

Objective vs. Perceived Corporate Greenness: Do Individuals Understand Corporate Sustainability Information?

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The Frictionless-Transmission Assumption

Disclosure as a disciplining device: EU CSRD or ISSB IFRS S2.

The mechanism (e.g., Bolton and Kacperczyk, 2021; Pástor et al., 2021): once **emissions data** are released, investors correctly **update priors** and **carbon risk is priced** in equilibrium.

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A largely **untested** premise underlies this mechanism: investors can accurately *interpret* CO₂ figures and translate them into assessments of firm greenness.

If this premise fails, disclosure mandates produce less market discipline than envisioned.

This Paper - Approach

Research question: To what degree can individuals interpret corporate carbon emissions data and use them to assess firm greenness?

Pre-registered randomized experiment:

- Students, finance professionals, retail investors, US/UK general population
- Three industries, three emission formats, battery of design variations
- $N = 3,437$ participants — 10,311 firm-level evaluations

This Paper - Findings

Research question: To what degree can individuals interpret corporate carbon emissions data and use them to assess firm greenness?

Three main findings:

- **Yes:** individuals can *coarsely* distinguish green from brown firms (AUC = 69%)
- **But:** perceptions are compressed toward the middle — and the compression is *asymmetric*
- **Design matters:** benchmarks and relative formats help; expertise does not

Literature and Contribution

- **Real effects of carbon disclosure:** Carbon risk is priced assuming a frictionless transmission from disclosure to beliefs (e.g., Bolton and Kacperczyk, 2021; Pástor et al., 2021).
⇒ We identify a perceptual friction that attenuates this mechanism.
- **Belief formation under complexity:** Agents compress high-dimensional signals (e.g., Mullainathan et al., 2008; Bordalo et al., 2020).
⇒ We isolate an *asymmetric* central-tendency bias specific to ESG data.
- **ESG data quality:** Existing literature focuses on noise from rating divergence or self-reporting (e.g., Berg et al., 2022; Bingler et al., 2022).
⇒ We propose a *third* noise source: investor perception, even with perfect data.

Two Core Hypotheses

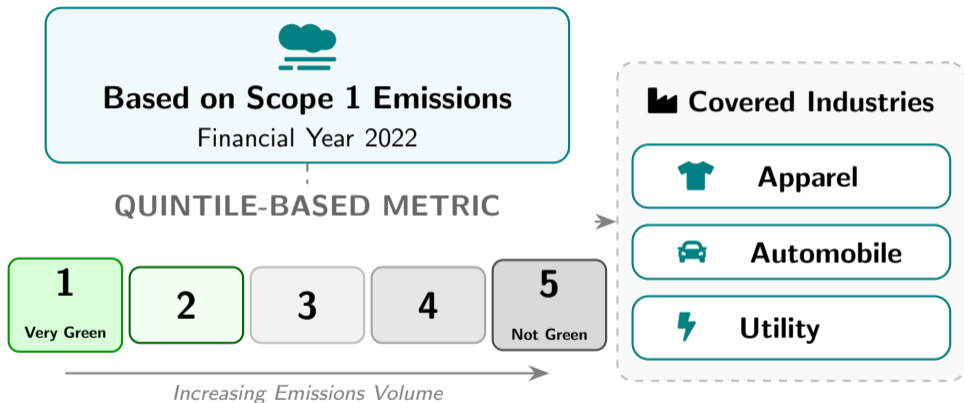
Hypothesis 1 (Sustainability Differentiation): Individuals are able to distinguish greener from browner companies.

- First-order condition for disclosure to be effective at all
- Tested against uninformed guessing

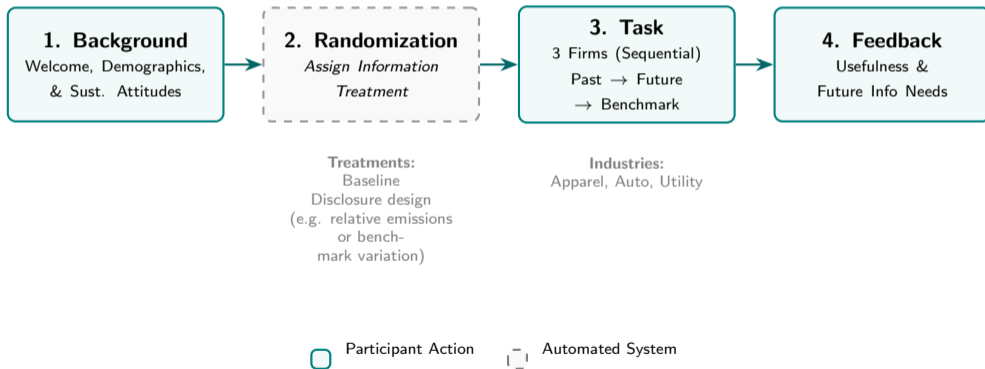
Hypothesis 2 (Central Tendency): Individuals overestimate the greenness of brown firms and underestimate the greenness of green firms.

- *Greenness Error* \equiv *Perceived Greenness* – *Objective Greenness*

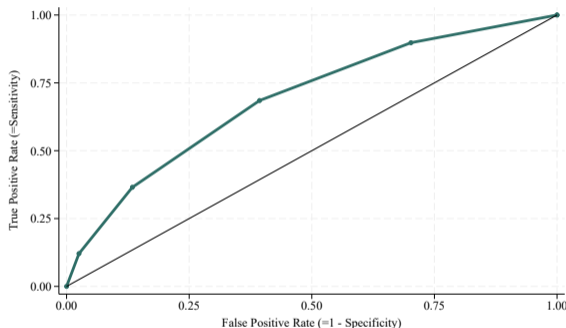
Measuring Objective Greenness



Experimental Design



H1: Discriminatory Power — AUC = 69.1%



$N = 8,302$ responses

- AUC = 50%: random guessing
- AUC \approx 60%: good in information-sparse settings (Iyer et al., 2016)
- AUC = 100%: perfect

AUC = 69.1%

Retail investors best
(AUC \approx 72.3%)

\Rightarrow **H1 supported**

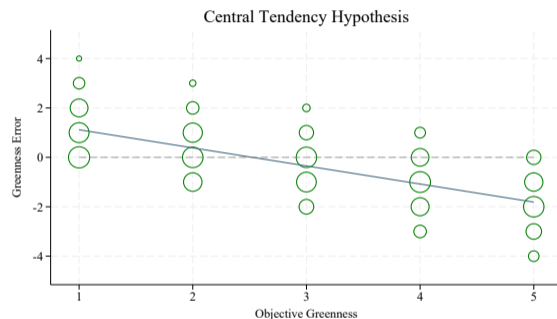
H2: Econometric Specification

We regress the *Greenness Error* on *Objective Greenness*:

$$\underbrace{\text{Perceived Greenness}_i - \text{Objective Greenness}_i}_{\text{Greenness Error}_i} = \beta_0 + \beta_1 \cdot \text{Objective Greenness}_i + \gamma \cdot \mathbf{X}_i + \delta_j + \varepsilon_i$$

- Central tendency $\Rightarrow \hat{\beta}_1 < 0$: greener firms are systematically underestimated
- $\hat{\beta}_1$ stable across framing conditions and information treatments \Rightarrow structural, not context-dependent

H2: Systematic Compression — The Greenness Error



Greenness Error = Perceived – Objective.

Fitted OLS slope = -0.73 .

Mean errors (pooled)

- Green (≥ 4): -1.43
- Brown (≤ 2): $+0.75$
- Difference = -2.18
($p < 0.001$)

$\hat{\beta}_1 \in [-1.87, -0.70]$ across specs

Stable: absolute, relative,
household

⇒ **H2 supported**

H2: Asymmetric — Green Firms Bear the Larger Cost

Multinomial logit: predicted probability of each bias type

Objectively **green** firms

- $P(\text{underestimated}) = 76.1\%$
- $P(\text{accurate}) = 19.5\%$
- $P(\text{overestimated}) = 4.4\%$

Objectively **brown** firms

- $P(\text{overestimated}) = 54.3\%$
- $P(\text{accurate}) = 32.8\%$
- $P(\text{underestimated}) = 12.9\%$

Asymmetry: underestimation of green firms (-1.43 units) is nearly twice the overestimation of brown firms ($+0.75$ units).

With right-skewed real-world emissions distributions, incentive attenuation for decarbonization is likely far more pronounced.

Exploring Disclosure Design Options

Next, we explore which factors might improve information transmission:

- **Context & Benchmarks:** Comparative benchmarks vs. standalone figures.
- **Emission Framing:** Alternative formats vs. raw absolute figures.
- **Incremental Signals:** Historical emission trends and forward-looking targets.
- **Observer Characteristics:** Role of sustainability expertise, financial literacy, and investor type.
- **Attention & Effort:** Impact of financial incentives on cognitive processing frictions.
- **Brand Effect:** Role of pre-existing brand associations.

Testing Disclosure Design: Interaction Specification

Does disclosure format affect the sensitivity of *Perceived Greenness* to *Objective Greenness*?

$$\text{Perc. Green.}_i = \beta_0 + \beta_1 \cdot \text{Obj. Green.}_i + \beta_2 \cdot G_i + \beta_3 \cdot (\text{Obj. Green.}_i \times G_i) + \gamma \cdot \mathbf{X}_i + \delta_j + \varepsilon_i$$

G_i : indicator for the disclosure condition under test.

- $\hat{\beta}_1$: slope in the baseline condition
- $\hat{\beta}_3 > 0$: disclosure condition *improves* sensitivity
- Inference on $\hat{\beta}_3$ via Wald tests

Benchmarking Nearly Eliminates the Compression

Comparing “Past” (no context) vs. “Benchmark” (+ industry median/range):

Without benchmark (“Past”):

$$\hat{\beta}_1 = 0.18 \quad (\text{flat})$$

With benchmark (“Benchmark”):

$$\hat{\beta}_3 = 0.93 \quad (\text{near-perfect})$$

Wald $\chi^2(1) = 485.95, p < 0.001$

An industry median **quintuples** the sensitivity of perceived greenness.

Nearly half of respondents explicitly requested benchmarks when asked.

Consistent with Bordalo et al. (2020): comparative context activates salience and sharpens evaluation.

Emissions Format: Relative and Household Units Help

Format	$\hat{\beta}_3$	Test vs. absolute baseline
Absolute (tCO ₂ e)	0.26	—
Relative (tCO ₂ e / USD 1M rev.)	0.37	Wald $p = 0.011$ ↑
Household equivalents	0.40	Wald $p = 0.011$ ↑
Relative vs. Household		$p = 0.733$ (no difference)

How emissions are reported matters, not only *how much* is disclosed. Scaling by revenue or translating into household equivalents significantly improves differentiation relative to raw absolute figures.

What Does Not Help

Null results that are informative about the nature of the problem:

Expertise and respondent type

- Sustainability experts: $p = 0.31$
- Finance professionals: $p = 0.26$
- Retail investors: $p = 0.063$
(marginal)

Information and incentives

- Prior-year -3% reduction:
 $p = 0.20$
- Prior-year -30% reduction:
 $p = 0.20$
- Performance incentives ($4\times$ pay):
 $p = 0.92$

The interpretation problem is not resolved by expertise, effort, or incremental emissions signals.

Real Company Names: Brand Noise Overrides Data

Design: replace fictional names with *Volkswagen* (score 5, “Not green at all”) and *Volvo* (score 2, greener). Both brands chosen to *reinforce*, not contradict, the data signal.

$$\hat{\beta}_3 = -0.13, \quad \text{Wald } \chi^2(1) = 5.32, \quad p = 0.021$$

Real names weaken sensitivity — the opposite of the prediction.

Pre-existing brand associations override disclosed emissions figures, even for a firm associated with the Dieselgate scandal.

⇒ Real firms may not capture the full reputational benefits of strong environmental performance through disclosure alone.

Robustness and Placebo

Main results are robust to:

- Industry: apparel, automobile, utility — patterns consistent across sectors
- Country: US, UK, Germany, Switzerland
- Temporal framing: future-tense (Q2) produces *stronger* differentiation than past-tense (Q1), Wald $p < 0.001$ (learning?)
- Benchmark wording (average vs. median, min/max): Wald $p = 0.17$

Firm-size placebo: same 5-point rating task applied to total book assets.

Size differentiation is **worse** than greenness, despite a much longer history of standardized, audited financial reporting.

Our findings reflect processing frictions specific to environmental data.

Takeaways: H1 and H2

H1 — Sustainability Differentiation: Individuals can *coarsely* distinguish green from brown firms (AUC = 69%, above the 60% threshold in information-sparse settings). Differentiation is not driven by expertise or incentives.

H2 — Central Tendency: Perceptions are systematically compressed and *asymmetrically* so. Green firms are underestimated in 76% of evaluations; brown firms overestimated in 54%. Underestimation of green is nearly twice as large in magnitude as overestimation of brown.

Takeaways: Disclosure Design and Implications

Disclosure design matters: An industry benchmark quintuples sensitivity ($\hat{\beta}_3 = 0.93$). Relative and household-equivalent formats help. Prior-year trends do not – nor do real names.

Implications

- The frictionless-transmission assumption in Bolton and Kacperczyk (2021) and Pástor et al. (2021) may not fully unfold market discipline of polluters
- Coarse thinking (Mullainathan et al., 2008) may distort equilibrium pricing along the ESG-efficient frontier (Pedersen et al., 2021)
- Greenness of green firms is systematically undervalued \Rightarrow attenuated decarbonization incentives

Thank you!

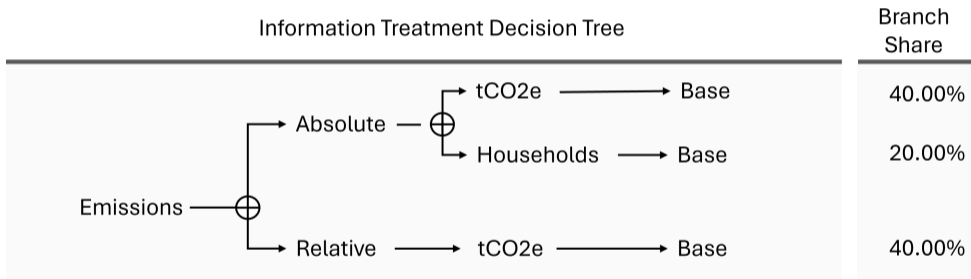
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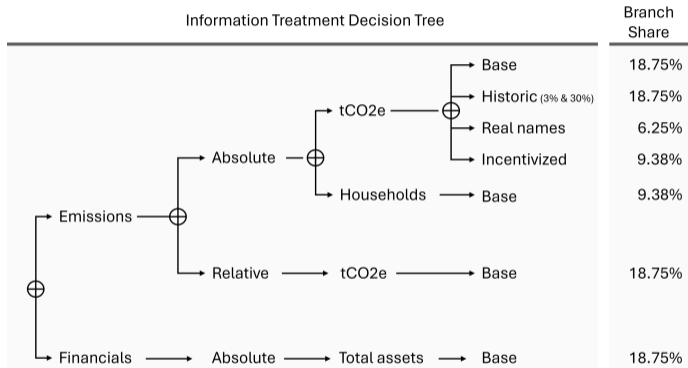


Scan to read the working paper

Backup: Survey Pathways — Phase I ($N = 902$)

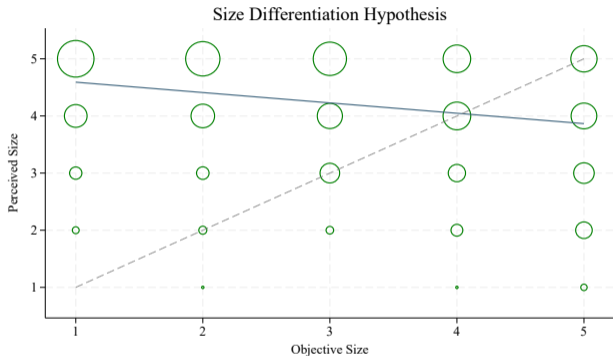


Backup: Survey Pathways — Phase II ($N = 2,535$)



Phase II adds: prior-year emissions ($-3\%/-30\%$), real names (VW/Volvo), performance incentives, firm-size placebo ($N_S = 584$).

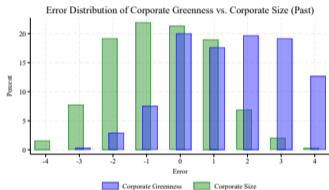
Backup: Placebo — Firm Size Differentiation



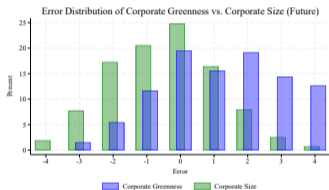
Participants rated firm size (total book assets) on the same 5-point scale. Size differentiation is *worse* than greenness despite a far longer history of standardized financial reporting.

Backup: Error Distribution by Assessment Stage

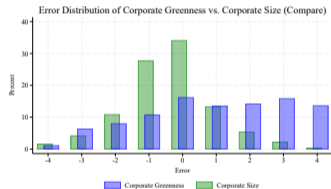
Q1: Past Emissions



Q2: Future Targets



Q3: Benchmark (Median)



Backup: Sample Summary Statistics

Variable	Mean	Scale / Notes
Age	41.62	years
Female	0.48	share
University Degree	0.55	share
Climate Awareness	4.21	1–5 Likert
Sustainability Exposure	3.03	1–5 Likert
Life Attitude	3.72	1–5 Likert
Current Mood	3.84	1–5 Likert
High Budget (> €3,500/month)	0.32	share
Participants	3,437	Phase I: 902; Phase II: 2,535
Firm evaluations	10,311	3 per participant

Sample Breakdown

Phase I: 633 students + 269 finance professionals.

Phase II: 1,425 US + 1,110 UK (Prolific, nationally representative).

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