SUSTAINABLE INVESTING

Ľuboš Pástor

University of Chicago Booth School of Business
National Bank of Slovakia

Kolektívne investovanie, Slovakia, November 2020
Growing interest in **sustainable investing**

- Objectives: Financial + ESG (Environmental, Social, Governance)
- AUM of $30+ trillion globally at the start of 2018, growing fast (2018 Global Sustainable Investment Review)
- 2,600+ signatories to the UN Principles of Responsible Investment
Growing interest in **sustainable investing**

- Objectives: Financial + ESG (Environmental, Social, Governance)
- AUM of $30+ trillion globally at the start of 2018, growing fast (2018 Global Sustainable Investment Review)
- 2,600+ signatories to the UN Principles of Responsible Investment

I will show results from two studies

Mutual Fund Performance and Flows During the COVID-19 Crisis

Ľuboš Pástor (Chicago Booth)
Blair Vorsatz (Chicago Booth)

Panel A. Performance vs. FTSE/Russell
Fund Flows under COVID-19

Panel A. Total Cumulative Flows

- Percent
- Mar 01, Mar 15, Apr 01, Apr 15, May 01
- 5 Globes
- 4 Globes
- 3 Globes
- 2 Globes
- 1 Globe
Sustainable Investing in Equilibrium

Ľuboš Pástor (Chicago Booth)
Rob Stambaugh (Wharton)
Luke Taylor (Wharton)

Main Theoretical Results

- Greener assets have lower **expected returns**
  - Because agents have green tastes & green assets hedge **climate risk**
  - Green assets have negative alphas, brown assets have positive alphas
Main Theoretical Results

- Greener assets have lower **expected returns**
  - Because agents have green tastes & green assets hedge **climate risk**
  - Green assets have negative alphas, brown assets have positive alphas

- Greener assets outperform when **ESG factor** performs well
  - ESG factor captures shifts in customers’ and investors’ tastes
  - **Two-factor pricing**: Market + ESG factor

Sustainable investing leads to positive social impact
Green firms invest more, brown firms less
Firms become greener
Greener assets have lower expected returns
- Because agents have green tastes & green assets hedge climate risk
- Green assets have negative alphas, brown assets have positive alphas

Greener assets outperform when ESG factor performs well
- ESG factor captures shifts in customers’ and investors’ tastes
- Two-factor pricing: Market + ESG factor

Sustainable investing leads to positive social impact
- Green firms invest more, brown firms less
- Firms become greener
Model Overview

FIRMS

[Diagram showing a bag of money and a globe with hands reaching out]

- Bag of money
- Globe with hands reaching out
Model Overview
Model Overview

FIRMS

INVESTORS
Model Overview

INVESTORS

FIRMS
Model Overview

FIRMS

INVESTORS

Heart

Sad

Happy

Cold

Warm
Model Overview

\[ g_n < 0 \quad \text{vs} \quad g_n > 0 \]

INVESTORS

FIRMS
Model Overview

\[ g_n < 0 \]

\[ g_n > 0 \]

FIRMS

INVESTORS

\[ d_i > 0 \]

\[ d_i = 0 \]
Model

- **Firms** \( n = 1, \ldots, N \)
  - ESG characteristics \( g \ (N \times 1) \)
    - \( g_n > 0 \): “green” firm, positive externalities
    - \( g_n < 0 \): “brown” firm, negative externalities
  - Excess stock returns \( \tilde{r} = \mu + \tilde{\epsilon} \), where \( \tilde{\epsilon} \sim N(0, \Sigma) \)
Model

- **Firms** $n = 1, \ldots, N$
  - ESG characteristics $g (N \times 1)$
    - $g_n > 0$: “green” firm, positive externalities
    - $g_n < 0$: “brown” firm, negative externalities
  - Excess stock returns $\tilde{r} = \mu + \tilde{\epsilon}$, where $\tilde{\epsilon} \sim N(0, \Sigma)$

- **Agents** $i$ (continuum), with CARA utility $-e^{-A_i \tilde{W}_{1i} - b'_i X_i}$
  - $A_i$: Absolute risk aversion of agent $i$
  - $\tilde{W}_{1i} = W_{0i} (1 + r_f + X'_i \tilde{r})$: Wealth of agent $i$ at time 1
  - $X_i$: Portfolio weights of agent $i$ ($N \times 1$)
  - $b_{i,n} = d_i g_n$: Nonpecuniary benefit agent $i$ derives from holding stock $n$
    - $d_i \geq 0$ is agent $i$’s “ESG taste”
Equilibrium Expected Returns: Market-Level

**Equity premium:**

\[ \mu_m = a \sigma_m^2 \]

\( \mu_m \) is decreasing in \( \bar{d} \)

\( \mu_m \) is increasing in \( \bar{d} \)

Assume \( x'g = 0 \) (market portfolio is ESG-neutral)
Equilibrium Expected Returns: Market-Level

- **Equity premium:**

\[
\mu_m = a \left( \frac{\sigma^2_m}{\text{rel. risk aversion}} \right) - \frac{\bar{d}}{a} w'_m g
\]

where \( \mu_m = w'_m \mu \), \( \sigma^2_m = w'_m \sum w_m \), \( w_m = \text{mkt. portfolio weights} \), \( \bar{d} = \text{average } d_i \text{ across agents} \) (i.e., \( \bar{d} \equiv \int \omega_i d_i di \), \( \omega_i \equiv \frac{W_{0i}}{\int \omega_i W_{0i} di} \))

- \( w'_m g > 0 \Rightarrow \mu_m \text{ is decreasing in } \bar{d} \)
- \( w'_m g < 0 \Rightarrow \mu_m \text{ is increasing in } \bar{d} \)

- **Assume** \( w'_m g = 0 \) (market portfolio is ESG-neutral)
Equilibrium Expected Returns: Firm-Level

- Expected excess stock returns:

  \[ \mu = \mu_m \beta_m - \bar{d}/\bar{a} \]

  \[ \text{CAPM} \]

- Greener stocks have lower \textbf{alphas}:

  \[ \alpha_n = -\bar{d}/\bar{a} \]

  \[ \text{Green stocks have negative alphas} \]

  \[ \text{Brown stocks have positive alphas} \]
Expected excess return on agent $i$’s portfolio:

$$E(\tilde{r}_i) = \mu_m - \delta_i \left( \frac{\bar{d} a^3 g' \Sigma^{-1} g}{>0} \right)$$

where $\delta_i \equiv d_i - \bar{d}$. Note:

- $\delta_i \uparrow \Rightarrow E(\tilde{r}_i) \downarrow$
- $\delta_i > 0 \Rightarrow E(\tilde{r}_i) < \mu_m$
- $\delta_i < 0 \Rightarrow E(\tilde{r}_i) > \mu_m$
Agent $i$’s equilibrium portfolio weights:

$$X_i = w_m + \frac{\delta_i}{a^2} \left( \Sigma^{-1} g \right)$$

\[\text{“ESG tilt”}\]

**Three-fund separation:**

1. Riskless asset
2. Market portfolio, $w_m$
3. “ESG portfolio”, $\Sigma^{-1} g$

- Agents with $\delta_i > 0$ (i.e., $d_i > \bar{d}$) tilt toward green assets
- Agents with $\delta_i < 0$ (i.e., $d_i < \bar{d}$) tilt toward brown assets
- Agents with $\delta_i = 0$ (i.e., $d_i = \bar{d}$) hold the market

No dispersion in ESG tastes $\Rightarrow$ everyone holds the market
Two-Factor Pricing with the ESG Portfolio

- Expected excess returns:
  \[ \mu = \mu_m \beta_m + \mu_g \beta_g, \]

  where \( \beta_g \) = loading on ESG portfolio return, \( \tilde{r}_g \)

- Excess returns obey the regression model
  \[ \tilde{r} = \beta_m \tilde{r}_m + \beta_g \tilde{r}_g + \tilde{\nu} \]

- CAPM alphas:
  \[ \alpha = \mu_g \beta_g \]
  \[ = -(\bar{d}/a)g \]

  [\( \alpha \) comes from omitted priced ESG risk factor]

  [\( \alpha \) comes from tastes, not aversion to ESG risk]
ESG Factor

- ESG factor: excess return on a position in the ESG portfolio
  \[ \tilde{f}_g = \left(\frac{1}{g_g}\right) \tilde{r}_g \]

- Two-factor model:
  \[ \tilde{r} = \beta_m \tilde{r}_m + g \tilde{f}_g + \tilde{\nu} \]
  \[ \mathbb{E}\left\{ \tilde{f}_g \right\} = -\bar{d}/a < 0 \]

- How to measure the ESG factor:
  1. Cross-sectional regression of returns on \( \beta_m \) and \( g \)
  2. Special case: long green, short brown
Strength of ESG concerns can change over time

- “Investor” channel: $\bar{d}$ shifts ($\Delta \bar{d}$)
- “Customer” channel: Demand for firms’ products shifts ($\tilde{z}_g$)
Strength of ESG concerns can change over time
  • “Investor” channel: $\Delta \bar{d}$ shifts
  • “Customer” channel: Demand for firms’ products shifts ($\tilde{z}_g$)

Green (brown) stocks perform better (worse) than expected if ESG concerns strengthen unexpectedly via either channel
Agent $i$’s utility:

$$\exp^{-A_i \tilde{w}_i - b'_i X_i - c_i \tilde{C}}$$

where \textbf{climate} $\tilde{C} \sim N(0, 1)$

- $c_i \geq 0 \Rightarrow$ Agents dislike low realizations of $\tilde{C}$
- Let $\bar{c} \equiv \int \omega_i c_i di$
Expected excess returns in equilibrium:

\[
\mu = \mu_m \beta_m - \frac{\bar{d}}{\bar{g}} g + \bar{c} \left(1 - \rho^2_{mC}\right) \psi
\]

where \(\psi\) = slopes on \(\tilde{C}\) in a regression of \(\tilde{r}\) on both \(\tilde{C}\) and \(\tilde{r}_M\)
Extension: Climate Risk (cont’d)

- Expected excess returns in equilibrium:

\[ \mu = \mu_m \beta_m - \frac{\bar{d}}{a} g + \bar{c} \left( 1 - \rho_{mC}^2 \right) \psi \]

where \( \psi = \text{slopes on } \tilde{C} \text{ in a regression of } \tilde{r} \text{ on both } \tilde{C} \text{ and } \tilde{r}_M \)

- **Greener stocks likely better hedge climate risk:** \( \text{Corr}(\psi_n, g_n) < 0 \)
  - If \( \psi_n = -\xi g_n \), where \( \xi > 0 \), then
    \[ \alpha_n = - \left[ \frac{\bar{d}}{a} + \bar{c} (1 - \rho_{mC}^2) \xi \right] g_n \]
  - **Greener stocks have lower alphas for two reasons:** tastes and risk
Social impact of firm $n$:

$$S_n \equiv g_n K_n$$

where $K_n$ is the firm’s operating capital.
Extension: Social Impact

- **Social impact** of firm $n$:

  \[ S_n \equiv g_n K_n \]

  where $K_n$ is the firm’s operating capital

- **Firm maximizes its market value** by choosing $\Delta K_n$ and $\Delta g_n$
  - Firm is endowed with capital $K_{0,n}$ and ESG characteristic $g_{0,n}$

- **Firm’s cash flows at time 1**: $\Pi_n K_n$ minus adjustment costs
  - Capital adjustment costs: $\frac{\kappa_n}{2} (\Delta K_n)^2$
  - ESG adjustment costs: $\frac{\omega_n}{2} (\Delta g_n)^2$
Green tastes have **positive social impact**:

\[ S_n(\bar{d}) > S_n(0) \]

- Green firms invest more (cost of capital ↓)
  - Brown firms invest less (cost of capital ↑)

- All firms choose to become **greener**
Conclusions

In our equilibrium model of sustainable investing,

- Greener assets have lower **expected returns**
  - Because agents have green tastes & green assets hedge **climate risk**
  - Green assets have negative alphas, brown assets have positive alphas

- Greener assets outperform when **ESG factor** performs well
  - ESG factor captures shifts in customers’ and investors’ tastes
  - **Two-factor pricing**: Market + ESG factor

- Sustainable investing leads to **positive social impact**
  - Green firms invest more, brown firms less
  - Firms become greener