A theory of socially responsible investment

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2020

Motivation

- ESG is the most important trend in the asset management industry (AUM grew by factor of 10 since 2000)
- Most research focuses on asset pricing implications (e.g., do sin or green stocks generate higher / lower returns)?
- However, for ESG investing to have real impact (and not just buzz), it needs to affect firms' choices of production technologies

$\Rightarrow$ Requires corporate financing perspective

Relevant questions

- Under which conditions can ESG investors affect firms' adoption of production technologies?
- What is the optimal way of achieving impact?
- How should ESG capital be allocated across firms? Only clean firms?
- Would welfare be higher if 100% capital was ESG-driven?

Contribution and results

- Holmstrom-Tirole #XR or (Coase with financing constraints): Interaction of financing constraints & negative production externalities
- Results:
  - "Broad mandate" is necessary condition for impact
  - Socially responsible (SR) investors optimally achieve impact via enabling scale increase of clean(er) production
  - Financial and socially responsible capital are complementary purely profit-motivated capital increases social welfare
  - SR investors should rank investments according to social profitability index that reflects counterfactual pollution decrease (not level!)
  - Pigouvian taxes not a panacea (see paper)

Literature

Theory:

Coase (1960), Heinkel, Kraus, and Zechner (2001); Hart and Zingales (2017); Chowdhry, Davies, and Waters (2018); Davies and van Wesep (2018); Morgan and Tumlinson (2018), Roth (2019), Landier and Lovo (2020)

Empirical:

Hong and Kacperczyk (2009); Chava (2014); Barber, Morse, and Yasuda (2018), Baker et al. (2018), Zerbib (2019)

Asset pricing:

Pastor, Stambaugh, and Taylor (2019), Pedersen, Fitzgibbons, and Pomorski (2019)

Production and agency primitives

- An entrepreneur with initial resources of A chooses between clean and dirty technology $\tau \in \{C, D\}$ and sets scale K
- Trade-off between financial and social returns
  - Financial returns: Each technology is CRS yielding payoff RK with probability p, but clean tech has higher per-unit cost $k_C > k_D$
  - Externalities: C has lower per-unit social cost of $0 < \phi_C < \phi_D$
  - Assumption: Clean tech is socially preferable, $\Delta\phi > \Delta k$ and creates social value $pR - k_C - \phi_C > 0$ ($\Rightarrow$ first-best scale is "large")
- Agency problem: If entrepreneur shirks, probability of success is reduced to $p - \Delta p$, yielding private benefit of BK
- Entrepreneur may (partially) internalize social costs $\gamma^E \in [0, 1)$

$$U^E = \text{Expected net financial payoff} + \text{private benefit} - \gamma^E \text{ social cost}$$

Investors

There are **two types of risk-neutral (outside) investors:**

Financial investors (F):

- care only about financial returns
- financial capital is abundant and competitive

Socially responsible investors (SR):

- Condition 1 (**Broad mandate**): concern for social cost unconditional (independent of own investment)
- Condition 2 (**Size**): Either one large fund or coordinated
- internalization of social cost given by γ^{SR} where $(\gamma^{SR} + \gamma^{E} \leq 1)$

$$U^i = \text{Expected net financial payoff } - \gamma^i \text{ social cost}, \; i \in \{F, SR\}$$

Benchmark equilibrium: only financial investors

- financial investors contribute I_τ^F against promised repayment of X^F
- entrepreneur chooses technology $\tau \in \{C, D\}$ and scale K_τ^F
  - resource constraint:
    $$K_\tau^F k_\tau = A + I_\tau^F$$
  - entrepreneur's **IC constraint**:
    $$p(RK_\tau^F - X^F) \geq (p - \Delta p)(RK_\tau^F - X^F) + BK_\tau^F$$
  - financial investors' **IR constraint**:
    $$pX^F - I_\tau^F \geq 0$$

Benchmark: only financial investors

- Binding IC and IR imply optimum firm scale under technology τ:

$$K_\tau^F = \frac{A}{\xi - \pi_\tau}$$

  - $\xi := p\frac{B}{\Delta p}$: agency rent per unit of investment
  - $\pi_\tau := pR - k_\tau$: per-unit financial return of technology $\tau \in \{C, D\}$

- Because dirty technology has higher financial payoff $(\pi_D > \pi_C)$

$$K_D^F > K_C^F$$

- Larger financing capacity implies that entrepreneur adopts dirty iff

$$(\xi - \gamma^E \phi_D) K_D^F > (\xi - \gamma^E \phi_C) K_C^F$$

Equilibrium with SR investors

Suppose entrepreneur chooses D, then SR (reservation) utility is given by

$$\bar{U}^{SR} = -\gamma^{SR}\phi_D K_D^F < 0$$

SR investors can induce entrepreneur to switch technology via providing entrepreneur with upfront consumption c and/or increased scale

Problem (Socially responsible investors)

$$\max_{I^F, I^{SR}, X^{SR}, X^F, K, c, \tau} pX^{SR} - I^{SR} - \gamma^{SR}\phi_\tau K$$

subject to IR of the entrepreneur:

$$U^E\left(K, X^{SR} + X^F, \tau, c, 1\right) \geq \bar{U}^E$$

as well as IC, financial investors' IR, and resource constraint.

Theorem (Optimal financing agreement)

Let $\hat{v}_\tau := \pi_\tau - \left(\gamma^E + \gamma^{SR}\right)\phi_\tau$ *denote joint surplus per unit of scale, accruing to all investors & entrepreneur. Then,* $\hat{c} = 0$ *and*

$$\hat{\tau} = \arg\max_\tau \hat{v}_\tau \hat{K}(\tau)$$

- Technology choice governed by total value added: per-unit surplus $\hat{v}_\tau$ and scale $\hat{K}(\tau) = \frac{\xi - \gamma^E \phi_D}{\xi - \gamma^E \phi_\tau} K_D^F$: If $\gamma^{SR} + \gamma^E \uparrow \Rightarrow$ Clean production
  - Financing constraints $\Rightarrow$ optimal to induce switch via scale increase of clean production ($\hat{K}(C) > K_C^F$) rather than consumption $\hat{c} = 0$
  - As competitive financial investors would not fund this scale increase $\Rightarrow$ financial loss for SR investors, but outweighed by reduced externality
- Implementation:
  - Bond / Green bond issue: Fairly priced regular bond + green bond issued at premium in primary market (with technology choice covenant)
  - Dual-class equity issuance: (with and without voting rights)

Complementarity between financial and social capital

Presence of **both types of capital** is strictly **better**

- **even relative to** a world with **only SR investors**

Financial investors:

- **alleviate underinvestment** given clean technology: $K_C^F > K_C^{SR}$
- but may induce entrepreneur to **adopt dirty technology**

Socially responsible investors:

- SR investors can ensure **clean technology is chosen**
- but **by themselves less efficient** financiers
- **counterfactual pollution necessary** to unlock SR capital

Necessary conditions for impact

- **Broad mandate:** If socially responsible only care about social costs generated by own investment (narrow mandate):
  - Dirty firms would be financed by financial investors, ...
  - Social costs by these firms do not relax participation constraint of SR investors $\Rightarrow$ no additional financing capacity (no impact)
- **Coordination/ size:** If socially responsible investors are infinitesimal and uncoordinated, they behave like financial investors $\gamma^{SR} = 0$
- **Sufficient capital:** SR investors have enough capital to induce technology change

Multi-firm economy

- Suppose there are **many heterogeneous firms**:
  - denote firm types by j
  - firm type characteristics: A_j, R_j, $\phi_{\tau,j}$, $k_{\tau,j}$, etc.
  - each individual firm infinitesimally small

- **SR investors** have **limited capital** κ in aggregate:
  How should scarce socially responsible capital be allocated?
  In absence of SR investment, SR payoff is:

$$\underbrace{\int_{\gamma_j^E < \bar{\gamma}_j^E} \phi_{D,j} K_{D,j}^F d\mu(j)}_{\text{Reformable}} + \underbrace{\int_{\gamma_j^E \geq \bar{\gamma}_j^E} \phi_{C,j} K_{C,j}^F d\mu(j)}_{\text{already clean}}.$$

Multi-firm economy investment criterion

- For reformable firm type j, reform payoff to SR investors is:

$$\Delta U_j^{SR} = \underbrace{\left(\pi_{C,j} - \xi_j\right)\hat{K}_j + A_j}_{\text{Financial loss}} + \underbrace{\gamma^{SR}\left[\phi_{D,j} K_{D,j}^F - \phi_{C,j}\hat{K}_j\right]}_{\text{Change in externality}}.$$

- With scarce capital, decision metric is social profitability index:

$$\mathrm{SPI}_j = \mathbb{1}_{\gamma_j^E < \bar{\gamma}_j^E} \frac{\Delta U_j^{SR}}{I_j^{SR}} = \frac{\Delta\phi_j - \Delta\pi_j}{\Delta\pi_j + \lambda_j\left(p_j R_j - \xi_j\right)}$$

  - Invest in firms with $\mathrm{SPI}_j > \mathrm{SPI}^*(\kappa)$
  - Never invest in firms / entrepreneurs that are already clean
  - Not level of pollution matters ϕ_C, but avoided pollution $\Delta\phi$ matters

Balance of capital

- When **SR capital is abundant**, F and SR capital are **complements**.

- When **SR capital is scarce**, there is a **trade-off**:
  - Financial investors alleviate underinvestment problem for clean firms
  - cause overinvestment in dirty technology for non-reformed firms

$\Rightarrow$ **Welfare** is **highest** when **capital is balanced**

- financial capital needed to alleviate underinvestment
- sufficient SR capital needed to "discipline" financial capital when it leads to inefficient production choices

Regulation

- So far we treated regulation as exogenous (suboptimal)
- What is the effect of textbook policies? With enough SR capital, text-book policies may backfire
  - Pigouvian pollution tax, say tax of ϕ_τ per unit of production
  - Production limit / ban of dirty production

  eliminate "threat" of dirty production $\Rightarrow$ no Δ financing capacity

  Bigger point: Policies are one-sided as they only "target" inefficient technology choice, but ignore to address financing constraints!

Future work

- Dynamic setting:
  - How to account for dirty legacy assets
  - How to ensure the timely adoption of novel (and cleaner) technologies
    Adoption hard to contract on ex ante (implications for control rights)
- Spill-over effects across firms in GE setting
- Heterogeneous SR investors with conflicting goals
- Interaction of regulatory policies and ESG investing

Conclusion

Model of financing constraints and production externalities

- Impact requires broad mandate (financial loss)
  $\Rightarrow$ SR funds should be evaluated according to broader metrics
- Impact investing occurs optimally via **increase in clean scale**
- Financial and SR capital are **complementary (**$\Rightarrow$ balance needed)
- Optimal capital allocation according to social profitability index (SPI)
  avoided pollution, not level of pollution matters!

Implementation of optimal agreement

- Any optimal agreement produces same "real choices", $\hat{\tau}$ and $\hat{K}$ and same total payout to investors $\hat{X} = X^{SR} + X^F$ given by IC:

$$\hat{X} = \left(R - \frac{B}{\Delta p}\right)\hat{K}$$

- All possible financing arrangements can be traced out by varying cash flow share accruing to SR investors $\lambda \in [0, 1]$

$$I^F = (1 - \lambda)\, p\hat{X}$$
$$I^{SR} = k_C\hat{K} - A - I^F$$

- **Implementation:**
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Production technologies

- Formal results readily extend to
  - arbitrary number of production technologies
  - technology-specific agency rents
  - even positive production externalities (think of R&D)
- Decreasing returns to scale with first-best scale K_C^{FB}
  - Strong financing constraints ($K_C^F \leq \bar{K} < K_C^{FB}$): Financial investors provide so little capital for clean technology, that optimal agreement by SR investors only rewards entrepreneur via scale increase
  - Medium financing constraints ($K_C^F \in \left[\bar{K}, K_C^{FB}\right]$): SR investors optimally just enable scale increase up to K_C^{FB} (rest in consumption)
  - Weak financing constraints ($K_C^F > K_C^{FB}$): SR investors pay entrepreneur to reduce scale to K_C^{FB}