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Green Sentiment, Stock Returns, and Corporate Behavior

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Motivation

Environmental factors have gained a central role in financial markets:



Money invested in ESG funds more than doubles in a year

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The New York Times

BlackRock C.E.O. Larry Fink: Climate Crisis Will Reshape Finance

EUROPEAN CENTRAL BANK | EUROSISTEM 8 July 2021

ECB presents action plan to include climate change considerations in its monetary policy strategy

- Common narrative: Green investing decreases green firms' cost of capital, which can nudge "dirty" firms to adopt cleaner technologies (Heinkel, Kraus, and Zechner, 2001).
- But we still know relatively little about whether this mechanism is actually at work, and through which channels.

Motivation

Two different drivers of demand for environmental responsibility in financial markets:

- 1. Changes in environment-related firm fundamentals** (cash flows and uncertainties). E.g., institutional investors anticipating a tightening in climate policy (Krüger, Sautner and Stark, RFS 2020; Ramelli, Wagner, Zeckhauser, Ziegler, RCFS 2021).
- 2. Intensification of investors' non-fundamental green taste.** E.g., warmer warm glow, speculative behavior.
 - The two drivers associated with different predictions on expected future returns (e.g., Hong and Kacperczyk, 2009; Pastor et al., 2021).
 - News-based climate indexes (e.g., Ardia et al., 2021; Pastor et al., 2021b) likely to reflect an undefined mix of **1** and **2**.

How to disentangle the two drivers of green demand and study their effects on financial markets?

Research questions..

...and preview of results

How to measure shifts in investors' non-fundamental green demand?

- We propose a new method to estimate shocks in non-fundamental green demand based on abnormal inflows into green Exchange Traded Funds (ETFs).

What is the impact of green sentiment on stock returns?

- Higher green sentiment is associated with an increase in stock returns for more environmentally responsible firms.

What is the impact of green sentiment on corporate behavior?

- Higher green sentiment is associated with higher investments and cash holdings by environmentally responsible firms, but only by those more equity dependent.

Outline

1. Identifying green sentiment from ETF arbitrage activity



2. Effects of green sentiment on stock returns



3. Effects of green sentiment on corporate behavior



1. Identifying green sentiment from ETF arbitrage activity



1. Identifying green sentiment from ETF arbitrage activity

Empirical strategy

Exchange-traded funds (ETFs): listed investment vehicles tracking an index or a basket of underlying securities. Rely on arbitrage mechanism to keep ETF price aligned with underlying NAV.

A unique setting to study non-fundamental demand (see Ben-David et al., JF 2017; Brown et al., RoF 2021; Davies, JQFA 2020):

- ETFs and their underlying assets have the same fundamental value.
- ETFs are more prone to non-fundamental demand than individual securities, due to their different ownership structure more tilted towards retail and short-term investors.
- Shocks in non-fundamental demand push ETF price away from NAV.
- Mispricing between ETFs and NAV incentivizes arbitrageurs to create (or redeem ETF) shares, generating observable ETF flows.

We use abnormal flows into green ETFs to capture market-wide shifts in non-fundamental demand for environmental responsibility, that is, **green sentiment**.

1. Identifying green sentiment from ETF arbitrage activity

Empirical strategy

Estimate abnormal monthly flows into green ETFs relative to conventional ETF:

T cross-sectional regressions of monthly ETF flows on a “GreenETF” dummy and controls:

$$\text{Flows}_{(i,t)} = c_t + \gamma_t * \text{GreenETF}_{(i,t)} + \delta_t * \text{controls}_{(i,t)} + \varepsilon_{(i,t)} \quad \forall t$$

$\hat{\gamma}_t \rightarrow$ Estimated green sentiment at time t

Standardized time series of $\hat{\gamma}_t \rightarrow$ **Green Sentiment Index**

1. Identifying green sentiment from ETF arbitrage activity

Data and green ETFs

- US-listed equity ETFs 2010-2020. Bloomberg, Morningstar, and ETF Global → 1,050 ETFs.
- Green ETFs: 22 US ETFs with explicit environment-friendly names.

Ticker	ETF name	Net expense ratio (bp)	Inception - delisting	Morningstar sustainable?
ICLN	iShares Global Clean Energy	48	2008 -	yes
TAN	Invesco Solar	70	2008 -	yes
SPYX	SPDR S&P 500 Fossil Fuel Reserves Free	20	2015 -	yes
CRBN	iShares MSCI ACWI Low Carbon Target	20	2014 -	yes
PBW	Invesco WilderHill Clean Energy	70	2005 -	yes
QCLN	First Trust NASDAQ Clean Edge Green Energy	60	2007 -	yes
PZD	Invesco Cleantech	68	2006 -	yes
ACES	ALPS Clean Energy	65	2018 -	yes
SMOG	VanEck Vectors Low Carbon Energy	63	2007 -	yes
FAN	First Trust Global Wind Energy	60	2008 -	yes
ETHO	Etho Climate Leadership US	47	2015 -	yes
PBD	Invesco Global Clean Energy	75	2007 -	yes
LOWC	SPDR MSCI ACWI Low Carbon Target	20	2014 -	yes
YLCO	Global X YieldCo&Renewable Engy Income	65	2015 -	no
EVX	VanEck Vectors Environmental Services	55	2006 -	yes
CNRG	SPDR Kensho Clean Power	45	2018 -	yes
VEGN	US Vegan Climate	60	2019 -	yes
CHGX	Change Finance US LargeCap FossilFuel Free	49	2017 -	yes
PUW	Invesco WilderHill Progressive Energy	70	2006 - 2019	yes
HECO	Strategy Shares EcoLogical Strategy	95	2012 -	yes
RENW	Pickens Morningstar Renewable Energy Response	65	2019 -	yes
ECLN	First Trust EIP Carbon Impact	95	2019 -	yes

Median institutional ownership:

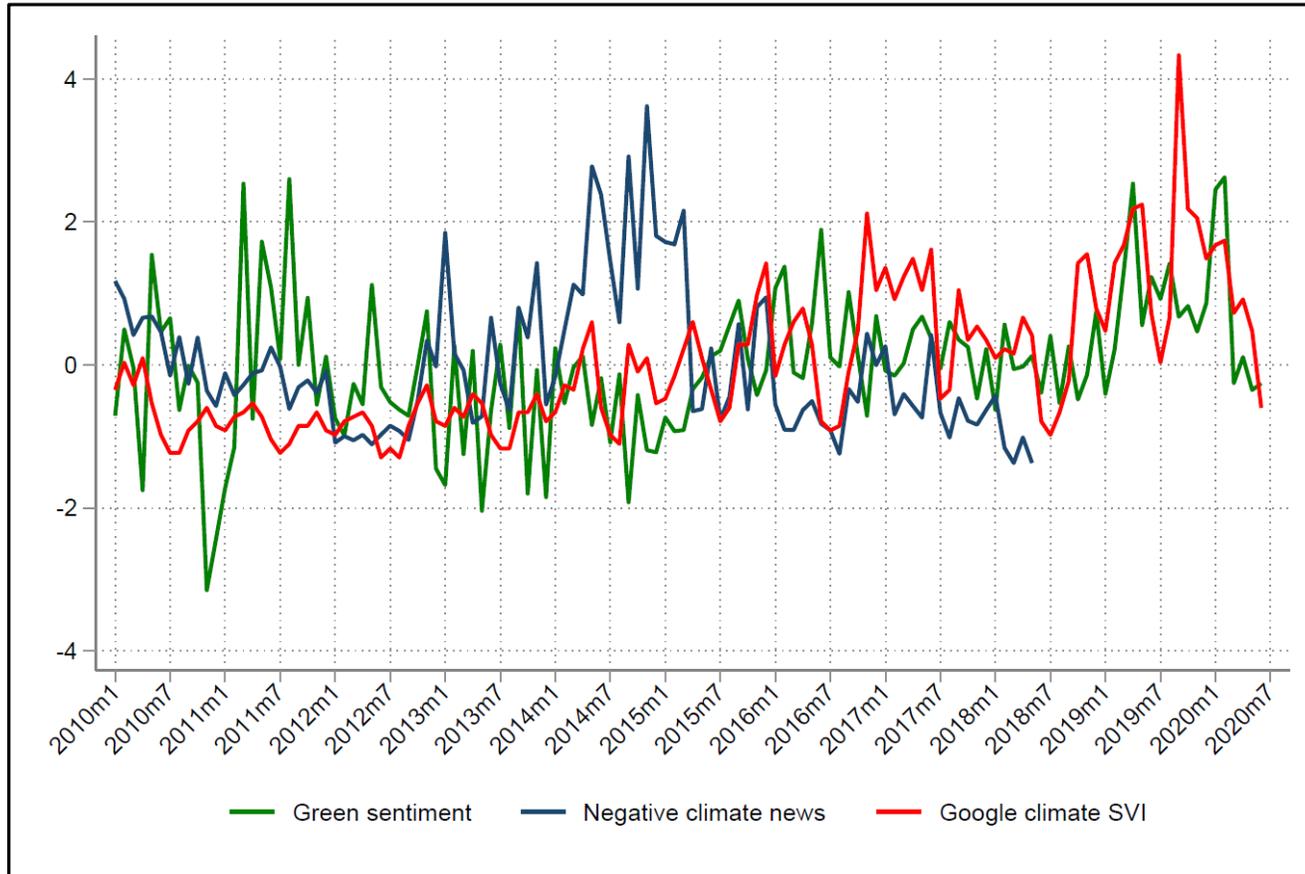
- Individual stocks: > 70%
- Conventional ETFs: ~42%
- Green ETFs: ~24%

Robustness:

- Monthly premium instead of inflows.
- Drop 1/2/3 funds at a time.
- Placebo: Random basket of 22 ETFs.
- Asset-weighted regressions.

1. Identifying green sentiment from ETF arbitrage activity

The Green Sentiment Index



- Negative correlation (-.28) with negative climate change news index proposed by Engle et al. (RFS, 2020), likely to reflect fundamental news.
- Positively correlation (.29) with Google search value index in US for “Climate change” (Choi et al, RFS, 2020, Ilhan et al., RFS, 2021), likely to reflect public attention.

2. Effects of green sentiment on stock returns



2. Effects of green sentiment on stock returns

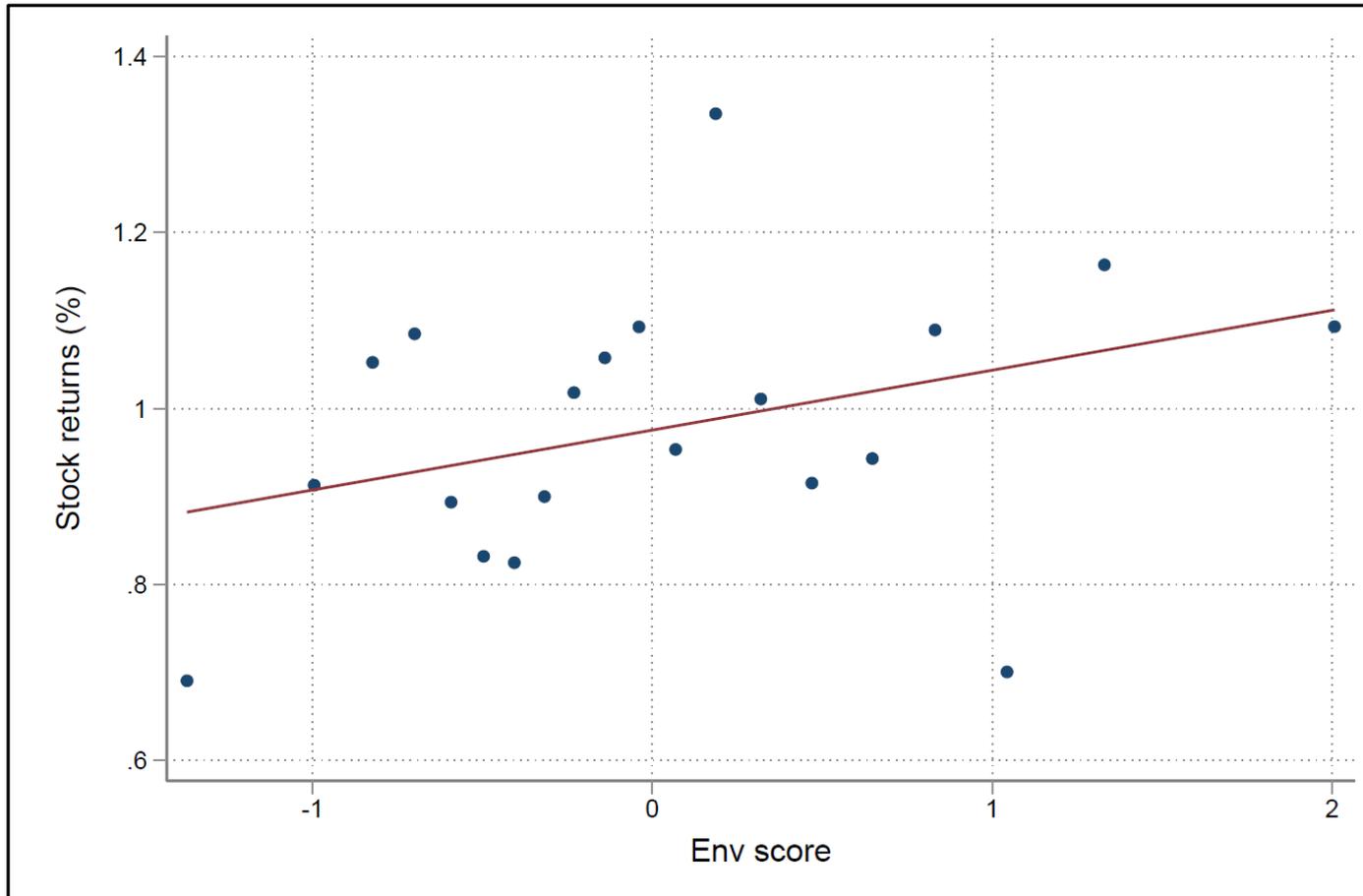
Variables and summary statistics

	p5	p25	mean	p50	p75	p95	sd	N
Firm-level characteristics (monthly observations)								
Return	-12.88	-3.55	0.98	1.12	5.54	14.36	8.92	95,248
Cumulative return t+6	-28.64	-6.18	6.38	6.33	18.35	40.89	21.74	87,756
Env score	-1.32	-0.78	0.04	-0.14	0.73	1.90	1.01	95,248
Env score (kld)	-0.39	-0.39	0.49	-0.39	1.17	3.21	1.33	84,995
Leverage	0.00	13.34	28.95	26.82	40.60	64.10	21.62	95,248
Market beta	0.21	0.71	1.12	1.07	1.47	2.18	0.61	95,248
Log(market cap)	7.43	8.26	9.12	8.97	9.84	11.41	1.21	95,248
Book-to-market	0.03	0.20	0.45	0.37	0.62	1.13	0.41	95,248
Profitability	-3.24	1.55	4.98	4.38	8.28	16.16	7.41	95,248
Momentum	-2.83	-0.13	1.08	1.18	2.41	4.63	2.35	95,248
Green ETF ownership	0.00	0.00	0.01	0.00	0.00	0.01	0.06	95,248
Firm-level characteristics (quarterly observations)								
Capex/PPE	-10.35	0.95	4.15	3.96	7.80	19.03	9.19	25,055
Cash/Assets	0.35	2.31	9.00	6.11	12.62	27.46	9.35	32,599
R&D/Assets	0.00	0.00	1.29	0.64	1.90	4.70	1.89	15,277

- Dividend-adjusted returns (%) and firm characteristics from Compustat.
- Environmental score from Sustainalytics, standardized.
- Sample period: January 2010 through June 2020.

2. Effects of green sentiment on stock returns

Effect of environmental performance on realized returns



- Over the period 2010-2020, greener stocks outperformed otherwise similar, less green, stocks.
- 1 SD higher Env score → Around 7 basis points higher monthly returns (net of other firm characteristics).

Can green sentiment explain part of this performance?

2. Effects of green sentiment on stock returns

Main results on stock returns

Dependent variable:	Return in t	Cumulative return through:					
		t+1	t+2	t+3	t+4	t+5	t+6
Green sentiment × Env score	0.069** (2.37)	0.273*** (5.31)	0.300*** (4.37)	0.448*** (5.66)	0.485*** (5.22)	0.371*** (3.38)	0.517*** (4.10)
Env score	0.042 (1.25)	0.041 (0.60)	0.103 (1.01)	0.199 (1.49)	0.165 (1.00)	0.181 (0.92)	0.192 (0.84)
Green sentiment	-1.169*** (-36.11)	-2.268*** (-42.33)	-2.416*** (-36.16)	-2.407*** (-30.82)	-2.661*** (-28.94)	-2.336*** (-22.20)	-2.057*** (-17.77)
Leverage	0.003 (1.48)	0.004 (1.18)	0.004 (0.78)	-0.001 (-0.09)	-0.000 (-0.00)	0.001 (0.06)	0.001 (0.10)
Market beta	0.245*** (3.48)	0.177 (1.36)	0.159 (0.86)	-0.208 (-0.90)	-0.342 (-1.19)	-0.544 (-1.58)	-0.725* (-1.79)
Log(marketcap)	0.002 (0.06)	0.008 (0.14)	-0.053 (-0.62)	-0.162 (-1.45)	-0.152 (-1.10)	-0.193 (-1.17)	-0.222 (-1.16)
Book-to-market	-0.134 (-1.00)	-0.405 (-1.54)	-0.567 (-1.52)	-0.685 (-1.49)	-1.003* (-1.84)	-1.015 (-1.58)	-0.971 (-1.31)
Profitability	-0.003 (-0.59)	-0.017 (-1.52)	-0.030* (-1.80)	-0.048** (-2.28)	-0.070*** (-2.73)	-0.090*** (-2.90)	-0.112*** (-3.07)
Momentum	-0.141*** (-9.05)	-0.249*** (-8.41)	-0.290*** (-6.61)	-0.143** (-2.57)	-0.144** (-2.09)	-0.090 (-1.10)	-0.027 (-0.29)
Constant	0.859*** (2.74)	2.086*** (3.42)	3.731*** (4.21)	5.886*** (5.14)	7.093*** (5.05)	8.679*** (5.16)	10.158*** (5.20)
Observations	95,248	93,972	92,704	91,444	90,199	88,969	87,756
R-squared	0.018	0.037	0.032	0.030	0.032	0.027	0.025

2. Effects of green sentiment on stock returns

Main results on stock returns

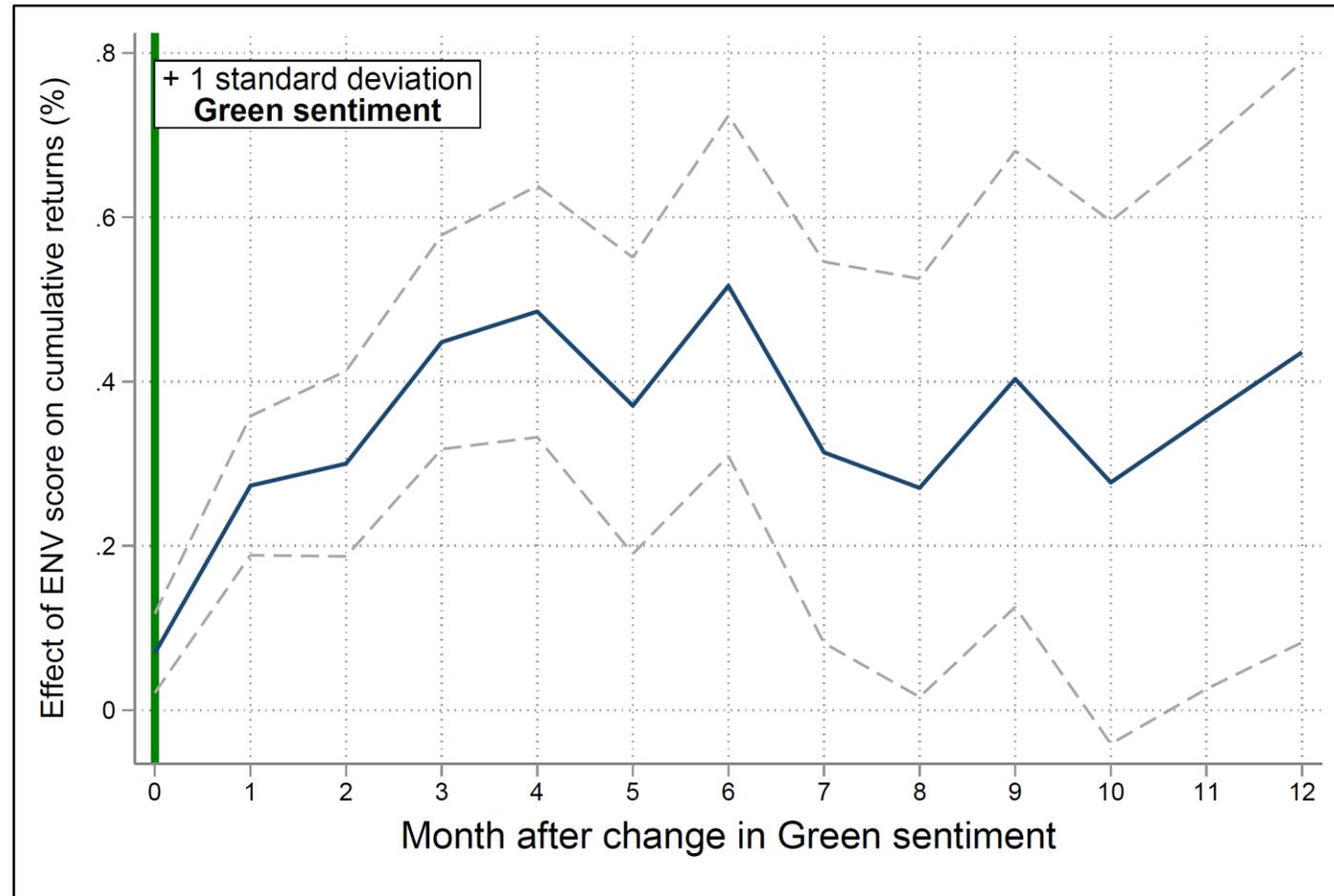
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		t+1	t+2	t+3	t+4	t+5	t+6
Green sentiment × Env score	0.069** (2.37)	0.273*** (5.31)	0.300*** (4.37)	0.448*** (5.66)	0.485*** (5.22)	0.371*** (3.38)	0.517*** (4.10)
Green sentiment	-1.169*** (-36.11)	-2.268*** (-42.33)	-2.416*** (-36.16)	-2.407*** (-30.82)	-2.661*** (-28.94)	-2.336*** (-22.20)	-2.057*** (-17.77)
Leverage	0.003 (1.48)	0.004 (1.18)	0.004 (0.78)	-0.001 (-0.09)	-0.000 (-0.00)	0.000 (0.00)	0.000 (0.00)
Market beta	0.245*** (3.48)	0.177 (1.36)	0.159 (0.86)	-0.208 (-0.90)	-0.342 (-1.19)	-0.342 (-1.19)	-0.342 (-1.19)
Log(marketcap)	0.002 (0.06)	0.008 (0.14)	-0.053 (-0.62)	-0.162 (-1.45)	-0.152 (-1.10)	-0.152 (-1.10)	-0.152 (-1.10)
Book-to-market	-0.134 (-1.00)	-0.405 (-1.54)	-0.567 (-1.52)	-0.685 (-1.49)	-1.003* (-1.84)	-1.003* (-1.84)	-1.003* (-1.84)
Profitability	-0.003 (-0.59)	-0.017 (-1.52)	-0.030* (-1.80)	-0.048** (-2.28)	-0.070*** (-2.73)	-0.070*** (-2.73)	-0.070*** (-2.73)
Momentum	-0.141*** (-9.05)	-0.249*** (-8.41)	-0.290*** (-6.61)	-0.143** (-2.57)	-0.144** (-2.09)	-0.144** (-2.09)	-0.144** (-2.09)
Constant	0.859*** (2.74)	2.086*** (3.42)	3.731*** (4.21)	5.886*** (5.14)	7.093*** (5.05)	8.679*** (5.16)	10.158*** (5.20)
Observations	95,248	93,972	92,704	91,444	90,199	88,969	87,756
R-squared	0.018	0.037	0.032	0.030	0.032	0.027	0.025

- ↑ 1-SD Green sentiment in $t \rightarrow 27$ bp higher return in $t+1$, and 52 bp in $t+6$ for ↑ 1-SD higher Env score.
- Robust to different specifications.
- Robust to alternative versions of Green sentiment index.

2. Effects of green sentiment on stock returns

Main results on stock returns

Even through $t+12$, only partial reversal of the effect:



2. Effects of green sentiment on stock returns

Green sentiment vs climate-related fundamental news

Dependent variable:	Return in t	Cumulative return through:					
		t+1	t+2	t+3	t+4	t+5	t+6
Green sentiment × Env score	0.066* (1.66)	0.490*** (8.81)	0.449*** (7.00)	0.686*** (9.14)	0.688*** (8.67)	0.609*** (6.44)	0.691*** (6.31)
Negative climate news × Env score	0.045* (1.76)	0.209*** (4.74)	0.276*** (4.61)	0.356*** (4.75)	0.331*** (3.43)	0.320*** (2.91)	0.351*** (2.74)
Observations	73,280	72,986	72,691	72,397	72,111	71,833	71,563
R-squared	0.021	0.019	0.016	0.016	0.022	0.018	0.021
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

- Even when accounting for negative climate news, green sentiment predicts green returns...
- ..., but climate-related fundamental news predicts green returns too (Engle et al., 2020).

Two different drivers of green stock-price performance: Green sentiment and climate-related fundamental news. Both have a similar effect in the short term.

2. Effects of green sentiment on stock returns

Effect on cash-flows expectations

Analysts' earnings forecast revisions as proxy for changes in cash-flows expectations (e.g., Brown and Rozeff, 1978; Landier and Thesmar, 2020).

Dependent variable: Horizon:	(1)	(2)	(3)
	1-year ahead	Δ EPS forecast 2-year ahead	3-year ahead
Green sentiment \times Env score	-0.025 (-0.65)	-0.003 (-0.12)	0.044 (1.35)
Negative climate news \times Env score	0.031 (1.01)	0.066*** (2.79)	0.061** (2.43)
Env score	-0.117 (-1.58)	-0.067 (-1.18)	-0.071 (-1.41)
Observations	61,055	62,102	58,608
R-squared	0.026	0.045	0.035
Firm controls	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes

Δ EPS forecast:
monthly change in
average analysts'
earnings forecasts
(IBES).

Results consistent with our two-channel interpretation:

- Green sentiment does not explain earnings forecasts revisions (despite stock-price effect!).
- Negative climate news is associated with upgrade of forecasts at the 2- and 3-year horizons.

2. Effects of green sentiment on stock returns

Controlling for direct ETF price pressure

Do the results reflect a “mechanical” propagation of non-fundamental shocks from ETFs to the underlying securities, à la Franzoni et al. (2017)?

Dependent variable:	Return in t	Cumulative return through:					
		t+1	t+2	t+3	t+4	t+5	t+6
Green sentiment × Env score	0.069** (2.41)	0.273*** (5.33)	0.292*** (4.28)	0.445*** (5.59)	0.500*** (5.39)	0.403*** (3.65)	0.533*** (4.19)
Green sentiment × Green ETF ownership	-0.287 (-0.60)	0.003 (0.01)	0.153 (0.16)	-0.687 (-0.56)	-0.773 (-0.44)	-0.907 (-0.42)	-0.905 (-0.33)
Env score	0.044 (1.29)	0.042 (0.61)	0.112 (1.10)	0.207 (1.56)	0.176 (1.07)	0.201 (1.03)	0.211 (0.92)
Green sentiment	-1.150*** (-36.21)	-2.160*** (-40.56)	-2.246*** (-33.85)	-2.266*** (-28.88)	-2.561*** (-27.98)	-2.094*** (-19.93)	-1.939*** (-16.75)
Green ETF ownership	-2.014*** (-4.86)	-3.988*** (-4.44)	-6.184*** (-4.63)	-8.413*** (-5.03)	-10.024*** (-4.63)	-11.873*** (-4.53)	-14.615*** (-4.43)
Observations	95,248	93,972	92,704	91,444	90,199	88,969	87,756
R-squared	0.019	0.035	0.030	0.029	0.033	0.026	0.026
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Green-ETF ownership:
% of market cap own by Green ETFs, based on CRSP mutual funds holdings data.

3. Effects of green sentiment on corporate behavior



3. Effects of green sentiment on corporate behavior

Main results

Dependent variable:	Capex/PPE	Cash/Assets	R&D/Assets
Green sentiment (q) × Env score	0.257*** (3.03)	0.316*** (3.05)	-0.007 (-0.41)
Env score	-0.322*** (-3.91)	-0.079 (-0.39)	-0.081 (-1.28)
Green sentiment (q)	-1.303*** (-14.34)	-0.113 (-1.08)	0.040* (1.77)
Leverage	-0.009 (-1.31)	-0.083*** (-6.04)	-0.016*** (-5.75)
Market beta	-0.024 (-0.17)	0.637** (2.12)	0.156* (1.72)
Log(marketcap)	0.072 (0.96)	-0.822*** (-4.40)	-0.015 (-0.23)
Book-to-market	-1.531*** (-6.26)	-4.559*** (-6.63)	-1.300*** (-4.10)
Profitability	-0.021 (-1.57)	0.038 (0.83)	-0.057*** (-5.28)
Momentum	-0.095*** (-3.91)	0.098** (2.51)	0.015 (1.43)
Constant	4.661*** (5.93)	19.839*** (9.66)	2.477*** (3.61)
Observations	23,656	30,018	14,136
R-squared	0.035	0.281	0.475
Industry FE	Yes	Yes	Yes

3. Effects of green sentiment on corporate behavior

Main results

Dependent variable:	Capex/PPE	Cash/Assets	R&D/Assets
Green sentiment (q) × Env score	0.257*** (3.03)	0.316*** (3.05)	-0.007 (-0.41)
Green sentiment (q)	(-3.91) -1.303***	(-0.39) -0.113	(-1.28) 0.040*
Leverage	(-14.34) -0.009	(-1.08) -0.083***	(1.77) -0.009
Market beta	(-1.31) -0.024	(-6.04) 0.637**	(-0.17) 0.072
Log(marketcap)	(0.96) -1.531***	(-4.40) -4.559***	(-0.17) 0.072
Book-to-market	(-6.26) -0.021	(-6.63) 0.038	(-0.17) 0.072
Profitability	(-1.57) -0.095***	(0.83) 0.098**	(-0.17) 0.072
Momentum	(-3.91) 4.661***	(2.51) 19.839***	(-0.17) 0.072
Constant	(5.93)	(9.66)	(-0.17) 0.072
Observations	23,656	30,018	0.475
R-squared	0.035	0.281	0.475
Industry FE	Yes	Yes	Yes

↑ 1-SD average Green Sentiment in quarter q , associated with:

- ↑ 0.25% capex (6% of median)
- ↑ 0.31% cash holdings (5% of median)

for 1-SD greener firms.

Interpretation à la Dessaint et al. (RFS, 2019).
Currently looking at actual share issuances.

→ No apparent effects on R&D activities.

3. Effects of green sentiment on corporate behavior

Heterogeneity across credit ratings

Heterogenous effect based on firms' access to capital and equity dependence (in line with Baker et al., QJE 2003).

	Low credit rating	Medium credit rating	High credit rating
Panel A: Dependent variable: Capex/PPE			
Green sentiment (q) × Env score	0.555*** (2.66)	0.365** (2.35)	-0.009 (-0.05)
Env score	-0.107 (-0.54)	-0.173 (-1.24)	-0.070 (-0.54)
Green sentiment (q)	-1.525*** (-7.89)	-1.453*** (-8.83)	-1.004*** (-4.86)
Observations	4,469	7,643	4,389
R-squared	0.047	0.042	0.027
Panel B: Dependent variable: Cash/Assets			
Green sentiment (q) × Env score	0.578*** (2.93)	0.036 (0.30)	0.252 (1.62)
Env score	0.257 (0.77)	0.520* (1.92)	-0.020 (-0.06)
Green sentiment (q)	-0.241 (-1.36)	-0.170 (-1.21)	-0.176 (-1.07)
Observations	5,526	10,003	5,338
R-squared	0.263	0.362	0.371

Heterogeneity across S&P credit ratings:

- Impact on capex driven by firms with low (< BBB-) and medium (BBB) credit ratings.
- Effect on cash holdings driven by firms with low (< BBB-) credit ratings.
- No effects on high-rated (AA+, AAA, etc.) companies.

Concluding remarks

- We propose a method to capture “green sentiment” -- a new type of investor sentiment -- based on the estimation of non-fundamental demand shocks on green ETFs.
- Changes in green sentiment predict a stock price outperformance of more environmentally responsible firms, net of the effect of environmental-related fundamental news.
- As theory predicts, higher green sentiment allows green firms to increase capital investments and cash holdings. But the real impact of green sentiment is significantly influenced by a firm’s equity dependence.

Many thanks for your attention!

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1. Identifying green sentiment from ETF arbitrage activity

The Green Sentiment Index

