Climate Capitalists

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Motivation

Challenge: incentivize green investments, despite low carbon taxes

Cost of capital approach

- Green funding (e.g., buy green stocks) $\Uparrow$ → green CoC $\Downarrow$ → green investment $\Uparrow$
- Can work like carbon tax (Chitarro et al. 2024; Pedersen 2023)
- Even if returns to brown production are high and taxes low

Broad interest

- 25% of fin. assets under management in ESG funds in 2024
- Green investors: ECB, government funds, BlackRock, Catholic Church, . . .

Real impact unclear

- Depends on how firms set their CoC
- CoC unobserved, no agreed calculation, no quant. analysis
- Hard to measure using fin. prices or surveys
- 21% of academics say green firms have lower CoC; 23% no; 55% unsure

Main Results

1. Hand-collected data on CoC **used by firms**

2. Across firms: CoC of green firms lower since 2016
   - Greenness 3rd-strongest predictor of CoC
   - Suggests: increased investment by green firms

3. Within firms: Large energy firms use lower CoC for green divisions since 2016
   - Suggests: brown firms become greener

4. Magnitude in 2023: 2 ppt.
   - 100$ CO_2 tax $\approx$ 6-10 ppt. (Pedersen 2023; Chitarro et al. 2024)
   - Sizable potential of CoC channel

5. Implications
   - Changes over time in green CoC, so firms willing to adjust
   - Variation within firms, so some firms are sophisticated
   - Open question on drivers: investor taste, risk, managers' views?

Framework: Investment Decisions

1. Firms invest if

$$\text{expected return of project} > \text{CoC} + \kappa$$

2. CoC = managers' perception of expected return to debt & equity (WACC)
   - Firms use asset pricing models, past returns, subjective beliefs

3. κ = wedge, capturing:
   - project-specific risk, preferences, or option value
   - correction for inflated cash flow estimates
   - financial and capacity constraints

4. Today: focus on CoC
   - Key long-run determinant of investment

Data from Corporate Conference Calls

Nestlé, Q4-2006: *"We use an average cost of capital of 7.5%."*

Air Canada, Q3-2017: *"... our weighted average cost of capital of 7.6%."*

Phillips 66, Q2-2022: *"... our weighted average cost of capital of 10%."*

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Data collection

  - Manually read transcripts with RA team
  - 110k paragraphs containing keywords, 2002-22
  - Analyze only firm-level CoC; separately collect project-specific numbers

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Data collection

Data overview
- 3,200 observation of perc. CoC for 1,200 firms in 20 countries
- Representative, except larger firms
- Firms with perc. CoC account for 40% of Compustat assets
- Data under costofcapital.org

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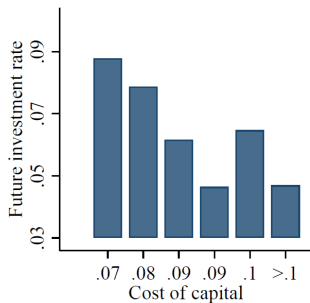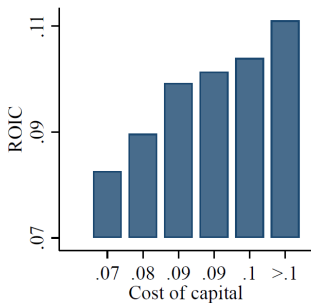
Data collection

Data overview

Verifiable data

- Calls are repeated high-stakes interactions (Hassan et al. 2019)
- Information from conference calls used in security lawsuits
- Data validation in paper and next

Perceived Cost of Capital and Real Outcomes

Perceived CoC influences real decisions, so it generates:

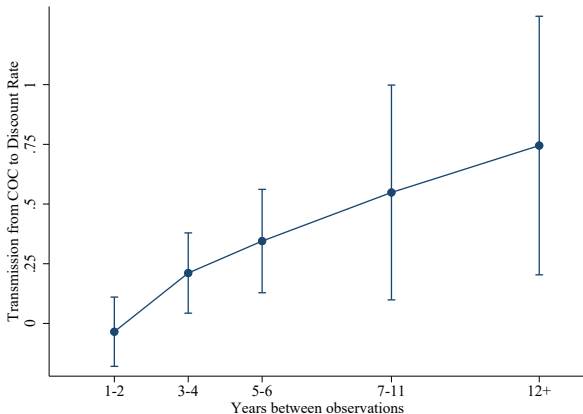- lower investment
- higher average realized returns

Magnitudes consistent with standard model and robust to controls
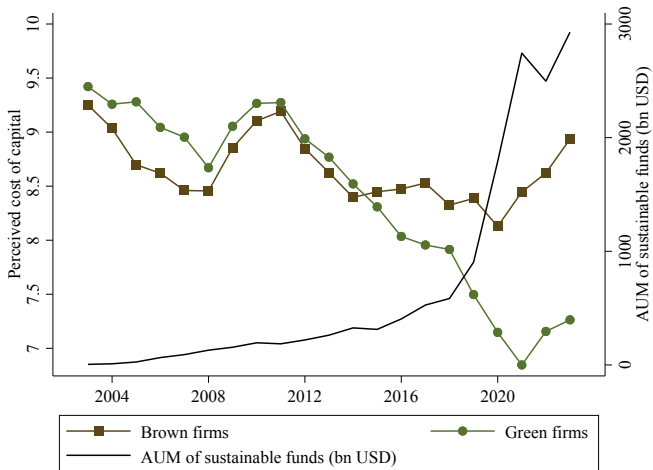
Why Does CoC Matter?

Investment depends on hurdle = CoC + κ

Changes in CoC incorporated in long run

Analysis requires within-firm data, previous surveys inconclusive
(e.g., Poterba and Summers 1995; Meier and Tarhan 2007; Sharpe and Suarez 2021; Graham 2022)

Firm-Level CoC

Measure firm-level greenness based on MSCI data, split at median

Firm-Level CoC

- MSCI E-score ranges from 0 to 1
- Controls: leverage, beta, market value, book-to-market, quarter-year

| | Perceived cost of capital | | | | | |
	US sample			Global sample		
E-score	-0.53	0.22	0.94	-1.38***	-0.74	-0.10
	(0.40)	(0.52)	(0.61)	(0.38)	(0.45)	(0.49)
E-score × Post-2016		-1.90**	-2.12**		-1.46**	-1.71***
		(0.87)	(0.84)		(0.65)	(0.60)
Controls:	No	No	Yes	No	No	Yes
Observations	1,026	1,026	885	1,606	1,606	1,384
Within R^2	0.0029	0.012	0.15	0.021	0.027	0.19

Greenness: Key Predictor Among Factor Zoo

- Estimate predictors of perc. CoC using Lasso
- 150 factors from Jensen et al. (2021)
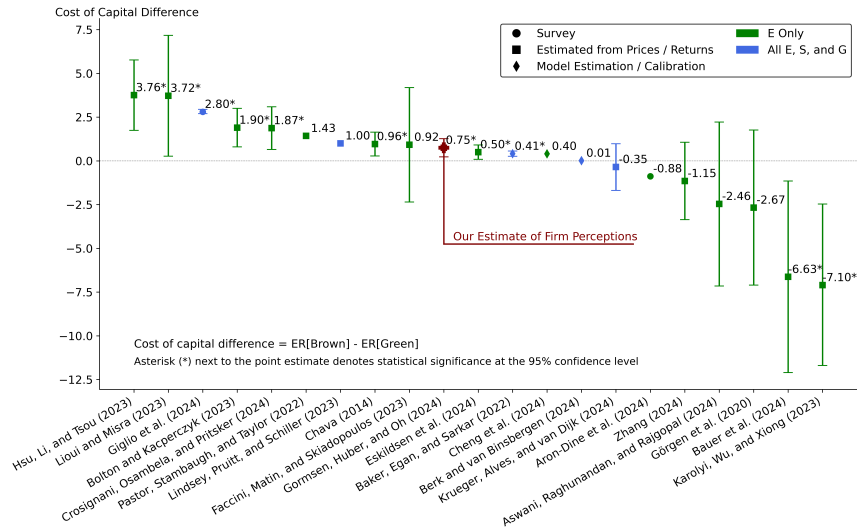- E-score post-2016 is 3rd-largest predictor
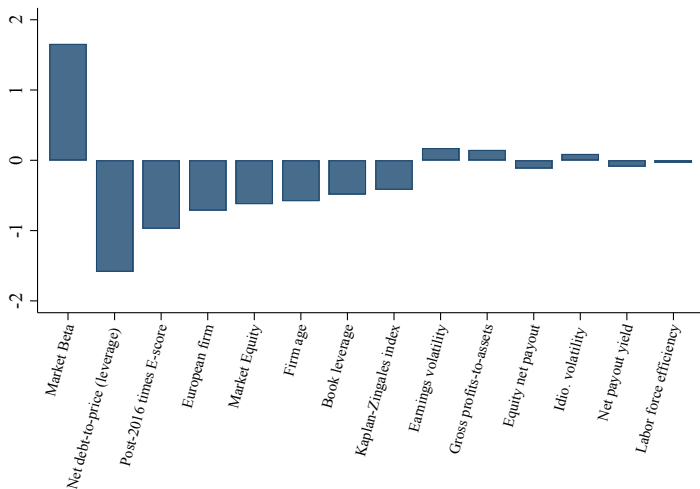
Robust to Alternative Green Measures

Use "robust green score" from Eskildsen et al. (2024)
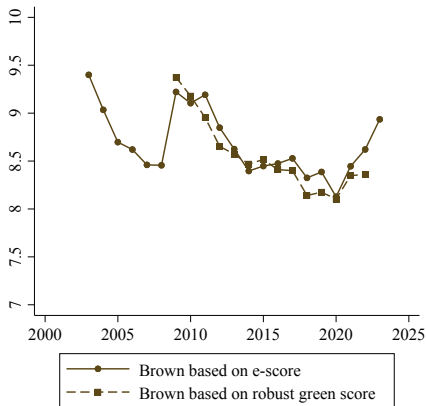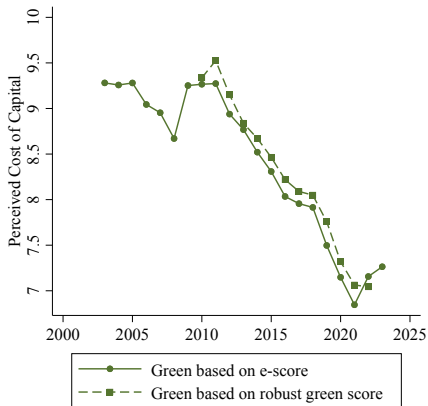
Estimates in the Literature

- Literature using fin. prices: much uncertainty on what firms should use
- We observe the CoC used by firms

Within-Firm Variation

- Some firms apply different CoC or hurdle to green divisions
- E.g., Shell

Disciplined, value-focused capital allocation

$ billion		Cash Capex			Power dilutions	Cash Capex after power dilutions	FCF	IRR hurdle rates
		2022	2023	24-25		24-25	2025[1]	
Integrated Gas	IG	4	~5	~5		~5	~8	11%
Upstream	UP	8	~8	~8		~8	~10	15%
Integrated Gas and Upstream	IGU	12	~13	~13		~13	17-18	
Marketing (gas stations)	MKT	5	~6[2]	~3		~3	~4	MKT ex. LCF/EV 15% LCF 12% EV 12%
Chemicals & Products	C&P	4	3-4	3-4		3-4	~5	12%
Renewables & Energy Solutions	R&ES	3	2-4	4-5	(1-2)	~3	~(2)	R&ES excl. power 10% Power generation 6-8%
Downstream and Renewables & Energy Solutions	DSR	12	11-14	10-12		9-10	7-8	
	Total	25	23-27	22-25		21-23	24-26	

[1] For price assumptions see appendix [2] Includes acquisition of Nature Energy (nearly $2 billion)

Capital Markets Day 2023 | June 14   43

12/25

Division-Level Cost of Capital

- Search slides of 200 largest energy & utility firms
- 50 firms report division values
- Includes Shell, BP, Total, EDF (jointly 4% of global emissions)
- Consistent with capital reallocation toward green divisions since 2016

	(1) Regulated CoC	(2) Perceived CoC	(3) Hurdle
Green division	0.49	-0.84***	-4.06**
× Post-2016	(0.36)	(0.20)	(1.57)
Green division	-3.07	0.043	2.65
× Pre-2016	(2.57)	(0.74)	(1.57)
Brown division	0.21	0.16**	-0.0096
	(0.25)	(0.063)	(0.57)
Observations	443	193	248

Potential Drivers

1. CoC: Investor preferences
   - Taste for green fin. assets $\Uparrow$ → exp. returns $\Downarrow$ → CoC $\Downarrow$
   - Consistent with realized fin. returns $\Uparrow$ unexpectedly (Pástor et al. 2022)
   - Consistent with heterogeneous beliefs and green investors expecting higher returns (Aron-Dine et al. 2024; Giglio et al. 2025; Edmans et al. 2024)

2. CoC: Risk assessment
   - Green firms' risk $\Downarrow$ → exp. returns $\Downarrow$ → CoC $\Downarrow$
   - Could be due to future regulation

3. Hurdle: Managerial views
   - Believe that risk has fallen more than exp. returns in fin. markets
   - Want to make firm greener by favoring green divisions
   - May explain why effect on hurdle > effect on CoC

Low Green CoC, Low Pledged Emissions

- Cannot observe long-run emissions of post-2016 investments
- Observe post-2016 emissions pledges
- Compare to green CoC in firm's sector post-2016
    - Depends on risk of substitution from brown to green production
    - E.g., green CoC high in mining, low in food

	Firm-level CO_2 change (pct)		Firm-level CO_2 change per year (pct)	
Brown CoC in sector	-15.5**	-17.0**	-2.38***	-2.08***
	(4.89)	(5.37)	(0.67)	(0.57)
Green CoC in sector	6.88**	2.91	1.41**	-0.067
	(2.79)	(4.63)	(0.51)	(0.48)
Fin. CoC (CAPM)		7.01		1.31*
		(5.13)		(0.63)
Return on equity		1.25		0.45***
		(1.02)		(0.13)
Tobin's Q		-0.78		-2.19*
		(7.40)		(1.00)
Observations	615	615	520	520
R^2	0.49	0.50	0.12	0.13

Conclusion

1. Analyze CoC used by firms

2. Lower green CoC since 2016

3. Firms incorporate changes over time, so firms willing to adjust green CoC

4. Within-firm variation, so some firms are sophisticated

5. Suggests CoC channel has real potential

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Framework

- Firms produce output using green and brown capital

- Fall in green CoC leads to reallocation from brown to green capital
    Channel 1: cross-firm reallocation
    Channel 2: within-firm reallocation

- Relative strength of the two channels depends on
    1 Elasticity of substitution in product market
    2 Capital budgeting of firms

Model

- Firms $i \in [0, I]$ produce differentiated products to representative household

Households

Spends W to consume Q_i of each product, with elasticity of substitution σ :

$$U = \left(\int_{i=0}^{I} Q_i^{(\sigma-1)/\sigma} di \right)^{\frac{\sigma}{\sigma-1}}. \tag{1}$$

Demand

$$Q_i = P_i^{-\sigma} \frac{W}{\boldsymbol{P}^{1-\sigma}}. \tag{2}$$

where P is price and $\boldsymbol{P}^{1-\sigma} = \left(\int_{i=0}^{I} P_i^{1-\sigma} di \right)^{1/(1-\sigma)}$ is the price index

Firm production

Cobb-Douglas based on brown (K) and green (G) capital

$$Y_i(K_i, L_i, G_i) = K_i^{\alpha_i} G_i^{1-\alpha_i}, \tag{3}$$

Brown firms: $\alpha = 0.7$, green firms: $\alpha = 0.3$.

Firm Optimization (I)

Baseline optimization

$$\Pi_i^{\text{Baseline}} = \max_{K_i, G_i} \quad P_i Y_i(K_i, L_i, G_i) - r^{\text{Brown}} K_i - r^{\text{Green}} G_i \tag{4}$$

$r^{\text{Brown}} = r$ and $r^{\text{Green}} = r - \zeta$
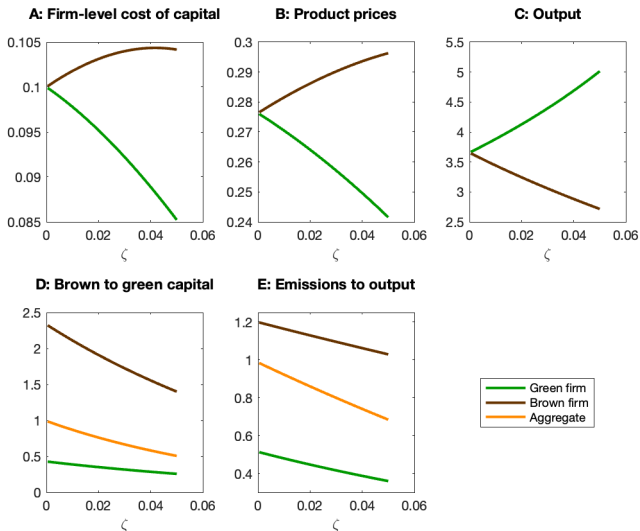
Firms' choose optimal mix of capital

$$\frac{K_i^*}{G_i^*} = \frac{\alpha_i}{1 - \alpha_i} \times \frac{r^{\text{Green}}}{r^{\text{Brown}}} \tag{5}$$

and quantities such that

$$P_i^* = \frac{\sigma}{\sigma - 1} \left(\frac{r^{\text{Brown}}}{\alpha_i} \right)^{\alpha_i} \left(\frac{r^{\text{Green}}}{1 - \alpha_i} \right)^{1 - \alpha_i} \tag{6}$$

Results of Baseline Model

Effects of increasing discount on green capital ζ (and r)

Firm Optimization (II)

Optimization with one cost of capital

$$\Pi_i^{\text{WACC}} = \max_{K_i, G_i} \quad P_i Y_i(K_i, L_i, G_i) - \text{WACC}_i(K_i + G_i), \tag{7}$$
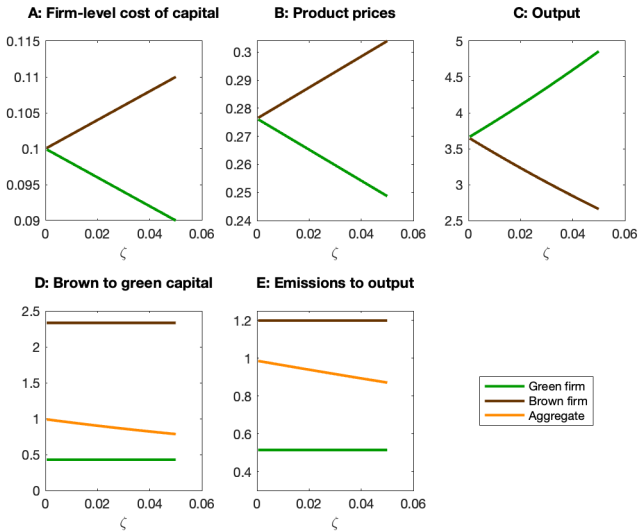
$$\text{WACC}_i = r - \zeta(1 - \alpha_i)$$

Firms' choose optimal mix of capital

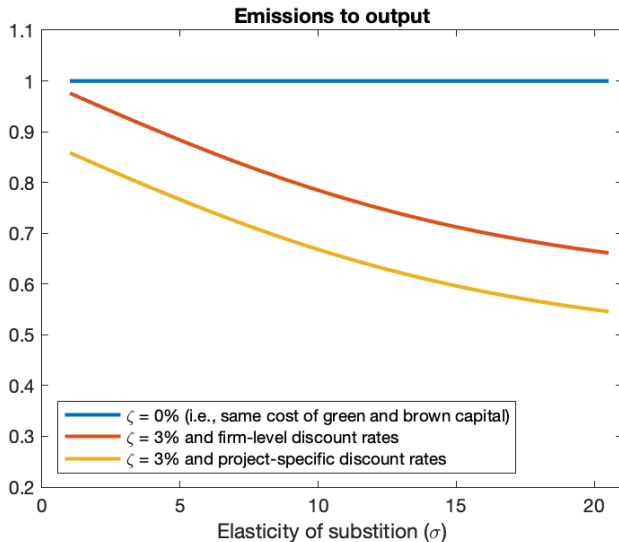$$\frac{K_i^{'}}{G_i^{'}} = \frac{\alpha_i}{1 - \alpha_i}, \tag{8}$$

and quantities such that

$$P_i^{'} = \frac{\sigma}{\sigma - 1} \frac{\text{WACC}_i}{\alpha_i^{\alpha_i}(1 - \alpha_i)^{1 - \alpha_i}}. \tag{9}$$

Results with Single Cost of Capital

Comparison of the Two Channels

Emissions to output

Legend:
- $\zeta = 0\%$ (i.e., same cost of green and brown capital)
- $\zeta = 3\%$ and firm-level discount rates
- $\zeta = 3\%$ and project-specific discount rates

x-axis: Elasticity of substitution (σ)

Expectations, Preferences, and Holdings

Toy model with CARA investors:

- Green (G) and brown (B) investors disagree about future value of green and brown firms (risk and disagreement symmetric)
- G and B have same risk capacity (no effect of disagreement on prices and true exp. return)
- G has preference for holding green stocks
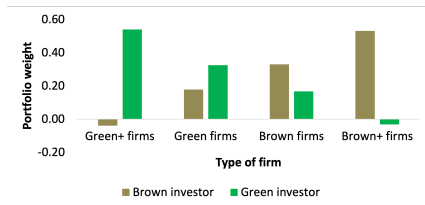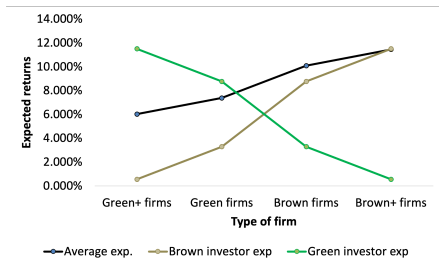
Takeaway

- G holds green firms, support them with lower CoC, *and* believe green firms have high exp. returns