production such that $T^{delay} = \infty$. With a single socially responsible investor in the financial market ($N_s = 1$), any dirty firm is eventually acquired by this investor and the expected delay is finite. However, the presence of a socially responsible investor incentivizes an entrepreneur with $\gamma \in [\eta_1, \eta_2(1))$ to not reform the firm herself and instead sell a dirty firm when she meets a socially responsible investor, where $\eta_2(1)$ denotes the threshold (14) when $N_s = 1$. If $\gamma < \eta_2(1)$, then the expected delay is equal to N. Finally, as long as $N > \frac{\beta}{1-\beta}$, a further increase in N_s increases the strategic delay region but also shortens the expected delay 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 (14) from Proposition 2 as a function of the number of socially responsible investors N_s.

5 Investment Mandates

In this section, we seek to understand whether investment mandates can induce the entrepreneur to reform the firm immediately and thereby implement zero delay. The entrepreneur's incentive to reform the firm is not only determined by the strength of her pro-social preferences but also by the relative prices for a green and a dirty firm in the financial market. The key problem we highlight in Section 4 is that the price for a dirty firm can be too high in the presence of socially responsible investors, which can induce strategic delay of reform by the entrepreneur. Thus, correcting the entrepreneur's incentive to reform the firm requires a mechanism that allows socially responsible investors to alter the trading behavior as a function of the firm's status—green or dirty. As such, there are two natural candidates for such mechanisms in our model: a commitment by socially responsible investors to not trade with the entrepreneur as a function of the firm's status, and a commitment to a pre-set price for the firm as a function of the firm's status. We refer to the former as an exclusionary investment mandate and study it in Section 5.1, and to the latter as a price commitment investment mandate and study it in Sections 5.2 and 5.3.

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, the investment mandate must be individually rational ex ante in the sense that no socially responsible investor has an incentive to deviate to not adopting the investment mandate.[13] After the adoption of an investment mandate, the model proceeds as described in Section 3 subject to the changes due to the investment mandate. In particular, 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 practice, socially responsible investors typically outline specific objectives of their investment strategies ex ante, similar to the notion of investment mandates we adopt in this paper. For example, 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.

While we study the existence of investment mandates that induce the entrepreneur to reform the firm immediately, we do not explicitly model the entity that proposes the investment mandate. Since we require that the investment mandate is individually rational, any of the socially responsible investors would be willing to propose such an investment mandate. 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 aiming to minimize delay in the firm's reform. However, the social planner cannot force individual socially responsible investors to adopt the investment mandate and hence has to respect their individual rationality constraints. For example, the UN 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 adopt the UN Principles for Responsible Investment, but it is not a mandatory regulatory framework socially responsible investors have to adopt. The design of such principles therefore has to take into account the willingness of individual investors to adopt these principles. In addition, adopting the internationally-recognized UN Principles for Responsi-

[13] 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 investment mandate. Our main results hold if we allow for these more general deviations.

ble Investment may allow socially responsible investors to publicly demonstrate their commitment to certain investment strategies. Deviating from those principles ex post may result in exclusion from a signatory list which can be reputationally damaging for socially responsible investors.

5.1 Exclusionary Investment Mandate

In this section, we consider an exclusionary investment mandate through which socially responsible investors 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, then the entrepreneur cannot sell the firm to a socially responsible investor at any price if they meet in the financial market. 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 incentives. 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 3. *If $\gamma \in [0, \eta_1)$, then 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 $\gamma \in [\eta_1, \eta_2)$, then 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 3 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 the gains from trade that arise in this case. 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, the dirty firm is eventually acquired by a socially responsible investor and reformed. Since 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.

Note that 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 commit to offer 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. 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 4. *If $\gamma \in [0, \eta_2)$, then there exists an individually rational investment mandate with price commitment through which socially responsible investors commit to pay 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 4 establishes that if $\gamma \in [0, \eta_2)$, socially responsible investors adopt an investment

mandate through which they commit to offer a price for a green firm that is greater 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.[14] Recall from Section 4.3.1 that in the absence of an investment mandate, the price a socially responsible investor would be willing to pay for a green firm is lower than or equal to $\frac{\pi}{1-\beta}$, which is not sufficient to induce the entrepreneur with $\gamma \in [0, \eta_2)$ to reform the firm. In particular, if $\gamma \in [\eta_1, \eta_2)$, the entrepreneur strategically delays the firm's reform. The problem 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 incentives 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 such an investment mandate would be adopted in equilibrium because paying a premium for a green firm is costly for socially responsible investors. 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 that socially responsible investors must commit to for a green firm to induce the entrepreneur to reform the firm. Importantly, 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. Since socially responsible investors incur an additional disutility from this delay in each period in which the firm is dirty, they find it individually rational to commit to the investment mandate even though offering a premium is costly. Intuitively, socially responsible investors prefer to commit to a high price for a green firm ex ante to avoid the cost of delay rather than paying for a dirty firm later and suffering from a high social cost until an acquisition by a socially responsible investor.

Notably, the equilibrium with a price commitment investment mandate from Proposition 4 differs from the equilibrium without investment mandates in Section 4 in terms of the behavior of entrepreneurs and socially responsible investors. In the equilibrium without investment mandates, socially responsible investors only acquire a dirty firm but do not acquire a green firm. In the equi-

[14] Note that this is equivalent to an investment mandate with price commitment through which socially responsible investors also commit to a sufficiently low price $\tilde{P}_H$ for a dirty firm.

librium with investment mandates with price commitment, socially responsible investors acquire a green firm at a premium over the discounted profits.

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 33% of impact investors are "below-market-rate" investors explicitly expecting lower financial returns to achieve impact goals (GIIN, 2020). Interestingly, the investment mandate adopted by socially responsible investors is observationally similar to the investment strategy of an investor who receives a positive utility (a "warm glow") from investing in green firms. Some researchers have raised concerns that this type of "narrow" strategy 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, 2020; Oehmke and Opp, 2020). While a concern in their setting, in our model such a "narrow" strategy is optimal for investors who care about broad impact because it can incentivize current owners to turn their firms green proactively. An interesting implication is that "naive" socially responsible investors, who receive a warm glow from investing in green firms but do not internalize the broader impact of their actions, may unintentionally create demand pressure and increase market prices for green assets, which may help support timely impact.

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

$$\frac{\pi}{1-\beta} - \tilde{P}_L = -\frac{c_H - c_L}{\beta \frac{N_s}{N}} (\eta_2 - \gamma) < 0. \tag{15}$$

As shown in Section 4.3.2, in the absence of investment mandates, a socially responsible investor also incurs a financial loss if he acquires a dirty firm and reforms it. The financial loss that socially responsible investors incur in the presence of investment mandates, given by (15), is lower than that in the absence of investment mandates, given by (11), 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

cost of delay incurred by socially responsible investors. In particular, Proposition 4 implies that this utility gain always exceeds the potentially higher financial loss.

5.3 Price Commitment Investment Mandate: Multiple Entrepreneur Types

Proposition 4 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 because the price can be chosen such that the entrepreneur is just indifferent between reforming and not reforming the firm. Intuitively, the investment mandate can be tailored to the specific entrepreneur 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.

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 $\gamma = \gamma_h > 0$.[15] 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 or a dirty firm, respectively, but cannot condition these prices on the entrepreneur's type $\gamma \in \{0, \gamma_h\}$.

Proposition 4 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

$$\tilde{P}_L(\gamma) = \frac{\pi}{1-\beta} + \frac{c_H - c_L}{\beta \frac{N_s}{N}} (\eta_2 - \gamma). \tag{16}$$

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

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 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. Intuitively, in contrast to the low-γ entrepreneur type, 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 sufficient incentives to reform it.

Corollary 2. *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 pay the price $\tilde{P}_L(\gamma_h)$ for a green firm, where $\tilde{P}_L(\gamma)$ is defined in* (16) *and η_2 is defined in Proposition 2, that induces only the high-γ entrepreneur to reform the firm in period $t = 0$.*

If $\gamma_h \geq \eta_2$, then the high-γ entrepreneur reforms the firm herself even in the presence of socially responsible investors and there is no need for an investment mandate that targets the high-γ entrepreneur. We therefore consider the case $\gamma_h < \eta_2$ in Corollary 2. Corollary 2 follows from Proposition 4 and establishes that there always exists an investment mandate with price commitment that induces at least the high-γ entrepreneur to reform the firm. Intuitively, socially responsible investors do not need to overpay to incentivize only the high-γ entrepreneur to reform the firm. Consequently, similar to Proposition 4, it is always individually rational to induce at least such an entrepreneur to reform the firm immediately.

Proposition 5. *Consider an investment mandate with price commitment through which socially responsible investors commit to pay the price $\tilde{P}_L(0)$ for a green firm, where $\tilde{P}_L(\gamma)$ is defined in* (16)*, 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 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 5 characterizes when socially responsible investors adopt an investment mandate that induces both entrepreneur types to reform the firm. In particular, they will not always find it optimal to do so. 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 a 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. Intuitively, if both entrepreneur types switch to not reforming the firm, then this generates a high cost of delay for socially responsible investors and the price commitment investment mandate is always individually rational in this case.

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 a 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 a 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 effect dominates therefore depends on the probability of drawing a low-γ entrepreneur, w_0. If the probability of drawing a low-γ entrepreneur is high, incurring the cost of delay due to the deviation

outweighs the benefit of saving on paying the premium.

Finally, we discuss how 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 5.

Corollary 3. *$\bar{\gamma}$ 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 3 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. Intuitively, an increase in the strength of socially responsible investors' pro-social preferences increases the likelihood that socially responsible investors adopt the investment mandate. The reason is that a higher λ implies a higher cost of delay in reform for socially responsible investors, 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 Corollary 1, which shows that, in the absence of investment mandates, the problem of strategic delay in reform worsens 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 incentives 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 pay a premium for a green firm to avoid any delay in reform.

Corollary 3 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 that induces both entrepreneur types to reform the firm is individually rational. Intuitively, an increase in the share of socially responsible investors in the financial market may increase or decrease the likelihood that socially responsible investors adopt the investment mandate. 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 deviation incentive. In other words, 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.[16] 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 Concluding Remarks

The speed at which firms reduce negative externalities is crucially important in light of climate change. Scientists have argued that greenhouse gas emissions must be reduced as quickly as possible to avoid potentially catastrophic consequences. Motivated by the urgency of this issue, we study the pace at which socially responsible investors can induce firms to reduce negative externalities. To the best of our knowledge, we are the first to study the pace at which socially responsible investors can impact firms.

Our key insight is that the presence of socially responsible investors with broad pro-social preferences can cause a delay in reforming firms. Investment mandates through which investors can commit to paying a premium for green firms can resolve this delay and can speed up the process of turning firms green. Our analysis can rationalize the widespread adoption of investment mandates by socially responsible investors.

Our paper has implications for the appropriate definition and measurement of "impact" in financial markets. In particular, socially responsible investors who employ positive or negative screening when choosing which firms to invest in but who do not try to create additional positive change post investment are typically not considered "impact investors" (GIIN, 2020). Our research

[16] By plugging η_2 from (14) into $\tilde{P}_L(\gamma)$ defined in (16), it is straightforward to derive that $\tilde{P}_L(0)$ decreases in N_s.

suggests that only focusing on impact post investment can in fact generate delays in firm reform. In our paper, the best and quickest way for socially responsible investors to have impact is to commit to acquiring firms that are already green at a premium. This investment strategy incentivizes current owners to make their firms green before they are acquired by socially responsible investors. All of the measurable improvement in the firm will therefore happen before the investment rather than after. Our results imply that focusing on post-transaction impact only provides a partial picture of the impact socially responsible investors can generate. In addition, it is important to consider how socially responsible investors affect market prices for green and dirty firms because market prices in turn affect the incentives of current owners to reform their firms.

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A Proofs

A.1 Proof of Proposition 1

Using the fact that the entrepreneur makes a take-it-or-leave-it price offer such that $Z_s^1(c_H) - P_s(c_H) = Z_s^0(c_H)$, the socially responsible investor's expected discounted utility solves

$$Z_s^0(c_H) = -\lambda c_H + \beta \left(\frac{1}{N} Z_s^0(c_H) - \frac{N_s - 1}{N} \mathbb{1}_{\{P_s(c_H) > \Delta V_s(c_H)\}} \frac{\lambda c_L}{1-\beta} + \left(\frac{N_s - 1}{N} \mathbb{1}_{\{P_s(c_H) \leq \Delta V_s(c_H)\}} + \frac{N_f}{N} \right) Z_s^0(c_H) \right), \quad (17)$$

where $\Delta V_s(c_H)$ solves (7). We can solve (17) for $Z_s^0(c_H)$ and get

$$Z_s^0(c_H) = \frac{1}{1 - \beta \left(1 - \frac{N_s - 1}{N} \mathbb{1}_{\{P_s(c_H) > \Delta V_s(c_H)\}} \right)} \left(-\lambda c_H - \frac{N_s - 1}{N} \mathbb{1}_{\{P_s(c_H) > \Delta V_s(c_H)\}} \frac{\beta \lambda c_L}{1-\beta} \right).$$

Using $Z_s^1(c_H) = \frac{\pi - \lambda c_L}{1-\beta} - \kappa$, we get

$$P_s(c_H) = \Delta Z_s(c_H) = Z_s^1(c_H) - Z_s^0(c_H) = \frac{\pi}{1-\beta} + \frac{\lambda (c_H - c_L)}{1 - \beta \left(1 - \frac{N_s - 1}{N} \mathbb{1}_{\{P_s(c_H) > \Delta V_s(c_H)\}} \right)} - \kappa. \quad (18)$$

Note that an equilibrium exists if there exist $P_s(c_H)$ and $\Delta V_s(c_H)$ that satisfy (7) and (18). We first show that there does not exist a solution to (7) and (18) satisfying $P_s(c_H) \leq \Delta V_s(c_H)$. Assume instead that there exists a solution satisfying $P_s(c_H) \leq \Delta V_s(c_H)$. Then we get

$$P_s(c_H) = \frac{\pi}{1-\beta} + \frac{\lambda (c_H - c_L)}{1-\beta} - \kappa, \quad (19)$$

and

$$\Delta V_s(c_H) = \frac{\pi}{1-\beta} - \frac{\gamma (c_H - c_L)}{1-\beta}. \quad (20)$$

Equations (19) and (20) imply that $P_s(c_H) \leq \Delta V_s(c_H) \Leftrightarrow \lambda \leq \eta_1 - \gamma$, contradicting Assumption 1.

We next show that there exists a solution to (7) and (18) satisfying $P_s(c_H) > \Delta V_s(c_H)$ if and only if condition (10) holds. Assume there exists a solution to (7) and (18) satisfying $P_s(c_H) > \Delta V_s(c_H)$.

That is, there exist $P_s(c_H)$ and $\Delta V_s(c_H)$ satisfying

$$P_s(c_H) = \frac{\pi}{1-\beta} + \frac{\lambda(c_H - c_L)}{1-\beta\left(1-\frac{N_s-1}{N}\right)} - \kappa, \tag{21}$$

and

$$\Delta V_s(c_H) = \frac{\pi}{1-\beta} - \frac{\gamma(c_H - c_L)}{1-\beta} + \frac{\beta}{1-\beta}\frac{N_s}{N}(P_s(c_H) - \Delta V_s(c_H)), \tag{22}$$

and $P_s(c_H) > \Delta V_s(c_H)$. Since (21) and (22) are two linear equations in $P_s(c_H)$ and $\Delta V_s(c_H)$, we can solve for $P_s(c_H)$ and $\Delta V_s(c_H)$. Simple algebra implies that $P_s(c_H) > \Delta V_s(c_H)$ if and only if (10) holds. ■

A.2 Proof of Proposition 2

Using (21) and (22) from the proof of Proposition 1, simple algebra implies that condition (13) is equivalent to condition (14). ■

A.3 Proof of Corollary 1

Differentiating η_2, given by (14), 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. ■

A.4 Proof of Proposition 3

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 commit to 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. Thus, an exclusionary investment mandate cannot induce the entrepreneur to reform the firm in period $t = 0$.

Consider next the case in which $\gamma \in [\eta_1, \eta_2)$. If socially responsible investors commit to 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 and enters the financial market. Since 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 (14) for $\bar{N}_s = 1$ and $\bar{N} = N_f + 1$. Note that condition (10) is always satisfied in this case because $\bar{N}_s = 1$. Using (21), the expected discounted utility of the socially responsible investor is given by

$$Z_s^0(c_H) = Z_s^1(c_H) - \Delta Z_s(c_H) = \frac{\pi - \lambda c_L}{1-\beta} - \kappa - P_s(c_H) = -\frac{\lambda c_H}{1-\beta}.$$

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. ■

A.5 Proof of Proposition 4

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 $t = 0$, which we denote by $\tilde{P}_L$, and show that this price is accepted by the entrepreneur in equilibrium. 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 accept the offer, 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

$$\hat{V}^1 = \pi - \gamma c_L + \beta \left(\frac{N_s}{N} \mathbb{1}_{\left\{P_L - \frac{\gamma c_L}{1-\beta} > V^b\right\}} \left(P_L - \frac{\gamma c_L}{1-\beta} \right) + \frac{N_s}{N} \mathbb{1}_{\left\{P_L - \frac{\gamma c_L}{1-\beta} \leq V^b\right\}} V^b + \left(1 - \frac{N_s}{N}\right) \hat{V}^1 \right), \quad (23)$$

where

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

Two cases are possible.

Case 1: $P_L - \frac{\gamma c_L}{1-\beta} \leq V^b$ In this case, the pre-bargaining offer P_L is never accepted in equilibrium. This is the model of Section 4.3.1. As shown in Section 4.3.1, there are no trading gains if the entrepreneur meets a socially responsible investor such that $V^b = \hat{V}^1$. Plugging this into (23), we obtain $\hat{V}^1 = \frac{\pi-\gamma c_L}{1-\beta}$. As a result, the condition for this case is $P_L \leq \frac{\pi}{1-\beta}$, which contradicts our premise that $P_L > \frac{\pi}{1-\beta}$.

Case 2: $P_L - \frac{\gamma c_L}{1-\beta} > V^b$ In this case, (23) simplifies to

$$\hat{V}^1 = \pi - \gamma c_L + \beta \left(\frac{N_s}{N} \left(P_L - \frac{\gamma c_L}{1-\beta} \right) + \left(1 - \frac{N_s}{N} \right) \hat{V}^1 \right). \tag{24}$$

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

$$\hat{Z}_s^0 = -\lambda c_L + \beta \left(\frac{1}{N} \left(-P_L + \frac{\pi - \lambda c_L}{1-\beta} \right) + \frac{N_s - 1}{N} \left(-\frac{\lambda c_L}{1-\beta} \right) + \left(1 - \frac{N_s}{N} \right) \hat{Z}_s^0 \right). \tag{25}$$

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

$$\hat{V}^1 + \frac{\gamma c_L}{1-\beta} < P_{sg} = \frac{\pi - \lambda c_L}{1-\beta} - \hat{Z}_s^0.$$

Plugging (24) and (25) 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 trading gains if the entrepreneur makes a take-it-or-leave-it offer to a socially responsible investor. As a result, $V^b = \hat{V}^1$. Under (24), the condition of this case becomes

$$P_L - \frac{\gamma c_L}{1-\beta} > \hat{V}^1 \Leftrightarrow P_L > \frac{\pi}{1-\beta}.$$

Step 2 In the second step, we use the results of Step 1 to derive a minimum possible P_L, denoted by $\tilde{P}_L$, such that the entrepreneur is willing to reform the firm in period $t = 0$.

Consider an entrepreneur with $\gamma \in [0, \eta_2)$. If the entrepreneur does not reform the firm, her expected discounted utility is equal to $V^1(c_H)$, given by (12). 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 $\hat{V}^1$, given by (24). Therefore, the entrepreneur reforms the firm in period $t = 0$ if and only if

$$\hat{V}^1 - \kappa \geq V^1(c_H).$$

Using expressions (12), (21) and (22), it is straightforward to simplify this inequality to

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

Since $\gamma < \eta_2$, $\tilde{P}_L > \frac{\pi}{1-\beta}$, 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 $Z_s^0(c_H)$ given by (8). If instead none of the socially responsible investors deviates, then the expected discounted utility of a given socially responsible investor is $\hat{Z}_s^0$ given by (25). Thus, an individual socially responsible investor does not deviate if $\hat{Z}_s^0 \geq Z_s^0(c_H)$, 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. ■

A.6 Proof of Corollary 2

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 4 it follows that such a deviation is not profitable. ■

A.7 Proof of Proposition 5

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

$$\hat{V}^1\left(N_s-1,\tilde{P}_L(0),\gamma_h\right)-\kappa\geq V^1\left(N_s,\gamma_h\right), \tag{26}$$

where $\hat{V}^1\left(N_s,P_L,\gamma_h\right)$ 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 N_s socially responsible investors. It is implicitly given by (24). $V^1\left(N_s,\gamma_h\right)$, defined in (12), is the expected discounted utility that the high-γ entrepreneur gets from selling the dirty firm in the financial market populated by N_s socially responsible investors.

Using (24), we obtain

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

where κ is expressed using the definition of η_1 given in Assumption 1. Plugging (21) and (22) in (12), we obtain

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

Using the two expressions above, the inequality (26) can be rewritten as

$$\gamma_h \geq \bar{\gamma} := \frac{1}{N_s} \frac{1-\beta}{1-\beta\left(1-\frac{N_s-1}{N}\right)} \eta_2. \tag{27}$$

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

$$w_0 Z_s^0(c_H) + (1-w_0)\left(-\frac{\lambda c_L}{1-\beta}\right) \leq \hat{Z}_s^0\left(\tilde{P}_L(0)\right). \tag{28}$$

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 $Z_s^0(c_H)$ given by (8). 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 (28) is the expected discounted utility of each socially responsible investor if they all adopt the proposed investment mandate. $\hat{Z}_s^0\left(\tilde{P}_L\right)$ is implicitly defined by (25). Using the definitions of $Z_s^0(c_H)$ and $\hat{Z}_s^0\left(\tilde{P}_L\right)$, we can simplify (28) to

$$w_0 \geq \bar{w}_0 := \frac{\beta\frac{1}{N}}{1-\beta\left(1-\frac{N_s}{N}\right)} + \frac{1}{N_s}\frac{1-\beta\left(1-\frac{N_s-1}{N}\right)}{1-\beta\left(1-\frac{N_s}{N}\right)}\frac{1}{\lambda}\eta_1. \tag{29}$$

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

Case 2: Deviation can induce the high-γ entrepreneur to not reform the firm Suppose now that the deviation by an individual socially responsible investor can induce the high-γ entrepreneur to not reform the firm. This is case if $\gamma_h < \bar{\gamma}$, where $\bar{\gamma}$ is defined in (27). 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 $Z_s^0(c_H) \leq \hat{Z}_s^0\left(\tilde{P}_L(0)\right)$, which simplifies to $\lambda \geq \frac{1}{N_s}\eta_1$. By Assumption 1, this inequality holds.

Existence of 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 pay $P_L < \tilde{P}_L(0)$ for a green firm, then the low-γ entrepreneur does not reform the firm at $t = 0$.

Suppose that socially responsible investors commit to pay $P_L > \tilde{P}_L(0)$ for a green firm. In this case, (26) becomes

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

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 (27). Therefore, if $\gamma_h \geq \bar{\gamma}$, a deviation by an individual socially responsible investor cannot 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 (28) becomes

$$w_0 Z_s^0(c_H) + (1 - w_0)\left(-\frac{\lambda c_L}{1-\beta}\right) \leq \hat{Z}_s^0(P_L).$$

This inequality can be rewritten as $w_0 \geq \bar{w}_0(P_L)$, 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 (29). 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. ■

A.8 Proof of Corollary 3

The threshold $\bar{\gamma}$ is given by (27). Plugging in η_2 defined by (14), 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, $\gamma(\lambda, N_s)$ increases in λ and decreases in N_s.

The threshold $\bar{w}_0$ is given by (29). 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, $\lambda > \eta_1$, so $\frac{\partial \bar{w}_0}{\partial N_s} < 0$. ■

B Extension to Recurring Reform Option

In this appendix, 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 $t \in \mathbb{N}_0$. Note that as in Section 4.3.2, 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. In addition, 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

$$V^1(c_H) = \max\left\{\frac{\pi-\gamma c_L}{1-\beta} - \kappa, \pi - \gamma c_H + \beta V^{1,pre}(c_H)\right\}. \tag{30}$$

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.

$V^{1,pre}(c_H)$ is given by

$$V^{1,pre}(c_H) = \frac{N_s}{N} \max\left\{ -\frac{\gamma c_L}{1-\beta} + P_s(c_H), V^1(c_H) \right\} + \left(1 - \frac{N_s}{N}\right) V^1(c_H). \tag{31}$$

If the entrepreneur meets a socially responsible investor, she sells a dirty firm for the price $P_s(c_H)$, anticipating that it will be reformed immediately if and only if this generates a higher expected discounted utility than $V^1(c_H)$.

We consider two cases.

Case 1: $\frac{\pi-\gamma c_L}{1-\beta} - \kappa \geq \pi - \gamma c_H + \beta V^{1,pre}(c_H)$ In this case, the entrepreneur's expected discounted utility from owning a dirty firm after entrepreneur-investor meetings, given (30), yields

$$V^1(c_H) = \frac{\pi - \gamma c_L}{1-\beta} - \kappa.$$

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

$$-\frac{\gamma c_L}{1-\beta} + P_s(c_H) > V^1(c_H) \Leftrightarrow P_s(c_H) > \frac{\pi}{1-\beta} - \kappa. \tag{32}$$

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

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

Since 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

$$Z_s^0(c_H) = -\lambda c_L + \beta Z_s^0(c_H).$$

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

$$\frac{\pi-\lambda c_L}{1-\beta}-\kappa-P_s(c_H)\geq Z_s^0(c_H)\Leftrightarrow P_s(c_H)\leq\frac{\pi}{1-\beta}-\kappa,$$

which contradicts (32). Therefore, there are no grains from trade if a socially responsible investor meets the entrepreneur with a dirty firm. As a result, (31) yields

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

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

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

Case 2: $\frac{\pi-\gamma c_L}{1-\beta}-\kappa<\pi-\gamma c_H+\beta V^{1,pre}(c_H)$ In this case, the expected discounted utility of the entrepreneur owning a dirty firm after entrepreneur-investor meetings, given by (30), yields

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

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

$$\begin{aligned}Z_s^{0,pre}(c_H)=&\frac{1}{N}\max\left\{\frac{\pi-\lambda c_L}{1-\beta}-\kappa-P_s(c_H),Z_s^0(c_H)\right\}\\&-\frac{N_s-1}{N}\mathbb{1}_{\left\{-\frac{\gamma c_L}{1-\beta}+P_s(c_H)>V^1(c_H)\right\}}\frac{\lambda c_L}{1-\beta}+\left(\frac{N_f}{N}+\frac{N_s-1}{N}\mathbb{1}_{\left\{-\frac{\gamma c_L}{1-\beta}+P_s(c_H)\leq V^1(c_H)\right\}}\right)Z_s^0(c_H).\end{aligned}$$

Since 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

$$Z_s^0(c_H)=-\lambda c_H+\beta Z_s^{0,pre}(c_H).$$

Note that this case is equivalent to the one considered in Section 4.3.2 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.

C Extension to Generalized Nash Bargaining

In this section, we study an extension in which the acquisition price is determined by generalized Nash bargaining and we show that the results from Section 4 are robust to this generalization of our baseline model. Specifically, we assume that the price paid by an investor to acquire the firm 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 $\theta = 1$.

C.1 Definition of Equilibrium

The only difference between the definition of equilibrium in Section 4.1 and the definition of equilibrium in the presence of generalized Nash bargaining is the determination of the acquisition prices. Specifically, when the entrepreneur who owns a firm with social cost of production $c \in \{c_L, c_H\}$ meets a type $k \in \{f, s\}$ investor in the financial market, the price $P_k(c)$ solves

$$P_k(c) \in \arg\max_P \left(V_k^0(c) + P - V^1(c)\right)^\theta \left(Z_k^1(c) - P - Z_k^0(c)\right)^{1-\theta},$$

subject to

$$\Delta V_k(c) \leq P \leq \Delta Z_k(c).$$

Thus, if $\Delta V_k(c) < \Delta Z_k(c)$, there are gains from trade and the acquisition price is given by

$$P_k(c) = (1-\theta)\,\Delta V_k(c) + \theta \Delta Z_k(c) = \Delta V_k(c) + \theta X_k(c), \tag{33}$$

where $X_k(c) := \Delta Z_k(c) - \Delta V_k(c)$ denotes the trading surplus. If $\Delta V_k(c) \geq \Delta Z_k(c)$, then there are no gains from trade and the entrepreneur does not sell the firm to the investor.

As in Section 4.1, there are no gains from trade if the entrepreneur meets a financial investor. The discounted utility of a financial investor when he owns the firm is given by $Z_f^1 = \frac{\pi}{1-\beta}$. Since a financial investor has a per-period utility of zero if he does not own the firm, the expected discounted utility of a financial investor when the entrepreneur owns the firm satisfies $Z_f^0(c) \geq 0$. Using $Z_f^0(c) \geq 0$, we get

$$\Delta Z_f(c) = Z_f^1 - Z_f^0(c) = \frac{\pi}{1-\beta} - Z_f^0(c) \leq \frac{\pi}{1-\beta}.$$

Equation (3) implies that $\Delta V_f(c) = V^1(c) - V_f^0(c) \geq \frac{\pi}{1-\beta}$. Taken together, this implies that $\Delta Z_f(c) \leq \Delta V_f(c)$. That is, there are no gains from trade if the entrepreneur meets a financial investor and the entrepreneur therefore never sells the firm to a financial investor irrespective of its status. As a result, we can define equilibrium as follows.

Definition 2. *An equilibrium is a collection of values* $V_f^0(c_L) = -\frac{\gamma c_L}{1-\beta}$, $V_f^0(c_H) = -\frac{\gamma c_H}{1-\beta}$, $V_s^0 = -\frac{\gamma c_L}{1-\beta}$, $V^1(c_L)$, $V^1(c_H)$, $Z_f^0(c_L)$, $Z_f^0(c_H)$, $Z_f^1 = \frac{\pi}{1-\beta}$, $Z_s^0(c_L)$, $Z_s^0(c_H)$, $Z_s^1(c_L) = \frac{\pi - \lambda c_L}{1-\beta}$, *and* $Z_s^1(c_H) = \frac{\pi - \lambda c_L}{1-\beta} - \kappa$, *and acquisition prices* $P_f(c_L)$, $P_f(c_H)$, $P_s(c_L)$, *and* $P_s(c_H)$, *satisfying* (4), (5), (6), *and* (33), *and a reform decision* $c \in \{c_L, c_H\}$ *satisfying*

$$c \in \underset{\tilde{c} \in \{c_L, c_H\}}{\arg\max} \left(V^1(\tilde{c}) - \mathbb{1}_{\{\tilde{c} = c_L\}} \kappa \right).$$

C.2 Financial Market with Only Financial Investors

In this section, we consider a financial market that is populated only by financial investors. Formally, we assume that $N_f = N$ such that $N_s = 0$. Recall from Section C.1 that there are no gains from trade if the entrepreneur meets a financial investor. As a result, the entrepreneur never sells the firm to a financial investor irrespective of its status and the entrepreneur's discounted utility

from owning a green and from owning a dirty firm are given by

$$V^1(c_L) = \frac{\pi - \gamma c_L}{1-\beta} \text{ and } V^1(c_H) = \frac{\pi - \gamma c_H}{1-\beta}.$$

In particular, as in Section 4.1, the entrepreneur reforms the firm if and only if $\gamma \geq \eta_1$, where η_1 is defined in Assumption 1.

C.3 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 $N_s > 0$.

C.3.1 Entrepreneur with a Green Firm

Assume that the entrepreneur reduces the social cost of production and therefore owns a green firm.

Lemma C.1. *The trading surplus when the entrepreneur meets a socially responsible investor is nonpositive, that is, $X_s(c_L) \leq 0$.*

Proof. Using the price $P_s(c_L)$, determined in (33), the entrepreneur's expected discounted utility (5) can be rewritten as

$$V^1(c_L) = \frac{\pi - \gamma c_L}{1-\beta} + \frac{\beta\theta}{1-\beta}\frac{N_s}{N}\max\{0, X_s(c_L)\}.$$

Since a socially responsible investor has a per-period utility of $-\lambda c_L$ if he does not own the firm, the expected discounted utility of a socially responsible investor when the entrepreneur owns the firm satisfies $Z_s^0(c_L) \geq -\frac{\lambda c_L}{1-\beta}$. This implies

$$\Delta Z_s(c_L) = Z_s^1(c_L) - Z_s^0(c_L) = \frac{\pi - \lambda c_L}{1-\beta} - Z_s^0(c_L) \leq \frac{\pi}{1-\beta}.$$

Since $V^1(c_L) \geq \frac{\pi-\gamma c_L}{1-\beta}$, we get

$$\Delta V_s(c_L) = V^1(c_L) - V_s^0(c_L) \geq \frac{\pi-\gamma c_L}{1-\beta} + \frac{\gamma c_L}{1-\beta} = \frac{\pi}{1-\beta}.$$

Together, this implies that $X_s(c_L) = \Delta Z_s(c_L) - \Delta V_s(c_L) \leq 0$. ■

As a result, the entrepreneur does not sell the firm to a financial investor or a socially responsible investor if she reforms the firm. Her discounted utility is given by $V^1(c_L) - \kappa = \frac{\pi-\gamma c_L}{1-\beta} - \kappa$.

C.3.2 Entrepreneur with a Dirty Firm

Assume that the entrepreneur does not reduce the social cost of production and therefore owns a dirty firm. The entrepreneur's expected discounted utility when she owns the firm is given by

$$V^1(c_H) = \frac{\pi-\gamma c_H}{1-\beta} + \frac{\beta\theta}{1-\beta}\frac{N_s}{N}\max\{0, X_s(c_H)\}. \tag{34}$$

Proposition C.1. *There exist values $V^1(c_H)$ and $Z_s^0(c_H)$ and an acquisition price $P_s(c_H)$ satisfying the equilibrium conditions* (5)*,* (6)*, and* (33) *if and only if*

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

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, $X_s(c_H)$, is positive and the entrepreneur sells the firm when she meets a socially responsible investor.*

Proof. We have

$$Z_s^0(c_H) = -\lambda c_H + \beta\left(\frac{1}{N}\max\left\{Z_s^1(c_H) - P_s(c_H), Z_s^0(c_H)\right\} - \frac{N_s-1}{N}\mathbb{1}_{\{X_s(c_H)>0\}}\frac{\lambda c_L}{1-\beta} + \left(\frac{N_s-1}{N}\mathbb{1}_{\{X_s(c_H)\leq 0\}} + \frac{N_f}{N}\right)Z_s^0(c_H)\right). \tag{36}$$

Using (33), (36) can be rewritten as

$$Z_s^0(c_H) = -\lambda c_H + \beta \left(\frac{1-\theta}{N} \max\{X_s(c_H), 0\} - \frac{N_s - 1}{N} \mathbb{1}_{\{X_s(c_H)>0\}} \frac{\lambda c_L}{1-\beta} + \left(\frac{1}{N} + \frac{N_s - 1}{N} \mathbb{1}_{\{X_s(c_H)\leq 0\}} + \frac{N_f}{N} \right) Z_s^0(c_H) \right).$$

Notice that

$$\frac{N_s - 1}{N} \mathbb{1}_{\{X_s(c_H)>0\}} + \frac{1}{N} + \frac{N_s - 1}{N} \mathbb{1}_{\{X_s(c_H)\leq 0\}} + \frac{N_f}{N} = 1.$$

Then

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

which can be rewritten as

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

Thus, we get

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

Finally,

$$X_s(c_H) = \Delta Z_s(c_H) - \Delta V_s(c_H) = \frac{\pi}{1-\beta} - \frac{\beta(1-\theta)}{N\left(1-\beta\left(1-\frac{N_s-1}{N}\mathbb{1}_{\{X_s(c_H)>0\}}\right)\right)}\max\{X_s(c_H),0\}$$
$$+\frac{1}{1-\beta\left(1-\frac{N_s-1}{N}\mathbb{1}_{\{X_s(c_H)>0\}}\right)}\lambda(c_H-c_L) - \kappa - \frac{\pi-\gamma(c_H-c_L)}{1-\beta} - \frac{\beta\theta}{1-\beta}\frac{N_s}{N}\max\{0,X_s(c_H)\},$$

which can be simplified to

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

We first show that there does not exist a solution to (37) satisfying $X_s(c_H) \leq 0$. Assume instead that there exists a solution satisfying $X_s(c_H) \leq 0$. Then we get

$$X_s(c_H) = (c_H - c_L)\left(\frac{\lambda}{1-\beta} + \frac{\gamma}{1-\beta}\right) - \kappa.$$

In particular,

$$X_s(c_H) = (c_H - c_L)\left(\frac{\lambda}{1-\beta} + \frac{\gamma}{1-\beta}\right) - \kappa \leq 0 \Leftrightarrow \lambda \leq \eta_1 - \gamma,$$

which contradicts Assumption 1.

We next show that there exists a solution to (37) satisfying $X_s(c_H) > 0$ if and only if condition (35) holds. Assume that there exists a solution to (37) satisfying $X_s(c_H) > 0$. That is, there exists an $X_s(c_H)$ satisfying

$$X_s(c_H) = -\left(\frac{\beta(1-\theta)}{N\left(1-\beta\left(1-\frac{N_s-1}{N}\right)\right)} + \frac{\beta\theta}{1-\beta}\frac{N_s}{N}\right)X_s(c_H)$$
$$+(c_H-c_L)\left(\frac{\lambda}{1-\beta\left(1-\frac{N_s-1}{N}\right)} + \frac{\gamma}{1-\beta}\right) - \kappa, \quad (38)$$

and $X_s(c_H) > 0$. Solving (38) for $X_s(c_H)$ yields

$$X_s(c_H) = \frac{(c_H - c_L)\left(\frac{\lambda}{1-\beta\left(1-\frac{N_s-1}{N}\right)} + \frac{\gamma}{1-\beta}\right) - \kappa}{1 + \frac{\beta(1-\theta)}{N\left(1-\beta\left(1-\frac{N_s-1}{N}\right)\right)} + \frac{\beta\theta}{1-\beta}\frac{N_s}{N}}. \tag{39}$$

Simple algebra implies that $X_s(c_H) > 0$ if and only if (35) holds. ■

C.4 Entrepreneur's Choice of the Social Cost of Production

The entrepreneur reduces the social cost of production in period $t = 0$ if and only if

$$\frac{\pi - \gamma c_L}{1-\beta} - \kappa \geq \frac{\pi - \gamma c_H}{1-\beta} + \frac{\beta\theta}{1-\beta}\frac{N_s}{N}X_s(c_H), \tag{40}$$

where the right-hand-side of the inequality is derived from equation (34) using $X_s(c_H) > 0$.

Proposition C.2. *Assume that condition* (35) *holds. Then the entrepreneur reduces the social cost of production in period* $t = 0$ *if and only if*

$$\gamma \geq \eta_1 + \lambda \frac{\beta\theta\frac{N_s}{N}}{1-\beta\left(1-\frac{N_s-\theta}{N}\right)} =: \eta_2. \tag{41}$$

Proof. Using (39), simple algebra implies that (40) is equivalent to (41). ■

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.