FINM 35000: Topics in Economics

Week 1: Course Overview, ESG and Climate Risk

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Course Logistics I

- We will cover a variety of topics related to macroeconomics and finance, focusing on real world applications
- Grading:
  - Four problem sets, which will be mostly computational (50%)
  - The final project is a trading strategy, which should be based on one of the topics we cover in class (40%)
  - Class participation (10%)
- Problem sets and the final project can be completed in groups of up to three students
- Each assignment will have a short set of bonus questions to be completed individually

Course Logistics II

- There will be a proposal for the final project due Week 6 (November 1). This is graded only for completion and is meant to ensure you start thinking about the project early and that you have an opportunity to get feedback on your idea.
- Joanna's email: joanna.harris@chicagobooth.edu.
  - Please email me (or use the anonymous form) if you have feedback about course content or style!
  - Feedback form: `https://forms.gle/vRnSV1ZuMhHp1VsA9`
- Lisheng's email: lisheng.su@gmail.com
- Lisheng will hold TA sessions/office hours over Zoom on Sundays from 5-6PM
  - Email Lisheng at least 24 hours in advance of each week's office hour to let him know what questions you would like to discuss

Group Work Policy

- To ensure that the entire group participates, submissions should be color-coded based on which group member was responsible for completing each section
  - We expect that all group members take responsibility for a portion of each homework
  - Should still discuss the entire assignment as a group
- You are welcome to change groups throughout the quarter
- Let us know if you are having issues with your group
- Sign up: https://forms.gle/HpqRRaMP21SNBK3WA (respond once per group)

Topic Descriptions I

- ESG and Climate Risk (Weeks 1-3)
  - What do we mean by ESG?
  - Do investors care about ESG? Why do they care?
  - How is ESG (in particular E) similar to and distinct from climate risk?
  - How do we measure ESG and exposure to climate risk?
  - What evidence do we have about the relationship between ESG/climate risk and returns? How can we interpret this evidence?
  - How is ESG regulated in different countries? Why do these regulations matter?
- Monetary Policy and Inflation (Weeks 4 and 5)
  - What are the goals of central banks? What tools do they use in order to achieve their goals?
  - How does monetary policy affect inflation?
  - What determines inflation other than monetary policy?
  - How does monetary policy affect asset prices?

Topic Descriptions II

- International Finance and Emerging Markets (Week 6)
  - What are the important considerations for investors when evaluating foreign assets?
  - What role do tariffs and other trade policies play?
  - How is investing in emerging markets different than investing in developed markets?
- Business Cycles, Financial Crises and Inequality (Week 7)
  - What characterizes business cycle fluctuations?
  - To what extent are these fluctuations forecastable?
  - What distinguishes a financial crisis from "usual" business cycle fluctuations?
  - How do policy makers respond to financial crises?
  - How do financial markets affect inequality?

Topic Descriptions III

- The Equity Premium Puzzle, Heterogeneity and Retail Investors (Week 8)
  - Why do stocks earn higher returns than bonds? Does this mean that stocks are a better investment?
  - To what extent can the high return of stocks be justified by their riskiness?
  - Investors vary according to their beliefs, risk preferences, wealth, etc. Why do these differences matter for markets?
  - How has the "democratization" of finance through platforms like Robinhood changed the role of retail investors in markets? How can we measure retail investor beliefs?

What is ESG?

- ESG encompasses three non-financial factors that investors are increasingly taking into account: environmental, social and governance
- Environmental considers whether firms take actions to conserve the natural environment
- Social focuses the impact of the firm's business on society (for example, diversity initiatives, labor standards and human rights)
- Governance considers how the firm is structured in terms of board composition, executive compensation, incentivizing whistle-blowers, etc.

History of ESG Investing

- 1980s: movement to divest from Apartheid South Africa was first iteration of investors allocating capital away from firms causing social ill
- Late 1980s and early 1990s: climate change concerns grow, leading to a push toward sustainable investing
- 2006: UN "Principles for Responsible Investment"
  - Over 2,300 asset managers as as signatories
  - "As institutional investors, we have a duty to act in the best long-term interests of our beneficiaries. In this fiduciary role, we believe that environmental, social, and corporate governance (ESG) issues can affect the performance of investment portfolios (to varying degrees across companies, sectors, regions, asset classes and through time)"
- Led to development of ESG ratings, making it easier for investors to identify sustainable investments

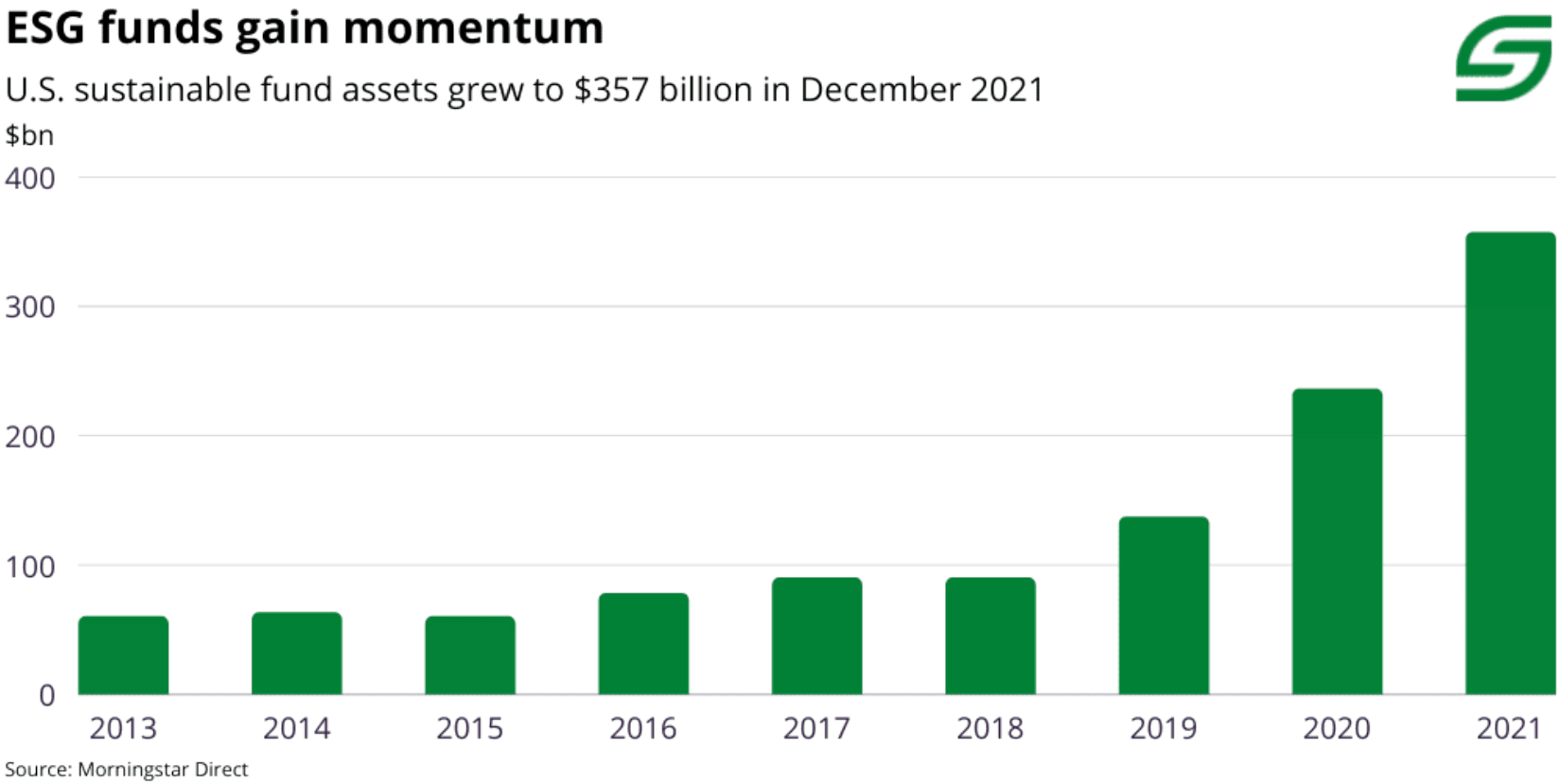
Stakeholder Capitalism

- 1970s: using social criteria to make investment decisions was unheard of, e.g. "the social responsibility of business is to increase profits" (Milton Friedman, 1970)
- 2019: shift away from this view by Business Roundtable. Redefined the purpose of a corporation to "benefit of all stakeholders – customers, employees, suppliers, communities and shareholders."
- Hart and Zingales (2017) consider this idea using economic theory:
  - They point out that if investors value sustainability, maximizing shareholder welfare is not necessarily equivalent to maximizing market value
  - Example: Suppose an investor dislikes pollution. Since reversing the effects of emissions is costly, the investor will be worse off if they invest in a polluting corporation and then use the proceeds to reverse the effects than they would be if the firm had not polluted in the first place.

How Do We Measure ESG?

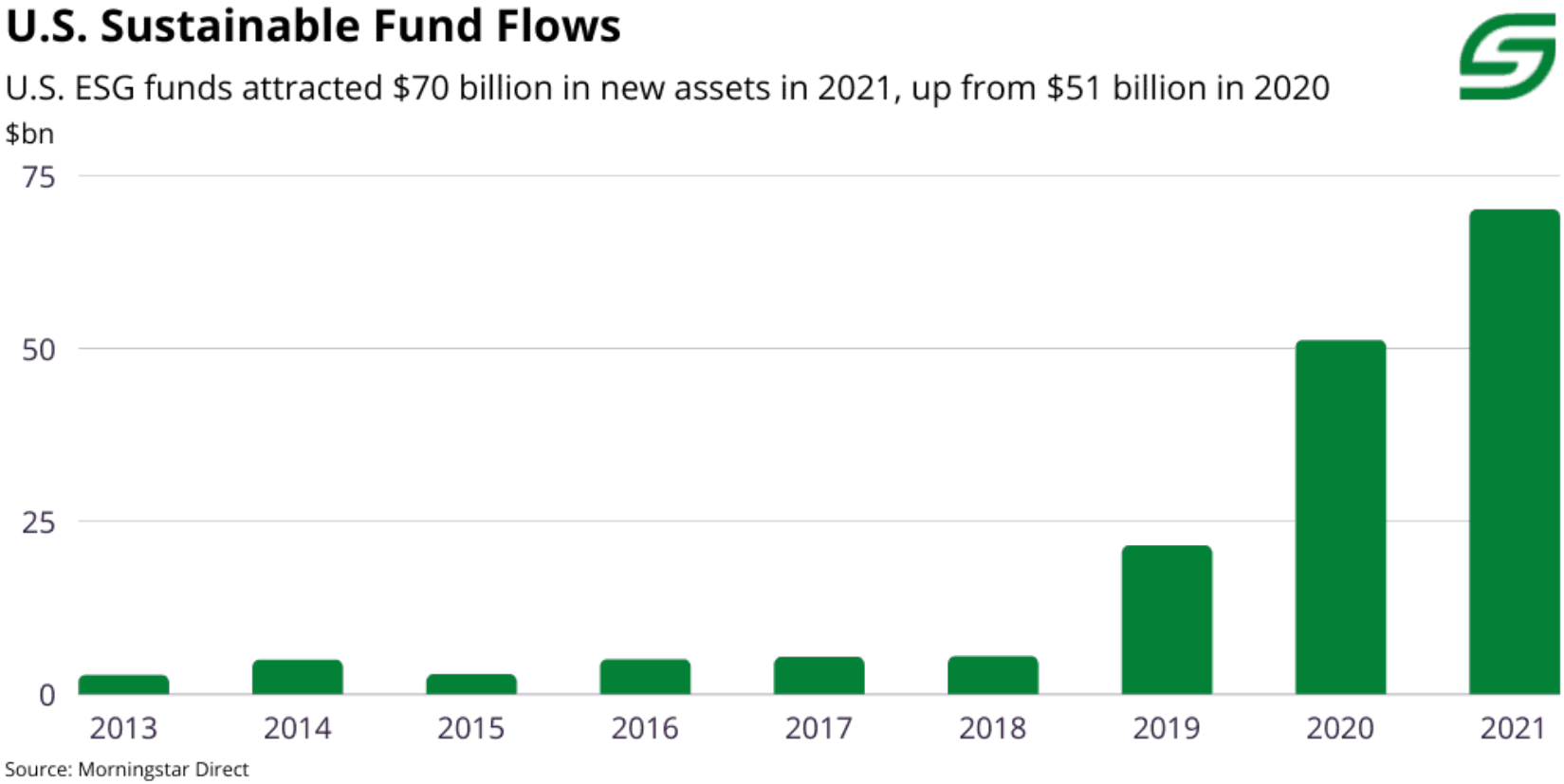
- There are several data providers and they don't always agree
- Berg et al. (2019) focuses on six major providers (KLD, Sustainalytics, Moody's, S&P Global, Refinitiv, and MSCI) and find that pairwise correlations of ESG scores range from 0.38 to 0.71 (0.54 on average)
- Highlights the importance of understanding what a specific provider's score is actually measuring before using the data!
- Measurement varies in two broad ways:
  1. What fundamental information does the ratings firm consider when measuring each factor (environment, social and governance)?
  2. How does the ratings firm aggregate across this fundamental information in order to assign one score for each factor and one overall ESG score?
- Example: MSCI uses hundreds of data points such as % of board members that are independent, carbon emissions, and recordable injuries to compute 35 issue scores, which they aggregate to ten themes and three pillars (Details)

Do Investors Care About ESG?



- 51% growth in ESG fund assets between from December 2020 to December 2021

Do Investors Care About ESG?



- Takeaway: inflows are an important driver of growth in AUM of ESG funds (not just returns)

ESG and Portfolio Allocation: Evidence

Hartzmark and Sussman (2019)

- Key result: "investors marketwide value sustainability: being categorized as low sustainability resulted in net outflows of more than $12 billion while being categorized as high sustainability led to net inflows of more than $24 billion"
- Setting: in March 2016, Morningstar first published sustainability ratings for mutual funds
- Prior to these ratings, it was difficult for investors to determine whether funds were sustainable
- Assuming nothing else changed at the time the ratings were released, flows reflect investor preferences for greenness

ESG and Portfolio Allocation: Evidence (cont'd)

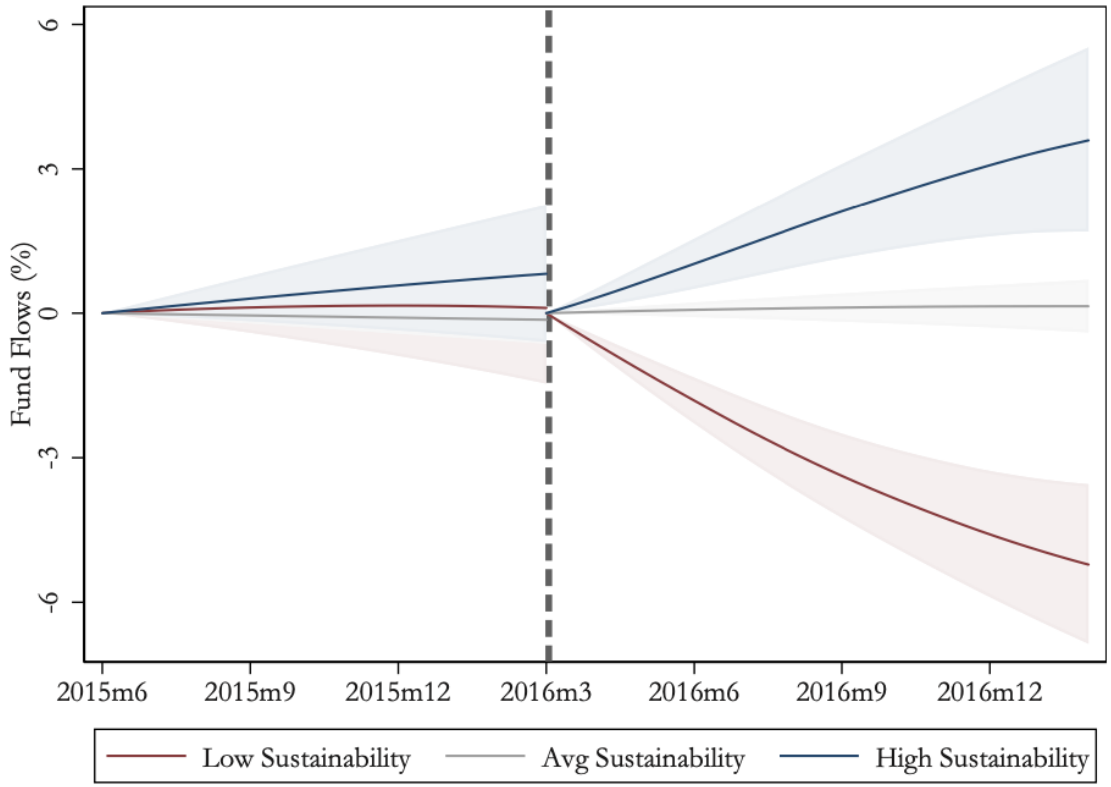


Figure 1. Cumulative fund flows by sustainability rating. Estimates are accumulated from a local linear plot of monthly flows after removing year-by-month fixed effects for nine months before and 11 months after rating publication (denoted by the dashed vertical line). Shaded areas indicate the 90% confidence interval. (Color figure can be viewed at wileyonlinelibrary.com)

ESG and Portfolio Allocation: Evidence (cont'd)

Table III

Fund Flows in Response to Sustainability Rating

This table shows how mutual fund flows vary with measures of sustainability. The dependent variable is fund flows, which are regressed on three proxies for sustainability, namely, the raw sustainability score, the percentile rank within category, and dummy variables for globe rankings. Columns (4) through (6) of Panel A and the even numbered columns in Panel B include as additional controls the return in the prior month, the return over the prior 12 months, the return over the prior 24 months, the log of size in the prior month, the expense ratio, the Morningstar star rating in the prior month, and the log of fund age. Panel A does not weight regressions, while Panel B weights by log of TNA in the prior month in columns (3) through (6). All columns include year × Morningstar category × month fixed effects. Data are restricted to March 2016 and after, the period when the globe ratings were published, and analysis is at the fund level. Standard errors are clustered by month and fund, and t-statistics are in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Baseline Flow Regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Sustainability score	0.0744					0.0612
	(0.94)					(0.65)
Category percent rank	0.000983					0.00398
	(0.23)					(0.89)
One globe		−0.441**	−0.457***	−0.352**	−0.402***	−0.408**
		(−2.80)	(−3.21)	(−2.81)	(−3.38)	(−2.55)
Two globes		0.0964		0.134		
		(0.92)		(1.33)		
Four globes		−0.0353		0.0440		
		(−0.40)		(0.51)		
Five globes		0.297	0.281*	0.379**	0.331**	0.319*
		(1.81)	(1.87)	(2.39)	(2.35)	(1.85)
Diff: five globes − one globe		0.737	0.738	0.731	0.733	0.727
p-value: five globes = one globe		0.00384	0.00382	0.00377	0.00376	0.0296
Cat by YM FE	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	No	No	No	Yes	Yes	Yes
R^2	0.0503	0.0511	0.0510	0.0909	0.0907	0.0909
Observations	34,046	34,046	34,046	32,421	32,421	32,421

(*Continued*)

Table III—*Continued*

Panel B: Normalized Flow and Size-Weighted Regressions

	Normalized Flows		Size-Weighted Flows		Size-Weighted Normalized Flows	
	(1)	(2)	(3)	(4)	(5)	(6)
One globe	−5.743***	−4.427***	−0.444***	−0.353**	−5.802***	−4.389***
	(−5.53)	(−4.62)	(−3.20)	(−3.07)	(−5.47)	(−4.59)
Five globes	2.474**	3.253***	0.302*	0.358**	2.686**	3.465***
	(2.25)	(3.19)	(2.07)	(2.64)	(2.35)	(3.29)
Diff: five globes − one globe	8.217	7.680	0.746	0.711	8.487	7.855
p-value: five globes = one globe	0.000402	0.000397	0.00299	0.00330	0.000380	0.000347
Cat by YM FE	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	No	Yes	No	Yes	No	Yes
R^2	0.0711	0.157	0.0498	0.0883	0.0725	0.160
Observations	34,046	32,421	34,046	32,421	34,046	32,421

Why Might Investors Care About ESG?

- We will focus on four potential explanations:
  1. Investors derive a non-pecuniary benefit from holding stocks of firms that have a positive social impact
  2. Investors want to use their money to incentivize socially responsible behavior
  3. ESG investments perform well
  4. ESG investments help hedge risks investors are concerned about (more details next week)
- Explanations 1 and 2 require us to think of investors as valuing social good, not just returns and risk
- Explanations 3 and 4 are consistent with standard models where investors choose portfolio weights to maximize their utility of consumption

Aside: Overview of Portfolio Choice Problems

Portfolio Choice Problems: What is Utility?

- Theory will not be the focus of this class, but it can sometimes be useful to use models in order to be concrete about certain concepts
- What is a utility function?
  - A function, $u(c)$ which maps from units of consumption to utils (can also have more than one argument, for example $u(lettuce, tomatoes)$ would map from bundles of different amounts of lettuce and tomatoes to utils)
  - Utils are a construct designed to represent preferences (i.e. agents prefer an alternative which gives them more utils)
  - In general, we focus on functional forms that are increasing and concave, that is $u'(c) > 0$ and $u''(c) < 0$. Why?
- Utility functions are a useful construct to allow economists to deduce what agents would choose if their preferences take a certain form

Portfolio Choice Problems: Defining Risk Aversion

- What does it mean to be risk averse?
  - Conceptually, an agent is risk averse if they prefer a certain outcome, to a lottery with the same expected value
  - For example, would you prefer I gave you \$50 or gave you a lottery ticket where you had a 50% chance of winning \$100 and a 50% of getting nothing?
- Formally, we measure risk aversion using the Arrow-Pratt measures:
  - Absolute risk aversion, $A(c) = -\frac{u''(c)}{u'(c)}$
  - Relative risk aversion, $R(c) = cA(c) = -\frac{cu''(c)}{u'(c)}$
  - Relative risk aversion allows for the possibility that your willingness to take the gamble above depends on the level of your wealth

Portfolio Choice Problems: Deriving the Pricing Equation

(Follows Chapter 1 of *Asset Pricing* by John Cochrane)

- Consider an investor with utility function $u(.)$ and one-period discount rate β who is choosing how much to invest in a risky asset:

$$\begin{aligned} \max_{\xi} \quad & u(c_t) + \mathbb{E}_t[\beta u(c_{t+1})] \\ s.t. \quad & c_t = e_t - p_t \xi \\ & c_{t+1} = e_{t+1} + x_{t+1} \xi \end{aligned}$$

- The risky asset costs p_t in period t and pays off x_{t+1} in period $t+1$. If the investor did not purchase any of the asset, he would consume his endowment e in each period.
- Substitute the constraints into the objective and take first order conditions to obtain the pricing equation:

$$p_t = \mathbb{E}_t \left[\underbrace{\beta \frac{u'(c_{t+1})}{u'(c_t)}}_{\equiv m_{t+1}} x_{t+1} \right]$$

Portfolio Choice Problems: Why Does Covariance Matter?

(Follows Chapter 1 of *Asset Pricing* by John Cochrane)

- We call $m_{t+1} = \beta \frac{u'(c_{t+1})}{u'(c_t)}$ the stochastic discount factor (SDF)
- The SDF is a generalization of the standard idea that price should be the discounted value of cash flows. Because of uncertainty and risk aversion, we need an SDF instead of a standard discount factor
- Note: the risk free rate is given by $R_f = \frac{1}{\mathbb{E}[m]}$ (see Cochrane's book if you want the derivation)
- Observation:

$$\begin{aligned} p_t &= \mathbb{E}_t[m_{t+1} x_{t+1}] \\ &= \mathrm{Cov}_t(m_{t+1}, x_{t+1}) + \mathbb{E}_t[m_{t+1}]\mathbb{E}_t[x_{t+1}] \\ &= \mathrm{Cov}_t(m_{t+1}, x_{t+1}) + \frac{\mathbb{E}_t[x_{t+1}]}{R_f} \end{aligned}$$

  This means that the price of an asset depends on its expected payoff as well as the covariance of that payoff with the SDF (i.e. with consumption)

Portfolio Choice Problems: Example

- Discrete state example:
  - One consumption good (pizza)
  - Two states, "good" and "bad"
  - Each state occurs with 50% probability
  - In the good state, endowment is ten pizzas and in the bad state it is zero pizzas
  - Asset 1 pays off one pizza in the good state and zero in the bad state
  - Asset 2 pays off zero pizzas in the good state and one pizza in the bad state
- Both assets have the same expected payoff (0.5 pizzas)
- Which asset would you pay more for? This is why covariance matters!
- Why does any of this matter when thinking about climate change? Because an asset's exposure to climate risk might affect its covariance with consumption

Back to ESG

Reminder: Why Do Investors Care About ESG?

- We will focus on four potential explanations:
  1. Investors derive a non-pecuniary benefit from holding stocks of firms that have a positive social impact
  2. Investors want to use their money to incentivize socially responsible behavior
  3. ESG investments perform well
  4. ESG investments help hedge risks investors are concerned about (more details next week)
- Explanations 1 and 2 require us to think of investors as valuing social good, not just returns and risk
- Explanations 3 and 4 are consistent with standard models where investors choose portfolio weights to maximize their utility of consumption
- The framework we discussed above will help us make sense of these four explanations

Explanation 1: Non-Pecuniary Benefits (Definition)

- Non-pecuniary benefit of ESG investing means that even if investing in socially responsible firms does not increase consumption, these holdings still increase utility
- In the case of ESG, we can think of non-pecuniary benefits as coming from the "warm glow" effect, i.e. the good feeling that comes from investing in firms whose mission an investor believes in (even if, on the margin, a small investor's choice to invest does not have any impact on any tangible outcome)

Explanation 1: Non-Pecuniary Benefits

Theory

- Pástor et al. (2021) formalize this (see section 2 of the paper for details)
- There are N firms, with $\tilde{r}$ denoting the $N \times 1$ vector whose n^{th} element is the return of firm n and g denoting the $N \times 1$ vector whose n^{th} element is the social impact of firm n
- Investor i is infinitesimally small and has initial wealth W_{0i} and chooses an $N \times 1$ vector of portfolio weights, X_i
- Investors have utility of the form:

$$V(\tilde{W}_{1i}, X_i) = -e^{A_i \tilde{W}_{1i} - d_i g' X_i},$$

  where $\tilde{W}_{1i} = W_{0i}(1 + r_f + X_i' \tilde{r})$, A_i is the absolute risk aversion of agent i and d_i is a scalar representing investor i's taste for ESG
- For a given stock n, $d_i g_n$ is the non-pecuniary benefit obtained by agent i from holding stock n
- Key implication: in this model, green assets have lower expected returns because of the non-pecuniary benefits

Explanation 1: Non-Pecuniary Benefits

Evidence from Giglio et al. (2023)

Panel C: Share of Investors by ESG Holdings

	Reasons of ESG Investments				Level of Concerns		
	ESG will outperform	ESG hedges climate risk	It's the right thing to do	No specific reason	Low	Moderate	High
By ESG Investments							
Has no ESG Investments	0.07	0.22	0.24	0.47	0.26	0.26	0.48
Has ESG Investments	0.13	0.27	0.49	0.11	0.07	0.12	0.80

Note: Table summarizes the fraction of respondents that selected each answer to the second (i.e., motivations for ESG investments) and third (i.e., level of concern about climate change) ESG questions. Note that the third question was added in Dec 2021. Panel A shows the share of investors, pooled all responses and divided by demographic characteristics of the respondents. Panel B shows the share of investors divided by another ESG question, such as the share of each stated motivation of ESG investments in relation to the level of concern about climate change, and vice versa. Panel C reports the share of investors by whether a respondent has any ESG investment. The flood risk exposures are based on the average risk scores (measured by the First Street Foundation) of the zipcodes where respondents are located. The political views of living areas are based on county-level vote shares (considering only Democrat and Republican votes) from the 2020 US election.

Explanation 2: Incentivizing Socially Responsible Behavior

Intuition

- In the model above, investors are infinitesimally small, so any one investor does not affect firm behavior
- This means that (rational) investors should not take into account whether allocating capital away from brown firms will cause them to improve
- In the Pástor et al. (2021) model, ESG investing does affect firm behavior (see section 6 for details). How?
  - In the aggregate, investor preference for ESG lowers the cost of capital for green firms
  - This causes green firms to invest more than brown firms (i.e. green firms will grow faster) and causes firms to be more green than they would be in the absence of such preferences

Explanation 2: Incentivizing Socially Responsible Behavior

Large Investors

- While an infinitely small investor's portfolio choice decisions cannot influence firm behavior, the choices of large investors can (this is moving outside the framework above)
- The most prominent example of this is Blackrock, led by CEO Larry Fink
  - Example: "Capital markets have allowed companies and countries to flourish. But access to capital is not a right. It is a privilege. And the duty to attract that capital in a responsible and sustainable way lies with you." (2022 Letter to CEOs)
  - This statement implies that firms should adjust their behavior to become more sustainable if they want to attract capital

Explanation 2: Incentivizing Socially Responsible Behavior

Theory

- Theory: Heinkel et al. (2001)
  - Show that exclusionary ethical investing leads to polluting firms being held by fewer investors since green investors eschew polluting firms' stock
  - This leads to lower stock prices for polluting firms (i.e. a higher cost of capital)
  - If the higher cost of capital more than overcomes a cost of reforming, then ESG investing will lead polluting firms to reform
  - Given reasonable estimates for the cost of reforming, the model implies 20% of funds must be controlled by green investors

Explanation 2: Incentivizing Socially Responsible Behavior

Mechanism

- Can think of this effect in two parts:

$$\text{ESG Investing} \underbrace{\Longrightarrow}_{①} \text{Higher Cost of Capital for Brown Firms}$$

$$\underbrace{\Longrightarrow}_{②} \text{Firms Become Greener}$$

- Is there empirical evidence that ESG investing is effective at making firms more socially responsible?
  - For $\underbrace{\Longrightarrow}_{①}$, there is (mostly related to green bonds having lower yields than comparable non-green bonds), but for $\underbrace{\Longrightarrow}_{②}$, there is less
  - See Kölbel et al. (2020) for an overview

Explanation 2: Incentivizing Socially Responsible Behavior

Overview of Heath et al. (2021)

- Why is it difficult to measure the effect of sustainable investing on firm behavior?
  - Classic example of an omitted variable problem
  - If we observe a positive relationship between money in ESG funds and firm greenness, can we determine that the money in ESG funds is causing firms to be more green? No! It could be that there is a third variable that is leading investors to care more about ESG and also causing firms to become more green
- This paper: uses an exogenous shock to the capital of socially responsible investors and finds that socially responsible investors do not significantly change firm behavior[1]
- The exogenous shock here is based on the technical details of how Morningstar rates funds

[1] Exogenous shock means something that leads to an increase in the capital of socially responsible investors, but is not otherwise related to firm greenness. We will talk more about this next week.

Explanation 2: Incentivizing Socially Responsible Behavior

Heath et al. (2021) Results I

Table III

Selection Effects: SRI funds and corporate environmental behavior

The table presents estimates of the relation between SRI fund investment and firm total pollution (*Total releases*), air pollution (*Air*), water pollution (*Water*), land pollution (*Land*), investments in pollution abatement (*Abatement* and *logAbatements*), and climate change exposure (*CCExposure*). *SRI Investment* is the percentage of a firm's ownership held by SRI funds (to facilitate the interpretation of the results, the measure is standardized). Definitions for all variables are in the Appendix Section A2. Robust standard errors, clustered at the firm level, are shown in parenthesis with raw and Romano and Wolf (2005) p-values shown below. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Total releases (1)	Air (2)	Water (3)	Land (4)	Abatement (5)	logAbatements (6)	CCExposure (7)
SRI Investment	-0.245	-0.251	-0.684	-0.340	0.022	0.032	-0.061
	(0.094)	(0.092)	(0.162)	(0.286)	(0.012)	(0.040)	(0.023)
Unadjusted p	0.010***	0.007***	0.001***	0.233	0.067*	0.421	0.009***
Romano-Wolf p	0.081*	0.077*	0.004***	0.435	0.229	0.435	0.081*
Observations	3,759	3,584	1,885	1,222	3,579	1,526	15,004
Adjusted R-squared	0.005	0.006	0.038	-0.000	0.015	0.013	0.002
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Explanation 2: Incentivizing Socially Responsible Behavior

Heath et al. (2021) Results II

Table V

Treatment effects: SRI funds and corporate environmental behavior

The table presents estimates of the effect of SRI fund investment on firm total pollution (*Total releases*), air pollution (*Air*), water pollution (*Water*), land pollution (*Land*), total off-site pollution (*Off-site*), one time pollution (*One-time*), investments in pollution abatement (*Abatement* and *logAbatements*), and climate change exposure (*CCExposure*). $\Delta\widehat{SRI\ Investment}$ is the predicted change in SRI investment for each firm in the sample from our paired fund-level difference-in-differences regression (to facilitate the interpretation of the results, the measure is standardized). MDES is the minimum detectable effect size (Bloom, 1995). Definitions for all variables are in the Appendix Section A2. Robust standard errors, clustered at the firm level, are shown in parenthesis with raw and Romano and Wolf (2005) p-values shown below. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Total releases (1)	Air (2)	Water (3)	Land (4)	Abatement (5)	logAbatements (6)	CCExposure (7)
$\Delta\widehat{SRI\ Investment}$	0.030	0.018	0.077	0.031	0.013	0.019	-0.000
	(0.042)	(0.041)	(0.064)	(0.098)	(0.016)	(0.040)	(0.023)
MDES	±0.119	±0.116	±0.181	±0.278	±0.046	±0.114	±0.065
Unadjusted p	0.481	0.658	0.230	0.729	0.420	0.628	0.998
Romano-Wolf p	0.959	0.985	0.811	0.985	0.959	0.985	0.996
Observations	3,728	3,555	1,869	1,183	3,551	1,456	14,973
Adjusted R-squared	0.887	0.892	0.888	0.906	0.508	0.718	0.857
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Explanation 2: Incentivizing Socially Responsible Behavior

Overview of Dyck et al. (2019)

- Research question: do shareholders drive the environmental and social performance of firms?
- Empirical design:

$$\log(Score_{it}) = \alpha + \beta X_{it-1} + \gamma' Y_{it-1} + \Lambda + \varepsilon_{it}$$

  - $Score_{it}$ is the environmental or social score of firm i at time t
  - X_{it-1} is the percentage of total institutional ownership in year $t-1$
  - Y_{it-1} are a set of firm-level control variables in year $t-1$
  - Λ are year, country, and industry fixed effects
- Coefficient of interest is β, which the authors claim measures the effect of institutional ownership on environmental/social performance

Explanation 2: Incentivizing Socially Responsible Behavior

Dyck et al. (2019) Results I

	Environmental scores		Social scores	
	Overall score (1)	ASSET4 *z*-score (2)	Overall score (3)	ASSET4 *z*-score (4)
Panel A: Full sample				
Total IO	0.268	0.403	0.124	0.491
	(0.00)	(0.00)	(0.00)	(0.00)
Log (total assets)	0.214	0.255	0.084	0.274
	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	0.194	0.228	0.031	0.116
	(0.00)	(0.00)	(0.16)	(0.16)
Leverage	−0.116	−0.141	−0.041	−0.133
	(0.13)	(0.21)	(0.14)	(0.22)
Tobin's q	0.033	0.027	0.015	0.032
	(0.00)	(0.00)	(0.00)	(0.03)
Profitability	0.082	0.176	0.068	0.350
	(0.43)	(0.18)	(0.11)	(0.04)
Cross-list	−0.027	−0.071	0.004	−0.040
	(0.23)	(0.06)	(0.73)	(0.38)
Country fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.543	0.446	0.523	0.393
Number of observations	19,849	19,785	19,849	19,785
Panel B: Institutional ownership split by UN PRI signatory status				
IO UN PRI Signatories	0.773	1.147	0.271	1.013
	(0.00)	(0.00)	(0.00)	(0.00)
IO non–UN PRI Signatories	0.073	0.091	0.054	0.241
	(0.13)	(0.22)	(0.04)	(0.02)
Control variables	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.546	0.450	0.525	0.394
Number of observations	19,849	19,785	19,849	19,785
IO UN PRI versus IO non–UN PRI (*p*-value)	(0.00)	(0.00)	(0.00)	(0.00)
Panel C: Subsamples of firms with weak and strong initial E&S performance				
Weak initial E&S performance subsample				
Total IO	0.259	0.415	0.128	0.487
	(0.00)	(0.00)	(0.00)	(0.00)
Control variables	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.446	0.329	0.456	0.293
Number of observations	11,918	11,907	11,989	11,862
Strong initial E&S performance subsample				
Total IO	0.137	0.207	0.039	0.093
	(0.03)	(0.01)	(0.11)	(0.26)
Control variables	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.611	0.228	0.65	0.277
Number of observations	7931	7878	7860	7923
Total IO, weak versus strong initial E&S performance (*p*-value)	(0.02)	(0.02)	(0.00)	(0.00)

Explanation 2: Incentivizing Socially Responsible Behavior

Dyck et al. (2019) Discussion I

- Do you think these regressions are estimating the causal impact of institutional ownership on firm E&S?
  - Probably not, because we would see the same results if institutional investors chose to invest in firms with higher E&S
- Potential solution: BP oil spill as a natural experiment
  - "This unexpected event serves as an exogenous shock to the importance that institutional investors assign to firms' environmental commitments. While the immediate negative economic effect of the oil spill was on BP, the event arguably focused investors' attention on all extractive industries and the potential risks of weak environmental policies even in the most developed countries."
- Revised empirical design:

$$\log(Score_{it}) = \alpha + \beta_1 X_i + \beta_2 Post_t + \beta_3 X_i \times Post_t + \gamma' Y_{it} + \Lambda + \varepsilon_{it},$$

Explanation 2: Incentivizing Socially Responsible Behavior

Dyck et al. (2019) Results II

	Overall environmental score			Environmental ASSET4 *z*-score		
	Oil and gas extraction (SIC 13) (1)	Oil and petroleum products (FF 17) (2)	Mining (SIC Division B) (3)	Oil and gas extraction (SIC 13) (4)	Oil and petroleum products (FF 17) (5)	Mining (SIC Division B) (6)
Panel A: Within-industry regressions						
Total IO	0.100	0.093	0.168	0.394	0.252	0.337
	(0.32)	(0.46)	(0.12)	(0.05)	(0.17)	(0.01)
Post event	−0.007	0.028	0.008	−0.154	−0.099	−0.125
	(0.88)	(0.40)	(0.78)	(0.07)	(0.13)	(0.03)
Total IO × Post event	0.216	0.150	0.120	0.332	0.240	0.235
	(0.02)	(0.02)	(0.00)	(0.03)	(0.03)	(0.00)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.722	0.727	0.616	0.667	0.677	0.586
Number of observations	222	302	606	222	302	606
Number of treated firms	111	151	303	111	151	303
Panel B: Difference-in-differences regressions						
Total IO	0.288	0.306	0.377	0.431	0.454	0.523
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Post event	0.087	0.089	0.097	0.002	0.005	0.017
	(0.00)	(0.00)	(0.00)	(0.90)	(0.78)	(0.38)
Treated firm	−0.100	−0.038	−0.122	−0.091	−0.032	−0.195
	(0.45)	(0.68)	(0.28)	(0.68)	(0.78)	(0.27)
Total IO × Post event × Treated firm	0.156	0.091	0.116	0.247	0.149	0.222
	(0.06)	(0.12)	(0.01)	(0.08)	(0.17)	(0.01)
Control variables and other interactions	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.515	0.474	0.483	0.465	0.423	0.43
Number of observations	5172	5172	5172	5168	5168	5168
Number of treated firms	111	151	303	111	151	303
Number of control firms	2475	2435	2283	2473	2433	2281

Explanation 3: Performance

- Is ESG associated with higher returns, lower returns or neither?
  - The empirical evidence is ambiguous
  - A few examples:
    1. Pástor et al. (2022) find that German green bonds outperformed their non-green twins and U.S. green stocks outperformed brown stocks
    2. Larcker and Watts (2020) find that green securities are priced almost identically to comparable non-green securities
    3. Ardia et al. (2020) find that on days with an unexpected increase in climate change concerns, the green firms' stock prices tend to increase while brown firms' prices decrease
    4. Riedl and Smeets (2017) find that socially responsible investors expect to earn lower returns on SRI funds than on conventional funds and pay higher management fees
- In problem set 1, you will replicate some results from Pástor et al. (2022), which examines the effect of ESG on stock returns

Explanation 4: Hedging

- What is the correlation of ESG assets with macroeconomic conditions? Can ESG assets be used as hedges against systematic risk?
- If so, investors would be willing to accept a lower return (recall our pizza example)
- In week 3, we will explore these questions further by focusing on the similarities and differences between ESG and exposure to climate change risk

Green R&D

Cohen et al. (2020) Overview

- Key finding: "oil, gas, and energy-producing firms – firms with lower Environmental, Social, and Governance (ESG) scores, and who are often explicitly excluded from ESG funds' investment universe – are key innovators in the United States' green patent landscape."
- What is a green patent? This paper uses the OECD classification, which identifies patents that are related to environmental technologies are classified into various broad environmental technology categories including environmental management, water-related adaptation technologies, biodiversity protection and ecosystem health, climate change mitigation technologies related to energy generation, and waste-water treatment or waste management

Green R&D

Cohen et al. (2020) Results

Table 4. Green Patent Production, Environmental Score, and Energy Sector – Patent level Analysis

This table reports the results of OLS regressions where the dependent variable is a dummy variable that takes a value of one if the granted patent is a green patent, as defined in the description of Table 1. The independent variable is the Environmental Score (out of 100) which shows how well companies proactively manage the environmental issues that are the most material to their business. Energy Sector is a dummy variable that equals one if the first two digits of Standard Industrial Classification (SIC) is 10 (Metal, Mining), 12 (Coal Mining), 13 (Oil & Gas Extraction), 14 (Nonmetallic Minerals, Except Fuels), 29 (Petroleum & Coal Products), or 49 (Electric, Gas, & Sanitary Services). *Top 3 Sector (outside of Energy)* is a dummy variable that equals one if the sector is among the top 3 sectors in terms of green patent production, excluding the Energy Sector: Manufacturing, Services, and Transportation & Public Utilities. The sample period is from 2008 to 2017. Reported t-statistics in parentheses are heteroscedasticity-robust and clustered by year. Reported t-statistics in parentheses are heteroscedasticity-robust and clustered by year.

	(1) Green Patent	(2) Green Patent	(3) Green Patent
Environmental Score	-0.0011*** (-3.70)		
Energy Sector		0.1364*** (5.50)	
Top 3 Sectors (outside of Energy)			-0.1620*** (-13.76)
Observations	217,083	199,557	199,557
R-squared	0.006	0.007	0.053
Year FE	YES	YES	YES

Green R&D

Bolton et al. (2022) Overview

- Emphasizes distinction between green R&D and brown efficiency improving R&D, which leads to a very different conclusion about which firms engage in green innovation
- Definitions:
  - Green patents: environmental technologies (e.g. solar panels)
  - Brown efficiency improvement patents: technologies that improve process efficiency and therefore could reduce emission intensity
  - Brown patents: technological innovation for fossil fuel based technologies

Green R&D

Bolton et al. (2022) Results I

Panel A: *GREENRATIOWW* as dependent variable						
	(1)	(2)	(3)	(4)	(5)	(6)
LOGS1TOT	0.094***	−0.009	−0.007	0.100***	−0.021**	−0.023**
	(0.004)	(0.006)	(0.006)	(0.006)	(0.009)	(0.009)
LOGSIZE				−0.134***	−0.058***	−0.061***
				(0.013)	(0.014)	(0.014)
LOGPPE				0.078***	0.086***	0.091***
				(0.012)	(0.013)	(0.013)
LEVERAGE				−0.005***	−0.003***	−0.003***
				(0.001)	(0.001)	(0.001)
ROE				−0.004***	−0.001***	−0.001***
				(0.000)	(0.000)	(0.000)
M/B				0.014***	0.014***	0.013***
				(0.005)	(0.005)	(0.005)
INVEST/A				0.018***	0.008***	0.008***
				(0.002)	(0.002)	(0.003)
BETA				0.186***	0.044	0.052
				(0.031)	(0.031)	(0.032)
VOLAT				1.594***	1.244***	1.346***
				(0.221)	(0.172)	(0.175)
MOM				−0.022	−0.567*	−0.746**
				(0.385)	(0.341)	(0.359)
RET				0.021	0.033	−0.005
				(0.098)	(0.087)	(0.092)
MSCI				0.025	0.026	0.022
				(0.028)	(0.027)	(0.027)
Constant	−3.083***	−2.079***	−1.986***	−2.852***	−2.264***	−2.177***
	(0.031)	(0.042)	(0.042)	(0.077)	(0.076)	(0.076)
Country F.E.	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes
Industry F.E.	no	yes	yes	no	yes	yes
Industry X Year F.E.	no	no	yes	no	no	yes
Observations	53399	53191	50178	53399	53191	50178
Pseudo R2	0.0311	0.123	0.144	0.0418	0.126	0.146
Std dev dep. var.	0.180	0.180	0.183	0.180	0.180	0.183
Std dev LOGS1TOT	2.703	2.705	2.728	2.703	2.705	2.728
Eco sig LOGS1TOT	1.419	0.129	0.107	1.502	0.313	0.337

Green R&D

Bolton et al. (2022) Results II

Panel A: *BROWNEFFRATIOWW* as dependent variable

	(1)	(2)	(3)	(4)	(5)	(6)
LOGS1TOT	0.158***	0.050***	0.051***	0.090***	0.052***	0.043***
	(0.006)	(0.010)	(0.010)	(0.010)	(0.016)	(0.016)
LOGSIZE				−0.266***	−0.084***	−0.072***
				(0.026)	(0.027)	(0.028)
LOGPPE				0.246***	0.052**	0.053**
				(0.025)	(0.025)	(0.025)
LEVERAGE				−0.006***	−0.001	−0.001
				(0.001)	(0.001)	(0.001)
ROE				0.004***	0.001	0.002**
				(0.001)	(0.001)	(0.001)
M/B				−0.030***	−0.007	−0.011
				(0.009)	(0.010)	(0.010)
INVEST/A				0.013***	0.005	0.007
				(0.005)	(0.005)	(0.005)
BETA				0.273***	−0.034	−0.013
				(0.054)	(0.049)	(0.050)
VOLAT				−0.102	−0.473	−0.595
				(0.387)	(0.394)	(0.421)
MOM				0.467	−0.050	−0.156
				(0.667)	(0.623)	(0.654)
RET				−0.071	0.229	0.192
				(0.180)	(0.167)	(0.177)
MSCI				−0.051	0.055	0.059
				(0.050)	(0.048)	(0.047)
Constant	−4.662***	−3.191***	−2.976***	−3.730***	−2.844***	−2.691***
	(0.051)	(0.079)	(0.080)	(0.144)	(0.149)	(0.151)
Country F.E.	yes	yes	yes	yes	yes	yes
Year F.E.	yes	yes	yes	yes	yes	yes
Industry F.E.	no	yes	yes	no	yes	yes
Industry X Year F.E.	no	no	yes	no	no	yes
Observations	53166	51787	43813	53166	51787	43813
Pseudo R2	0.0624	0.208	0.234	0.0749	0.209	0.235
Std dev dep. var.	0.0946	0.0958	0.102	0.0946	0.0958	0.102
Std dev LOGS1TOT	2.701	2.717	2.779	2.701	2.717	2.779
Eco sig LOGS1TOT	4.502	1.405	1.387	2.564	1.472	1.163

Green R&D

Takeaways

- Bolton et al. (2022): "a successful global decarbonization cannot be founded only on regulations. It necessarily entails major technical advances in substitute energy sources and other technologies to reduce or capture carbon emissions."
- Cohen et al. (2020) and Bolton et al. (2022) have very different conclusions about which firms engage in green innovation
  - This distinction matters for investors who want their capital to support these technical advances
- Open question: how much progress toward decarbonization can be made by improving the efficiency of brown technologies? Should regulators be encouraging this type of innovation or only innovation in green technologies?
- We will return to these questions when we talk about regulation next week

Preview of Next Two Lectures

- Week 2:
  - How prevalent is "greenwashing"?
  - What are regulators in different countries doing to prevent "greenwashing"?
  - Why are standardized disclosure requirements important?
- Week 3:
  - How are ESG (in particular E) and climate risk exposure similar? How do they differ?
  - What is the difference between physical and transition risk?
  - What are some techniques we can use to measure firm-level exposure to climate change risk? What are the advantages and disadvantages of the various approaches?
  - Do investors care about exposure to climate risk? Why do they care?
- We will also go over some basic econometrics that will be useful background

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