Can Sustainable Finance Save the Planet?

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Carbon Pricing versus Green Finance

In Search of the True Greenium

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Can sustainable finance save the planet?

- **Asset-pricing channel**
  - Cost of capital lower for green firms relative to brown

  $\longrightarrow$ raise investment+output for green firms relative to brown

- **Questions:** How much
  1. *should* firms' cost of capital be changed to save planet?
  2. *are* firms' costs of capital affected in the real world?

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$$\text{actual discount rate}_i = \text{normal rate} + 4\$/\text{tCO}_2 \times \frac{\text{emission}_i}{\text{value}_i} + \varepsilon_i$$

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$$\begin{aligned}\text{actual discount rate}_i &= \text{normal rate} + 4\$/\text{tCO}_2 \times \frac{\text{emission}_i}{\text{value}_i} + \varepsilon_i \\ &= \text{normal rate} - 0.4\% \times \text{agg. green score}_i\end{aligned}$$

Overview of talk

- Can sustainable finance address **climate change**?
  - Theory
  - Evidence
- Can sustainable finance address **all externalities**?
  - Theory
  - Evidence

How should discount rates change to save the planet?

How should discount rates change to save the planet?

- **Problem:**
  - Emission externality, X_{it}, of each firm i and time t
  - Social cost of carbon, S_t
- **Solution from economics:**
  - Firm pays tax of $S_t X_{it}$
  - Nordhaus Nobel Prize 2018: $S_t = 43\$/\text{tCO}_2$ (or 300)
- **Sustainable finance:**
  - Firm faces higher cost of capital if it pollutes more
  - EU regulation, UN, global investors, your own pension, ...
  - Question: *How much* should cost of capital change?

Sustainable discount rates to save the planet

"Carbon Pricing versus Green Finance," Pedersen, *JF forthcoming*

- Sustainable discount rate, r_{it}^{x}:

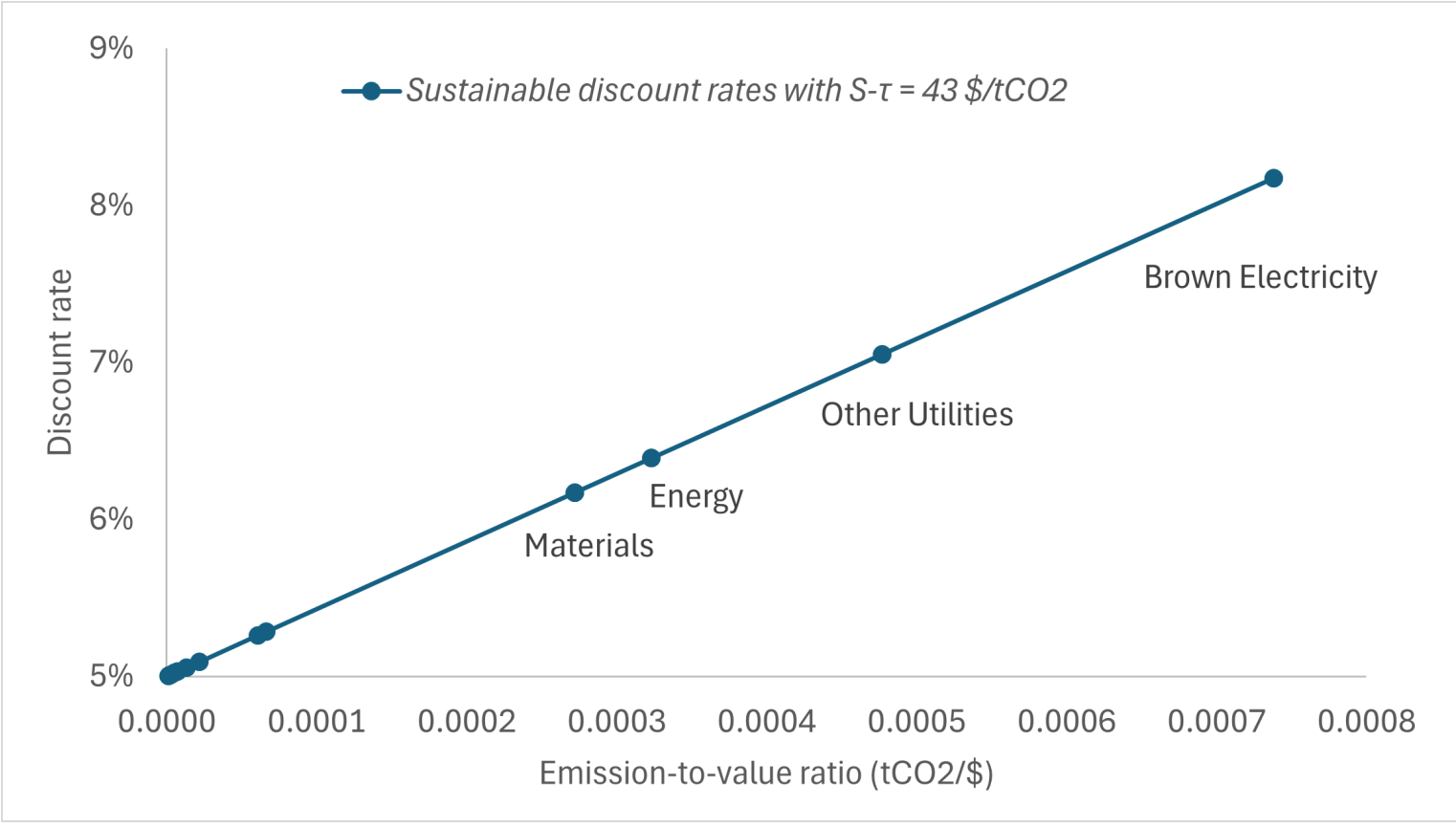
$$r_{it}^{x} = r + (S_{t+1} - \tau_{it+1})\frac{X_{it+1}}{v_{it}}$$

  - r = expected return, ignoring externality
  - X = externality, e.g., carbon emission (tCO_2)
  - S = social cost of externality=desired Pigouvian tax ($\$/tCO_2$)
  - τ = actual carbon tax ($\$/tCO_2$)
  - v = firm value ($)

- Intuition and implication
  - Firm should feel same cost as a tax, turned into discount rate
  - Cost of externality can be translated into discount rates

Sustainable discount rates to save the climate

Sustainable discount rate : $r_{it}^{x} = r + (S_{t+1} - \tau_{it+1})\frac{X_{it+1}}{v_{it}}$



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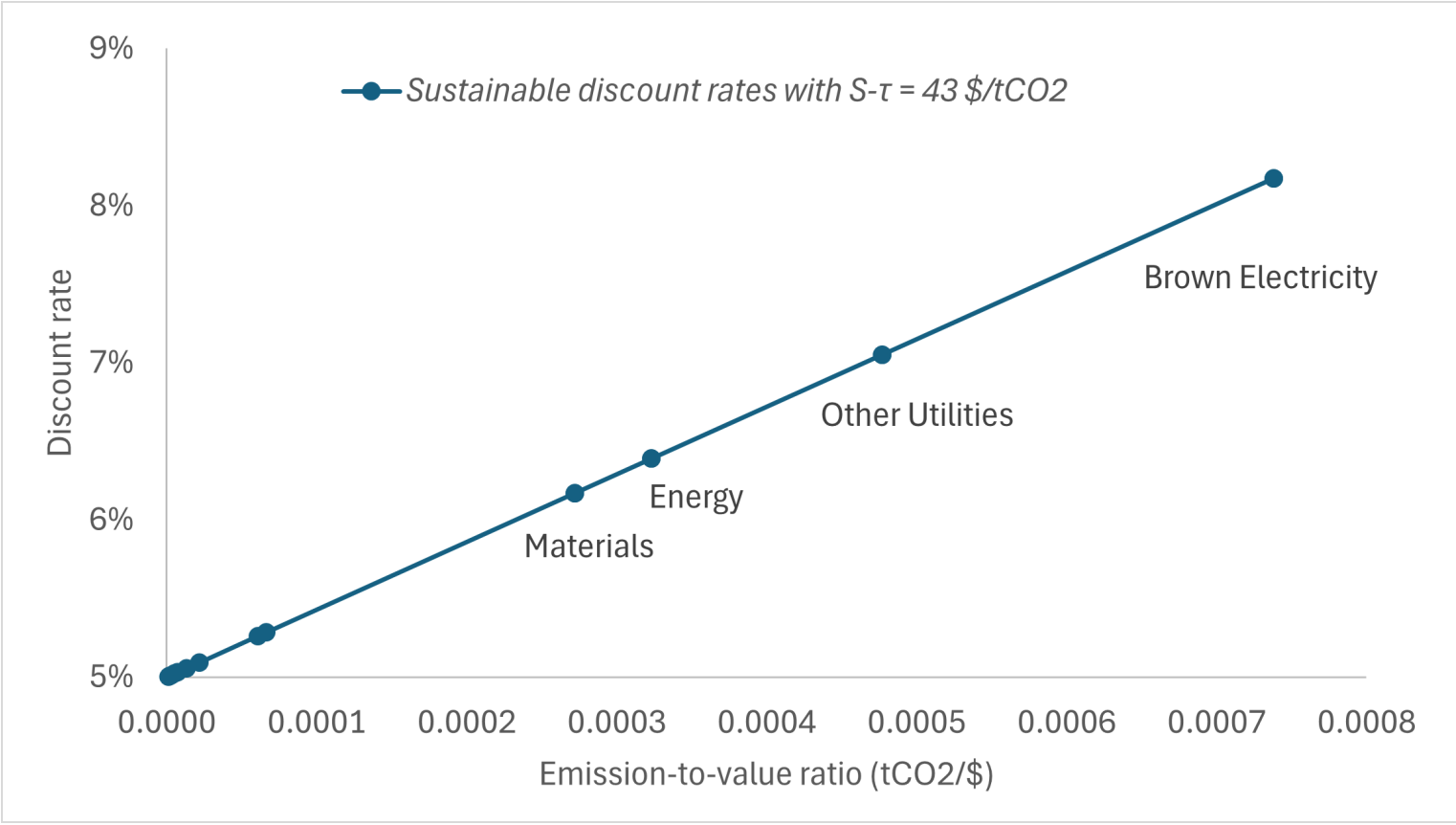

Empirical counterpart: regress expected return on $\frac{X_{it+1}}{v_{it}}$

Empirical results

"In Search of the True Greenium,"

Eskildsen, Ibert, Jensen, Pedersen

Empirical effect of sustainable finance: ICC

- Empirical counterpart with regression coefficient b:

$$\hat{E}_t(r_{it+1}) = b\,\frac{X_{it+1}}{v_{it}} + \text{controls} + \varepsilon_{it+1}$$

- Estimate using implied cost of capital (ICC) as $\hat{E}_t(r_{it+1})$
  - Controls: country-time FE, beta, log book eq., net debt-to-assets, ebit-to-assets
  - $\hat{b} = 4.2$ is "implicit carbon tax" due to climate finance

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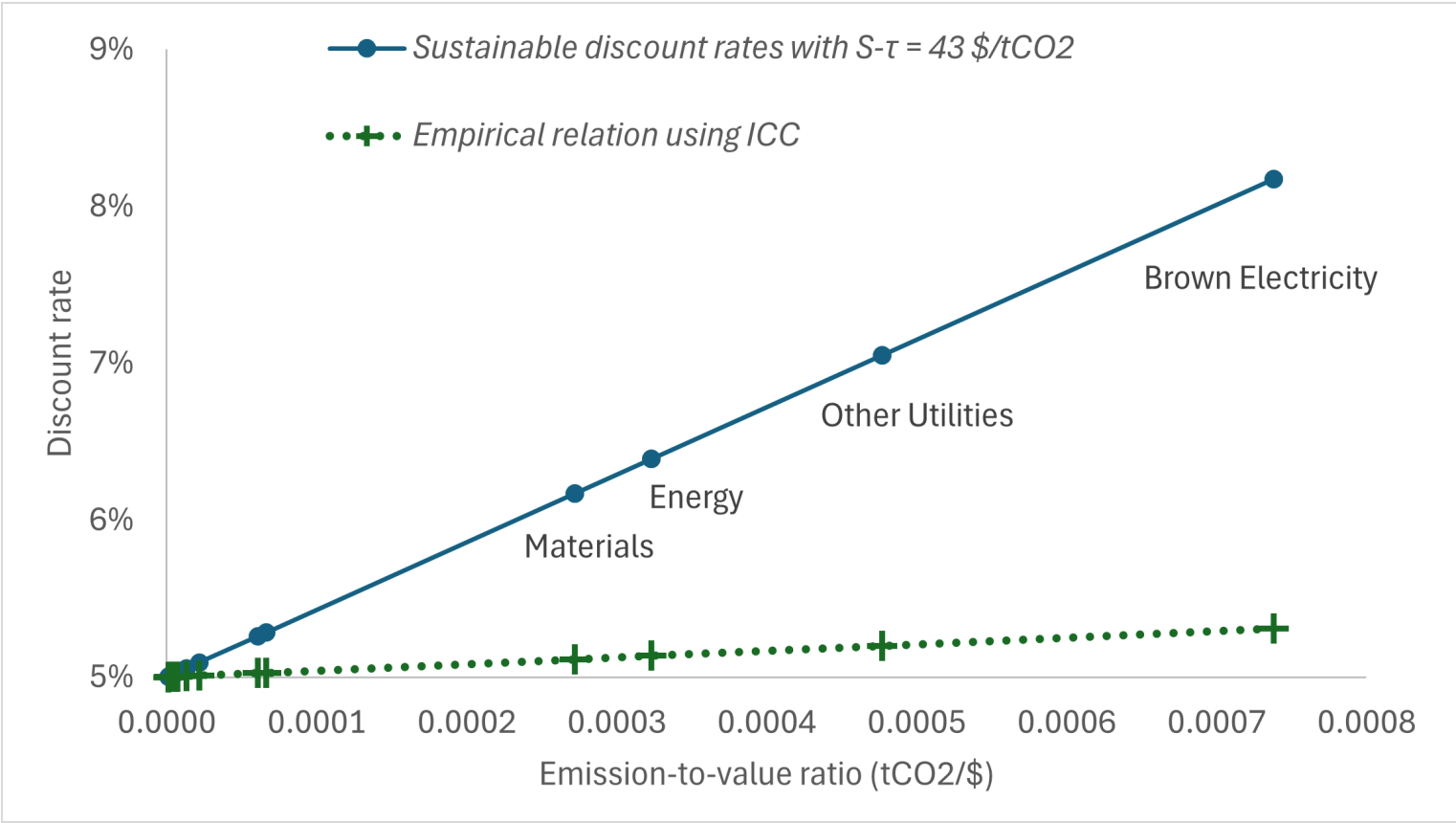

Can sustainable finance address *all* externalities?

What sustainable investors want

- **Many environmental measures**
  - Carbon: emission-to-value, emission-to-sale, total emissions, ...
  - Toxic waste
  - Biodiversity
  - E, S, G, and ESG scores
  - Virtuous firms, not sin stocks

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  - Biodiversity
  - E, S, G, and ESG scores
  - Virtuous firms, not sin stocks
- **Questions:**
  - Are these externalities? If so, what are the social costs?
  - What happens when investors care about many things?

Sustainable discount rates with many externalities

Extending *"Carbon pricing versus green finance"*

- **Generalized sustainable discount rates:**

$$r_{it}^{x} = r + \sum_{j} (S_{jt+1} - \tau_{jit+1}) \frac{X_{jit+1}}{v_{it}}$$

- where
  - X_{jit+1} is externality j by firm i
  - S_{jt+1} is the social cost of externality j
  - τ_{jit+1} is the tax already paid by firm i for externality j

How markets aggregate investor beliefs about externalities

"In search for the true greenium," Eskildsen et al. (2024)

- Different sustainability scores, $\tilde{s}_i$, for each investor i

$$\tilde{s}_{ij} = -\frac{x_{ij} - Ave((x_{ij})_{j=1,...N})}{Std((x_{ij})_{j=1,...N})}$$

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$$\tilde{s}_{ij} = -\frac{x_{ij} - Ave((x_{ij})_{j=1,...N})}{Std((x_{ij})_{j=1,...N})}$$

- Prop. 1: Mkt aggregates views in *"aggregate green score,"* s

$$E(r_n) = \lambda\beta_n + gs_n$$

s: largest greenium, exact pricing, most expl. power

Further Predictions: In search for the true greenium

"In search for the true greenium," Eskildsen et al. (2024)

- Prop. 2: Other greeniums depend on $\rho_i = \text{Cor}(\tilde{s}_i, s) \in (-1, 1)$

$$E(r_n) = \lambda\beta_n + \tilde{g}_i\,\tilde{s}_{i,n} + \tilde{\varepsilon}_{i,n}$$

$$\tilde{g}_i = \rho_i g,$$

- Prop. 3–4: Sustainable investor portfolios identify s
- Prop. 5–6: Greenium larger in green countries and over time

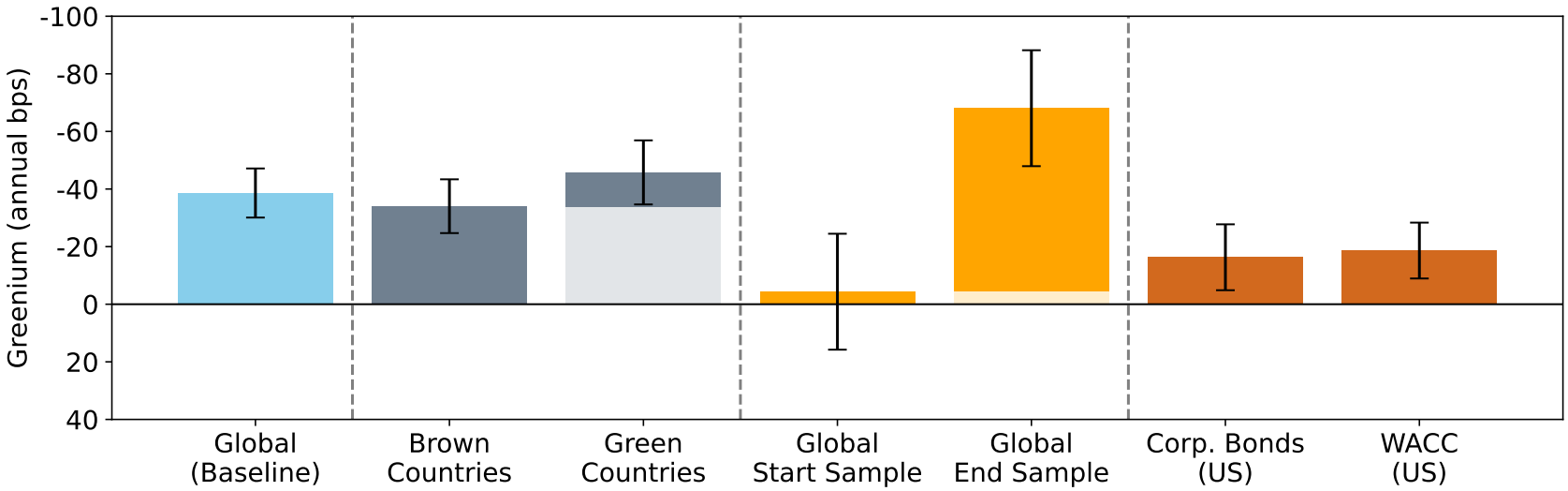
Evidence

Greenium estimate based on aggregate green score

New estimate of greenium, g, based on Prop. 1, 3–4

- forward-looking exp. returns, $\hat{E}_t(r^n_{t+1})$: implied cost of capital
- aggregate green score, s^n_t

$$\hat{E}_t(r^n_{t+1}) = g \times s^n_t + \text{controls} + \varepsilon^n_{t+1}$$



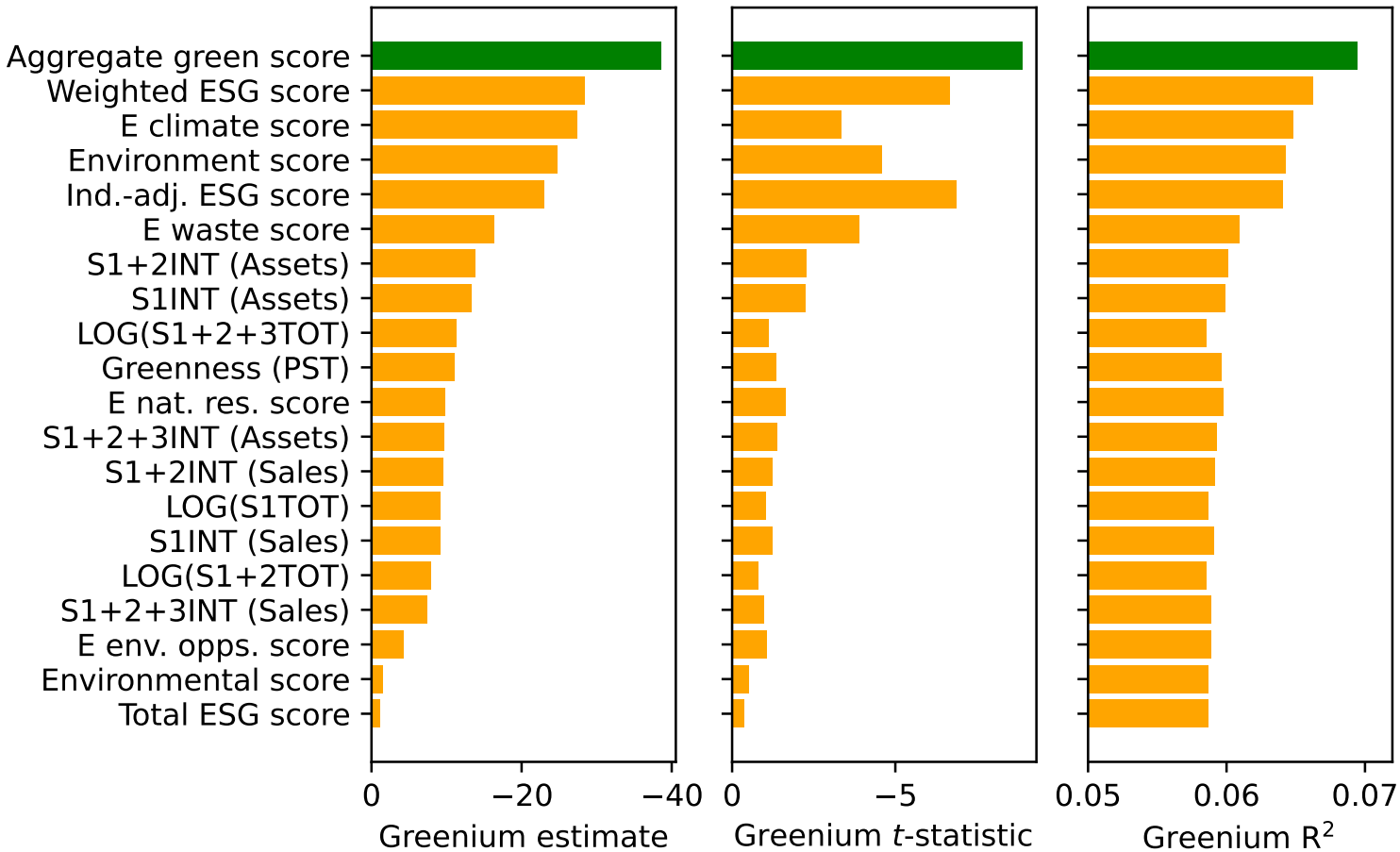
- Prop. 5–6: Greenium larger in green countries and over time

Greeniums based on individual green scores

- Return-sensitivity to different standardized green scores, s_{it}

$$\hat{E}_t(r_{nt+1}) = \tilde{g}_i \times \tilde{s}_{i,n,t} + \text{controls} + \epsilon_{nt},$$

- Prop. 1: aggregate green score (Eskildsen et al., 2024):
  - largest greenium, exact pricing, most explanatory power

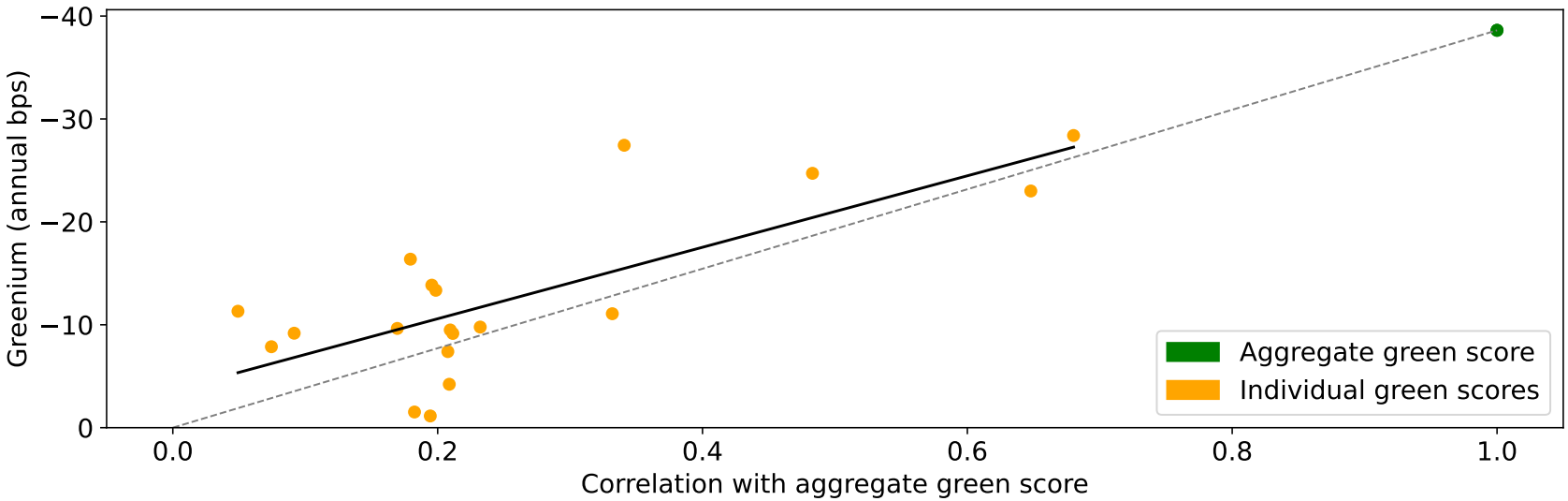


Connection between greeniums

- Prop. 2: Other greeniums depend on $\rho_i = \text{Cor}(\tilde{s}_i, s)$

$$E(r_n) = \lambda\beta_n + \tilde{g}_i\,\tilde{s}_{i,n} + \tilde{\varepsilon}_{i,n}$$

$$\tilde{g}_i = \rho_i g,$$



- CO_2/assets: $\rho_i = 0.2$, $\tilde{g}_i = -13$ bps
- Investors care about a lot of other things than carbon emission

Conclusion

Conclusion

- Can sustainable finance address climate change?
  - In principle, yes, can mimic carbon tax
  - Empirically, mimics a carbon tax of 0–10 $\$/tCO_2$
- In search for the true greenium, more broadly
  - Investors appear to value many different ESG criteria
  - Aggregate green score captures what is priced
- Society should focus on
  - taxing externalities, or
  - investment based on untaxed externalities, wgt by social costs

Appendix

References I

Eskildsen, M., M. Ibert, T. I. Jensen, and L. H. Pedersen (2024). In search of the true greenium. Working paper, Copenhagen Business School.

Gormsen, N. J., K. Huber, and S. S. Oh (2024). Climate capitalists. Working paper, University of Chicago.

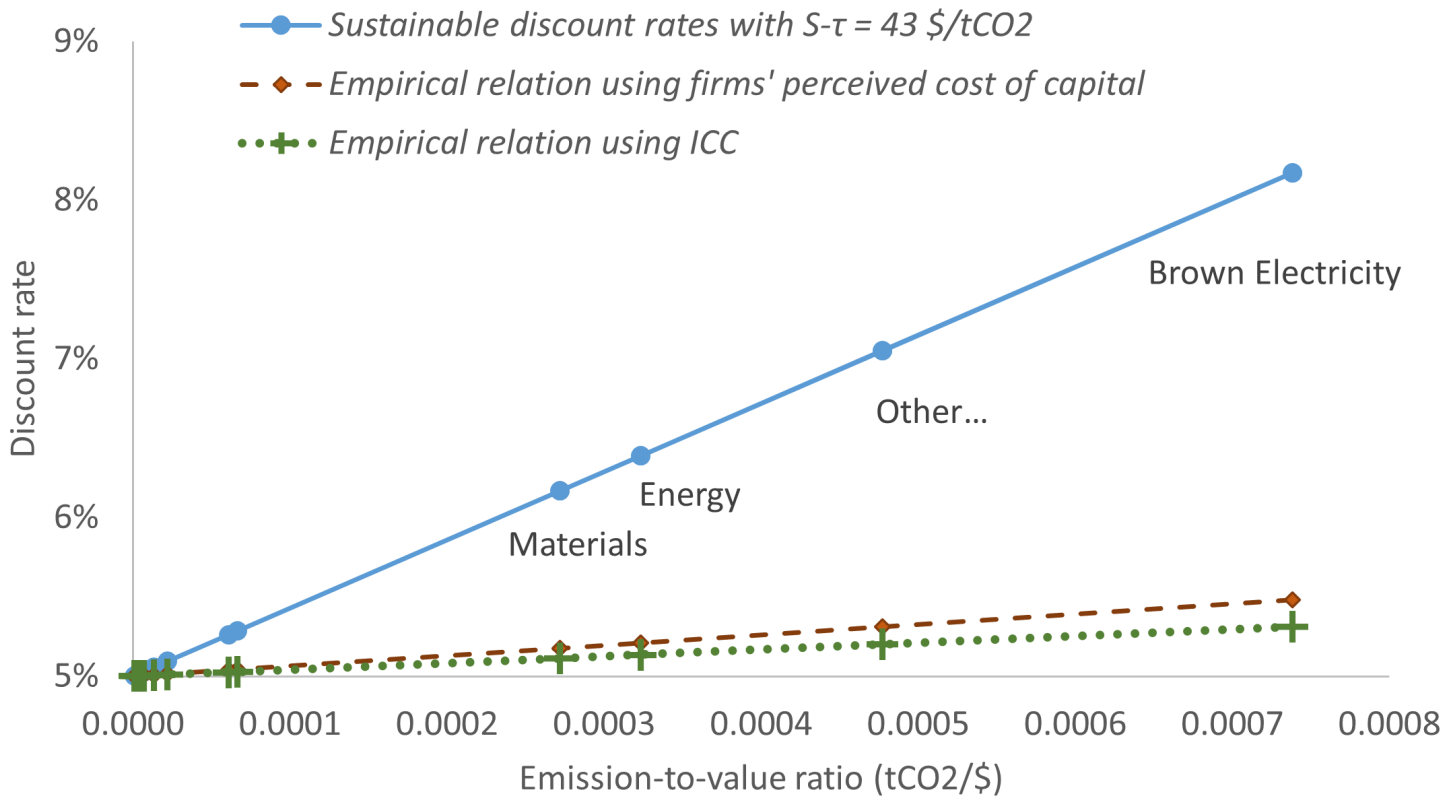
Pedersen, L. H. (2023). Carbon pricing versus green finance. *Journal of Finance, forthcoming*.

See paper for further references

Further evidence

- **Firms' perceived cost of capital** (Gormsen et al., 2024):

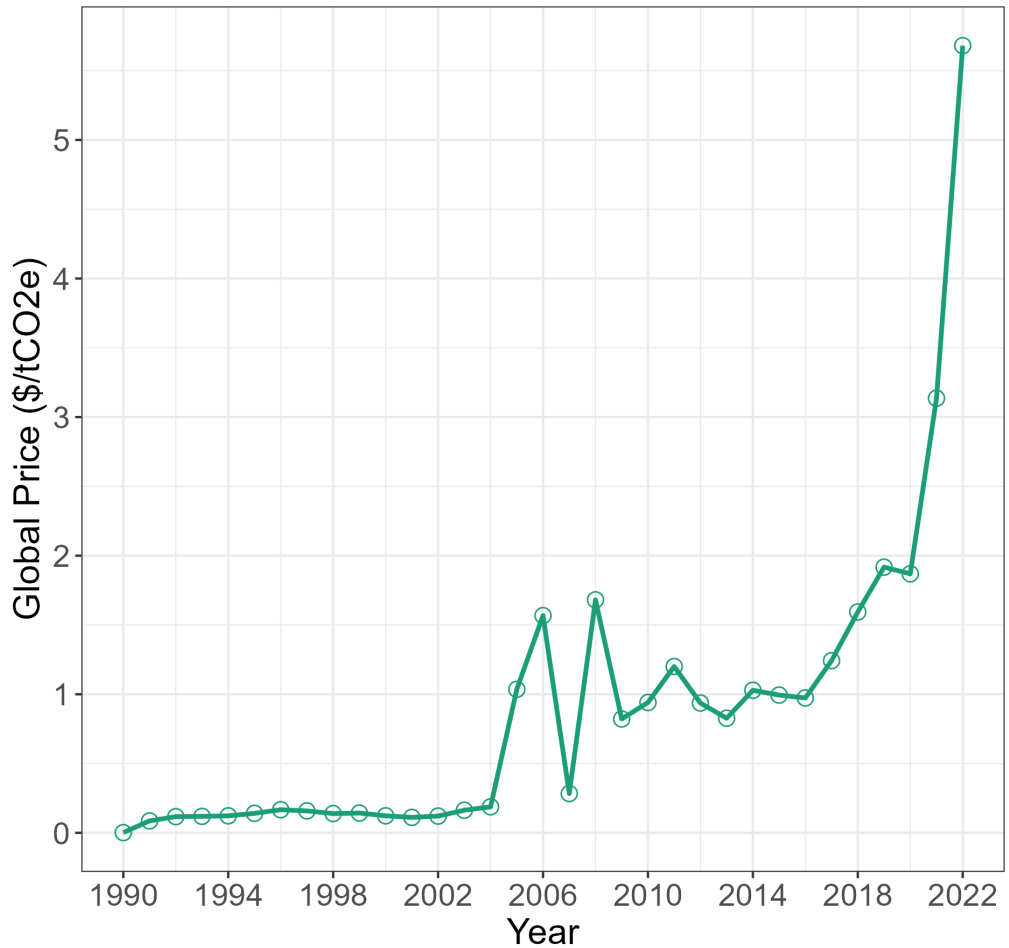
$$r_{it}^{perceived} = 6.5 \times \frac{X_{it+1}}{v_{it}} + \text{controls} + \varepsilon_{it+1}$$



- **Surveys, experiments, calibrations** → similar conclusions

Global Carbon Price

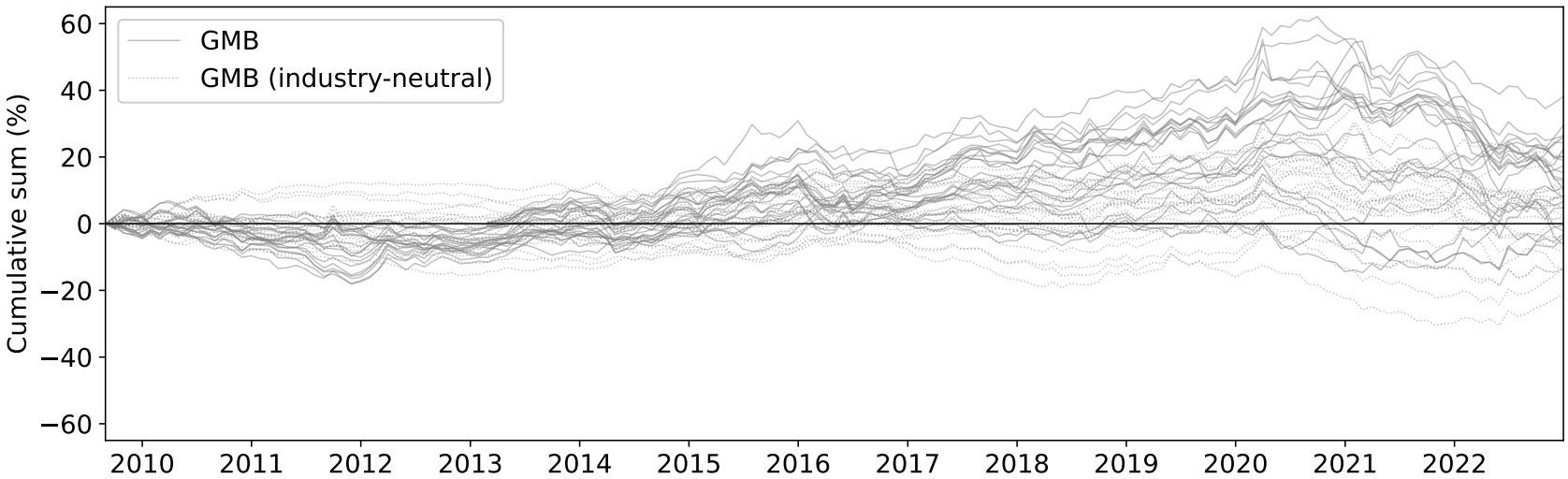
$$\bar{p}_c = \tau_c^{tax} \frac{\text{CO2 covered}_c^{tax}}{\text{Total CO2 in country}_c} + \tau_c^{ETS} \frac{\text{CO2 covered}_c^{ETS}}{\text{Total CO2 in country}_c}$$



Greenness measures

Name	Time period	Avg. N (US)	Avg. N (Global ex-US)	Source
Aggregate Green Score	2009-08 to 2022-12	1966	6002	Several
LOG(S1TOT)	2009-05 to 2022-12	1337	5933	Trucost
LOG(S1+2TOT)	2009-05 to 2022-12	1337	5933	Trucost
LOG(S1+2+3TOT)	2009-05 to 2022-12	1337	5933	Trucost
S1INT (Sales)	2009-05 to 2022-12	1337	5932	Trucost
S1+2INT (Sales)	2009-05 to 2022-12	1337	5932	Trucost
S1+2+3INT (Sales)	2009-05 to 2022-12	1337	5932	Trucost
S1INT (Assets)	2009-05 to 2022-12	1337	5933	Trucost
S1+2INT (Assets)	2009-05 to 2022-12	1337	5933	Trucost
S1+2+3INT (Assets)	2009-05 to 2022-12	1337	5933	Trucost
Ind.-adj. ESG score	2007-01 to 2022-12	1529	3333	MSCI
Weighted ESG score	2007-01 to 2022-12	1529	3332	MSCI
Environment score	2007-01 to 2022-12	1529	3333	MSCI
Greenness (PST)	2007-01 to 2022-12	1528	3333	MSCI
E climate score	2013-01 to 2022-12	2043	4384	MSCI
E nat. res. score	2013-01 to 2022-12	1449	3285	MSCI
E waste score	2013-01 to 2022-12	1374	2685	MSCI
E env. opps. score	2013-01 to 2022-12	718	1840	MSCI
Total ESG score	2009-08 to 2022-12	788	2717	Sustainalytics
Environmental score	2009-08 to 2022-12	788	2718	Sustainalytics

Replicating the literature: US green-minus-brown portfolios



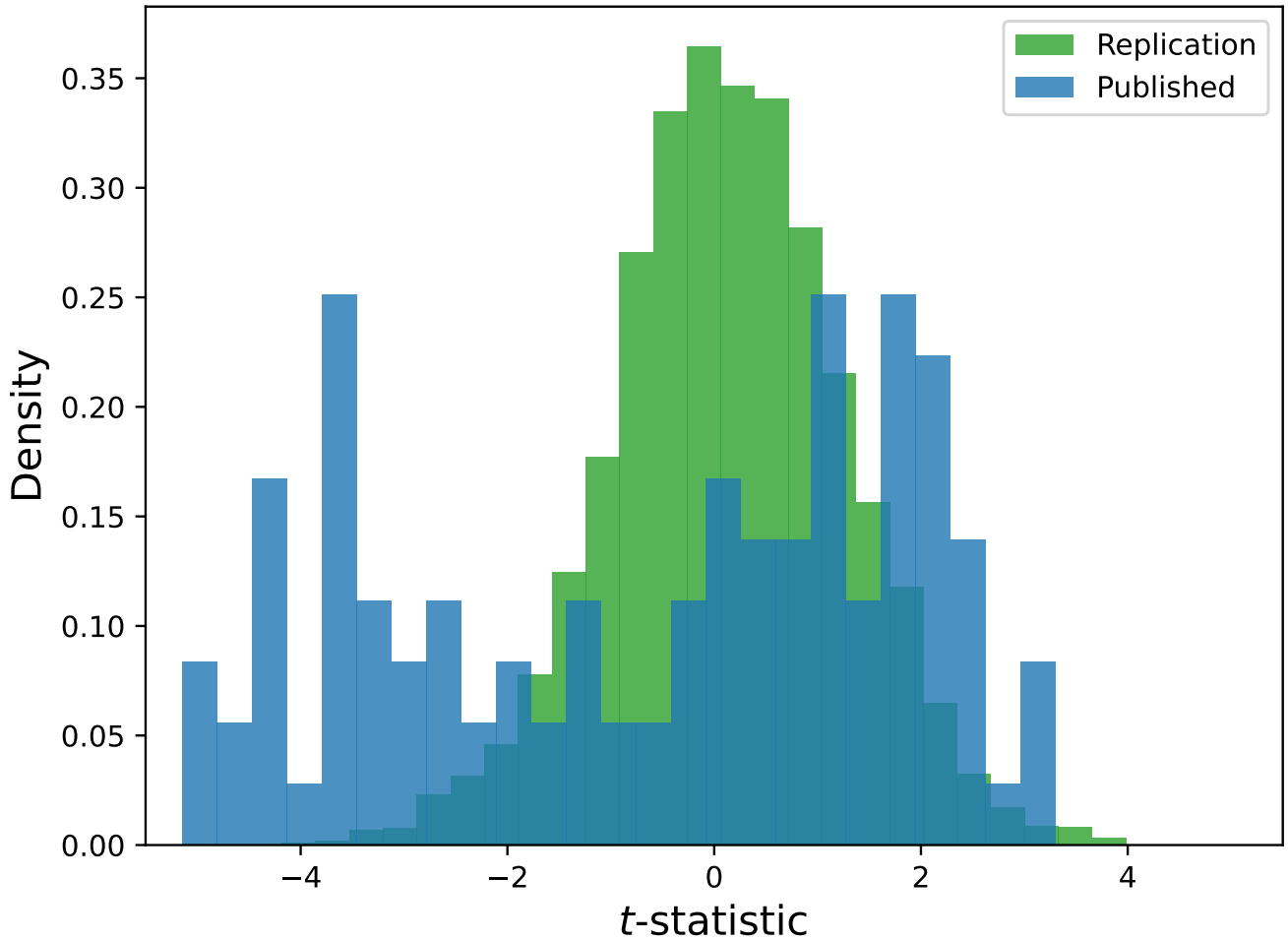
Cumulative returns of 46 US GMB portfolios:

- 23 greenness measures
- Industry-neutral or agnostic

Literature replication: Realized returns

"In Search of the True Greenium," Eskildsen, Ibert, Jensen, and Pedersen ('24)

Global t-stat distribution: Replicated and Published



Result: everything insignificant with multiple-testing adjustment

Why can greenium not be estimated with realized returns?

- We estimate
$$\text{SR}^{\text{GMB}} = -0.82\%/5.4\% = -0.15$$
- The Sharpe ratio of a strategy is linked to its t-statistic:
$$t = \sqrt{T} \times \frac{E[r]}{\sigma} = \sqrt{T} \times \text{SR} = -0.55$$
- How many years T needed for significance (i.e., $t = -1.96$):
$$T = \left(\frac{1.96}{SR}\right)^2 = \left(\frac{1.96}{0.1}\right)^2 = 167 \text{ years}$$