# 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) $\Uparrow \rightarrow$ green CoC $\Downarrow \rightarrow$ 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$ CO2 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. $\kappa$ = 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 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 in advanced economies
- Predicted data under costofcapital.org

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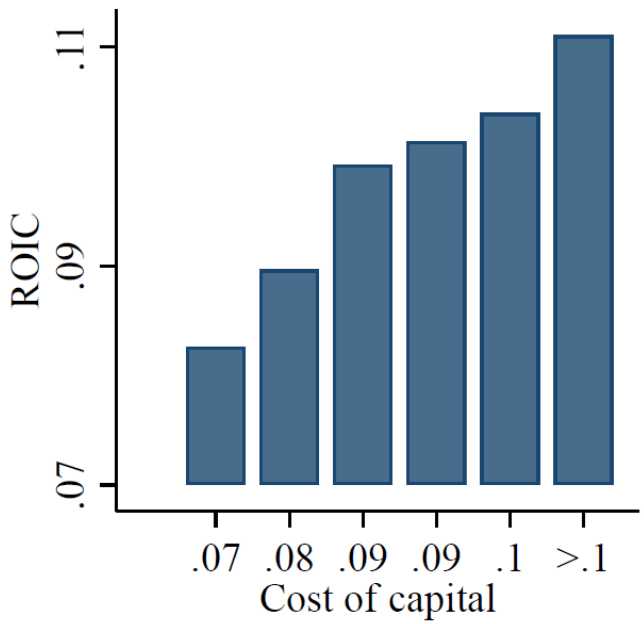
**Verifiable data**

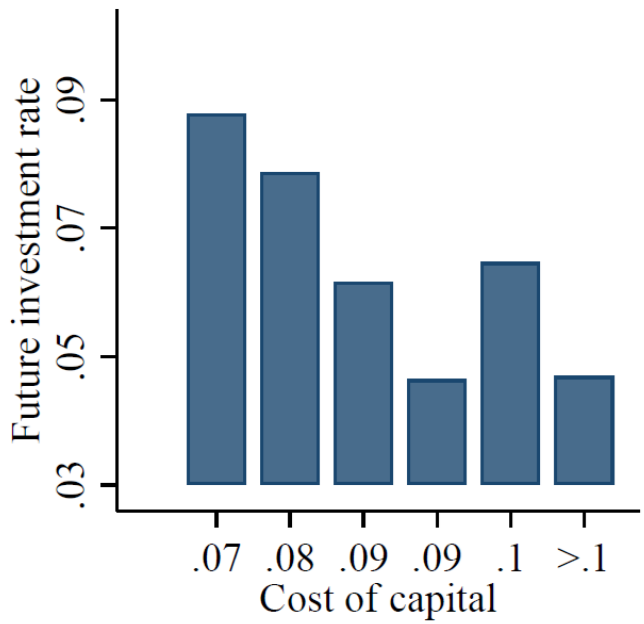
- Calls are repeated high-stakes interactions (Hassan et al. 2019)
- Information from conference calls used in security lawsuits
- Data validation in paper and next

# Perceived Cost of Capital and Real Outcomes

Perceived CoC influences real decisions, so it generates:

- lower investment
- higher average realized returns



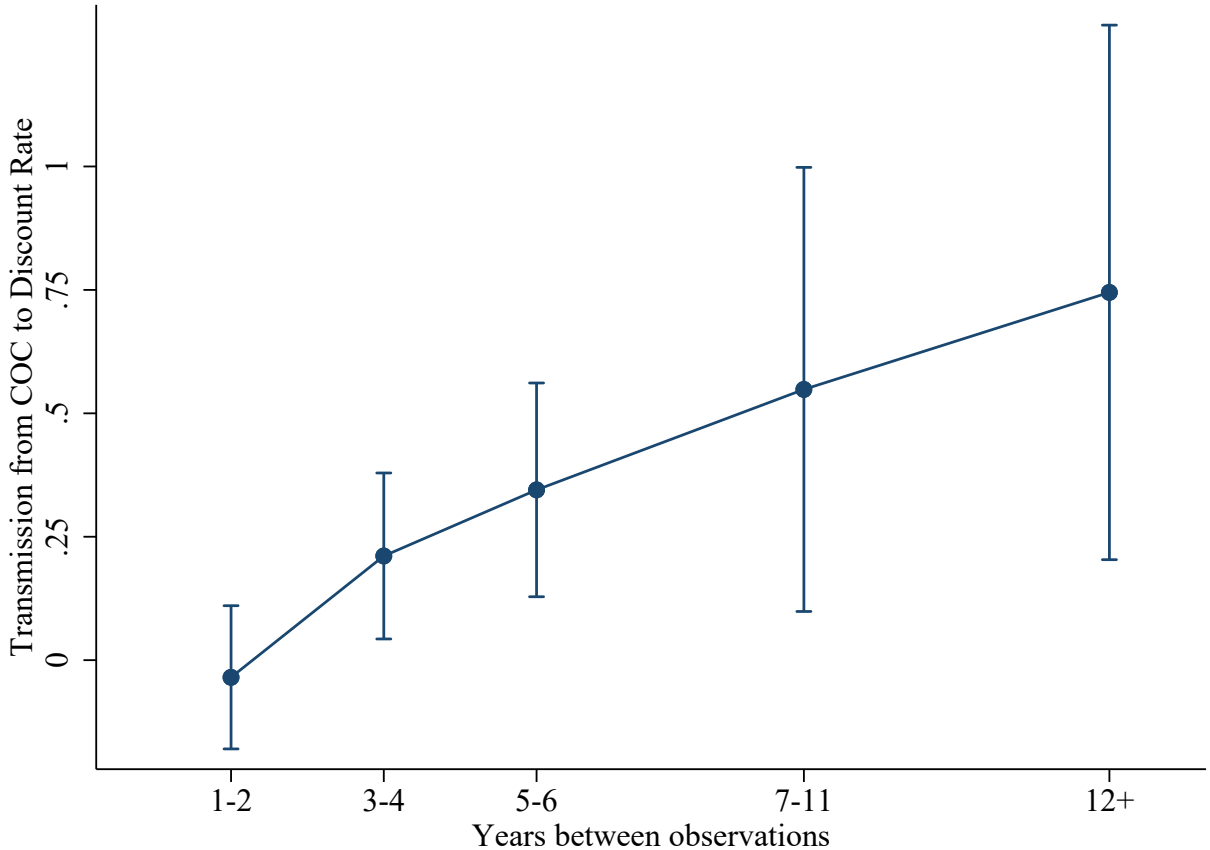




Magnitudes consistent with standard model and robust to controls

# Why Does CoC Matter?

Investment depends on hurdle = CoC + $\kappa$

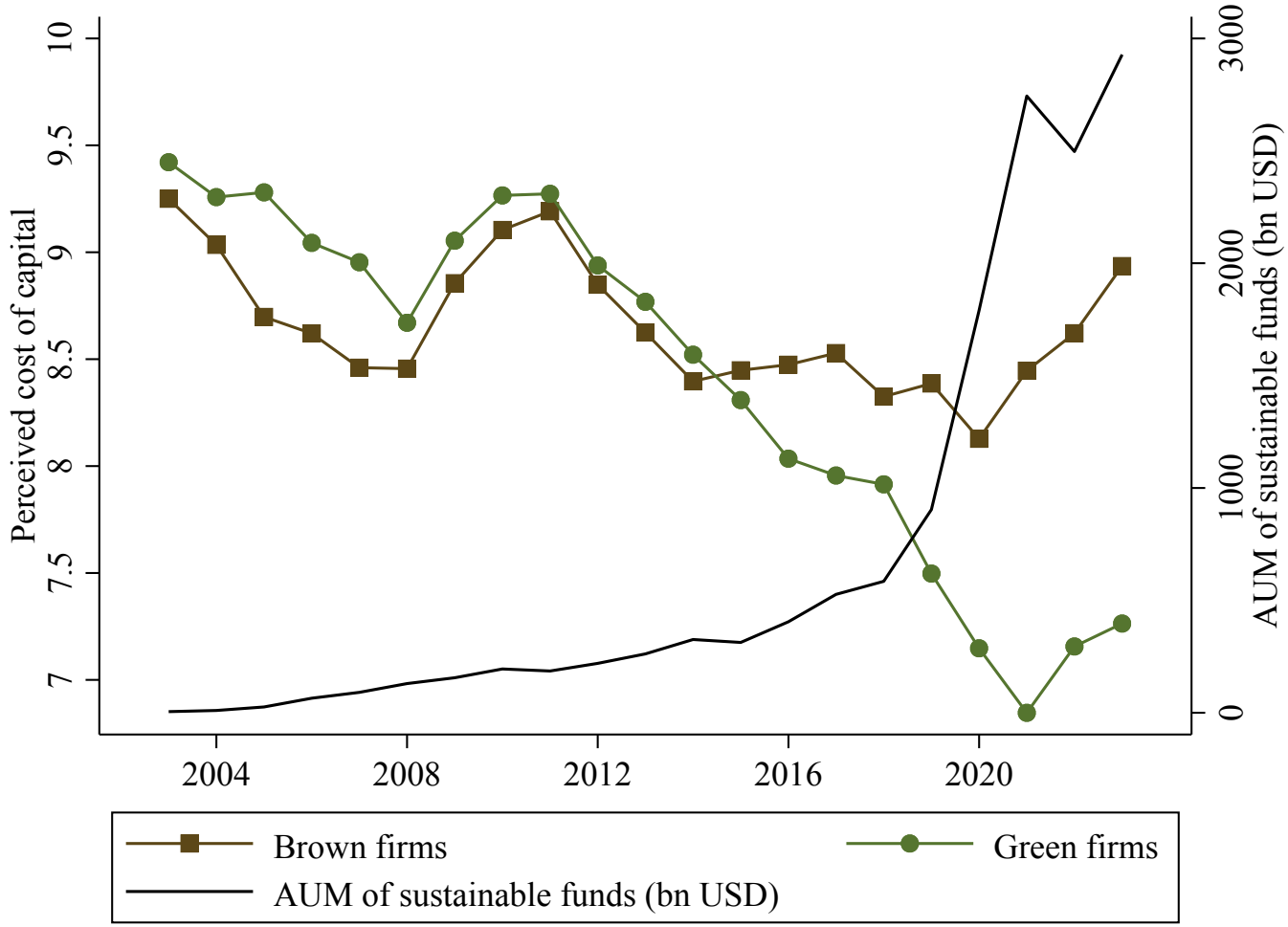
Changes in CoC incorporated in long run




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

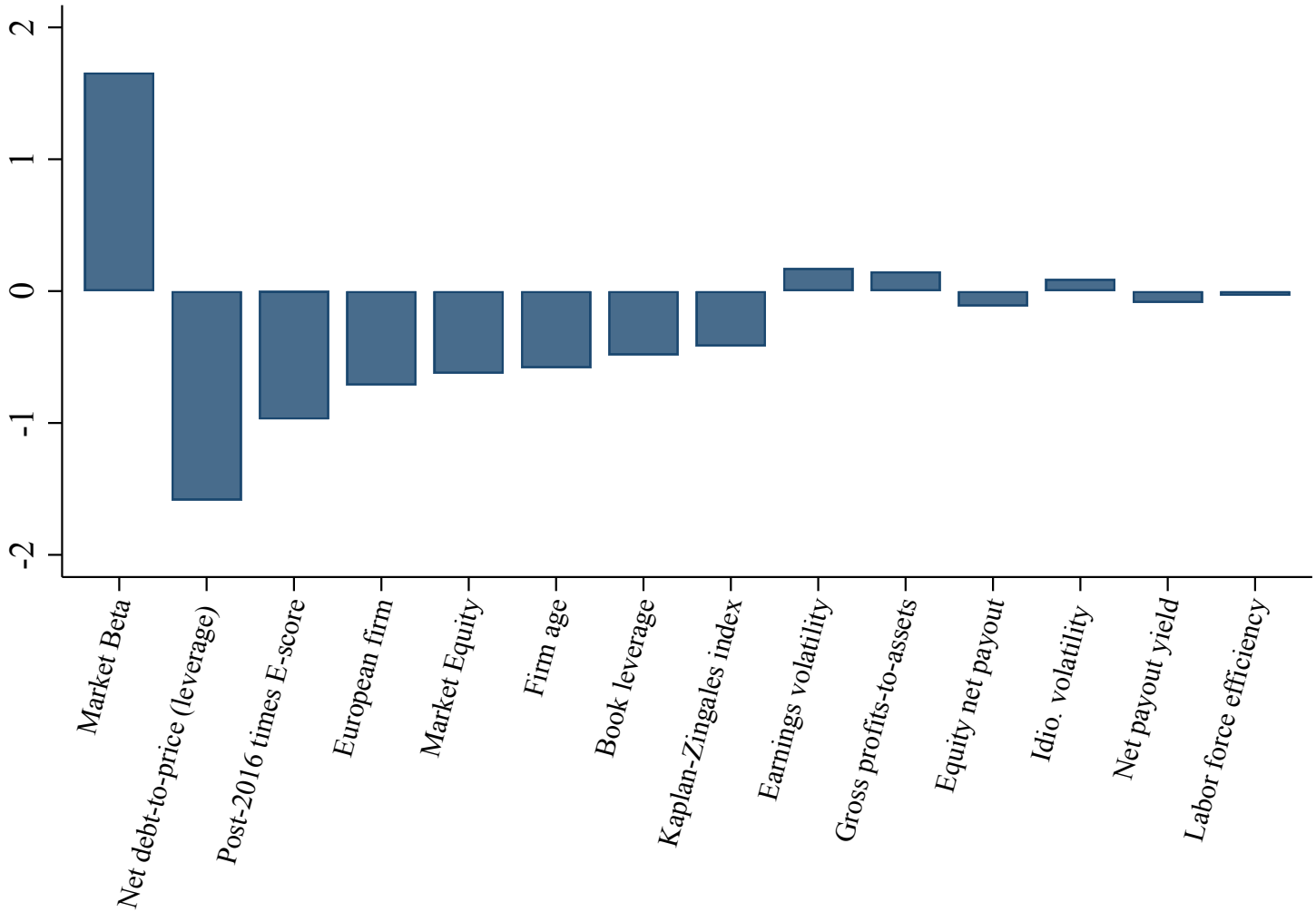
# Firm-Level CoC

- 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 |

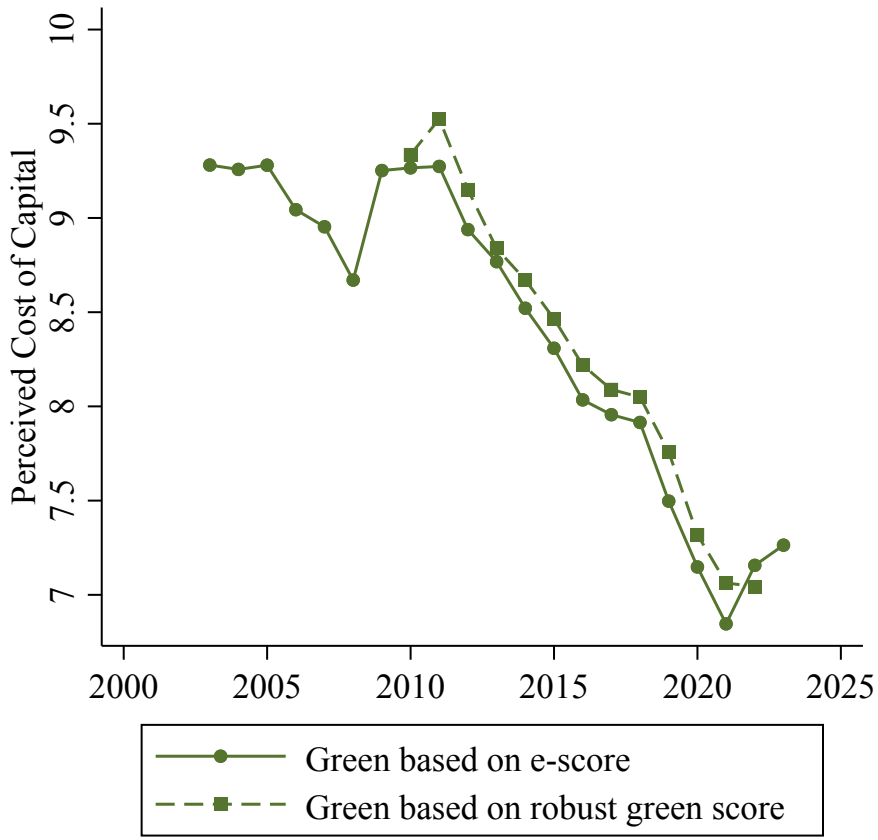
# Greenness: Key Predictor Among Factor Zoo

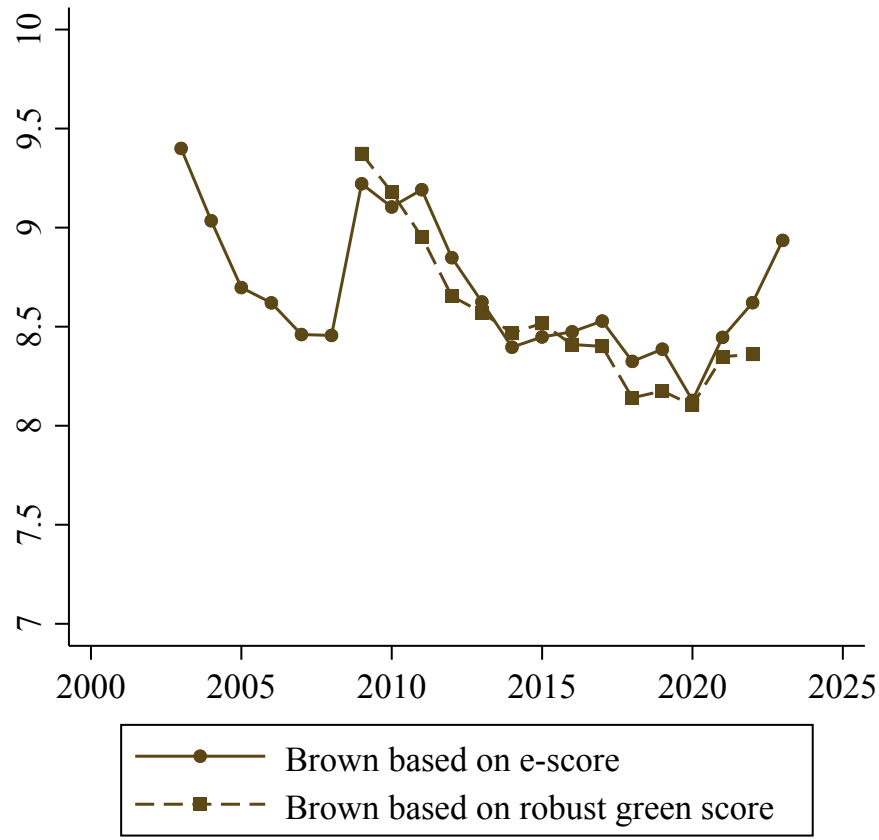
- Estimate predictors of perc. CoC using Lasso
- 150 factors from Jensen et al. (2021)
- E-score post-2016 is 3rd-largest predictor



# Robust to Alternative Green Measures

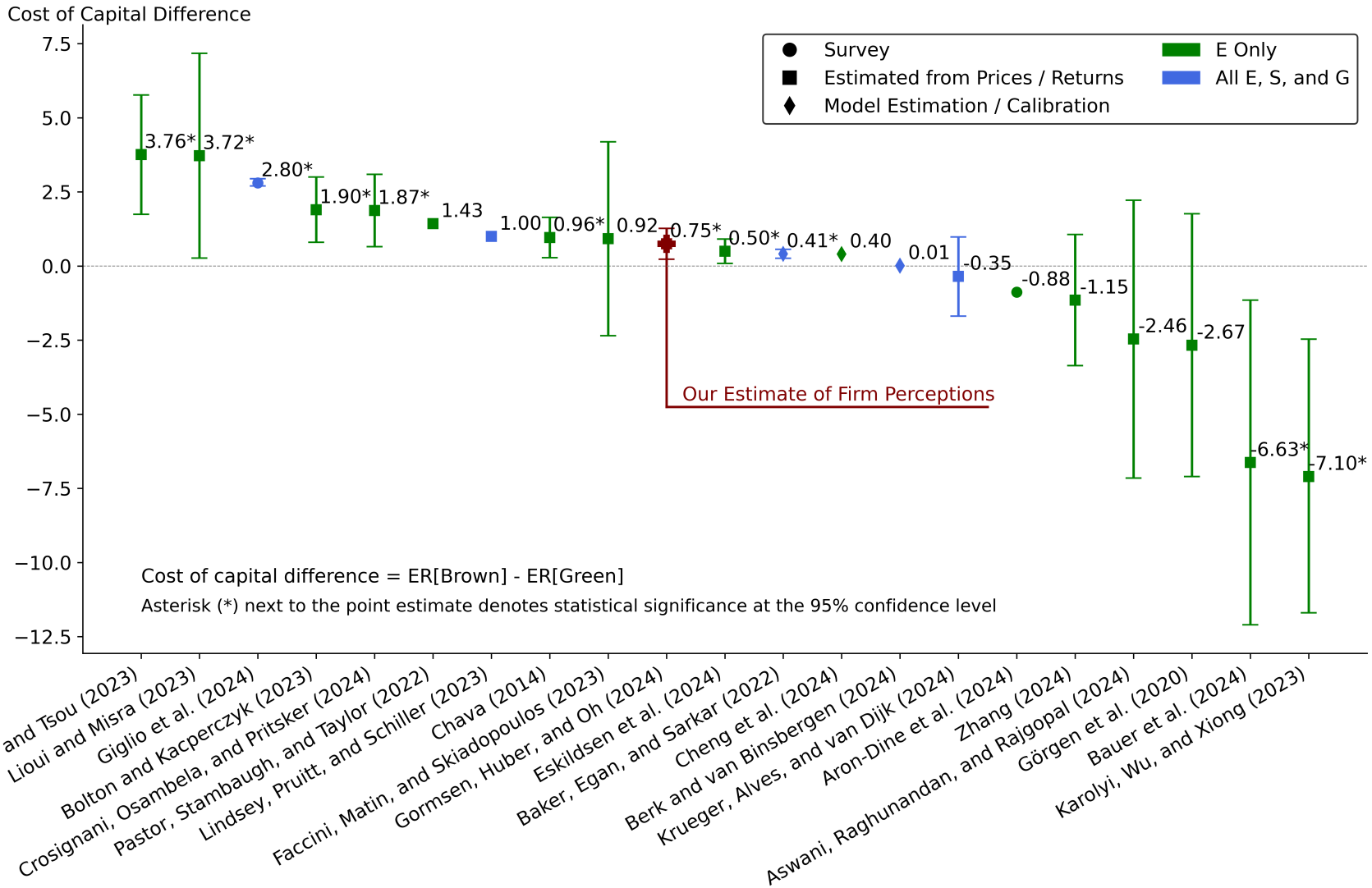
Use ”robust green score” from Eskildsen et al. (2024)



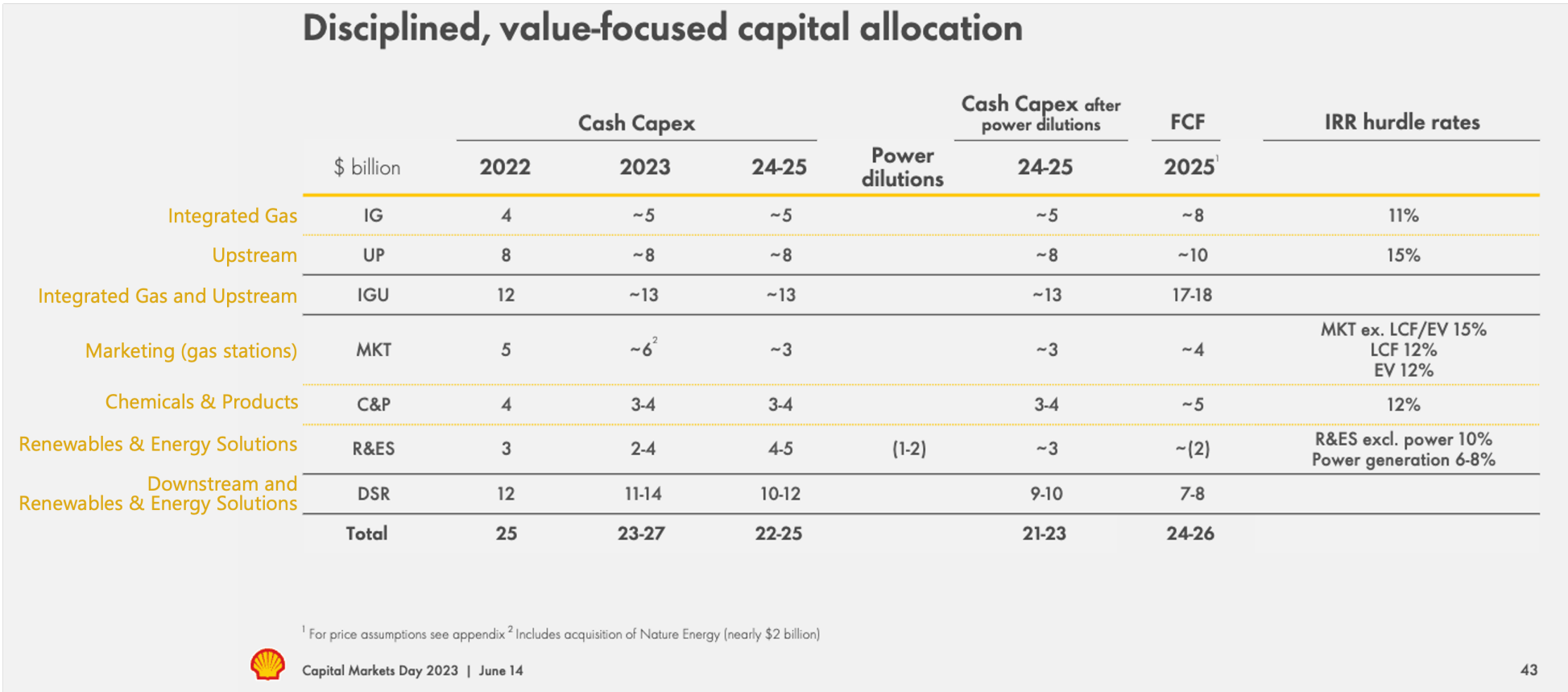
# Estimates in the Literature

- 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 2022 | Cash Capex 2023 | Cash Capex 24-25 | Power dilutions | Cash Capex after power dilutions 24-25 | FCF 2025[1] | IRR hurdle rates |
|---|---|---|---|---|---|---|---|---|
| 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%<br>LCF 12%<br>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%<br>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)

# 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 $\Uparrow \rightarrow$ exp. returns $\Downarrow \rightarrow$ 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 $\Downarrow \rightarrow$ exp. returns $\Downarrow \rightarrow$ 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 CO2 change (pct) | | Firm-level CO2 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 $\sigma$ :

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

**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

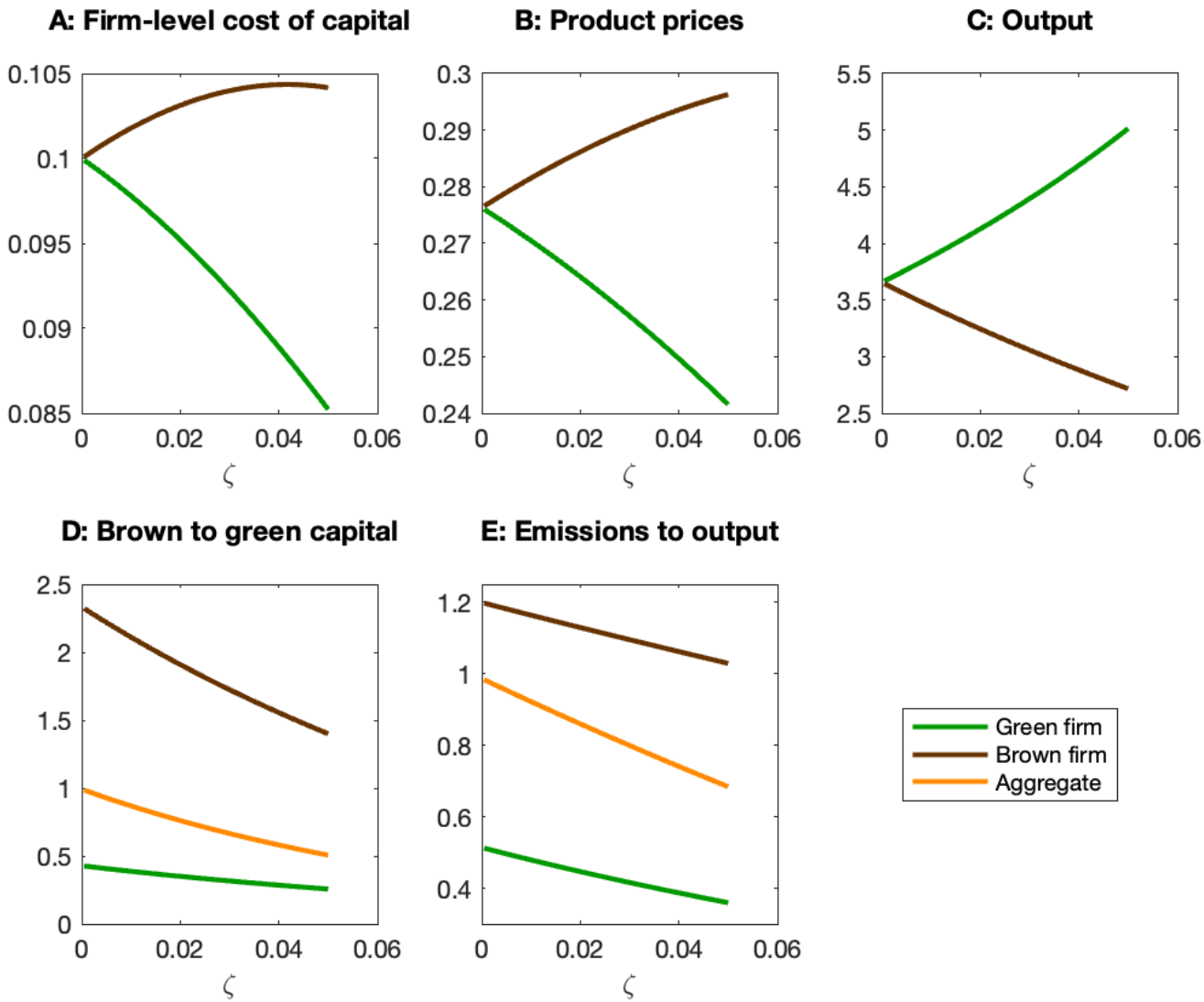
$$\frac{K_i^*}{G_i^*} = \frac{\alpha_i}{1-\alpha_i} \times \frac{r^{\text{Green}}}{r^{\text{Brown}}} \tag{5}$$

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 $\zeta$ (and $r$)



# Firm Optimization (II)

**Optimization with one cost of capital**

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

$$\text{WACC}_i = r - \zeta(1 - \alpha_i)$$

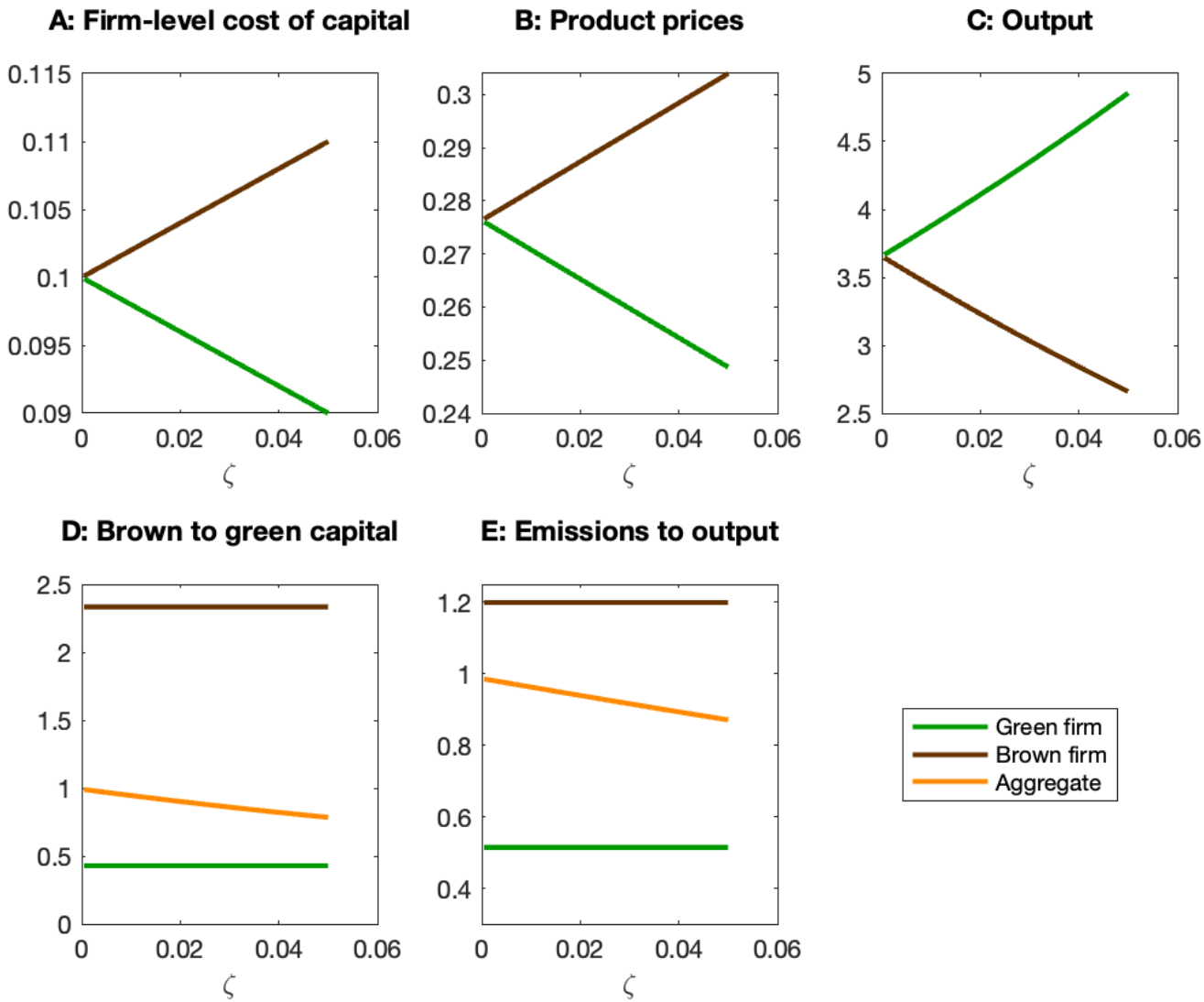
Firms' choose optimal mix of capital

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

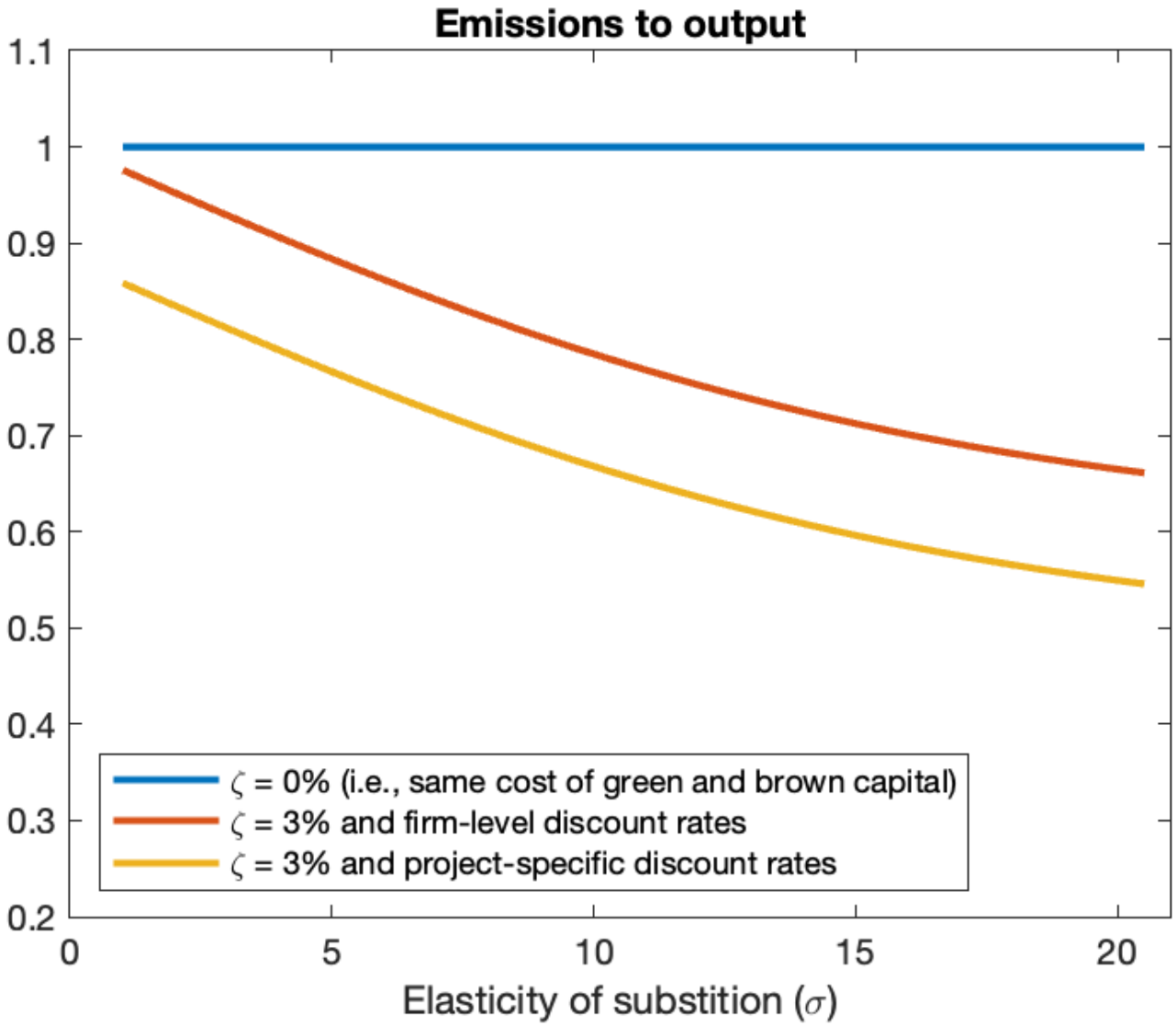
and quantities such that

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

# Results with Single Cost of Capital



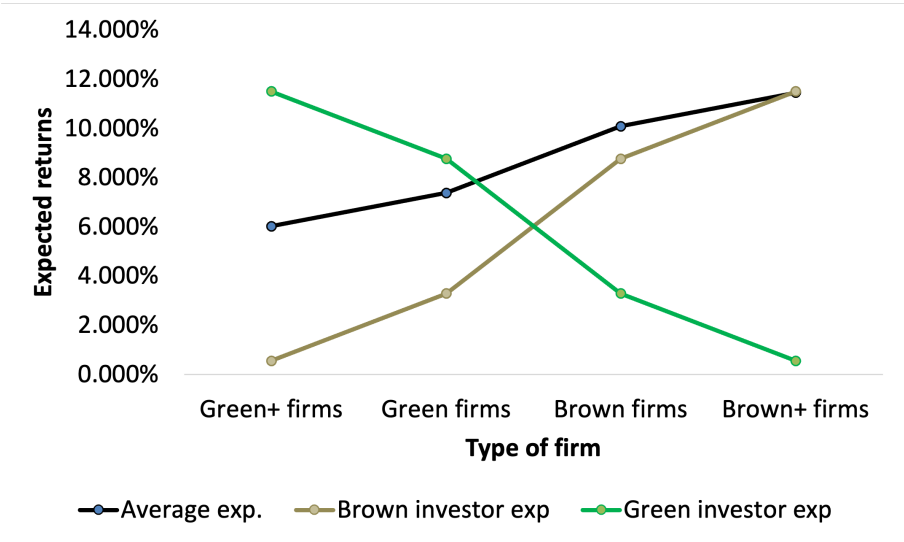
# Comparison of the Two Channels

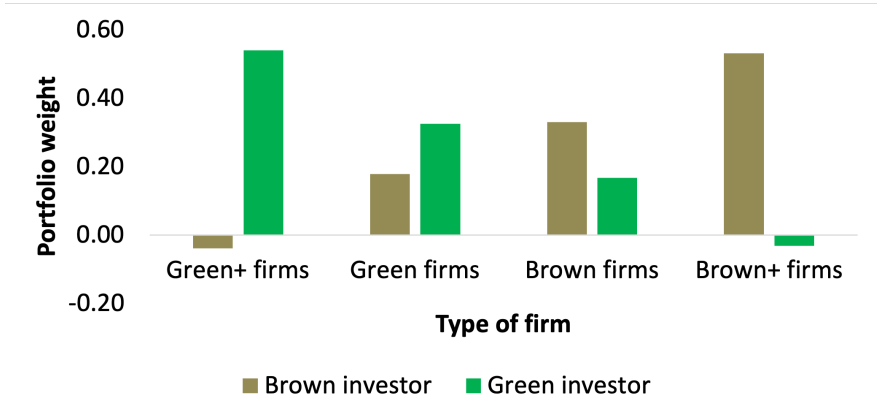


# Expectations, Preferences, and Holdings

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