

Impact Through Catalytic Finance

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Abstract

Impact investments requiring industry-wide adoption often stall because of a coordination trap: success depends on both individual firm effort and sufficient peer uptake, creating strategic complementarities. We study optimal financing by an impact investor who seeks to uniquely implement universal adoption while maximizing her guaranteed payoff. In this coordination environment with hidden effort, inducing coordination generally requires distorting firms' effort incentives. To manage this trade-off, the impact investor finances an endogenously chosen critical mass of firms using distortive concessionary contracts, which unlocks competitive, non-concessionary financing for the remaining firms. Unlike uniform taxes or subsidies, optimal impact financing is discriminatory in both instrument (e.g., debt vs. equity) and contractual terms, and its costs depend critically on how this heterogeneous financing is allocated across firms. Concessionary terms are optimally directed toward smaller, less efficient firms with high opportunity costs, whereas larger, better-run firms—essential for adoption—are financed at (near-)competitive terms.

Keywords: Impact financing, catalytic capital, coordination frictions, security design, green bonds, sustainability-linked bonds, subsidies, taxes

JEL Classification: D21, D86, G23, G32, D62, Q56

Catalytic capital accepts disproportionate risk and/or concessionary return to generate positive impact and enable third-party investment that otherwise would not be possible.—Global Impact Investing Network (GIIN)

1 Introduction

Technological shifts that require industry-wide change often face a coordination problem: with high fixed costs, network externalities, and the importance of agreeing on standards, it is unprofitable for individual firms to adopt a new technology alone, even if coordinated adoption makes everyone better off. This coordination friction can depress and delay adoption. Classic examples include the shifts to industrialization, railroads, and electrification (Rosenstein-Rodan, 1943; Murphy, Shleifer, and Vishny, 1989), and more recent ones include the so-called “green transition.” The electric-vehicle (EV) industry offers a vivid illustration: although the first electric car appeared in 1890, more than a century passed before Tesla’s commercialization of the technology unlocked large-scale investment in charging infrastructure and battery storage, prompting other major car firms to follow suit. Lack of coordination on investments with large network externalities has similarly hampered adoption in power generation, smart grids, recycling, as well as carbon-capture and storage (Edwards and Celia, 2018; Vora et al., 2021; Armstrong et al., 2024). One solution to such coordination problems is government intervention, but it is no panacea, as coordination is only one obstacle. Since adoption also requires costly, unobservable effort, public direction or ownership cannot substitute for private initiative and incentives, which are instrumental for mitigating the agency problems associated with technology adoption (Shleifer, 1998; Acemoglu et al., 2007).

We develop a theory pointing to a central tension in simultaneously overcoming coordination and agency problems in such settings. While resolving coordination frictions requires that firm owners be *insured* against the cash-flow risk associated with industry-wide adoption decisions, agency frictions require that they be *exposed* to cash-flow risk to have appropriate effort incentives. Yet simultaneously satisfying these opposing prescriptions is generally impossible. This tension between coordination and agency poses a challenge when financing adoption externally since it erodes the surplus that can be shared between firms and financiers and forces financiers seeking to unlock impact investments to accept “disproportionate risk and/or concessionary return” (GIIN). Understanding the causes and remedies for this problem is vital because large industry-wide shifts require major financial commitments. As a case in point, the International Energy Agency estimates that reaching net-zero emissions by 2050 will require annual green capital expenditures of about \$4 trillion (Bouckaert et al., 2024). Such immense funding needs imply that efficiently mobilizing and allocating

both private and public capital is crucial.

Our theory offers guidance on how impact investors, willing to accept (limited) concessionary returns to unlock industry-wide change at scale, can help achieve this goal at the lowest cost.¹ The optimal strategy that facilitates broad investment—targeting a critical mass of adopters to catalyze impact investment at non-concessionary financing terms by remaining firms—differs starkly from funding disruptive innovation, which focuses on winner-picking with the promise of monopoly-like payoffs. A key takeaway from our model is that concessions (when needed) are best directed to promising but smaller, more agency-prone firms. While investing in larger, better-governed firms is critical, such firms are best offered less-concessionary/less-distortive financing to preserve their drive to perform.

More concretely, we develop a model with multiple firms, each of which needs to privately choose between a conventional technology and one with positive network externalities, favored by impact investors (for short, *impact* technology). The impact technology’s success probability rises with (i) the number of adopters—capturing network externalities—and (ii) firm managers’ unobservable effort. Firms seek external funding in perfectly competitive capital markets populated by conventional investors and an impact investor. While all investors maximize their financial return, the impact investor has the additional objective of achieving industry-wide adoption of the impact technology, even if that requires absorbing some losses. Investors compete in the financing contracts they offer to firms, which affect both firm-level effort incentives and the coordination problem by affecting firms’ exposure to the actions of others. We study the optimal financing scheme that uniquely implements universal adoption and guarantees a maximum payoff to the impact investor.

The impossibility result at the heart of our theory is now straightforward to see. In the benchmark without coordination friction, achieving any positive level of effort requires sufficiently exposing firms to cash-flow risk; absent effort frictions, achieving coordination requires insuring firms against cash-flow risk. The opposing predictions imply that in such coordination environments with hidden effort, resolving one friction comes at the expense of the other. The resulting inefficiency is particularly severe under symmetric financial contracting: the only contract that insulates individual firms from the adoption decisions of others and, thus, ensures universal adoption as the unique equilibrium eliminating all “coordination risk,” is one that shifts all cash-flow risk to investors. However, such “full insurance” destroys managerial effort incentives.

Optimal catalytic finance mitigates this trade-off by leveraging the fact that private

¹Impact investors include private-sector investors, such as private equity, venture capital funds, and family offices, as well as public or semi-public investors, such as sovereign wealth funds and development finance institutions (Cole et al., 2024). As of 2024, \$1.6 trillion in assets is explicitly allocated to impact investing.

contracting can discriminate across firms. Even with ex-ante identical firms, offering different terms can mitigate the coordination trap. To illustrate this, suppose there are two ex ante identical firms. If the impact investor fully insures firm 1 against adoption-related cash-flow risk (implemented, e.g., by buying the firm’s equity or offering guarantees), firm 1 adopts regardless of firm 2’s choice, making adoption a dominant strategy. Anticipating this, firm 2 no longer fears being the lone adopter and can be financed competitively with a (debt) contract tailored to provide firms with high-powered effort incentives. While full insurance undermines firm 1’s effort incentives, lowering surplus, and potentially forcing the impact investor to accept concessionary returns, this is not the case with firm 2. Heterogeneous contracts that differ in the effort distortions they induce are optimal more generally: while substantial distortions and associated concessions might be needed for “early adopters,” remaining firms can be induced to adopt with financing contracts featuring progressively smaller negative effort distortions and financial concessions. Once a critical mass of firms invests in the impact technology, they crowd in conventional financing at non-concessionary terms for remaining firms.

Our model’s primary focus is on heterogeneous firms, raising the central question of how heterogeneous financing is optimally allocated, that is, which firms should be targeted with distortive and concessionary financing (as with firm 1 in the above example) and which should be funded at competitive terms (as with firm 2). We show that this choice can have a large impact on both efficiency and investors’ financial returns. Suppose, first, that firms differ in size, and achieving adoption at scale requires that both small and large firms adopt. An advantage of larger firms is that they coordinate internally and invest on a larger scale, thereby exerting larger externalities. Thus, if one firm is large enough to catalyze adoption by everyone else, concessionary and distortive financing is not needed.² However, if this is not the case, directing financing that sacrifices effort incentives and financial returns to smaller firms—so as to enable the large firm to become catalytic—reduces aggregate effort distortions and unlocks competitive financing for more firms.

As a simple illustration, suppose that catalyzing electric-vehicle (EV) adoption at competitive financing terms requires certainty that firms invest in three or more EV projects. That is, with four small one-project firms, the investor must offer concessionary terms to two projects; a third firm can then invest at market terms, and the fourth follows. Now, suppose instead there is one large two-project firm and two small one-project firms. Offering concessionary terms to the large firm results again in concessionary terms for two projects. However, offering concessionary terms to one small firm can be enough: given that

²Firm *A* comes “first,” i.e., before firm *B*, if firm *A*’s financing terms incentivize it to adopt the impact technology, regardless of what firm *B* is doing. Thus, firm *B* invests knowing that firm *A* invests for sure.

one EV project is pursued for sure, the large firm’s two projects bring the total to three, so it can invest at market terms. The remaining small firm can then also finance its project competitively.

We identify several further criteria for how to allocate concessionary financing among the firms, important for achieving a broad impact. Concessionary financing is optimally targeted at: (i) firms with higher effort costs. Because concessionary financing results from the need to sacrifice effort incentives to ensure adoption, it should be aimed at less cost-efficient (worse governed) firms, whose effort would have been limited anyway. Firms with low effort costs should be targeted with less effort-distorting financing so as not to interfere too much with their natural drive to perform. (ii) Concessionary (distortive) financing should further be directed to *safer* firms with less dispersed cash flows, because then low effort distorts cash flows less. (iii) Furthermore, it is optimal to direct concessionary financing to firms with *higher outside options* since they require higher insurance against cash-flow risk (leading to higher agency costs), even without a coordination problem. (iv) In extensions, we consider signals (such as ratings) about firms’ technology choice and firms’ ability to strategically affect the informativeness of these signals via their disclosure policies. One insight is that costly, high-quality disclosure cannot be sustained, as greater informativeness is not always associated with cheaper financing.

A key implication of our model is that impact investors, which often include private equity and venture capital funds, will not succeed in catalyzing impact at scale by investing exclusively in the most likely “stars.” While identifying the most promising set of firms is crucial, achieving impact through adoption at a larger scale means that not all firms in this set can be stars. Specifically, minimizing aggregate effort distortions and maximizing overall portfolio returns requires directing concessionary financing terms to the possibly smaller, less efficient, higher-opportunity-cost firms. This helps catalyze investment at the larger and better-run firms at (near) competitive terms, which, in turn, unlocks broader adoption and more competitive financing for more firms.

Another key implication is that private impact financing is not a substitute but a complement to public policy tools. First, private contracts can flexibly discriminate among firms, which is a key advantage relative to one-size-fits-all public interventions. Second, private contracts offer predictability and commitment, shielding financing terms from policy reversals tied to political cycles (e.g., Besley and Persson, 2023), which tends to dampen investment (Gulen and Ion, 2016; Jens, 2017). Still, public intervention (or the lack of it) enhances the effectiveness of private contracting. A key example is reducing antitrust hurdles for impact investor consortia, allowing such investors to coordinate better, pool resources, and improve their risk-return profile. Another example is directing public capital to private impact funds

and blended finance initiatives (Flammer et al., 2025 a,b). Notably, our framework highlights that there should be no illusions: competition from non-impact investors means that catalytic impact financing can achieve at best market returns. However, the “additionality” of going first where conventional investors would not, coupled with optimal targeting of catalytic capital recipients, maximizes both impact and financial returns.

Related literature. Our paper’s main contribution on the applied side is to study the role of financial contracts in mitigating coordination problems hampering the broad adoption of impact technologies. The positive network externalities underlying the coordination frictions in our model are widely considered to hamper impact investment, technological change, and the green transition (Murphy et al., 1989; Acemoglu et al., 2012; Aghion et al., 2016; Biais and Landier, 2022). However, work in this field has not considered the role of investors and financial contracting in facilitating coordinated adoption. This is surprising given the historical role of investors in facilitating major technological shifts hampered by coordination problems. In particular, large banks are considered instrumental for the shift to industrialization in nineteenth-century continental Europe, because they provided not only capital but also “guidance” to coordinate firms in their portfolios (Schumpeter, 1934, 1939; Gerschenkron, 1962; Da Rin and Hellmann, 2002).

To bridge this gap and study which firms impact investors should target, our paper builds on the literature on contracting for coordination (Milgrom and Roberts, 1990; Segal, 2003; Halac, Kremer, and Winter, 2020; Hoffmann and Vladimirov, 2025; Halac, 2025). Perhaps closest to our paper is Halac, Kremer, and Winter (2020), who also use unique implementation as a solution concept to study how contracts to heterogeneous firms coordinate investment. However, this literature’s primary focus is on minimizing the rent principals need to leave agents to incentivize a coordinated action. By contrast, at the core of our analysis is the tension that contracts that mitigate coordination frictions exacerbate agency problems at the firm level, which further affects efficiency. This tension has novel implications for optimal collective contract design—when and how to pair subsidies with effort incentives.

Our paper also relates to the literature in corporate finance that investigates the role of investors in facilitating impact. This literature predominantly examines individual firm-investor frictions without explicitly modeling industry-wide coordination problems. In particular, Broccardo, Hart, and Zingales (2022) and Edmans, Levit, and Schneemeier (2024) explore how impact investors influence firm behavior through voice and exit mechanisms; Oehmke and Opp (2025a) and Chowdhry, Davies, and Waters (2019) study how investors’ sustainability preferences shape their willingness to fund green investments; and Landier and Lovo (2025) study the optimal strategies of socially responsible funds that need to cater to both impact and value investors. Further related, Bucourt and Inostroza (2024) and Chen

et al. (2024) investigate how ESG information and market governance affect managerial incentives and firm decisions. Gupta, Kopytov, and Starmans (2024) show that the prospect of selling to pro-social investors who value reforming “dirty” firms weakens current owners’ incentives to undertake reforms. Unlike these papers, our model explicitly captures the strategic interdependence among firms’ adoption decisions and identifies how targeted impact financing can resolve collective-action problems in adoption. This contribution relates to Bisceglia, Piccolo, and Schneemeier (2025), who show that socially responsible investors optimally concentrate investment in just a few firms, which can mitigate coordination issues in adopting green technologies but also crowd out green investments by excluded firms.

Our model’s perspective of how catalytic (concessionary) financing can (i) help overcome coordination frictions that prevent firms from pursuing impact technologies in settings with network externalities, while (ii) crowding in competitive private financing at the lowest cost also complements Flammer et al.’s (2025 a,b) work on blended finance. This work studies how development finance institutions (DFIs) implement blended finance in practice—offering concessionary financing to riskier firms with higher expected social impact to make them attractive to conventional investors—which provides institutional detail and empirical patterns resonating with the catalytic-financing logic at the heart of our paper. Interestingly, Roth and Green (2025) argue that impact investors can crowd out conventional investors when competing to finance firms that deliver social value; hence, impact investors should target socially beneficial projects with low financial returns. This insight aligns with our prescription not to offer concessionary financing to the best firms, though the rationales differ: in our model, concessionary financing is needed to achieve coordination but distorts effort, which is most harmful at larger and cost-efficient firms.

Our focus on private contracting mechanisms tailored to firm characteristics contrasts with traditional uniform public interventions, such as taxes and subsidies. Contributions like Hoffmann, Inderst, and Moslener (2017), Döttling and Rola-Janicka (2025), and Lanteri and Rampini (2025) emphasize the limitations of simple (uniform) taxes and subsidies to limit environmental externalities under financial constraints. Huang and Kopytov (2025), Inderst and Opp (2025), and Oehmke and Opp (2025b) similarly highlight unintended consequences of regulatory taxonomies and uniform sustainability standards. Our analysis complements these studies by demonstrating how, unlike uniform taxation and subsidies, differentiated financial contracts can efficiently align firms’ incentives to adopt impact technologies without incurring excessive efficiency losses. This aspect further adds to Barbalau and Zeni (2025) and Chen, Gupta, and Starmans (2025), who also consider how optimal contract design lowers the cost of achieving impact.³

³A key message from our paper is that the pressure to change comes not only via a financial but also an

2 Model

We study the financing of technology adoption with strategic complementarities and hidden effort. There are $N \geq 2$ penniless firms $i \in \{1, \dots, N\}$, each requiring an investment $I > 0$ to undertake a project. Each firm is run by a risk-neutral owner-manager who maximizes expected firm profits. There are three dates. At $t = 0$, firms raise external financing. At $t = 1$, conditional on financing, each firm privately chooses a technology to adopt $a_i \in \{0, 1\}$ together with an unobservable costly implementation effort e_i . At $t = 2$, cash flows are realized. If its project succeeds, firm i produces cash flow $x + \Delta x$; if it fails, it produces x , where $x \geq 0$ and $\Delta x > 0$.

Technologies. We consider the choice between a “conventional” technology ($a_i = 0$) and an “impact” technology ($a_i = 1$). To interpret the model through the lens of catalytic impact finance, we use the term “impact technology” to indicate that it is favored by the impact investor and refer to its choice by a firm as “adoption.” The key features of the impact technology are that its success probability depends on (i) how many firms adopt it—reflecting that the technology creates network externalities—and (ii) firm i ’s effort—reflecting that the technology is not yet mature and well understood. Specifically, let $n = \sum_{j=1}^N \mathbf{1}\{a_j = 1\}$ denote the total number of adopters and $p(n, e_i)$ denote the success probability of the impact technology. We assume that $p(n, e_i)$ is weakly increasing in n for any given level of effort e_i , which is the source of strategic complementarities in the model.⁴ Effort costs $\psi(e_i)$, where $\psi(0) = 0$ and ψ is strictly increasing in e for all n . For tractability in the baseline model, we consider binary effort $e_i \in \{0, e\}$ and write $\Delta p(n) := p(n, e) - p(n, 0) > 0$. Furthermore, effort is socially efficient in the sense that $\Delta p(n)\Delta x > \psi(e)$ for all n .

Firms can alternatively choose a conventional technology $a_i = 0$. The key difference is that this technology does not exhibit network externalities. As will become clear, the nature of the effort problem for the conventional technology does not affect our main results such that it is without loss of generality to abstract from it. Thus, we fix the conventional technology’s probability of success at a level p_0 . To focus on a coordination region, we assume that for any adopting firm—regardless of the firm’s own effort—the impact technology’s

operational channel, as firms adapt to peers’ behavior. Indeed, one firm alone will have a limited impact in the presence of network externalities, which helps explain why ESG investing focused on affecting individual firms’ cost of capital may have a limited impact (Pastor, Stambaugh, and Taylor, 2022; Berk and van Binsbergen, 2025). More broadly, our paper relates to the literature on the role of financial markets in governance and sustainability (Goldstein et al., 2025; Chen, Starmans, and Gupta, 2024; Geelen, Hajda, and Starmans, 2025). While these studies highlight the impact of market-based governance mechanisms and investor heterogeneity, we emphasize how financial contracting structures can coordinate adoption across firms strategically.

⁴We focus on the impact technology’s adoption phase. Once it matures and network externalities of adoption are no longer relevant, a higher n (if it means higher competition) could erode also profits.

success probability is higher than that of the conventional technology when all other firms adopt, and lower when none do, i.e.,

$$p(1, e_i) \leq p_0 \leq p(N, e_i) \quad (1)$$

for all e_i (see Section 3.3 for a discussion of this assumption). In addition, we require adoption and effort to be complements, i.e., $\Delta p(n) - \Delta p(n-1) \geq 0$ for all $n > 1$. That is, the incremental value of putting effort in implementing the impact technology increases as more firms adopt that technology, e.g., because knowledge spillovers or industry-wide standards make effort more productive. Our baseline analysis focuses on weak complementarity, i.e., $\Delta p(n)$ constant in n , which highlights the tension between coordination and incentives. This case cleanly illustrates that the main trade-off between effort and coordination we study is not technological. We discuss the cases of strict complementarity and the substitutes cases subsequently.

Information. The key frictions in our model are that technology choice a_i and effort e_i are not observable. Moral hazard arising from the unobservability of effort is widely considered a first-order problem for external financing, particularly when firms implement novel technologies that are not yet well understood, making monitoring more difficult than for mature conventional technologies (Acemoglu, Antras, and Helpman, 2007). Similarly, our assumption that project choice is unobservable is also standard (Aghion and Tirole, 1997; Burkart, Gromb, and Panunzi, 1997). Intuitively, outsiders cannot tell whether a firm is genuinely pursuing impact or merely pretending to do so while continuing business as usual. For example, it may be hard for outsiders to determine whether a firm is dedicating sufficient financial and human capital resources toward lowering its carbon footprint or whether it is primarily greenwashing while adhering to its existing operational practices.⁵

Financing and contracts. Each firm must raise the full investment I from external investors at $t = 0$. A financing contract for firm i is $\mathbf{R}_i = (R_i, \Delta R_i)$, where R_i is a state-independent repayment and ΔR_i is an additional repayment in the success state. Thus, repayments equal R_i if the project fails and $R_i + \Delta R_i$ if it succeeds. We refer to such contracts as “plain-vanilla” to distinguish them from more complex financing arrangements that can condition on signals about a firm’s technology choice, which we consider in Section 6. As is standard, feasible financing contracts must satisfy limited liability for both firms and investors, $0 \leq R_i \leq x$, and be monotonic in cash flow, $0 \leq \Delta R_i \leq \Delta x$ (Innes, 1990).

Investors and competition. Conventional investors are competitive and finance any

⁵While we assume for simplicity that both technologies require the same investment, our main results continue to hold if the impact technology requires a higher investment outlay and any excess financing can be diverted or consumed as perks by the entrepreneur, who benefits at a rate $\lambda \in (0, 1)$.

firm whenever they can at least break even. In addition, a single impact investor (she) competes for each firm. She also maximizes financial returns but also wants to ensure universal adoption of the impact technology by all firms ($a_i = 1$ for all i). A standard way of microfounding the impact investor’s preference for the impact technology is by introducing a negative (e.g., environmental) externality if firms adopt the conventional technology that the impact investor internalizes, but firms and conventional investors do not. The impact investor then provides financing as long as her expected financial payoff from incentivizing adoption of the impact technology (which can be negative) is higher than her utility loss from the negative externality. Though we abstract from modelling this trade-off explicitly, it highlights the importance of optimizing the impact investor’s financial return to avoid a “market breakdown” in the financing of the impact technology. Notably, in Section 3.3, we will characterize when a preference for the impact technology is necessary to avoid such a market breakdown.

We stipulate that the financing contracts that investors offer to firms are commonly observable.⁶ For concreteness, we stipulate that the impact investor moves first in the contract offer game and makes an offer to all firms. After observing these offers, non-impact investors may counteroffer to any firm that has not yet accepted financing, such that competition can be captured in reduced form by the constraint that the impact investor at most breaks even firm-by-firm. Subsequently, we will show that the impact investor does not need to finance all firms and may not fully finance any of them since her investment will crowd in investment by conventional investors.⁷

In the following, we analyze the case of ex ante homogeneous firms described above. We consider heterogeneous firms in Section 4. Sections 5 and 6 present further model extensions and generalizations, as well as the empirical and policy implications of our analysis.

3 Inducing Impact Through Financing Contracts

Since for any given firm, the attractiveness of the impact technology depends on the other firms’ adoption decisions, firms play a game with strategic complementarities. In particular,

⁶This assumption is trivially satisfied in the case of financing via publicly traded (e.g., green or sustainability-linked) bonds and is natural in the equivalent sequential formulation of our game (that we discuss below). Furthermore, note that it would be in the best interest of a firm to disclose that it has raised impact financing and of the impact investor to confirm this. Neither party would strictly benefit from disclosing the opposite if the firm has not raised financing from the impact investor to invest in $a_i = 1$.

⁷The impact investor could equivalently make contract offers only to a subset of firms, anticipating that the remaining firms will be served subsequently by conventional investors. One could also allow conventional investors to make financing offers first, i.e., before the impact investor, as long as they ration their supply of financing in the sense that a critical mass of firms can obtain financing only from the impact investor.

for a contract offer $(\mathbf{R}_i)_{i=1}^N$ by the impact investor, adopting is optimal for firm i whenever⁸

$$x - R_i + p(n, e_i^*)(\Delta x - \Delta R_i) - \psi(e_i^*) \geq x - R_i + p_0(\Delta x - \Delta R_i), \quad (2)$$

where, for brevity, e_i^* denotes the firm's optimal effort choice $e_i^*(\mathbf{R}_i)$ given contract $\mathbf{R}_i$

$$e^*(\mathbf{R}_i) := \arg \max_{e_i} x - R_i + p(n, e_i)(\Delta x - \Delta R_i) - \psi(e_i). \quad (3)$$

As expression (2) shows, a firm's decision to adopt the impact technology depends on its belief about how many other firms, n , also adopt. In particular, if firm i believes that no other firm adopts, its expected payoff from adopting is less than its expected payoff from not adopting since $p(1, e_i) < p_0$. However, adoption is optimal if firm i believes that all other firms adopt since $p(N, e_i) > p_0$ (see (1)).

To deal with the resulting potential for equilibrium multiplicity, we follow the literature on contracting with externalities and adopt unique implementation via iteratively dominant strategies as our solution concept (see, e.g., Halac, 2025). Concretely, to guarantee broad adoption of the impact technology as the unique equilibrium outcome, the impact investor's offer $(\mathbf{R}_i)_{i=1}^N$ must ensure that adoption is an iteratively dominant strategy for each firm i —that is, it survives iterative elimination of weakly dominated strategies (IEWDS). In particular, the offer must be such that for any permutation (ordering) of the firms into positions $1, \dots, N$, (i) adoption be a dominant strategy for the firm in position 1, regardless of what others do, that is, condition (2) must hold for all $n \geq 1$; (ii) given that the firm in position 1 adopts, the firm in position 2 must find adoption optimal regardless of what the remaining $N-2$ firms do, that is, condition (2) must hold for all $n \geq 2$; and so on (iteratively dominant strategies). More generally, at any position j in the iterative dominance chain, the adoption constraint has to hold independently of what firms in positions $j+1, \dots, N$ (rather than all firms) do. Since firms are homogeneous in the baseline model, it is without loss of generality to identify each firm with its position in the iterative dominance chain. Thus, adoption of the impact technology is an iteratively dominant strategy for firm i if (2) is satisfied for $n \geq i$.

We can now state the impact investor's problem. The impact investor chooses a feasible contract offer to each firm $(\mathbf{R}_i)_{i=1}^N = (x \geq R_i \geq 0, \Delta x \geq \Delta R_i \geq 0)_{i=1}^N$ to induce adoption of the impact technology by all firms as the unique equilibrium at the highest profit/lowest cost subject to the competition she faces from conventional investors:

⁸Without loss of generality, we assume that the firm chooses to adopt the impact technology whenever it is indifferent between the impact and the conventional technology.

Problem 1 (Impact Investor's Problem)

$$\max_{(0 \leq R_i \leq x, 0 \leq \Delta R_i \leq \Delta x)_{i=1}^N} \sum_i R_i + p(N, e^*(\mathbf{R}_i)) \Delta R_i, \quad (4)$$

s.t. for all i : (3) and (2) hold for all $n \geq i$

$$R_i + p(N, e_i^*) \Delta R_i \leq I. \quad (5)$$

The firm-by-firm competition constraint (5) captures that (price) competition from conventional investors bounds the impact investor's expected profit from financing any given firm i by the investment cost I (see Section 3.3 for a discussion of this assumption). If multiple break-even contracts exist for a given firm, competition selects the most efficient one since it leaves the highest surplus to the firm.

Two further points are worth noting. First, since the probability of success is increasing in n , for a firm in position i in the dominance chain, for which the adoption constraint (2) has to hold for all $n \geq i$, the relevant (i.e., tightest) constraint is at $n = i$. Second, condition (3) does not impose that all firms exert effort but merely that the effort choice be optimal given the offered contract. To induce effort from firm i , the investor's contract offer $\mathbf{R}_i$ must satisfy the effort incentive constraint:

$$\Delta p(\Delta x - \Delta R_i) \geq \psi, \quad (6)$$

where we make explicit that $\Delta p = \Delta p(n) = p(n, e) - p(n, 0)$ does not depend on n in the baseline model (see Section 5.3 for a relaxation of this assumption).

Discussion of Solution Concept. The solution concept of unique implementation guarantees that the impact investor maximizes her profits in the worst-case scenario. This approach avoids relying on firms' ability to predict others' actions or assign subjective probabilities to different outcomes. Instead, it requires only common knowledge of rationality and guarantees robustness without needing strong equilibrium selection assumptions. For a review of the literature on unique implementation, we refer to Halac (2025).

As our discussion of iterative dominance to achieve unique implementation makes clear, our results extend to a sequential setting, in which firms make adoption decisions one after another, observing the financing contracts of those who have moved earlier. Thereby, financing contracts incentivize firms to play a dominant strategy in the respective subgame of the sequential game. In this version of the model, we achieve again coordination on the impact technology without requiring strong assumptions about firms' beliefs. Given this close relation to the sequential-move game, we will refer to a firm with a low (high) index i as a

firm placed earlier (later) in the iterative dominance chain. Note that the assumption that contracts of firms earlier in the chain are observable to firms later in the chain is particularly natural in this sequential formulation of the game.

3.1 An Impossibility Result: Resolving Coordination vs. Effort

To illustrate how the coordination and moral hazard problems interact, we consider two benchmark versions of our model that feature only one but not the other friction. Consider, first, the benchmark with only the effort problem but no coordination friction. That is, suppose that each firm believes, for exogenous reasons, that the other $N - 1$ firms will choose the impact technology. This assumption substantially simplifies Problem 1 by fixing each firm's belief about the other firms' actions, eliminating any strategic uncertainty. As a consequence, it is always optimal for firms to adopt the impact technology, and—with only the moral hazard problem remaining—it is without loss of generality to consider only contracts $\mathbf{R} = (R, \Delta R)$ that are identical across firms. To induce effort, this contract has to give the firm's manager sufficient skin in the game, which limits the payment to the investor in the high cash-flow state. Concretely, from condition (6) it must hold that $\Delta R \leq \Delta x - \frac{\psi}{\Delta p}$. For investors to break even while inducing effort, the resulting pledgeable income must be at least as large as the investment outlay:

$$x + p(N, e) \left(\Delta x - \frac{\psi}{\Delta p} \right) \geq I, \quad (7)$$

which we assume to hold. Competition among investors then leads to the following equilibrium contracts:

Lemma 1 (*No strategic uncertainty*) *Assume that there is no strategic uncertainty, because each firm believes for exogenous reasons that all other firms will adopt the impact technology, and that (7) holds. Then, the impact investor will offer a contract $(R, \Delta R)$ that incentivizes effort, $0 \leq \Delta R \leq \Delta x - \frac{\psi}{\Delta p}$, and under which she breaks even, $R = I - p(N, e)\Delta R \in [0, x]$, leaving the entire surplus of $x + p(N, e)\Delta x - I - \psi > 0$ to the firm.*

From the set of contracts that are optimal absent the coordination friction (Lemma 1), we call the contract that maximally relaxes the firm's incentive constraint the *benchmark contract* $(R^b, \Delta R^b)$. This contract offers the least-distortive way to implement effort when adoption is not a coordination object. It does so by maximizing the wedge between the firm's payoff in the low- and high cash-flow state, $\Delta x - \Delta R^b$, which calls for lowering ΔR^b as much as feasible, while making sure that investors break even. Hence, the benchmark

contract sets $\Delta R^b = \max\left\{\frac{I-x}{p(N,e)}, 0\right\}$ and $R^b = \min\{x, I\}$. A standard implementation of such a contract is with debt financing (the owner-manager holds a levered equity claim).⁹

We now compare the benchmark without coordination frictions to a setting that isolates the coordination problem and, for exogenous reasons, shuts down the effort problem. The solution to this second benchmark is once again simple but looks very different. Specifically, from the adoption constraints (2), it is immediate that inducing a firm to choose the impact technology can be achieved by pledging all of the firm's risky cash flows to investors, $\Delta R_i = \Delta x$ for all i , with the fixed repayment in the low-cash flow state, R_i , determined from (5) or the feasibility constraint $R_i \leq x$. One implementation of this *full-insurance contract* is that the impact investor buys all of the firm's equity and employs the owner-manager at a fixed wage. An alternative implementation is that the impact investor offers guarantees to absorb more losses in the low cash-flow state to keep the owner-manager's payoff the same in all cash-flow states. A key aspect to note is that while the full-insurance contract satisfies the adoption constraint (2) with equality, it does not induce any effort since the effort constraint (6) is violated. Assuming for ease of exposition that

$$p(N, 0) \Delta x \leq I, \quad (8)$$

we obtain the following characterization.¹⁰

Lemma 2 (No effort problem) *Assume that (8) holds. Then, the impact investor can induce all firms to choose the impact technology with a contract $(R^{fi}, \Delta R^{fi})$ that provides firms with full insurance against cash flow risk, $\Delta R^{fi} = \Delta x$. Such a full-insurance contract induces no effort, and the impact investor at most breaks even, $R^{fi} = \min\{I - p(N, 0) \Delta x, x\}$, while firms receive an expected payoff of $\max\{x + p(N, 0) \Delta x - I, 0\}$.*

Lemmas 1 and 2 characterize the optimal contract when coordination and the effort problem, respectively, are exogenously shut down. They illustrate the inherent trade-off between incentivizing adoption and effort. Stimulating effort to increase the success probability of the impact technology requires exposing the owner-manager to the firm's cash-flow risk, i.e., offering $\Delta R < \Delta x$. However, with such a contract, incentivizing adoption as an (iteratively) dominant strategy for all firms becomes impossible.

⁹If effort choice were continuous, the corresponding benchmark contract would be uniquely optimal since it maximizes the surplus that firms and investors share.

¹⁰If $p(N, 0) \Delta x > I$, a plain-vanilla contract that ensures adoption as the unique equilibrium does not exist: setting $\Delta R = \Delta x$ would require $R < 0$ to avoid strictly positive investor profits, violating either investor limited liability or the no-positive-profit constraint (5). We set this case aside, as it can be resolved by letting the firm raise financing in excess of I at $t = 0$.

Proposition 1 *Suppose effort is unobservable and Assumption 1 holds. Then, there exists no plain-vanilla contract that (i) induces effort from every firm (satisfies (6)) and (ii) implements full adoption as the unique outcome.*

Designing financing contracts so as to mitigate this tension between the coordination and effort problems is at the center of the following analysis. The importance of doing so is immediate from a social perspective since the full-insurance contract (Lemma 2)—which achieves adoption at the expense of effort—makes all parties at least weakly worse off compared to a setting without coordination frictions (Lemma 1).

3.2 Catalyzing Impact With Plain-Vanilla Financing

Given that firms are homogeneous, it is natural to start with the case in which the impact investor offers the same, symmetric contract to all firms, i.e., $(R_i, \Delta R_i) = (R, \Delta R)$ for all i . Then, to guarantee adoption, the impact investor has to ensure that it is a dominant strategy for each firm. That is, the adoption constraint (2), which can be rewritten as

$$(p(n, e^*) - p_0) (\Delta x - \Delta R) \geq \psi(e^*), \quad (9)$$

must be satisfied even in the most unfavorable case in which no other firm adopts, i.e., $n = 1$. This inequality fails under any plain-vanilla symmetric financing contract with $\Delta R < \Delta x$ since $p(1, e^*) - p_0 < 0$ for any e^* from assumption (1). The only plain-vanilla contract that ensures that adoption is a dominant strategy is the full-insurance contract from Lemma 2, which features $\Delta R = \Delta x$ and, thus, provides no effort incentives.

Proposition 2 (Symmetric Plain-Vanilla Financing) *Any symmetric plain-vanilla financing contract that induces adoption of the impact technology by all firms, $\mathbf{a} = (1, \dots, 1)$, as the unique equilibrium must stipulate $\Delta R = \Delta R^{fi} = \Delta x$ and, thus, induces no effort. Under all other feasible symmetric plain-vanilla financing contracts, there are two pure-strategy Nash equilibria: $\mathbf{a} = (1, \dots, 1)$ (impact equilibrium) and $\mathbf{a} = (0, \dots, 0)$ (non-impact equilibrium).*

Apart from not incentivizing any effort, a key problem of the full-insurance contract is that the investor makes a loss from financing the firm if $\min \{I - p(N, 0) \Delta x, x\} = x$. In this case, adoption can only be achieved if she is willing to absorb the loss (i.e., offer concessions) associated with financing firms that adopt the impact technology but exert no effort.

Heterogeneous Financing. The general principle behind catalytic finance is that the impact investor can achieve a substantial improvement in terms of a lower loss and higher efficiency if she offers contracts $(R_i, \Delta R_i)$ that can differ across firms $i = 1, \dots, N$. The reason is that, in this case, the contract offer has to ensure that adoption is a dominant strategy for one firm only, while for all other firms it only has to be an iteratively dominant strategy. Recall that this corresponds to a relaxation of the adoption constraint (9), which now has to hold for $n = i$ instead of $n = 1$ for each i , which is easier to satisfy since $p(i, e)$ is increasing in i .

To illustrate how heterogeneous contracts help, suppose there are two firms, $N = 2$, and that the impact investor offers firm 1 the full-insurance contract $(R_1, \Delta R_1) = (R^{fi}, \Delta R^{fi})$, characterized in Lemma 2. With such a contract, it is a (weakly) dominant strategy for firm 1 to choose the impact technology (Proposition 2). Anticipating this choice, firm 2 faces no coordination problem. Thus, choosing the impact technology is an iteratively dominant strategy also for firm 2 for any feasible financing contract. In particular, the impact investor can ensure firm 2's adoption by offering the benchmark contract, $(R_2, \Delta R_2) = (R^b, \Delta R^b)$, it would offer if there were no coordination frictions (Lemma 1). This leads to a better outcome both in terms of efficiency and financial return for the investor compared to the symmetric offer characterized in Proposition 2.

This intuition extends to more than two firms. Let m be the lowest index such that if $m - 1$ firms adopt the impact technology for sure, the remaining $N - m + 1$ firms will have incentives to adopt and exert effort if they are financed with the benchmark contract $(R^b, \Delta R^b)$.¹¹ Then, the impact investor can offer the full-insurance contract $(R^{fi}, \Delta R^{fi})$ to firms $i = 1, \dots, m - 1$, which makes adoption a dominant strategy for these firms but induces no effort, and the benchmark contract $(R^b, \Delta R^b)$ to all remaining firms $i = m, \dots, N$, such that adoption is an iteratively dominant strategy for these firms, and they exert effort. This solution generalizes the two-firm example.

If the impact investor makes a loss on the full-insurance contract, she can sometimes do even better by inducing effort from more firms. In particular, as long as $(p(i, e) - p_0) > 0$ for some $i < m$, it is possible for the impact investor to satisfy the adoption constraint (9) for $n = i$ by offering a contract with $\Delta R_i < \Delta R^b$. Such a contract leaves the owner-manager a larger exposure to cash-flow risk than the benchmark contract, implying that it also strengthens the owner-manager's incentives to exert effort. Since $R_i = R^b$ remains unchanged but $\Delta R_i < \Delta R^b$, a straightforward implementation is through concessionary debt financing relative to the benchmark contract. If feasible, such contracts entail a loss

¹¹Formally, m is defined by (9) when choosing $\Delta R^b = \max \left\{ \frac{I-x}{p(N;e)}, 0 \right\}$, i.e., the lowest feasible ΔR^b under which investor's can break even while inducing both effort and adoption (see Lemma 1).

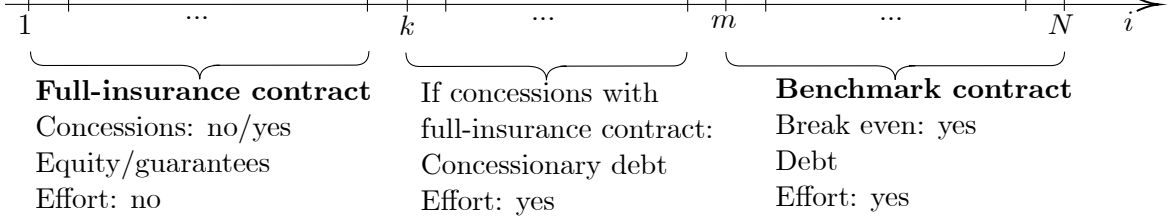


Figure 1: **Optimal financing.** The figure illustrates the three regions described in Proposition 3 with their implications for effort and possible implementations with debt or equity.

for the impact investor, but because of the higher effort, this loss may be smaller than with the full-insurance contract. In particular, since the impact investor's loss under the full-insurance contract is independent of i , while the loss when inducing both effort and adoption is decreasing in i (since the adoption constraint is easier to satisfy for higher i), there exists a cutoff $k \in (1, m]$ such that the investor prefers this solution of inducing both adoption and effort for all $i \geq k$ compared to offering the full-insurance contract (for an illustration, see Figure 1).¹²

Proposition 3 *The optimal plain-vanilla financing policy inducing adoption by all firms as the unique equilibrium is asymmetric and incentivizes heterogeneous effort levels. Specifically, there exist cutoffs k and m , with $1 < k \leq m \leq N$, such that (i) Firms indexed $i = 1, \dots, k-1$ receive the full-insurance contract $(R_i, \Delta R_i) = (R^{fi}, \Delta R^{fi})$ and exert no effort; (ii) firms indexed $i = m, \dots, N$ receive a contract $(R_i, \Delta R_i) = (R^b, \Delta R^b)$ that is also optimal in the benchmark without coordination frictions and exert effort. (iii) If $x + p(N, 0) \Delta x \geq I$, it holds that $k = m$, and the impact investor does not incur losses financing adoption. Otherwise, if $x + p(N, 0) \Delta x < I$, the impact investor incurs a loss financing firms $i = 1, \dots, m-1$. In this case, $k \leq m$, and firms $i = k, \dots, m-1$ receive a contract stipulating $\Delta R_i < \Delta R^b$ —with ΔR_i increasing in i —and exert effort.*

3.3 When Do We Need an Impact Investor?

A notable Corollary to Proposition 3 is that the impact investor only needs to finance the first $m-1$ firms to catalyze impact and induce all other firms to adopt the impact technology. The impact investor plays two key roles. First, by making an initial offer to all firms, she helps coordinate investors on what contracts to compete on for any given firm i . Second, she finances adoption by firms that competitive investors cannot profitably finance. Notably, the impact investor does not need to finance all firms in equilibrium. In particular, firms $m, \dots, N$, for which adoption is an iteratively dominant strategy and for which an investor can

¹²If $\Delta R^b = 0$, providing adoption incentives to $i < m$ is infeasible and $k = m$.

break even when offering $(R^b, \Delta R^b)$, can also be financed by conventional investors. Thus, the impact investor not only catalyzes adoption but also crowds in conventional investors.¹³

What about firms $i = 1, \dots, m - 1$? Clearly, if $x + p(N, 0) \Delta x < I$, such that financing adoption by these firms entails a loss, the impact investor is the only one willing to finance them. However, if $x + p(N, 0) \Delta x \geq I$, investors break even also for these firms. In this case, conventional investors can finance all firms provided some investor—the impact investor or any other—moves first with the menu from Proposition 3, thereby coordinating the contracts on which the remaining investors compete for any given firm i . As a result there are $m - 1$ contracts of the type $(R_i, \Delta R_i) = (\min\{x - p(N, 0) \Delta x, x\}, \Delta x)$ and $N - m$ contracts of the benchmark type $(R^b, \Delta R^b)$ in equilibrium.

Corollary 1 *A sufficient condition for coordinating all firms on the impact technology is that the impact investor finances firms $i = 1, \dots, m - 1$, while the remaining firms can be financed by either the impact investor or conventional ones. If $x + p(N, 0) \Delta x \geq I$, conventional investors can finance all firms and induce adoption as long as they compete with the impact investor to offer $m - 1$ contracts of the type $(R_i, \Delta R_i) = (\min\{x - p(N, 0) \Delta x, x\}, \Delta x)$ and $N - m$ contracts of the benchmark type $(R^b, \Delta R^b)$.*

Impact Investors and Competition. It is important to note that, without competition from conventional investors, the impact investor need not have an explicit preference for the impact technology. In particular, if the impact investor were a monopolist, her expected profit from financing the impact technology would again be determined by the solution to Program 4 but without the no-profit constraint (5). Given that the impact technology has a higher probability of success when all firms adopt it (Assumption 1), it follows that impact investor's expected profits from financing the impact technology will be higher than those from the conventional technology, as long as the rents the investor needs to share with the firms to satisfy their adoption and incentive constraints are not too high.

The assumption that the impact investor has a preference for the impact technology is necessary in two cases. (i) The first is if we have competition from other investors, and the impact investor makes a loss on the full-insurance contract, because then she cannot offset these losses by making profits on firms later in the iterative dominance chain that are financed with the (break-even) benchmark contract. (ii) The second case is if we dispense with the assumption that the probability of success when all firms adopt the impact technology is

¹³In a blended finance arrangement, the impact investor can propose to conventional investors to cofinance firms $1, \dots, m - 1$, whereby they receive a more senior contract for which they break even in expectation, with the impact investor providing the remaining financing against a contract for which she potentially does not break even. The joint financing contract held by the impact and conventional investors then still corresponds to the contract from Proposition 3.

higher than that of the conventional one. Without this assumption, we always need the impact investor to have a (non-monetary) preference for the impact technology in order to finance its adoption. Incentivizing adoption and effort is then possible if contracts can condition on additional signals informative about a firm’s technology choice (Section 6).

4 Optimal Allocation of Concessionary Financing

We have shown that achieving impact while inducing effort requires offering heterogeneous contracts to firms. This raises the central question of contract allocation: which firm identities are assigned to which positions in the iterative dominance chain, i.e., which firms receive (i) benchmark (effort-inducing) financing, (ii) subsidized financing, or (iii) full insurance. An arguably unsatisfactory prediction when all firms are identical is that contract allocation is irrelevant. However, with firm heterogeneity, it becomes first-order for both efficiency and financial returns.¹⁴ In what follows, the set of N firms our model considers are best thought as those deemed most important for achieving broad adoption. We allow these firms to differ along various characteristics, such as size, effort costs and opportunity costs, and cash-flow distributions.

4.1 Targeting Large or Small Firms

To model firms of different sizes, we consider firms as collections of projects. In particular, we fix the total number of projects to be N and identify a firm by the number of projects it runs. Our baseline model is a special case in which each firm is managing one project, such that the number of projects is equal to the number of firms. To capture size-heterogeneity in the simplest way, assume that there is one large firm that manages ω projects while all remaining $N - \omega$ firms are small one-project firms. The large firm can be thought of as a holding company of ω one-project-firms. The key features of a large firm we want to capture are (i) centralized decision making—i.e., a centralized owner-manager chooses adoption and effort at each subsidiary level—and (ii) centralized financing—i.e., each division is financed at the same firm-specific terms. To keep tractability by keeping the contract space binary, we stipulate that the financing contracts for each division are backed by its own cash flows.

Since the large firm can coordinate decision-making for its division, its presence mitigates the coordination problem compared to our baseline model of single-division firms. In fact, if $\omega \geq m$, the impact investor can achieve the same outcome as under full exogenous coordination (Lemma 1) by placing the large firm at the beginning of the iterative dominance chain.

¹⁴We will discuss a firm’s preferences over its position in Section 5 below.

By coordinating all of its ω divisions to adopt, the large firm alone generates enough critical mass of adoption to make adoption a dominant strategy for itself as well as an iteratively dominant strategy for all remaining (small), even when all firms are offered the benchmark contract $(R^b, \Delta R^b)$. That is, placing the very large firm first can catalyze impact for all other firms.

However, if $\omega < m$, this is no longer possible, and the optimal contract will resemble Proposition 3, with firms early in the iterative dominance chain receiving the full-insurance contract. The question then is whether the impact investor should optimally place the large firm at the beginning and offer it the full-insurance contract or offer such insurance to small firms, while inducing effort at minimal subsidies from the large firm or leaving it to the competitive financial market altogether. That is, we seek to characterize the optimal position of the large firm in the iterative dominance chain.

Benchmark: All Investors Break Even. Consider, first, the case in which investors can break even under the full-insurance contract, $(R^{fi}, \Delta R^{fi})$. In this case, the impact investor earns zero profit on each firm it finances, independent of the ordering of the firms. While the investor-optimal ordering is, thus, not pinned down uniquely, the orderings differ in their efficiency implications, and there is a unique ordering that maximizes efficiency (i.e., minimizes effort distortions).¹⁵

To see this, consider the optimal contract from Proposition 3 and suppose that the impact investor targets the large firm first, assigning it to positions $1, \dots, \omega$ in the iterative dominance chain. Since $\omega < k = m$, the only way to incentivize the large firm to adopt the impact technology with a break-even contract is to offer the full-insurance contract, which induces no effort. The same contract also needs to be offered to the small firms taking positions $\omega + 1, \dots, k - 1$, while the remaining small firms in positions $k, \dots, N$ receive the benchmark contract and, thus, exert effort. Hence, targeting the large firms first results in effort being exerted only on projects placed in positions $k, \dots, N$, just as in the baseline model.

However, the impact investor can improve efficiency while still breaking even by positioning the large firm where it becomes catalytic: As we illustrate in Figure 2, efficiency is maximized by targeting $k - \omega$ small firms before the large one, while putting the large one at the position at position $k - \omega + 1$, where it becomes catalytic. In analogy to the baseline model (where firms are homogeneous), the small firms in positions $1, \dots, k - \omega$ receive the

¹⁵When multiple contract offers result in the same investor payoff, it is natural to assume that the impact investor picks the efficiency-maximizing one. One way to microfound this tie-breaking rule is to assume that the impact investor obtains a small benefit π when the impact technology leads to financial success. Our baseline model corresponds then to the case of $\pi \rightarrow 0$. Alternatively, one could assume that the impact investor receives a share of $\pi \rightarrow 0$ in each firm's profit, e.g., because she moves before conventional investors, and delay is costly to firms, or that she is the only firm offering financing as discussed in Section 3.3.

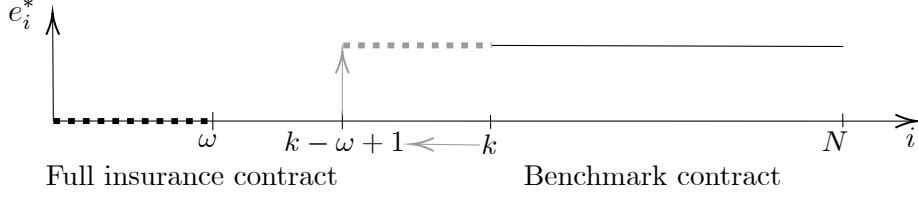


Figure 2: **Optimal position of large firm.** If $\omega < k$, placing the large firm at the beginning (black dotted line) does not affect efficiency. Instead, placing the large firm between positions $k - \omega + 1$ and k (gray dotted line) makes the large firm catalytic: it makes it possible to finance the large firm with the benchmark contract, which leads to higher effort and efficiency.

full-insurance contract, and those in positions $k + 1, \dots, N$ (placed after the large one) receive the benchmark contract, such that the latter group exerts effort while the former does not. The key observation is that by coordinating internally, the large firm finds it optimal to adopt and also exert effort when offered ω benchmark contracts. Thus, the impact investor induces effort on $\omega - 1$ additional projects.

Proposition 4 *Assume there is one large firm with $\omega < m$ projects and $N - \omega$ small one-project firms. Then, if investors break even with the full-insurance contract ($x + p(N, 0) \Delta x \geq I$), the following investor-optimal offer maximizes efficiency: (i) The impact investor targets $k - \omega$ of the small firms first (positions $1, \dots, k - \omega$ in the iterative dominance chain) with the full-insurance contract, $(R^{fi}, \Delta R^{fi})$. (ii) The large firm comes in positions $k - \omega + 1, \dots, k$ and receives the benchmark contract $(R^b, \Delta R^b)$ as do the remaining small firms in positions $k + 1, \dots, N$. This contract increases the number of projects with effort by $\omega - 1$ relative to the baseline with N small firms.*

A key implication of Proposition 4 vis-à-vis prior work on heterogeneous contracting is that the large firm's internal coordination advantage affects optimal ordering differently depending on the objective behind optimal contract design. In pure rent-extraction settings (absent efficiency distortions), placing the large player at the beginning of the iterative dominance chain is beneficial (Halac et al., 2020).¹⁶ However, Proposition 4 shows that if the objective is to achieve coordination while minimizing effort distortions, it is optimal to place *small* firms early and large only later only where they become catalytic. In what follows, we consider the case in which both rent extraction and efficiency maximization affect financing contracts.

¹⁶We use “players” instead of firms to avoid confusion since Halac et al. (2020) consider a coordination game among investors instead of firms.

Impact Investor Does Not Always Break Even. Minimizing efficiency distortions remains important also if the impact investor does not always break even ($x + p(N, 0) \Delta x < I$), but in this case, the impact investor will face a classical rent-extraction-efficiency trade-off. In particular, the impact investor's objective is to incentivize adoption while minimizing the subsidies needed to stimulate adoption by the firms at the beginning of the chain that conventional investors stay away from. As a result, the impact investor may be willing to sacrifice efficiency to minimize her losses.

A sufficient condition that placing small firms at the beginning of the chain is optimal despite this trade-off is that the impact investor's equilibrium payoff, $R_i + p(N, e_i^*) \Delta R_i - \psi(e_i^*)$, from the baseline model (Proposition 3) is convex in i .¹⁷ Since the large firm bridges multiple positions by coordinating and obtaining the same financing terms for its ω projects, placing it at positions $j - \omega, \dots, j$ allows the impact investor to offer all of its divisions the contract designed for position j and, accordingly, to achieve the payoff of position j also for positions $j - \omega, \dots, j - 1$. Convexity then implies that the benefit from flattening the impact investor's payoff over $j - \omega, \dots, j$ is larger for higher j , implying that the large firm should be placed later in the chain and small firms come first.

It remains to argue that the impact investor's equilibrium payoff in the baseline model is, indeed, convex at the beginning of the iterative dominance chain. This is the case, since in the baseline model, the impact investor offers the full-insurance contract to positions $1, \dots, k - 1$ (making her payoff flat in that region) and a contract inducing effort at k , such that her payoff features a hockey-stick-like increase at k . Thus, the large firm is always placed at position k or higher, at which the impact investor does not offer full insurance and induces effort. For positions higher than k (beyond which the impact investor does not offer the full-insurance contract), a sufficient condition that the impact investor benefits from placing the large firm later in the chain is that the firm's success probability $p(i, e)$ is sufficiently convex in i (see condition (A7) in the Appendix). Intuitively, this technological requirement means that the impact investment needs a certain scale of adoption to take off—which is arguably a standard characteristic in the adoption of new technologies.

Proposition 5 *If investors do not break even with the full-insurance contract ($x + p(N, 0) \Delta x < I$), the impact investor places the large firm at position k or higher. A sufficient condition that the impact investor finds it optimal to place the large firm at position m (i.e., even later in the iterative dominance chain) is that $p(i, \cdot)$ is sufficiently convex in i , as captured by condition (A7).*

¹⁷The investor's payoff is at least weakly increasing in i , because adoption and effort are easier to induce for higher i (since $p(i, e)$ increases in i). In particular, the impact investor can always offer firm $i + 1$ the same contract it offers to firm i and obtain the same payoff.

Modifying the contract offer game and endogenizing size. The result that the large firm is not targeted first is robust to modifications of the financing contract offer game. To illustrate this, suppose the impact investor competes with (for simplicity) a single conventional investor, and this investor makes the first financing offer. Suppose further that it is commonly known that the impact investor is committed to picking up the “slack,” that is, financing the firms that the conventional investor will not. In this modification, the conventional investor does not internalize the impact investor’s losses. Thus, the large firm will always be financed by the conventional investor, since placing the large firm in positions $k - \omega, \dots, k$ expands the number of firms that can be financed by the conventional investor without a subsidy. Note that while this may not be the outcome that minimizes the impact investor’s losses, it still makes her better off than in the baseline model. Moreover, it preserves the key prediction (the large firm is not placed first) and increases total surplus relative to the baseline.

Our analysis takes size as exogenously given. Yet one could conjecture that if a firm that is targeted earlier by the impact investor becomes more successful, it is likely to grow larger in size, implying that an ex ante small firm could eventually become larger than firms later in the chain. In our model, such reversals are unlikely. Since the first firms that the impact investor targets exert less effort, their success probability is lower. As a result, small firms, targeted first by the impact investor (Proposition 4-5), will also have a lower probability of success and, thus, likely remain smaller than the large firm, which has (endogenously) stronger incentives to exert effort.

4.2 Targeting Firms With Higher or Lower Effort Cost

Another dimension along which firms are likely to differ in practice is in their ease of adopting and successfully implementing the impact technology, captured by the effort cost ψ , which alternatively can also be thought of as capturing how well these firms are governed.¹⁸ As is intuitive, the expected cost of an effort-inducing contract rises with ψ . By contrast, the expected cost of a full-insurance contract, which does not induce effort, is independent of ψ . Thus, as effort costs increase in our baseline model with symmetric firms, the impact investor optimally offers the full-insurance contract to more firms and effort-inducing contracts to fewer. Formally, this means that the thresholds (k and m) determining whether investors incentivize both effort and adoption, and, respectively, break even, increase with ψ .

We can use these insights to analyze how the optimal order of firms depends on their cost-efficiency as captured by the effort cost ψ . Consider an extension of our baseline model

¹⁸As is standard, instead of effort cost, one could consider shirking benefits, which are an inverse measure of the quality of the firm’s corporate governance.

in which one firm has a higher effort cost (ψ^h) and one has a lower effort cost (ψ^l) than the remaining $N - 2$ firms who share the same cost ψ as in the baseline model with $0 < \psi^l < \psi < \psi^h \leq \frac{1}{\Delta p} \left(\Delta x - \frac{I-x}{p(N,e)} \right)$.¹⁹ Recall that in the baseline model, the impact investor offers the full-insurance contract to firms in positions $1, \dots, k - 1$, which then exert no effort, and an effort-inducing contract to firms in positions $k, \dots, N$. As is intuitive, placing the high-cost firm in the latter positions lowers the impact investor's payoff at least weakly. The decrease is strict for positions $k, \dots, m - 1$ for which the impact investor does not break even since the higher effort cost tightens both the effort and adoption constraints compared to the baseline model. It follows that placing the high-cost firm at the beginning of the chain, where no effort incentives are provided, is a better solution as it does not affect the investor's payoff. Accordingly, placing the low-cost firm in the middle of the dominance chain—between the first position at which incentivizing both effort and adoption is preferable over the full-insurance contract and the last position at which the impact investor cannot break even when incentivizing effort and adoption—increases the impact investor's payoff. This increase is highest at the beginning of this interval.²⁰

Proposition 6 *It is optimal for the impact investor to place the high effort-cost firm at the beginning of the chain, where she offers a full-insurance contract and does not induce any effort. It is optimal to place the low-cost firm at the position at which the impact investor first incentivizes both adoption and effort.*

What if there are $k + 1$ high-cost firms, such that placing all in positions $1, \dots, k$ is not feasible? In this case, it is optimal to place k of the high-cost firms in the first k positions (offered the full-insurance contract) and place the last high-cost firm at the very end of the chain (N). This ordering of the last high-cost firm makes sure that the higher cost does not exacerbate the adoption constraint, and the firm can be financed by competitive financiers, with the firm bearing its higher cost of effort itself. In short, it is optimal to position the high-cost firm where it causes the least distortions: either at the very beginning of the chain, where full cash-flow risk insurance is offered and effort costs do not matter, or at the very end, where the coordination problem does not matter.

¹⁹The last inequality ensures effort is not prohibitively costly: at $i = N$, the pledgeable income under effort is sufficient for investors to break even for the high-cost firm (see (7)).

²⁰Note that the cutoffs k and m can change depending on where the high- and low-cost firms are positioned. Furthermore, note that if the impact investor breaks even for all firms, placing the high-cost firm at the beginning of the chain and the low-cost firm at position $k - 1$ or higher is still optimal by our tie-breaking rule (see footnote 15), or, trivially, if effort cost are so high that breaking even while incentivizing effort is infeasible for any position in the chain, i.e., if $\psi^h > \frac{1}{\Delta p} \left(\Delta x - \frac{I-x}{p(N,e)} \right)$.

4.3 Further Sources of Heterogeneity

Opportunity Costs. Firms may also differ in their outside options, that is, in the profitability of their non-impact technology. In our framework, a higher outside option can be modeled as a higher baseline success probability p_0 , which tightens the adoption constraint under any contract that exposes workers to cash-flow risk. Consequently, higher outside options raise the thresholds k and m at which the impact investor can induce both adoption and effort and break even, respectively. Because this effect mirrors that of higher effort costs, the optimal ordering is qualitatively unchanged (see Lemma A1 in the Appendix): the investor places high outside option firms where their costs have no impact on her payoffs or efficiency. That is, she either places them among the firms to which she offers a full-insurance contract or places them last to let financial markets deal with them. Firms with comparably low outside options are, instead, placed where the cost-efficiency trade-off is most severe, i.e., in the middle of the dominance chain, where the impact investor induces both adoption and effort but does not break even.

Cash-Flow Dispersion. Furthermore, firms may differ in the dispersion of their cash flows, i.e., in their downside resilience and upside potential. We model dispersion as a mean-preserving spread: in particular, we take the expected cash flow $x_i + p(N, e) \Delta x_i$ to be the same for all firms, but x_i is lower and Δx_i is higher in the case of higher dispersion. Under the full-insurance contract offered to firms in positions $1, \dots, k - 1$, lower dispersion strictly increases the impact investor's payoff—downside protection is stronger (higher x_i) and the investor is harmed less when low effort reduces the probability of generating the upside Δx_i . In contrast, the investor's payoff for any higher positions $k, \dots, N$ is constant in dispersion. So, in an extension of the baseline model in which one firm has strictly higher and another strictly lower cash-flow dispersion than all other firms, the low-dispersion firm is placed at the front of the chain (in positions $1, \dots, k - 1$) while it is (weakly) optimal to place the high-dispersion firm at the first position for which effort is incentivized (k).

Lemma 3 *It is optimal to position the firm with low cash-flow dispersion among the positions receiving full insurance (below k) and the firm with high cash flow dispersion at or after the first effort-inducing position k .*

Investment Costs. Another source of firm heterogeneity is variations in investment costs I . Unlike effort costs or outside options, I enters the analysis primarily through the competition (break-even) constraint, and therefore affects ordering by changing where break-even financing is feasible.²¹ To see this, consider an extension of the baseline model in which

²¹This is equivalent to variation in firms' own funds, provided these are observable to the impact investor.

one firm has a higher and one a lower investment cost than all other firms whose investment costs are the same as in the baseline model. A lower investment cost translates into a higher overall return on investment (ROI). To keep the focus on ordering rather than feasibility, assume condition (7) continues to hold for the high-investment-cost firm. Then the following result holds:

Lemma 4 *It is optimal to place the low-investment cost (higher ROI) firm at the beginning (in $1, \dots, k - 1$) and the high-investment cost firm at the end (in $m, \dots, N$) of the iterative dominance chain.*

A higher investment cost tightens the competition constraint, making break-even harder or even impossible at low positions in the chain. Hence, it is (weakly) optimal to place the high-cost firm at the very end (N) where investors are guaranteed to break even. Conversely, since the investor's payoff is capped by the competition constraint, she gains the most by placing the low-cost firm at the position where the potential for a payoff increase is highest. Since the impact investor's loss is highest at the beginning of the chain, it is at least weakly optimal to place the low-cost firm there (in $1, \dots, k - 1$). Thereby, as long as the competition constraint remains slack, the contracts the impact investor offers to firms in positions $1, \dots, m - 1$ are unchanged since I enters only through the competition constraint.

Discussion. Correlations across firm characteristics can generate competing ordering forces. For example, larger firms are often incumbents with lucrative non-impact technologies. A positive correlation between size and outside options then creates opposing placement forces: stronger outside options (higher p_0) tend to push towards placing the firm earlier in the chain, whereas a larger size—when it expands the feasible scale of adoption—tends to push towards placing it later. This highlights that optimal contract allocation depends on the joint distribution of characteristics.

Furthermore, the results in this section suggest that firms might have incentives to strategically manipulate observable characteristics (governance, disclosure, cash-flow risk) to obtain a better positioning in the chain. To see this, we first summarize how a firm's payoff changes with its position in the iterative dominance chain:

Lemma 5 *A firm's expected payoff is: (i) lowest in positions $1, \dots, k - 1$, where no effort is induced; (ii) higher in positions $m, \dots, N$, where both adoption and effort are induced and the investor breaks even; and (iii) highest—and decreasing in i —in positions $k, \dots, m - 1$, where adoption and effort are induced but the investor does not break even.*

In our model, there are three regions for the firms' expected payoff, depending on where in the dominance chain they are positioned (Figure 1): at the beginning, where no effort

incentives are provided, firm payoff takes its lowest value of $\max \{x + p(N, 0) \Delta x - I, 0\}$, i.e., either the project NPV absent effort or zero, whichever is larger. At the end of the chain, where the coordination problem is resolved and effort incentives are provided, investor competition ensures that the firm’s expected payoff is equal to the project NPV *with* effort, $x + p(N, e) \Delta x - I$. In the middle of the chain, $k, \dots, m-1$, the firm’s expected payoff is highest since these firms are induced to adopt and exert effort, thus generating the same expected surplus as those at the end of the chain. However, these firms need to be subsidized by the impact investor—who makes a loss (decreasing in the position i) in order to be able to induce both adoption and effort.

Thus, if firms could affect the sources of heterogeneity discussed previously via an ex-ante investment, i.e., before the impact investor makes her offers, it follows from the optimal ordering of heterogeneous firms characterized above that they would have incentives to (i) increase the scale of their investment opportunity; (ii) improve the efficiency of their processes and governance (lowering ψ) at the expense of their outside options (lowering p_0) but not their funding needs (I); (iii) increase the dispersion of project payoffs.

5 Discussion and Implications

Before discussing some extensions of our model that allow for additional contractible impact metrics in Section 6, we consider its main implications and discuss some robustness issues.

5.1 Impact Investment Strategies: No Concessions to Winners

In this section, we translate our main contract-design results into practical portfolio rules for catalytic investors operating alongside competitive capital. Impact investors include private-sector investors, such as mission-aligned private equity and venture capital funds (e.g., Brookfield’s Alterra platform and BlackRock Decarbonization Partners) and family offices (Cole et al., 2024), as well as public or semi-public sector investors, such as sovereign wealth funds and development finance institutions (e.g., IFC, EBRD, KfW, and Norfund). According to the Global Impact Investing Network (GIIN), by 2024, approximately 3,907 organizations managed \$1.571 trillion in assets explicitly allocated to impact investing, growing at an annual compound rate of 21% since 2019.

Investment Strategies. Although impact investors frequently offer private capital that comes in the form of private equity (PE) or venture capital (VC), our model cautions against adopting traditional PE and VC strategies that focus on the most promising future “winners” or “stars.” The reason is that an important purpose of impact investing is to provide scale and

catalyze impact so that the competitive financial market can take over—thus, even among a pre-screened set of promising firms, not all targeted firms can be stars. That is, the objective is to ensure that sufficiently many firms adopt a given impact technology at the lowest cost to investors and with the least efficiency distortions. Indeed, while targeting first firms with the highest expected return on investment is still optimal (Lemma 4), Propositions 4-6 show that other standard investment criteria are partially reversed: Among the firms identified as important for achieving impact (the N firms in our model), impact investors should not start with those that can invest at the largest scale, are best-governed, or whose cash flows exhibit more upside potential (i.e., higher cash flow dispersion).²² The reason is that the firms targeted first need to be provided with larger insurance against cash-flow risk, which, in turn, leads to larger effort distortions. Given these efficiency distortions, it is best that (among the set of promising firms important for achieving impact) impact investors initially target firms where these efficiency distortions matter less—in particular smaller firms with higher exposure to agency problems, as well as safer firms whose downside resilience possibly comes at the cost of a lower upside potential. While making sure that the best firms can raise funding remains crucial, our prediction is that these firms should be targeted with financing that is close to what competitive markets would offer. In fact, such firms are often best left to the competitive market, which—although not well-suited to coordinate firms on investing in impact—can rein in agency conflicts at the firm level. A cautionary illustration is Northvolt, once hailed as Europe’s battery champion: it raised over \$15 billion in equity, debt, and public financing—yet filed for bankruptcy in early 2025 after mismanagement and overexpansion resulted in a failure to scale efficiently despite massive backing.²³

Expected Returns. Our analysis shows that when impact investors operate in a competitive capital market, there should be no illusions: impact investing is rarely a path to outperform market returns. The success of catalytic impact investing often depends on subsidies or concessional financing. As the quote in the Introduction by the Global Impact Investing Network (GIIN) states, “*Catalytic capital consists of debt, equity, guarantees, and other instruments that accept disproportionate risk or concessionary returns compared to conventional investments precisely to generate positive impact*” (GIIN, 2022). Our model captures exactly this kind of capital—financiers intentionally trade off financial return to ignite industry-wide shifts and unlock competitive financing once a critical mass of firms start adopting the impact technology. Allocating concessions primarily to “future winners” is counterproductive: Doing so means undermining many of these firms’ initiatives, increasing

²²The N firms in our model should be understood as those identified as most important by the impact investor for achieving broad impact. Our predictions focus on this set of firms.

²³See “Northvolt failure raises stakes for Europe’s battery industry,” May 22, 2025, Financial Times.

the number of firms needing subsidized impact financing, while not improving the investors’ returns on firms contested by competitive markets (since excess financial returns on these firms will be competed away). In practice, catalytic funds frequently deploy structures emphasizing price concessions, first-loss positions, longer patience, or flexibility in terms. While, in line with our model, the majority of impact investors do aim for market returns, over 35% of catalytic investors explicitly adhere to below-market return expectations (Riedl and Smeets, 2017; Brown et al., 2023; Hand et al., 2024).²⁴ Our model’s prediction—granting strong insurance to early adopters but scaling back as industry adoption progresses—mirrors these patterns: early-stage catalytic blocks enable later private capital flows for firms where coordination risk is lower.

Financing Instruments. The instruments that impact investors use involve debt and equity. The impact investor effectively buys up the equity in firms in which she wants to insure entrepreneurs against cash flow risk. Equivalently, impact investors can do so by providing guarantees and injecting further capital in low cash flow states. Otherwise—when impact investors stimulate both adoption and effort—they optimally rely on debt financing (Figure 1). This prediction is consistent with the practice of impact investors of using both equity and debt, often at preferential terms, to catalyze impact (Hand et al., 2024). Our model predicts that the optimal sequence is initially funding companies with equity and then transitioning to debt. The key is not the security label per se, but the payoff profile: early contracts must provide downside protection (equity-like), while later contracts must preserve managerial skin in the game (debt-like). Plain-vanilla financing contracts—such as straight debt—are viable in impact financing settings but generally require larger subsidies and produce greater effort distortions compared to contracts that condition on additional impact signals (as we will show in Section 6): when these signals are perfectly informative, use-of-proceeds bonds (e.g., green bonds) are optimal—forcing the firm to deploy funds in explicitly verified projects. When signals are noisy, sustainability-linked loans or bonds that tie financing terms (e.g., coupon reset, warranty trigger) to ESG metrics or milestones offer an efficient alternative. Indeed, the use of such debt has increased exponentially over the last decade, with its volume estimated at over \$7.5 trillion as of 2023 (Barbalau and Zeni, 2025).

²⁴The Impact Finance Research Consortium’s (IFRC) 2023 survey of (primarily VC and PE investors) shows that the main forms of catalytic capital include “patience” (accepting a longer and more uncertain time before exit), “purpose” (accepting non-traditional terms), “price,” and “position” (accepting below market-rate returns and providing credit enhancement via subordinated debt or equity positions, respectively).

5.2 Relation Between Impact Finance and Public Policy

Coordination failures—rooted in network externalities and strategic interdependence—are a classic rationale for government intervention. Policies such as uniform green subsidies, carbon pricing, or mandatory adoption thresholds can correct underinvestment by reducing coordination risk (Aghion et al., 2016). Such interventions are particularly valuable when no impact investor is willing to absorb losses to initiate adoption. Our results show, however, that public interventions and private contracting are complements rather than substitutes.

Private Contracting versus Taxation and Subsidies. The key advantage of private contracting that our model highlights is that it allows for firm-specific targeting. Unlike uniform subsidies, private contracts can discriminate across firms according to their coordination risk, size, effort cost, and outside options. As we have discussed in detail, this discretion minimizes the aggregate cost of industry-wide adoption. This result adds a novel perspective on the debate over the heterogeneous effects of subsidies (Criscuolo et al., 2019; Cingano et al., 2025) by shifting the focus of discretion: in our framework, it is exercised by investors who internalize financial risk-return trade-offs, rather than politicians or bureaucrats exposed to electoral cycles, lobbying, or corruption.

Another advantage of private contracts in helping firms coordinate on investment in impact technologies is that they allow for better commitment by locking in project-level terms for the full investment cycle. By contrast, public subsidies and tax rebates are politically reversible (Besley and Persson, 2023), and political uncertainty leads firms to reduce and delay investment (Gulen and Ion, 2016; Jens, 2017; Kumar et al., 2023).²⁵

Importance of Public Policy. Crucially, to achieve the scale needed for industry-wide impact, impact investors frequently form consortia—such as the Catalytic Capital Consortium (C3)—as well as affiliated blended finance vehicles and multi-stakeholder effort initiatives, including the Global Energy Alliance and Breakthrough Energy Catalyst. Coordinating impact investors in consortia is important since otherwise investors could face a similar coordination problem to that faced by firms. Furthermore, forming consortia also allows impact investors to better diversify their losses and achieve a better risk-return profile. In fact, we have shown that the pressure to compete with conventional investors is a key factor forcing impact investors to absorb losses on their investments (Section 3.3). Yet allowing investors to coordinate in such consortia has faced political and legal headwinds that have hindered their effectiveness.²⁶

²⁵Extending our model to consider a probability that initially favorable financing terms are worsened ex post—which would correspond to reneging on promises of favorable taxation or subsidies—makes satisfying the adoption and effort constraints more difficult or even impossible. This lack of commitment distorts efficiency and leads to less aggregate surplus that can be shared between firms and investors.

²⁶In early 2025, BlackRock exited the Net-Zero Asset Managers (NZAM) initiative amid U.S. political

Thus, our model highlights that government policy remains critical to scaling impact finance by playing three complementary roles: First, governments can legitimize investor consortia by relaxing antitrust scrutiny in designated high-impact sectors—creating legal safe harbors that enable soft coordination or joint contracting to pool resources and improve risk-return profiles without triggering collusion risks. This institutional flexibility allows multiple impact investors to act in concert without explicit collusion. Second, public capital injections into catalytic platforms (e.g., Green Climate Fund, Norfund co-investments) can support discretionary, firm-specific catalytic contracting with private-sector impact investors, helping avoid uniform industry-wide government subsidies. Similarly, promoting blended financing that combines purely financially-driven investors with (possibly public or semi-public) impact investors who offer conventional investors various guarantees or contractual advantages that are more likely to lead to market returns can also play a big role. Interestingly, Flammer et al. (2025 a,b) document that the concessionary returns offered by DFI institutions to promote blended finance tend to be higher for firms with a higher expected social impact as well as for riskier firms, which would not have been financed otherwise. Their empirical findings provide institutional detail and empirical patterns consistent with the catalytic-capital logic, underpinning our model. Third, public policy instruments such as carbon pricing or sector-wide subsidy programs—though very rough tools according to our model—are also useful, because they can help shift baseline beliefs and reduce upfront coordination risk—making it easier for private capital to catalyze impact at a lower cost.²⁷

We next provide some discussion of robustness. Subsequently, in Section 6 we extend the model to allow for contractible impact signals.

5.3 Discussion: Complementarity of Effort and Adoption

We have solved the model assuming that adoption and effort are weak complements, that is, $\Delta p(n) := p(n, e) - p(n, 0)$ was the same for all n , which we denoted by Δp . Extending our analysis to strict complementarity is straightforward. The main change is that the effort constraint then depends on a firm’s belief about overall adoption, n . That is, extending condition (6), the incentive constraint that needs to be satisfied in order for the firm at

backlash over ESG commitments. NZAM, which previously had over 325 members managing roughly \$57.5 trillion in assets, paused its public reporting and tracking in response. Major U.S.-based asset managers, including State Street, JPMorgan, and Pimco, similarly withdrew from investor climate alliances such as Climate Action 100+, citing legal and reputational concerns. See “A moment of truth for green financial alliances,” December 18, 2024, Financial Times.

²⁷One example is Brazil’s \$3.6 billion climate finance push with Brookfield and TPG alongside sovereign BNDES seed investment.

position i in the dominance chain to exert effort becomes

$$(p(n, e) - p(n, 0)) (\Delta x - \Delta R_i) \geq \psi, \forall n \geq i. \quad (10)$$

Since $\Delta p(n) = p(n, e) - p(n, 0)$ is increasing in n it is sufficient to satisfy (10) for $n = i$ in order to induce effort (and for $n = 1$ in the case of symmetric contracting).

Conceptually, this implies that the effort constraint is affected by the coordination problem and, hence, becomes more similar to the adoption constraint. In particular, the effort constraint is now more difficult to satisfy for firms targeted earlier, i.e., placed at lower positions i . Formally, this implies that the effort constraint can be binding for firms at positions lower than m . However, the main predictions of optimal contract design are unchanged. The impact investor will still offer the full-insurance contract to firms at positions below k , and an effort-inducing contract under which she breaks even (akin to the benchmark contract) to firms in positions at or above m , while firms $k, \dots, m - 1$ are incentivized to put effort via a subsidized contract. The only difference is that the thresholds k and m and the constraints that determine ΔR_i in the interval $\{k, \dots, m - 1\}$ can be different. Furthermore, the main intuition behind the optimal ordering of firms—which did not depend on whether the complementarity between effort and adoption is weak or strict—remains the same. Hence, the predictions from Section 4 about which firms the impact investor will put at the beginning and which at the end of the iterative dominance chain remain qualitatively the same.²⁸

6 Impact Metrics and Disclosure

We next extend our model to account for the possibility that outsiders observe signals about the firms' adoption choices. Examples of such signals include impact metrics such as ESG ratings, publicly observable carbon emissions or pollution figures, employee or customer satisfaction surveys, or observable milestones informative about a firm's pursuit of impact. We denote these firm-specific publicly observable and verifiable signals that realize alongside the projects' cash flows by s_i . In the main text, we consider the case of a binary signal $s_i \in \{s_L, s_H\}$ for each $i = 1, \dots, N$ with the high impact signal realization, $s_i = s_H$, being more likely if the respective firm adopts the impact technology, $q(s_H|1) > q(s_H|0)$.

²⁸In the case of substitutes, the effort constraint is more difficult to satisfy for higher i . Despite this, resolving the coordination problem for firms at the beginning of the chain will still lead to no effort if these firms must be offered the full-insurance contract to adopt, which is always the case with plain-vanilla contracts. Thus, we will again have three regions: firms receiving the full-insurance contract and exerting no effort; firms exerting effort for which the impact investor does not break even; and firms exerting effort for which the impact investor breaks even. Furthermore, the prediction that large firms will be at the edge between the second and third group also remains unchanged.

The availability of such signals allows the impact investor to go beyond plain-vanilla financing arrangements by conditioning contractual repayments on the impact signal realization, $\mathbf{R}_i(s_i) = (R_i(s_i), \Delta R_i(s_i))$, subject to the feasibility conditions of limited liability, $0 \leq R_i(s_i) \leq x$, and cash flow monotonicity, $0 \leq \Delta R_i(s_i) \leq \Delta x$, for all s_i, i . For our subsequent analysis of optimal signal-contingent contracts, we again assume that firms are ex-ante homogeneous as in our baseline model.

6.1 Contracting on Impact Metrics

Making financing contracts dependent on verifiable signals indicative of firms' technology choices does not alter the main qualitative predictions from our analysis of plain-vanilla financing in Proposition 3 and Corollary 1. However, such signals can help raise efficiency—i.e., the number of firms that exert high effort—while lowering the need to subsidize firms to achieve impact—i.e., lowering the number of firms on which investors make a loss, thereby crowding in competitive financing for more firms.

Mirroring our analysis in Section 3.2, we consider, first, optimal *symmetric* financing contracts. The adoption constraint in this case can be written as

$$\begin{aligned} & \sum_s q(s|1) (x - R(s) + p(1, e^*) (\Delta x - \Delta R(s))) - \psi(e^*) \\ & \geq \sum_s q(s|0) (x - R(s) + p_0 (\Delta x - \Delta R(s))). \end{aligned} \quad (11)$$

As is intuitive, incentivizing adoption calls for rewarding a firm for signals indicative of adoption of the impact technology and punishing it for signals indicating that it has chosen the conventional technology. Indeed, the optimal contract follows precisely this prescription by stipulating that the firm's contractual payments decrease for the high signal. The decrease is strict for at least one cash flow realization, except in the case of the full-insurance contract. The effectiveness of this two-tier contract structure is trivial to see when signals are fully informative, offering a contract $(R(s_H), \Delta R(s_H)) = (R^b, \Delta R^b)$ to all firms coupled with a penalty of $(R(s_L), \Delta R(s_L)) = (x, \Delta x)$ ensures that coordination can be achieved without any additional efficiency distortions and without any subsidies.²⁹

Proposition 7 *When contracts can condition on informative impact signals, the optimal symmetric financing contract $(R(s), \Delta R(s))$ stipulates that a firm's repayments to investors, R and ΔR , decrease if the signal realization is $s_i = s_H$.*

²⁹In the special case of fully informative signals, the penalty is not uniquely pinned down since it is only incurred off-equilibrium. When signals are noisy, arbitrarily high penalties are not optimal since the low signal is realized with positive probability even if the firm adopts the impact technology.

Before discussing the implications of impact financing contracts for efficiency and investor payoffs, we first extend the above characterization to heterogeneous contracts. The optimal heterogeneous impact financing contract $\mathbf{R}_i(s_i)$ extends the intuition we have developed in the context of plain-vanilla contracts (Proposition 3). Just as with plain-vanilla financing, if firms $i = 1, \dots, m - 1$ adopt the impact technology, adoption is an iteratively dominant strategy for all remaining firms. Hence, it is optimal for investors to offer firms $i = m, \dots, N$ the benchmark contract $(R^b, \Delta R^b)$, with both conventional and impact investors being able to offer such financing. The main difference to the case of plain-vanilla contracts is that the impact investor achieves higher efficiency while absorbing lower losses. First, by offering signal-contingent impact financing contracts along the lines of Proposition 7, investors can achieve the same outcome as with the benchmark contract for more firms. In particular, there is a two-tier contract that strictly relaxes the firms' adoption constraint and is payoff-equivalent to the benchmark contract cash-flow-state by cash-flow state, thus, achieving the same effort and payoffs for all parties. Second, it is possible to offer two-tier contracts for which the adoption constraint is satisfied, and investors break even for a wider set of firms. Thus, the set of firms that can be financed by all investors increases, so that the impact investor can catalyze impact by investing in a smaller set of firms (for which she incurs losses). Third, two-tier contracts are also optimal for firms for which the impact investor cannot break even, since they allow the impact investor to satisfy the firms' adoption constraint at a lower cost. Overall, impact financing contracts provide a smoother transition between the benchmark contract offered to the last set of firms in the dominance chain and the full-insurance contracts offered to firms at the beginning of the chain. In some cases, they improve on the full-insurance contract even for the first firm in the chain. In the Appendix, we provide a complete characterization of the contracts investors offer. The following Proposition summarizes their main properties.

Proposition 8 *Assume that contracts can condition on (imperfectly) informative impact signals. Then, the impact investor optimally offers two-tier effort-inducing contracts that stipulate a lower repayment to investors following a high signal, $R_i(s_H) \leq R_i(s_L)$ and $\Delta R_i(s_H) \leq \Delta R_i(s_L)$, with at least one of these inequalities being strict, to all firms ranked in positions $k, \dots, N$ in the iterative dominance chain. These contracts are payoff-equivalent to the benchmark contract for firms $m, \dots, N$, whereby $m \geq k$ is lower than under plain-vanilla financing, strictly so if the signal is sufficiently informative. Firms in positions $1, \dots, k - 1$ receive the full-insurance contract $(R^{fi}, \Delta R^{fi})$ and do not exert effort, with k being lower than under plain-vanilla financing, strictly so, if the signal is sufficiently informative. This offer ensures that (i) the impact investor's losses decrease for each firm and (ii) efficiency increases since more firms are exerting effort.*

6.2 Signal Informativeness and Disclosure

We next consider comparative statics as well as heterogeneity in signal informativeness. Comparing equilibrium effort provision when there are no informative impact metrics (Proposition 3) and when impact metrics are informative (Propositions 7-8) suggests that efficiency increases in the informativeness of the impact signal. The efficiency increase is strict if impact metrics are perfectly informative, since then all firms exert effort, while firms receiving the full-insurance contract under plain-vanilla financing do not exert effort. More generally, it can be shown that the number of firms that do not exert any effort decreases in the precision of the impact metric.

Consider, now, an extension of the impact-signal model that allows informativeness to differ across firms. For simplicity, we assume that there is one firm whose impact signal is more informative and one whose signal is less informative than that of the remaining $N - 2$ firms (who all have equally informative signals), where we capture signal informativeness in the following way: Let $0 < q(s_H|0) < q(s_H|1) < 1$ characterize the conditional signal distribution for the $N - 2$ firms with moderate signal informativeness. For the remaining two firms we then stipulate that $q_i(s_H|1) = q(s_H|1) + \varepsilon_i$ and $q_i(s_H|0) = q(s_H|0) - \varepsilon_i$, where $\varepsilon_i > 0$ corresponds to the case of a more informative signal and $\varepsilon_i < 0$ corresponds to the case of a less informative signal, and ε_i is such that $q_i(s_H|0), q_i(s_H|1) \in (0, 1)$.

The optimal position for the firm with the less-informative signal is either at the beginning of the dominance chain (i.e., in positions $1, \dots, k - 1$) or at the end (i.e., in position N), depending on whether the impact investor offers the full-insurance contract to some firms or not. In both of these cases, signal informativeness does not matter since optimal contracts at the respective positions (the full insurance or benchmark contract) do not condition on the impact signal. It remains to consider the optimal position of the firm with the more-informative signal, which is optimally placed between positions k and $m - 1$ at which contracts condition on the impact signal. At these positions, higher informativeness can help increase the number of firms that exert effort compared to the case in which all firms have a moderate level signal informativeness by placing the high-informativeness firm at $k = k_0 - 1$, i.e., the first position at which effort is incentivized (where k_0 denotes the respective position in the baseline model in which all signals are equally informative). Alternatively, even if lowering k is not possible (i.e., $k = k_0$), higher informativeness can be used to extend the number of firms on which the impact investor breaks even by placing the high-informativeness firm at $m = m_0 - 1$, i.e., the first position at which the impact investor breaks even (where m_0 denotes the respective position in the baseline model). In fact, if investors always break even, the only reason for targeting the firm with a higher signal precision is to extend the number

of firms that exert effort, implying that placing that firm at the first position at which the impact investor incentivizes both adoption and effort is optimal.

Proposition 9 *Assume that firms differ in the informativeness of their impact signal, with one firm's informativeness being higher and one firm's being lower than that of the remaining $N - 2$ firms. Then, the firm about which the investors' signal is less informative is optimally placed either at the beginning $(1, \dots, k - 1)$ or the end (N) of the iterative dominance chain, where signal informativeness is irrelevant for contracting. The optimal position of the firm about which the investors' signal is more informative is between k and m . This allows the impact investor to reduce her losses and potentially increase efficiency, i.e., the number of firms that exert effort, relative to the case in which all firms have a moderate level informativeness.*

Strategic Investment in Informativeness. In Proposition 9, we took the precision of the signals available to investors as given. In some cases, firms can affect signal precision, for example, by sharing additional information about their technology choices. Higher signal precision increases efficiency and the impact investor's payoff by inducing more effort (Proposition 9).³⁰ However, the implication of higher precision for firm payoffs is ex-ante unclear. On the one hand, if more informative signals increase efficiency, i.e., lead to more firms in the iterative dominance chain receiving effort incentives (lower $k = m$), firms can be better off. This is unambiguously true if the impact investor always breaks even since then firms extract the project's NPV, which is increasing in effort. On the other hand, higher signal precision may lead to lower subsidies, which lowers the payoffs of firms in positions $k, \dots, m - 1$.

In the following, we build on these ideas to consider an extension of our model in which firms can affect the informativeness of investors' signals. Specifically, before the impact investor makes an offer to all firms, firms can commit to a certain disclosure standard, e.g., via a costly investment in the firm's reporting technology. Concretely, we assume that the cost of establishing high-quality impact disclosure that leads to perfectly informative impact signals is c_h . The cost of moderate-quality disclosure that leads to informative but noisy signals is c_m . No (i.e., zero-cost) investment in reporting leads to fully uninformative impact signals.

Consider, first, a candidate equilibrium in which all firms invest in high-quality information disclosure. Hence, in the subsequent financing game, all firms have incentives to exert

³⁰In the limit of perfectly informative signals, coordination can be achieved without efficiency distortions or subsidies by the impact investor.

effort, and investors break even on each firm. The problem with this equilibrium candidate is that firms have an incentive to deviate. Indeed, if a firm anticipates that all other firms will invest in high-quality disclosure, it can benefit from not sharing any information. Non-disclosure will lead the impact investor to optimally put the firm at position N in the dominance chain (see Proposition 9), such that it will receive the benchmark contract and face no effort distortions. That is, the firm's gross payoff remains the same, but since the firm saves the disclosure cost c_h , its net payoff strictly increases with the deviation, breaking the equilibrium.

Consider, now, the opposite extreme, in which no firm discloses anything. Since in this case, investors can only offer plain-vanilla contracts, the impact investor will offer the full-insurance contract to a subset of k firms, which will not exert any effort. For simplicity, we assume that from an ex ante perspective, when all firms are identical, the positions in the dominance chain are allocated randomly, such that each firm will receive the full-insurance contract with probability k/N . In this case, by deviating and engaging in moderate-quality disclosure, a firm can guarantee that it will receive a contract that incentivizes effort. Since firms are better off under a contract that incentivizes effort than under the benchmark contract, this provides an incentive to deviate. The forces that counter this incentive are that (i) moderate disclosure entails a cost c_m and (ii) more informative signals reduce the subsidies the impact investor needs to pay in order to incentivize adoption and effort from firms placed in positions $k, \dots, m-1$. The latter force implies that even if moderate disclosure is costless ($c_m = 0$), firms may not deviate from non-disclosure.³¹

Proposition 10 *If firms can affect the informativeness of investors' signals by investing in the quality of their disclosure, then perfect disclosure by all firms cannot be sustained as an equilibrium. Because less precise signals lead to higher subsidies, non-disclosure can arise as an equilibrium, even if moderate disclosure is costless ($c_m = 0$).*

7 Conclusion

Industry-wide adoption of impact technologies is often held back not by lack of interest, but by strategic hesitation: firms are reluctant to invest unless they believe others will do so too. Large funding needs to realize adoption further compound this problem. This paper

³¹It is never optimal to break this candidate equilibrium by deviating to high-quality disclosure since (i) it is costlier and (ii) it leads to a contract that is never subsidized by the impact investor. Hence, the relevant disclosure costs are c_m . Furthermore, as is intuitive, a sufficient condition to sustain equilibria with non-disclosure is that the cost of moderate disclosure is sufficiently high. If, instead, the cost of moderate disclosure is not too high and the impact on subsidies is small, it is possible to sustain equilibria with moderate disclosure.

shows how catalytic impact investors operating in competitive financial markets can resolve this coordination failure through targeted financial contracts that encourage adoption by a critical mass of firms while minimizing agency distortions.

At the core of our analysis is the recognition that promoting impact investment involves a fundamental trade-off between reducing coordination risk and preserving effort incentives. Full insurance against cash-flow risk can ensure adoption, but saps managerial effort. Uniform policies—such as government subsidies or taxes—are most exposed to this trade-off and thus strike the worst compromise between incentivizing adoption and effort. While government intervention is still of first-order importance—by facilitating the legal framework and political climate needed to support impact investors—we argue that private contracting can meaningfully complement government policies. In particular, private contracting provides the flexibility of offering heterogeneous, firm-specific contracts that allow the impact investor to address the trade-off between incentivizing adoption and curbing agency problems more efficiently. The availability of informative and contractible adoption signals, e.g., in the form of ESG ratings or other impact metrics, can further help reduce both agency distortions associated with impact financing as well as the amount of subsidized financing impact investors need to provide.

Our model demonstrates that catalytic impact financing is most effective when it is initially not directed at tomorrow’s most likely winners—firms that can invest on a larger scale and more cost-efficiently—but at those firms that would otherwise remain on the sidelines. The reason is that impact financing is typically distortive. By providing insurance against cash-flow risk, impact financing often exacerbates agency problems. Thus—among the set of promising firms important for achieving impact at scale—early targets of impact financing should be smaller, safer, and less cost-efficient firms or firms with higher switching/opportunity costs, where impact financing will add comparatively less to potential agency distortions. While ensuring that the likely champions of tomorrow—cost-efficient firms that can invest on a larger scale and whose cash-flow distribution has fatter tails—receive funding remains crucial, these firms should be financed with as little distortive impact financing as possible. In fact, they are best left to competitive non-impact financiers who can take over once impact investors have financed a critical mass of adoption.

To derive the main new economic trade-offs, we have largely abstracted from dynamic financing considerations. Going forward, incorporating such considerations could provide further interesting insights. For instance, it would be interesting to model the optimal timing of repayments to the investor. Similar to guarantees and subsidies, allowing more time till repayments are due, i.e., being “patient,” appears to be a double-edged sword. On the one hand, it could incentivize impact investment in the face of technological uncertainty; on

the other hand, it could foster agency conflicts related to protracting decisions and exerting insufficient effort. Furthermore, an interesting avenue for future research is to consider the dynamic aspects of how earlier access to impact financing can shape firms' first-mover advantage in a competitive industry equilibrium.

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Appendix: Proofs

Proof of Lemma 1. It only remains to show that the adoption constraint is non-binding if a firm believes that all other firms adopt. The adoption constraint (2) absent coordination frictions is

$$(p(N, e_i^*) - p_0) (\Delta x - \Delta R_i) \geq \psi(e_i^*). \quad (\text{A1})$$

This constraint is always satisfied if $e_i^* = 0$, since assumption (1) implies that the left-hand side is nonnegative for any feasible contract while $\psi(0) = 0$. If $e_i^* = e$, we must have that (6) holds, which for exogenous coordination simplifies to

$$(p(N, e) - p(N, 0)) (\Delta x - \Delta R_i) \geq \psi. \quad (\text{A2})$$

It then directly follows from (1) that (A2) implies (A1). **Q.E.D.**

Proof of Lemma 2. Setting $\Delta R_i = \Delta x$ for all s_i, i , which leads to zero effort, satisfies the adoption constraint (2) for all i . R_i is then set as the maximum the investor can demand subject to the zero-profit constraint for investors and the feasibility constraint $R_i \leq x$: $R_i = \min \{I - p(N, 0) \Delta x, x\}$. **Q.E.D.**

Proof of Proposition 1. If a contract induces effort, then $\Delta R < \Delta x$ by (6). Robust adoption for the first firm requires the adoption constraint to hold at $n = 1$. However, with $p(1, e) - p_0 < 0$, the adoption inequality cannot hold for any $\Delta R < \Delta x$. Hence, robust adoption forces $\Delta R = \Delta x$ (full insurance), which violates effort incentives. **Q.E.D.**

Proof of Proposition 2. The proof follows from the arguments in the main text. **Q.E.D.**

Proof of Proposition 3. Step 1: *Optimal contract for firms $i = m, \dots, N$.* Recall that m is defined as the smallest index i such that the adoption constraint

$$(p(i, e^*) - p_0) (\Delta x - \Delta R_i) \geq \psi(e_i^*). \quad (\text{A3})$$

and the effort constraint (6) can be satisfied for contract $(R^b, \Delta R^b)$. That is, assuming that $i = 1, \dots, m - 1$ firms adopt the impact technology, adoption is an iteratively dominant strategy for firm $i = m$ if it is offered $(R^b, \Delta R^b)$ (regardless of what firms $m, \dots, N$ do). Observe that such an m always exists since (A3) and (6) always hold for $n = N$. Furthermore, since these constraints can hold with a strict inequality for N , it is possible that $m < N$. As long as the impact investor has offered firms $i = 1, \dots, m - 1$ contracts for which adoption is

an iteratively dominant strategy, then offering the benchmark contract $(R^b, \Delta R^b)$ to firms $i = m, \dots, N$ is optimal since it coincides with the solution to the benchmark problem in which there are no coordination frictions. Finally, since all investors anticipate that adoption is a dominant strategy for firms $i = 1, \dots, m - 1$, conventional investors can offer the same contract as the impact investor.

Step 2: *Optimal contract for firms $i \leq m - 1$.* If the benchmark contract violates the adoption constraint (A3), the investor's only option to satisfy this constraint (for $\Delta R_i \neq \Delta x$) is to lower ΔR_i . In particular, for any given e , condition (A3) can be satisfied with a contract different from $\Delta R_i = \Delta x$ only if ΔR_i is below an upper bound implicitly defined by

$$(p(i, e^*) - p_0)(\Delta x - \Delta R_i) = \psi(e^*). \quad (\text{A4})$$

Note that lowering ΔR_i relaxes also the effort constraint. This means that in principle, the impact investor could increase her payoff by raising R_i , but this is impossible since $R_i = x$. Since all constraints are relaxed for higher i , we obtain that ΔR_i will increase in i .

Observe now that the impact investor will not break even for firms $i \leq m - 1$. To see this, recall that the impact investor breaks even for firms $i \in m, \dots, N$. Solving (4) is a more-constrained version of the problem that produces the benchmark contract offered to $i \in m, \dots, N$. Because the adoption constraint binds for $i < m$ by definition of m , and for the benchmark contract, the impact investor breaks even, it follows that the impact investor will not break even for firms $i \leq m - 1$.

The final step is to find whether and, if so, to how many firms offering a contract with $\Delta R_i < \Delta x$ makes the impact investor better off than offering the full-insurance contract $(R_i, \Delta R_i) = (\min\{I - p(N, 0)\Delta x, x\}, \Delta x)$, which incentivizes adoption by induces no effort. This requires comparing the investor's payoff from offering the two types of contracts for all $i \leq m$. If $x + p(N, 0)\Delta x \geq I$, it is possible for all investors to break even offering the full-insurance contract, implying that offering a contract with $\Delta R_i < \Delta x$ is never optimal since it entails losses for the investor. Thus, conventional investors will compete with the impact investor to finance firms $i = 1, \dots, m$, and all these firms will exert no effort.

By contrast, if $x + p(N, 0)\Delta x < I$, investors cannot break even on any firm $i < m$, implying that all these firms will be financed by the impact investor. In this case, offering the full-insurance contract, which now will take the form of $(R_i, \Delta R_i) = (x, \Delta x)$, will continue to be preferable if

$$x + p(N, 0)\Delta x \geq x + p(N, e^*)\Delta R_i \iff \frac{p(N, 0)}{p(N, e^*)}\Delta x > \Delta R_i \quad (\text{A5})$$

where ΔR_i is defined by (A4). Observe that since ΔR_i increases in i , the impact investor's payoff when incentivizing both effort and adoption is increasing in i for $i < m$.

Define now with $\tilde{k} > 1$ the position below which the adoption constraint (A4) cannot be satisfied even if $\Delta R_i = 0$ ($\tilde{k} > 1$ since $p(1, e) < p_0$). Thus, firms $i < \tilde{k}$ always receive the full-insurance contract. Since at the threshold, $\tilde{k}$, the promised payment $\Delta R_{\tilde{k}}$ must be sufficiently low (possibly close to zero) for the adoption constraint (A4) to be satisfied, it follows that for some positions higher than $\tilde{k}$, the inequality (A5) could potentially still be satisfied. In particular, given that the impact investor breaks even at $i = m$ and that his payoff when incentivizing both effort and adoption is increasing in i , implies that there is a threshold $k \in \{\tilde{k}, \dots, m\}$ such that the impact investor is better off offering the full-insurance contract to all firms in positions below k and a contract incentivizing both effort and adoption to firms at or above position k . **Q.E.D.**

Proof of Proposition 4 Let $\omega \in \{1, \dots, m-1\}$ denote the number of investments a large firm can undertake. Thus, ω corresponds to the number of positions a large firm takes in the iterative dominance chain. We have argued in the main text that the impact investor's objective boils down to maximizing the aggregate success probability $\sum_{i=1}^m p(N, e_i^*)$. Comparing placing the large firm at positions $\{m - \omega + 1, \dots, m\}$ to placing it at the beginning at positions $\{1, \dots, \omega\}$ yields

$$\begin{aligned} D &= \left(\sum_{i=1}^{m-\omega} p(N, e_i^*) + \omega p(N, e_m^*) \right) - \left(\omega p(N, e_\omega^*) + \sum_{i=\omega+1}^m p(N, e_i^*) \right) \\ &= \omega [p(N, e_m^*) - p(N, e_\omega^*)] - \sum_{i=1}^{m-\omega} [p(N, e_{i+\omega}^*) - p(N, e_i^*)]. \end{aligned}$$

Define the adjacent increments $b_i := p(N, e_{i+1}^*) - p(N, e_i^*)$ for $i = 1, \dots, m-1$. We will show that $D \geq 0$ if b_i is nondecreasing in i . For any fixed $j \in \{0, \dots, \omega-1\}$, it holds that

$$\sum_{i=1}^{m-\omega} [p(N, e_{i+j+1}^*) - p(N, e_{i+j}^*)] = \sum_{i=1}^{m-\omega} b_{i+j} \leq \sum_{i=1}^{m-\omega} b_{\omega+i-1} = \sum_{t=\omega}^{m-1} b_t = p(N, e_m^*) - p(N, e_\omega^*),$$

where the inequality uses that b_i is non-decreasing and $\omega - 1 \geq j$. Summing the left- and right-hand sides over $j = 0, \dots, \omega - 1$ gives

$$\sum_{j=0}^{\omega-1} \sum_{i=1}^{m-\omega} [p(N, e_{i+j+1}^*) - p(N, e_{i+j}^*)] = \sum_{i=1}^{m-\omega} [p(N, e_{i+\omega}^*) - p(N, e_i^*)] \leq \omega [p(N, e_m^*) - p(N, e_\omega^*)].$$

Plugging into the expression for D yields $D \geq 0$, with $D > 0$ whenever at least one inequality is strict (i.e., if $b_i = p(N, e_{i+1}^*) - p(N, e_i^*)$ is strictly increasing for at least one position in $\{1, \dots, m-1\}$). Observe that this is always the case since $e_1^* = \dots = e_{m-1}^* = 0$ and $e_m^* > 0$, implying that $b_i = 0$ for all $i \leq m-2$ and $b_i > 0$ for $i = m-1$. **Q.E.D.**

Proof of Proposition 5. If the impact investor does not break even for positions below m , we know that her expected payoff (i) for positions below k , does not depend on i and is equal to $V^{fi} = R^{fi} + p(N, 0) \Delta R^{fi}$; (ii) for positions higher than m , does not depend on i and is equal to zero; (iii) for positions $\{k, \dots, m-1\}$ increases in i and is equal to

$$V_i = x_i + p(N, e) \left(\Delta x_i - \frac{\psi_i}{(p(i, e) - p_{i,0})} \right), \quad (\text{A6})$$

with this payoff being strictly higher than V_i^{fi} but less than zero. For use in the following propositions, we have added in (A6) subscripts to x_i , Δx_i , ψ_i , and $p_{i,0}$ since we will also consider the impact of heterogeneity along these dimensions. For the current proposition, x_i , Δx_i , ψ_i , and $p_{i,0}$ are the same for all i .

The impact investor's objective is to maximize $\sum_{i=i}^N V_i$. Placing the large firm at some position i' means that the impact investor can guarantee herself a payoff of $V_{i'}$ for all $\{i' - \omega, \dots, i'\}$. It follows that placing the large firm at position m is strictly better than any position $i' > m$, since it shifts ω payoffs from negative to zero, while any $i' > m$ leaves the already-zero segment $\{m, \dots, i'\}$ unchanged). Furthermore, placing the large firm at position $i'' \geq k$ is strictly better than at any position lower than k since the expected payoff at $V_{i''} > V^{fi}$.³²

Thus, it only remains to consider at which position between k and m it is optimal to place the large firm. Following similar steps to Proposition 4, we obtain that a sufficient condition that placing the large firm at position m is that V_i is nondecreasing and convex in i (simply replace $p(N, e_i^*)$ with V_i in the proof of that proposition). The fact that V_i is non-decreasing is immediate since the impact investor could always offer firm $i+1$ the same contract it offers to firm i . Furthermore, observe that the impact investor's payoff is convex at k since that payoff is constant for all positions lower than k and jumps up at k . Hence, the lowest position at which the impact investor places the large firm is k .

Denote now $d_i := p(i, e) - p_0$. Convexity of V_i requires that

$$0 \leq (V_{i+1} + V_{i-1}) - 2V_i,$$

³²If $s > k$, feasibility implies the earliest placement index is s .

which from (A6) becomes for positions $\{k + 1, \dots, m - 1\}$

$$\begin{aligned}
0 &\leq \psi p(N, e) \left(-\frac{1}{p(i-1, e) - p_0} - \frac{1}{p(i+1, e) - p_0} + \frac{2}{p(i, e) - p_0} \right) \\
&= \psi p(N, e) \left(\frac{2}{d_i} - \frac{1}{d_{i-1}} - \frac{1}{d_{i+1}} \right) \\
&= \psi p(N, e) \frac{d_{i-1} + d_{i+1}}{d_i d_{i-1} d_{i+1}} \left(\frac{2d_{i-1}d_{i+1}}{(d_{i-1} + d_{i+1})} - d_i \right)
\end{aligned}$$

So, a necessary and sufficient condition is that d_i is less than the harmonic mean of its neighbors d_{i-1} and d_{i+1} : $d_i \leq \frac{2d_{i-1}d_{i+1}}{d_{i-1} + d_{i+1}}$ (or, equivalently, that $\frac{1}{p(i, e) - p_0}$ is concave in i). The corresponding expression at the boundary k is a bit different since the firm exerts no effort at $k - 1$. Specifically, convexity over $\{k, -1, k, k + 1\}$ requires then that $d_k \leq \frac{2}{\frac{(p(N, e) - p(N, 0))\Delta x}{\psi p(N, e)} + \frac{1}{d_{k+1}}}$. Summarizing, the sufficient condition that V_i is convex for all $1, \dots, m$ is that:

$$p(i, e) - p_0 \leq \begin{cases} \frac{2(p(i-1, e) - p_0)(p(i+1, e) - p_0)}{p(i-1, e) + p(i+1, e) - 2p_0} & \text{if } i > k \\ \frac{2}{\frac{(p(N, e) - p(N, 0))\Delta x}{\psi p(N, e)} + \frac{1}{d_{k+1}}} & \text{if } i = k \end{cases} \quad (\text{A7})$$

Overall, it is optimal to place the large firm between k and m , with (A7) being a sufficient condition for the large firm to take positions $m - \omega + 1$ to m **Q.E.D.**

Proof of Proposition 6. We have already argued in the main text that it is optimal to place the high-effort-cost firm(s) in positions less than $k - 1$ since these firms are not incentivized to exert effort, so the cost of doing so is irrelevant. In what follows, we turn to the cases in which the impact investor optimally incentivizes effort. If placing the high-cost firm at a position at or below k is not possible (for exogenous reasons), then observe that the adoption and effort constraints are maximally relaxed at $i = N$. Hence, placing the high-cost firm at $i = N$ entails no additional costs for the impact investor, while minimizing any distortions to the benchmark contract compared to that offered to the firms in the baseline model.

It remains to consider the optimal positioning of the low-cost firm. We have argued in the main text that it is optimal to place that firm at positions higher than $k - 1$. If the impact investor does not break even for firms at positions below m , her payoff for positions $\{k, \dots, m - 1\}$ is given by (A6), and it holds that $\frac{\partial V_i}{\partial \psi_i}$ is increasing in i . Hence, the increase in the impact investor's payoff due to the lower effort cost is highest at the first position at which she incentivizes both effort and adoption.

Suppose, next, that the impact investor always breaks even. In this case, the only reason for targeting the low-cost firm is to extend the number of firms that exert effort since that

maximizes efficiency. Thus, we obtain the same qualitative prediction as above. **Q.E.D.**

Lemma A1 *It is optimal to position the firm with the high outside option at position $i = 1$ if the firm offers the full insurance contract to at least some firms, and at $i = N$ otherwise. It is optimal to place the low outside-option firm between positions $k - 1$ and m .*

Proof of Lemma A1. (i) The proof for the firm with the high opportunity cost is the same as in Proposition 6 (place the firm with a high outside option at position below k ; if doing so is not possible (for exogenous reasons), place it at $i = N$). The claim for the firm with the low opportunity cost is also analogous. From (A6), we have that $\frac{\partial V_i}{\partial p_{i,0}} = -p(N, e) \frac{\psi}{(p(i, e) - p_{i,0})} < 0$. Hence a smaller outside option raises the impact investor's payoff. Since the increase in the impact investor's payoff in the case of a lower outside option is higher for lower i , the gain from lowering $p_{i,0}$ is largest at the smallest index where effort is induced (i.e., at k or $k - 1$ if the lower outside option makes it optimal to incentivize the firm at position $k - 1$ to exert effort).

Suppose, next, that the impact investor always breaks even. In this case, the only reason for targeting the low-cost firm is to extend the number of firms that exert effort since that maximizes efficiency. Since a lower $p_{i,0}$ makes satisfying the adoption constraint easier, placing the low-cost firm at positions $k - 1$ can extend the number of firms incentivized to adopt and exert effort. Thus, we obtain the same qualitative prediction as above: It is optimal to place the low-cost firm at the first position at which the impact investor incentivizes both adoption and effort. **Q.E.D.**

Proof of Lemma 3. The impact investor's expected payoff when offering the full-insurance contract is

$$V_i = \min(I - p(N, 0) \Delta x, x) + p(N, 0) \Delta x = \min(I, x + p(N, 0) \Delta x).$$

Decreasing cash flow dispersion leads to a change in this payoff of either zero (if investors break even) or $1 - \frac{p(N, 0)}{p(N, e)} > 0$ (if investors do not break even). Thus, if investors do not always break even and offer plain-vanilla securities, placing the low-dispersion firm early in the chain (position below k) is optimal, and the high-dispersion firm is optimally placed at a position after k .

The impact investor's expected payoff for $\{k, \dots, m\}$ is given by (A6). Decreasing cash-flow dispersion, whereby a unit increase in x_i is associated with $\frac{d\Delta x_i}{dx_i} = -\frac{1}{p(N, e)}$, leaves the investor's expected payoff for positions below m unchanged. Note that since m is defined by $(p(i, e) - p_0) \left(\Delta x_i - \frac{I - x_i}{p(N, e)} \right) - \psi$, which is unchanged in cash flow dispersion, m remains the

same. Finally, note that since the impact investor's payoff from incentivizing both adoption and effort does not change in dispersion, but her expected payoff from the full-insurance contract decreases in dispersion, it follows that k decreases in dispersion. **Q.E.D.**

Proof of Proposition 7. To find the optimal contract $(R(s), \Delta R(s))$, formulate the Lagrangian

$$\begin{aligned}
\mathcal{L} = & \sum_{s=\{s_L, s_H\}} q(s|1) (R_i(s) + p(N, e) \Delta R_i(s)) \\
& + \mu \left(I - \sum_{s=\{s_L, s_H\}} q(s|1) (R_i(s) + p(N, e) \Delta R_i(s)) \right) \\
& + \lambda \left(\sum_{s=\{s_L, s_H\}} (q(s|1) - q(s|0)) (x - R_i(s)) \right. \\
& \quad \left. + (\Delta x - \Delta R(s)) (p(i, e) q(s|1) - p_0 q(s|0)) - \psi(e) \right) \\
& + \nu \left(\sum_{s=\{s_L, s_H\}} q(s|1) (p(i, e) - p(i, 0)) [\Delta x - \Delta R_i(s)] - \psi(e) \right) \\
& + \sum_{s=\{s_L, s_H\}} [\zeta_R(s) R_i(s) + \xi_R(s) (x - R_i(s)) + \zeta_{\Delta R}(s) \Delta R_i(s) \\
& \quad + \xi_{\Delta R}(s) (\Delta x - \Delta R_i(s))],
\end{aligned}$$

where λ , μ , $\zeta_R(s)$, $\zeta_{\Delta R}(s)$, $\xi_R(s)$, and $\xi_{\Delta R}(s)$ are the non-negative Kuhn-Tucker multipliers. We have formulated the Lagrangian for the general case in which contracts can be asymmetric. For the symmetric case, replace i with 1.

Observe that if the adoption constraint (2) is not binding (i.e., $\lambda = 0$), we can equivalently replace any contract $(R_i(s), \Delta R_i(s))$ with a plain-vanilla contract defined as $R_i = \sum_s q(s|1) R_i(s)$ and $\Delta R_i = \sum_s q(s|1) \Delta R_i(s)$ since that would neither affect the impact investor's objective function nor any of the remaining constraints. Thus, offering an impact-metric-dependent contract makes sense only if $\lambda > 0$. Thus, in what follows we focus on the case where $\lambda > 0$.

We maximize now pointwise for every s . Taking the first-order condition with respect to $R(s)$, we obtain

$$0 = \left(1 - \mu - \lambda \left(1 - \frac{q(s|0)}{q(s|1)} \right) \right) + \frac{\zeta_R(s) - \xi_R(s)}{q(s|1)}.$$

Observe that $\frac{q(s|0)}{q(s|1)}$ is decreasing in s (since $\frac{q(s_L|0)}{q(s_L|1)} = \frac{1-q(s_H|0)}{1-q(s_H|1)} > \frac{q(s_H|0)}{q(s_H|1)}$). Hence, if $(1 - \mu) - \lambda \left(1 - \frac{q(s|0)}{q(s|1)}\right)$ changes sign, it switches from positive to negative as s increases. Hence, if it is optimal to offer a two-tier contract for which $R(s)$ changes in s , for this contract, $R(s)$ will decrease in s .

Consider, next, the derivative with respect to $\Delta R(s)$:

$$\begin{aligned} 0 &= p(N, e) - p(N, e)\mu - \lambda \left(p(i, e) - p_0 \frac{q(s|0)}{q(s|1)} \right) \\ &\quad - \nu(p(i, e) - p(i, 0)) + \frac{\zeta_{\Delta R}(s) - \xi_{\Delta R}(s)}{q(s|1)}. \end{aligned}$$

Hence, we obtain again that if $\Delta R(s)$ changes in s , then it decreases in s .

The final step is to check whether the impact investor's payoff is higher than with the plain-vanilla contract $(R, \Delta R) = (\min\{I - p(N, 0)\Delta x, x\}, \Delta x)$, which follows the same steps as Proposition 3. This is the case if signals are sufficiently informative. We relegate a more precise characterization of this statement to the proof of Proposition 8. **Q.E.D.**

Proof of Proposition 8. We show the proof by first simplifying the contract's two-tier structure (Step 1); then showing that investors can break even for more firms than under plain-vanilla contracts (Step 2); finally, we characterize the full contract (Step 3).

Step 1. Simplifying the two-tier structure. Define the two-tier contract $(R_i(s), \Delta R_i(s))$ as

	s_L	s_H
$R_i(s)$	ρ_i	$\rho_i - r_i$
$\Delta R_i(s)$	$\Delta \rho_i$	$\Delta \rho_i - \Delta r_i$

where, (temporarily for this step of the proof) we define ρ_i and $\Delta \rho_i$ as the “base payments” and r_i and Δr_i as the associated “rebates” in case of a high signal. To simplify notation, we write $q_1 = q(s_H|1)$ and $q_0 = q(s_H|0)$. We impose the following conditions on the rebates r_i and Δr_i : $x \geq \rho_i \geq r_i \geq 0$ and $\Delta x \geq \Delta \rho_i \geq \Delta r_i \geq 0$. The adoption constraint becomes then

$$(q_1 - q_0)r_i + (p(i, e) - p_0)(\Delta x - \Delta \rho_i) + (p(i, e)q_1 - p_0q_0)\Delta r_i - \psi \geq 0. \quad (\text{A8})$$

Observe now that for any given level of an expected payment $\Delta R_i := \Delta \rho_i - q_1 \Delta r_i$, this level is best achieved by maximally increasing Δr_i . To see this, consider an increase in Δr_i , which must also entail an increase of $\Delta \rho_i$ ($\frac{d\Delta \rho_i}{d\Delta r_i} = q_1$) to keep ΔR_i the same. The impact on the

adoption constraint is

$$-(p(i, e) - p_0) q_1 + (p(i, e) q_1 - p_0 q_0) = p_0 (q_1 - q_0) > 0.$$

It follows that we can express $\Delta\rho_i$ and Δr_i as functions of ΔR_i . In particular, depending on whether it is feasible to choose $\Delta r_i = \Delta\rho_i = \frac{\Delta R_i}{1-q_1}$, we obtain

$$(\Delta\rho_i, \Delta r_i) = \begin{cases} \left(\frac{\Delta R_i}{1-q_1}, \frac{\Delta R_i}{1-q_1} \right) & \text{if } \Delta x \geq \frac{\Delta R_i}{1-q_1} \\ \left(\Delta x, \frac{\Delta x - \Delta R_i}{q_1} \right) & \text{if } \Delta x < \frac{\Delta R_i}{1-q_1} \end{cases}. \quad (\text{A9})$$

Step 2: *Investors can break even for more firms than under plain-vanilla financing.* To see this claim, consider a “two-tier benchmark” contract, given by (A9) that is in expectation cash-flow-state by cash-flow-state payoff-equivalent to the benchmark contract (i.e., $\Delta R_i = \Delta R^b$). We know that such a contract relaxes the adoption constraint (A8) compared to the benchmark contract while offering the same payoff to the impact investor and giving rise to the same effort level. Define with $\tilde{m}$ in analogy to m so that if $\tilde{m} - 1$ firms have a dominant strategy to adopt the impact technology, firms $\tilde{m}, \dots, N$ will also adopt if offered this two-tier benchmark contract. It holds that $\tilde{m}$ is strictly lower than under plain-vanilla financing ($m_{p.v.}$) if for the adoption constraints at $m_{p.v.} - 1$ at holds

$$\begin{aligned} (p(m_{p.v.} - 1, e) - p_0) (\Delta x - \Delta R^b) + p_0 \left(\frac{1-q_0}{1-q_1} - 1 \right) \Delta R^b - \psi &\geq 0 & \text{if } \Delta x \geq \frac{\Delta R^b}{1-q_1} \\ \left(p(m_{p.v.} - 1, e) - p_0 \frac{q_0}{q_1} \right) (\Delta x - \Delta R^b) - \psi &\geq 0 & \text{if } \Delta x < \frac{\Delta R^b}{1-q_1} \end{aligned}$$

which is always satisfied if $\frac{1-q_0}{1-q_1}$ is sufficiently high or, respectively, $\frac{q_0}{q_1}$ is sufficiently small (e.g., $q_1 \rightarrow 1$ or $q_0 \rightarrow 0$). In the next sections, we will relate these conditions to the degree of signal informativeness.

Consider, next, the contract that the impact investor offers to firm $\tilde{m} - 1$. In particular, consider a distortion to the “two-tier benchmark contract” that involves a higher rebate r_i (since $R^b = x$, this is the only feasible distortion) accompanied by an increase in ΔR_i such that the investor’s payoff

$$x - q_1 r_i + p(N, e) \Delta R_i, \quad (\text{A10})$$

remains unchanged, with the investor breaking even. Hence, such a distortion requires setting

$$\Delta R_i = \frac{I - x + q r_i}{p(N, e)}$$

and so it must hold that $\frac{d\Delta R_i}{dr_i} = \frac{q_1}{p(N,e^*)}$. The impact of this distortion on the adoption constraint (A8) is

$$\begin{aligned} (q_1 - q_0) - p(i, e) \frac{q_1}{p(N,e^*)} + \frac{p_0(1-q_0)}{1-q_1} \frac{q_1}{p(N,e^*)} & \quad \text{if } \Delta x \geq \frac{\Delta R_i}{1-q_1} \\ (q_1 - q_0) - p(i, e) \frac{q_1}{p(N,e^*)} + p_0 \frac{q_0}{q_1} \frac{q_1}{p(N,e^*)} & \quad \text{if } \Delta x < \frac{\Delta R_i}{1-q_1} \end{aligned}.$$

Thus, the change to the adoption constraint is positive if

$$p(i, e) \leq \begin{cases} \left(1 - \frac{q_0}{q_1}\right) p(N, e) + \frac{1-q_0}{1-q_1} p_0 & \text{if } \Delta x \geq \frac{\Delta R_i}{1-q_1} \\ \left(1 - \frac{q_0}{q_1}\right) p(N, e) + \frac{q_0}{q_1} p_0 & \text{if } \Delta x < \frac{\Delta R_i}{1-q_1} \end{cases}. \quad (\text{A11})$$

Thus, if condition (A11) holds for $i = \tilde{m} - 1$, we can increase r_i while keeping $\Delta R_i = \frac{I-x+qr_i}{p(N,e)}$ (so that investors break even) until the adoption constraint is just satisfied at i . Since if condition (A11) is satisfied for some i , it is also satisfied for all lower i , we can perform these perturbations to r and ΔR for all lower i until we reach an i for which this is no longer feasible, either because the effort constraint $\Delta R_i \leq \Delta x - \frac{\psi}{p(i,e)-p(i,0)}$ is violated or r has reached the corners of zero or x . In these cases, the impact investor can no longer break even. We consider these cases below, and (just as in the plain-vanilla case) we denote with k the lowest i for which the impact investor incentivizes both effort and adoption. With a slight abuse of notation, we will denote again with m the first position at which the impact investor breaks even when incentivizing both adoption and effort.

Step 3: The contract for positions below m . Observe that if the impact investor offers the full-insurance contract for some i , then she optimally does the same for all lower i since the adoption constraint is more difficult to satisfy for lower i .

We characterize in what follows the optimal contract for cases not characterized in Step 2, in which the adoption constraint cannot be satisfied with a feasible contract for which the impact investor breaks even. In this case, from the binding adoption constraint, we can express r_i as a function of ΔR_i

$$r_i(\Delta R_i) = \begin{cases} \frac{(p(i,e^*)(1-q_1)-p_0(1-q_0)) \frac{\Delta R_i}{1-q_1} - (p(i,e^*)-p_0)\Delta x + \psi(e^*)}{(q_1-q_0)} & \text{if } \Delta x \geq \frac{\Delta R_i}{1-q_1} \\ \frac{(p(i,e^*)q_1-p_0q_0) \frac{\Delta R_i - \Delta x}{q_1} + \psi(e)}{(q_1-q_0)} & \text{if } \Delta x < \frac{\Delta R_i}{1-q_1} \end{cases}, \quad (\text{A12})$$

with the feasibility constraints $x \geq r_i(\Delta R_i) \geq 0$, translating into additional upper and lower bounds on ΔR_i next to those from the effort constraint and ΔR_i 's own feasibility constraints:

$$\Delta x - \frac{\psi}{p(i,e)-p_0} \geq \Delta R \geq 0.^{33}$$

³³As can be seen from (A12), whether $0 \leq r_i(\Delta R_i)$ or $r_i(\Delta R_i) \leq x$ will define an upper or lower bound

Consider, now, the impact investor's payoff (A10). Since the adoption constraint is binding, we can plug in for r_i from (A12) and take the first derivative with respect to ΔR_i to obtain

$$-q_1 \frac{p(i, e^*) - A}{q_1 - q_0} + p(N, e^*), \quad (\text{A13})$$

where A is a constant that does not depend on i ($A = \frac{p_0(1-q_0)}{1-q_1}$ if $\Delta x \geq \frac{\Delta R_i}{1-q_1}$, and $A = \frac{p_0 q_0}{q_1}$ if $\Delta x < \frac{\Delta R_i}{1-q_1}$). Note that expression (A13) is positive if and only if condition (A11) is satisfied. Thus, if (A11) is satisfied and the impact investor cannot break even, ΔR_i will be given by the binding upper bound ($\Delta R \leq \Delta x - \frac{\psi}{p(i,e)-p(i,0)}$) or the upper bound implied by $0 \leq r_i$ ($\Delta R_i \leq x$).

If condition (A11) is not satisfied at i (in which case the impact investor cannot break even), expression (A13) is negative, and ΔR_i will be given by one of the lower bounds, defined by $\Delta R_i \geq 0$ or the lower bound derived from the feasibility restrictions $x \geq r_i$ ($\Delta R_i \geq 0$). We can proceed in the same manner for all $i < m$.

By analogy to Proposition 3, the final step is to compare the impact investor's payoff from incentivizing both effort and adoption—provided such a feasible contract exists—with incentivizing only adoption through the full-insurance contract. This comparison is relevant if $x + p(N, 0) \Delta x < I$ in which case the impact investor does not break even for $i < m$. If, instead, $x + p(N, 0) \Delta x \geq I$, the investor will always prefer offering the full-insurance contract to all $i < m$ since she can break even for that contract. **Q.E.D.**

Proof of Proposition 9. The proof follows from the arguments in the main text. **Q.E.D.**

Proof of Proposition 10. We have already argued in the main text that full disclosure cannot be sustained as equilibrium. In what follows, we show that non-disclosure can be sustained as equilibrium even if $c_m = 0$.

Let

$$U_i = x - R + p(N, e_i) (\Delta x - \Delta R_i) - \psi(e_i)$$

denote a firm's associated expected payoff when it is placed in position i . If a firm is offered the full-insurance contract, its expected payoff is $U^{fi} := \max\{0, x + p(N, 0) \Delta x - I\}$, while a firm placed in position $i \geq m$ obtains the full surplus of $U^{be} := x + p(N, e) \Delta x - I - \psi$, which is larger than the full-insurance payoff. Since the social surplus generated by firms $i \in \{k, \dots, m-1\}$ is the same as for firms $i \geq m$, but the impact investor does not break even on (some of) these firms, it follows that the equilibrium payoff for these firms, $U_i = p(N, e) \left(\Delta x - \frac{\psi}{p(N,e)-p_0} \right) - \psi$, is even higher than U^{be} . Since in the proposed equilibrium, all

on ΔR_i depends on the sign of $p(i, e^*) - p_0 \frac{(1-q_0)}{(1-q_1)}$ or $p(i, e^*) - p_0 \frac{q_0}{q_1}$, respectively.

firms are the same, the ex ante probability of being placed at any given position is simply $\frac{1}{N}$. Hence, a firm's equilibrium expected payoff is

$$\sum_{j=1}^N \frac{1}{N} U_i = \frac{(k-1)}{N} U^{fi} + \sum_{j=k}^{m-1} \frac{1}{N} U_i + \frac{m}{N} U^{be}. \quad (\text{A14})$$

Consider, now, a deviation to moderate disclosure. After observing all firms' disclosure, the impact investor chooses how to position the firms in the dominance chain. By Proposition 9, deviating to moderate disclosure will result in the firm being positioned between $k-1$ and m . However, because higher precision relaxes the adoption constraint, the deviation payoff, $\tilde{U}_i$, for positions $k, \dots, m$ will be lower than in equilibrium. In particular, if moderate disclosure is sufficiently informative, it can lead to no subsidies being paid to firms in these positions, thus leading to a deviation payoff of U^{be} . It follows that if under non-disclosure, k is small relative to N , the expected deviation payoff U^{be} can be smaller than the equilibrium payoff (A14), even if the cost of moderate disclosure is zero. By continuity, the same holds even if the subsidies under moderate disclosure are positive (but not too large). As we argued in the main text, if deviating to moderate disclosure is not profitable, the same holds for full disclosure since then there are no subsidies, and the cost of full disclosure is even higher.

Showing, instead, that non-disclosure equilibria cannot be sustained follows analogous steps, but requires that the subsidies to firms in positions $k, \dots, m-1$ be sufficiently large and the cost of disclosure c_m be sufficiently small. Similarly, showing that equilibria with moderate disclosure can be sustained in equilibrium is also straightforward, provided that c_m is not too high. We omit the formal proof, because it is standard. **Q.E.D.**