Designing ESG Benchmarks

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Introduction

- Environmental, Social and Governance (ESG) investing is receiving more attention, both in practice and in the academic literature
- ESG funds: $\approx$ \$3 trillion assets globally, 7648 funds (source: Morningstar)
- **Questions:**
  - How should fund investors concerned with climate change incentivize fund managers to invest accordingly?
  - What does "concerned with climate change" mean exactly and what do ESG ratings really measure?
    - The language in ESG literature is very muddled—see Starks (*JF*, 2023)
    - Our focus will be only on concerns with climate change, one part of E

This Talk

- Difference between Earth to Firm (EtoF) and Firm to Earth (FtoE)
    - Conceptual and empirical
- Modeling approach
- Some open questions

Earth to Firm vs. Firm to Earth

- Earth to Firm (EtoF): Climate change poses a business risk that should be priced (just like other business risks)
  - E.g., overall temperature rise, changes in transportation and energy costs, imposition of carbon taxes that affect suppliers, etc.
  - Starks (JF, 2023) calls investors who care about this risk as "value investors"

- Firm to Earth (FtoE): Some people may have an ethical view and are willing to sacrifice returns in order to support companies working to avert climate change
  - "Values investors" in Starks' language

- These considerations are very different conceptually
  - and what investors care about matters for their investment strategy

- But is there a difference empirically? Answer: YES

Data

- EtoF: use MSCI's *Carbon Emissions Exposure Score*
  - captures the extent to which a company's business is vulnerable to carbon emissions
  - coded on a scale $0-10$ where a higher score indicates greater risk
- FtoE: use Trucost Environmental's *GHG Direct and First-Tier Indirect intensity variable*
  - defined as "greenhouse-gas emissions over which a company has control divided by the company's revenue"
  - measured in metric tons of CO2 equivalent per million U.S. dollars
- Cross-section of firms worldwide in 2019
  - 4,950 firms common to both datasets, 74 industries (as defined by Trucost)

EtoF vs. FtoE Rankings

- Industries with highest scores are different:

3-Digit Industry	EtoF Rank	FtoE Rank	3-Digit Industry	FtoE Rank	EtoF Rank
Passenger Airlines	1	5	Electric Utilities	1	27
Construction Materials	2	2	Construction Materials	2	2
Marine Transportation	3	6	Independent Power and Renewable Electricity Producers	3	11
Oil, Gas and Consumable Fuels	4	9	Multi-Utilities	4	15
Metals and Mining	5	8	Passenger Airlines	5	1
Chemicals	6	12	Marine Transportation	6	3
Paper and Forest Products	7	7	Paper and Forest Products	7	7
Ground Transportation	8	17	Metals and Mining	8	5
Containers and Packaging	9	11	Oil, Gas and Consumable Fuels	9	4
Transportation Infrastructure	10	33	Food Products	10	15

Note: Ranks based on the median firms score within an industry.

- Correlation between (normalized) EtoF and FtoE scores is 0.361
  - average within-industry correlation is only 0.273

Our Hypothesis

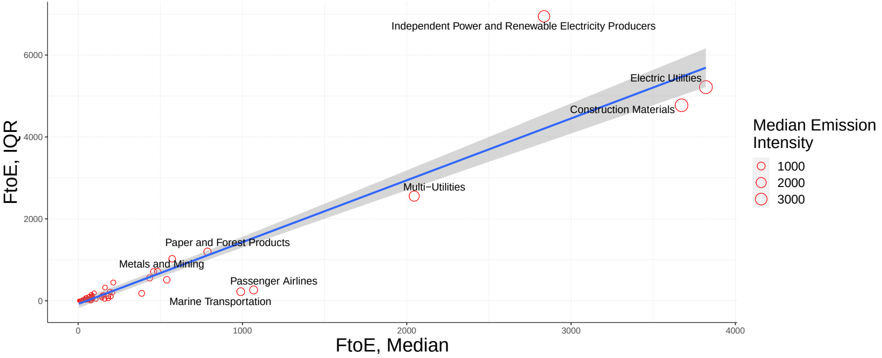
- Firms can control a big part of FtoE emissions
  - via buying carbon offsets, reducing air-travel, shifting to lower carbon vehicle fleets, changing office configurations to be more environmentally friendly, etc.
  - Assumption: mitigation possibilities scale with the size of firm's operations

- EtoF risk is more industry dependent because all firms affected by
  - overall temperature rise, changes in transportation and energy costs, imposition of carbon taxes that affect suppliers, etc.
  - some mitigation is possible but it is more limited

- Hypothesis: firms have more control over FtoE than EtoF, and the discretion that firms have is more important in industries where the average contribution of firms to climate change the largest

- To test this, compare correlation between the interquartile range (IQR) and the median raw score in the industry

FtoE: More Polluting Industries Have More Score Dispersion



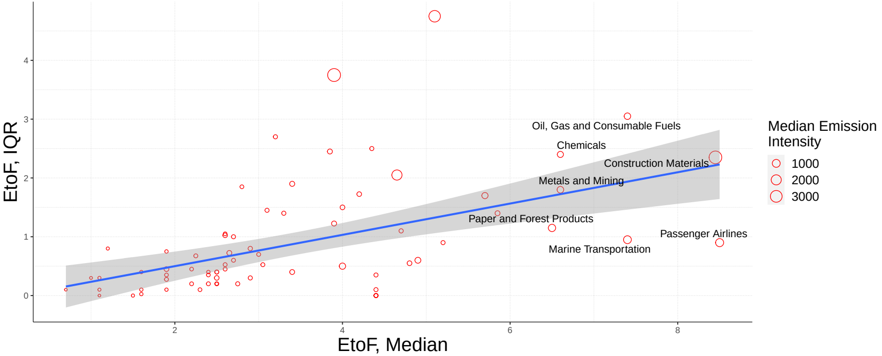
Correlation: 0.937

Slope: 1.510

t-stat: 22.823

- Strong positive correlation: industries that emit more greenhouse gasses show more dispersion with regard to firms' emissions
- "Best-in-class" firms in more polluting industries are significantly cleaner than "worst-in-class" $\rightarrow$ "best-in-class" goes a long way towards reducing GHG
- How much of this is due to FtoE mitigation?

EtoF: Quite Different from FtoE



Correlation: 0.339

Slope: 0.2

t-stat: 3.06

- Much lower correlation
- "Best-in-class" firms in more polluting industries much more similar to "worst-in-class" → "best-in-class" isn't a great way to manage EtoF risk
- Apparently less scope for EtoF mitigation

Importance of Distinguishing between EtoF and FtoE

- Focusing on the "wrong" ESG scores—EtoF instead of FtoE—will result in very different investment strategies

- But the distinction between EtoF and FtoE is not well understood in the literature or in practice!

- Example: Fidelity Climate Action Fund claims to "address climate change" but benchmarks to MSCI World Climate Change Index

- Typically, it is very hard to decide if a particular fund follows EtoF or FtoE considerations (often is a mixture)

Modeling Approach

- How to incentivize the managers to respect ESG principles?
- What are the implications of the difference between EtoF and FtoE considerations in the model?

- Build on Kashyap, Kovrijnykh, Li, and Pavlova (*AER*, 2023)
    - benchmarking is part of optimal contract under moral hazard

Model: Investment Opportunities

- Two periods, $t = 0, 1$
- N risky assets (stocks), claims to cash flow $\tilde{D} \sim N(\mu + \tilde{\kappa}, \Sigma)$ at $t = 1$
    - $\tilde{\kappa} = (\tilde{\kappa}_1, \ldots, \tilde{\kappa}_N)^\top$ captures the EtoF considerations
    - $\tilde{\kappa}$ affects the cashflows directly
- $p = (p_1, \ldots, p_N)^\top$ denotes asset prices
- Stocks are are in a fixed supply of $\bar{x} = (\bar{x}_1, \ldots, \bar{x}_N)^\top$ shares
- A risk-free bond with a zero interest rate
    - infinitely elastic supply, i.e., just a storage technology

Agents and Preferences

- Direct investors (fraction λ_D)
  - CARA preferences over final wealth W: $-E\exp(-\gamma W)$
- Fund managers (fraction λ_M)
  - CARA over compensation w: $-E\exp(-\gamma w)$
- Fund investors (same fraction λ_M), delegate investment to managers
  - $-E\exp[-\gamma(W + x^\top \kappa)]$
  - κ is a vector of nonpecuniary benefits that the investor derives from stock holdings x
  - κ is Pastor, Stambaugh and Taylor's (JFE, 2021) "warm glow"
  - captures investors' concerns about the FtoE impact

Value Added and Costs of Fund Managers

- Fund generates excess returns, but at a risk:

$$R = \underbrace{x^\top \Delta + \varepsilon}_{\text{excess return}} + \underbrace{x^\top (\tilde{D} - p)}_{\substack{\text{direct investor's} \\ \text{return}}}, \qquad \varepsilon \sim N(0, \sigma_\varepsilon)$$

- The manager incurs a private cost $\psi^\top x$ of managing risky assets
- The fund manager's portfolio is unobservable to the fund investor

$\Rightarrow$ Moral hazard

Linear Contract

- Compensation contract:

$$w = \hat{a}R + b(R - R_{benchmark}) + c = \underbrace{(\hat{a} + b)}_{\equiv a} R - bR_{benchmark} + c$$

  - R – performance of the fund
  - $R_{benchmark} = \theta^{\top}(\tilde{D} - p)$ – performance of benchmark
  - θ – benchmark weights
  - $\hat{a}$ – sensitivity to absolute performance
  - b – sensitivity to relative performance
  - c – independent of performance (e.g., based on time-0 AUM)
  - $a \equiv \hat{a} + b$ – "skin in the game"

- The contract parameters a, b, c, and θ are endogenous, chosen by the fund investors

- Empirical evidence for relative performance: Ma, Tang and Gomez (2019)

Manager's and Investor's Problems

- Fund manager's problem:

$$U^M = \max_x \; -E \exp\{-\gamma[aR - bR_{benchmark} + c - \psi^\top x]\}$$

$$\Leftrightarrow \max_x ax^\top(\Delta - \psi/a + \tilde{\kappa} + \mu - p) - b\theta^\top(\tilde{\kappa} + \mu - p) + c$$

$$- \frac{\gamma}{2}\left[(ax - b\theta)^\top \Sigma (ax - b\theta) + a^2\sigma_\varepsilon^2\right]$$

$$\Rightarrow \boxed{x^M = \Sigma^{-1}\frac{\Delta - \psi/a + \tilde{\kappa} + \mu - p}{a\gamma} + \frac{b\theta}{a}}$$

  – the benchmark creates inelastic demand for assets in the benchmark

- Fund investor's problem:

$$\max_{a,b,\theta,c} -E\exp\{-\gamma[W_0 + R(x) - (aR(x) - bR_{benchmark} + c) + x^\top \kappa]\}$$

$$\text{s.t.} \qquad x = \Sigma^{-1}\frac{\Delta - \psi/a + \tilde{\kappa} + \mu - p}{a\gamma} + \frac{b\theta}{a} \qquad (IC)$$

$$U^M \geq \underline{U} \qquad (PC)$$

Optimal Contract

- Tradeoff: risk sharing and incentives
- It's costly for manager to invest in assets with high ψ;
  investor wants manager to invest more in high-κ assets
- Skin-in-the-game, a: $-(2a-1)\gamma\sigma_\varepsilon^2 + \frac{\psi^\top \Sigma^{-1}}{\gamma a^3}\left[\psi(1-a)+\kappa a\right] = 0$
- Benchmark, $b\theta$:
  - Partial equilibrium:

$$(b\theta)(p) = \frac{\Sigma^{-1}}{\gamma}\left[(2a-1)\left(\kappa + \tilde{\kappa} + \Delta - \psi + \mu - p\right) + (1-a)\left(\frac{\psi}{a} - \psi + \kappa\right)\right]$$

  - General equilibrium:

$$b\theta = (2a-1)\left[\bar{x} + \frac{\Sigma^{-1}}{\gamma}\left\{\left(\frac{\lambda_M}{a} + \lambda_D\right)\kappa + \lambda_D(\Delta - \psi)\right\}\right] + (1-a)\frac{\Sigma^{-1}}{\gamma}\left[\frac{\psi}{a} - \left(\frac{\lambda_M}{a} + \lambda_D\right)(\psi - \kappa)\right]$$

Optimal Contract: κ vs. $\tilde{\kappa}$

- κ and $\tilde{\kappa}$ enter the benchmark differently
  - κ matters for both risk sharing and incentive provision; $\tilde{\kappa}$ only matters for risk sharing (to the extent that it affects returns)
  - κ affects the benchmark more (enters with a larger weight) than $\tilde{\kappa}$
  - If all investors believe in EtoF, then $\tilde{\kappa}$ disappears from contract in GE

- κ affects the skin-in-the-game, $\tilde{\kappa}$ does not
  - If $\psi^\top \Sigma^{-1} \kappa < 0$, then ESG considerations make the investor reduce a to incentivize the manager to invest less in risky stocks
  - The investor finetunes incentives asset by asset using $b\theta$

- If two assets, i and j, have the exact same characteristics except $\kappa_i > \kappa_j$, then the weight on i is greater the weight on j: $\theta_i > \theta_j$.

Example with Two Risky Assets

- κ enters the benchmark proportional to the following term:

$$\Sigma^{-1}\kappa = \frac{1}{1-\rho^2}\begin{pmatrix} \kappa_1 \frac{1}{\sigma_1^2} - \kappa_2 \frac{\rho}{\sigma_1\sigma_2} \\ \kappa_2 \frac{1}{\sigma_2^2} - \kappa_1 \frac{\rho}{\sigma_1\sigma_2} \end{pmatrix}$$

  - relative weight on an asset increases in that asset's κ and decreases in the κ of assets positively correlated with it
- Let $\kappa_1 > 0 > \kappa_2$ and $\rho > 0$
- The optimal benchmark gives a larger weight to green(er) firms (high κ_1), more so in highly polluting industries[1] (lower κ_2) 4 assets
  - this leads to a larger reduction in the cost of capital for green firms in dirty industries Benchmark inclusion subsidy
  - incentives to invest in green technologies are arguably most important in highly polluting industries

[1] Think of an industry as collection of firms with positively correlated cashflows

Comparing Exclusions to ESG Benchmarks

- In the U.S., ESG funds do not use ESG benchmarks, instead use exclusions
- Suppose the fund manager cannot go short ($x \geq 0$) $\Rightarrow$ assets with sufficiently negative κ's will not be held
- *Exclusions in the model:* fund uses a non-ESG benchmark and drops the most polluting firms
- Compared to the optimal ESG benchmark, exclusion
  - leads to lower weights on greener assets (missing κ_1)
  - underweighs the whole industry with worst polluting firms (missing κ_2) $\rightarrow$ hurts diversification
  - fails to disproportionately reward the best-in-class in the dirtiest industries

4 assets example

Summary and Future Work

- Empirics: EtoF and FtoE rankings are very different
  - FtoE allows more discretion to firms, especially for industries with high FtoE scores
- Theory: What is the best way to incentivize fund managers to invest according to ESG principles?
  - EtoF and FtoE considerations shape optimal contracts differently
  - Benchmarks are a powerful tool because they allow investors to finetune incentives firm by firm
  - Exclusions may lead to unintended consequences
- Still trying to better tie empirical results to the model
  - Any suggestions are much appreciated!

Real Effects of Benchmarks

- What role do benchmarks play for firms' corporate decisions?

- Kashyap, Kovrijnykh, Li & Pavlova (JFE, 2021): inelastic demand for assets in benchmark creates a "benchmark inclusion subsidy:"

    - a firm in the benchmark has higher valuation for investment than an otherwise identical firm outside the benchmark

        - i.e., benchmark firm has lower cost of capital for investment projects

  $\Rightarrow$ benchmarking has real implications, and a firm with a larger weight in the benchmark will be more likely to grow

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Example with Four Risky Assets

- Example: 4 assets, 2 (uncorrelated) industries, $\kappa_1 > \kappa_3 \geq 0 \gg \kappa_4 > \kappa_2$.

$$\Sigma^{-1}\kappa = \begin{pmatrix} \frac{1}{1-\rho_{12}^2}\left[\kappa_1 \frac{1}{\sigma_1^2} - \kappa_2 \frac{\rho_{12}}{\sigma_1\sigma_2}\right] \\ \frac{1}{1-\rho_{12}^2}\left[\kappa_2 \frac{1}{\sigma_2^2} - \kappa_1 \frac{\rho_{12}}{\sigma_1\sigma_2}\right] \\ \frac{1}{1-\rho_{34}^2}\left[\kappa_3 \frac{1}{\sigma_3^2} - \kappa_4 \frac{\rho_{34}}{\sigma_3\sigma_4}\right] \\ \frac{1}{1-\rho_{34}^2}\left[\kappa_4 \frac{1}{\sigma_4^2} - \kappa_3 \frac{\rho_{34}}{\sigma_3\sigma_4}\right] \end{pmatrix}$$

- Asset 1 will receive a lower weight than asset 3 with exclusion compared to the optimal benchmark
  - exclusion leads to lower weight on greener assets (b/c of missing κ_1 & κ_3)
  - exclusion of the most polluting assets yields to a lower weight on the whole industry (b/c of missing $\kappa_2 < \kappa_4$) $\rightarrow$ hurts diversification
- Relative to exclusion, benchmarking gives a larger subsidy to green firms in the most polluting industries
  - where incentives to invest in green technologies are arguably most important

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