The Impact of Impact Investing

Berk & van Binsbergen (working paper)

Env Climate discussion group S7

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Research goals

1. **How** divestment affects corporate strategy?
2. **Why** *(or whether)* would investors' choice to divest achieve the stated goal of reducing social costs in society?
   - transaction from one hand to another
   - two possible pathways for indirect effects
     - new owners to exercise right of control
     - stock price $\rightarrow$ cost of capital

The main channel of interest

- when socially conscious shareholder sells (dirty stocks):
  lower price $\rightarrow$ higher cost of capital (lower the number of positive NPV investment opportunities, lower growth rate)
- when socially conscious shareholders buy (clean stocks):
  (extra demand $\rightarrow$) higher price $\rightarrow$ lower cost of capital (higher growth rate)
- Socially desirable companies become a larger fraction of the economy at the expense of socially undesirable companies (?)

  $\Longleftarrow$ the divestment strategy results in a large enough change in the cost of capital to materially affect the firm's investment opportunity set

To evaluate the impact of divestiture initiatives by determining whether or not they have materially affected the cost of capital, and, if not, whether they are likely to do so in the future.

Outline

1. predict the impact of socially responsible investing on the cost of capital
   - demonstrate: a change in the cost of capital can be approximated by a simple formula
     f: fraction of economy made up by the companies that socially conscious investors target
     ρ: the correlation between these companies and the rest of the market
     MRP: the historical market risk premium

     $\Longrightarrow$ a divestment strategy will lead to a change in the cost of capital of
     $MRP \times (\frac{\text{socially conscious investor wealth}}{\text{rest of investor wealth}}) \times f \times (1-\rho)^2$
   - estimate the parameters with ESG mutual fund holdings
   - estimate the change in the cost of capital using the formula
2. show empirical data is consistent with this theoretical prediction
   study the effect of a firm either being included or excluded from the FTSE USA 4 Good Select Index (purely driven by changes in the ESG status of the firm)
3. Counterfactual: what it takes for a divestment strategy to successfully impact firm investment (1% change in the cost of capital)
4. Conclusion: divestiture has so little impact (because stocks are highly substitutable and socially costly stocks make up less than half of the economy)

Setup: homogeneous mean-variance investors & single-period CAPM

Investors:

- allocate portfolio by solving
$$\max \mathrm{E}[R_p] - k\sigma_p^2$$
where $R_p =$ portfolio return, $\sigma_p^2 =$ variance of this return, $k =$ investors' risk appetites
- endowed with a share of the market portfolio
- trade at the beginning of the period & consume stock dividends at the end of the period:
$\rightarrow D =$ cumulative dividend payment of all stocks
- price normalization: price of holding all stocks $= 1$
$\rightarrow$ return of the market portfolio $R = D - 1$

Two market portfolios: clean and dirty

- $D_E(D_D)$: cumulative dividend paid to all investors holding shares in the clean (dirty) portfolio
$D = D_E + D_D$
- $V_E(V_D)$: Value of the clean (dirty) portfolio at the beginning of the period
$1 = V_E + V_D$ *(i.e., fraction of market value)*
- $R_E = \frac{D_E}{V_E} - 1$ & $R_D = \frac{D_D}{V_D} - 1$

Setup 2

Important moments:

- Expectation: $\bar{R} = \mathrm{E}(R) = \bar{D_E} + \bar{D_D} - 1$
- $\sigma_D^2 = var(D_D)$, $\sigma_E^2 = var(D_E)$
- $\sigma_{ED} = cov(D_E, D_D)$
- $\sigma^2 = var(D) = var(D_D + D_E) = \sigma_D^2 + \sigma_E^2 + 2\sigma_{ED} = var(R)$
- $\rho = \frac{\sigma_{ED}}{\sigma_D \sigma_E} = \frac{cov(R_E, R_D)}{std(R_D)\ std(R_E)}$

(Price normalization $\Rightarrow$ cashflow variance (/correlation) = return variance (/correlation)

Last assumption: a risk-free asset in zero net supply with return r (endogenous)

Equilibrium with ESG investors (1)

(Recap of modern portfolio theory: market portfolio,efficient portfolio, tangency portfolio)

ESG investors: only hold clean stocks
In equilibrium: e fraction of the clean portfolio subject to budget constraint

$$\underbrace{\gamma}_{\text{total wealth of ESG investors}} = \underbrace{V_E}_{\text{value (price) of the clean portfolio}} e + \underbrace{b}_{\text{risk-free asset investment}} \implies e = \frac{\gamma - b}{V_E}$$

(next, determining asset prices $\leftarrow$ depends on the portfolio held by the other investors)

Other investors: hold both dirty and clean stocks
Total wealth invested in risky assets $= V_D + (1-e)V_E$, and $-b$ in risk-less assets,
gives portfolio weights in the dirty and clean portfolios respectively:

$$w_D = \frac{V_D}{V_D + (1-e)V_E} = \frac{V_D}{1-\gamma+b}$$
$$w_E = \frac{(1-e)V_E}{V_D + (1-e)V_E} = \frac{V_E - \gamma + b}{1-\gamma+b}$$

Equilibrium with ESG investors (2)

This portfolio held by other investors, i.e., the mean-variance efficient portfolio, is the tangency portfolio on the unconstrained mean-variance efficient frontier of risky assets, with return $R_{mv} = w_D R_D + w_E R_E = \frac{D_D + D_E}{1-\gamma+b} - 1 - \frac{D_E}{V_E}(\frac{\gamma - b}{1-\gamma+b}) = \frac{D_D + (1-e)D_E}{1-\gamma+b} - 1.$

The equilibrium returns in this economy: $(\Sigma_E = \frac{\sigma_E^2 + \sigma_{ED}}{\sigma^2}, \Sigma_D = \frac{\sigma_D^2 + \sigma_{ED}}{\sigma^2},\ \Gamma = \frac{\gamma}{1-\gamma}(1-\rho^2)\frac{\sigma_D^2}{\sigma^2})$

$$\beta_E = \frac{1-\gamma+b}{V_E}\left(\frac{{}_E\sigma^2 - e\sigma_E^2}{\sigma^2 - 2e\Sigma_E\sigma^2 + e^2\sigma_E^2}\right), \qquad \beta_D = \frac{1-\gamma+b}{V_D}\left(\frac{{}_D\sigma^2 - e\rho\sigma_E\sigma_D}{\sigma^2 - 2e\Sigma_E\sigma^2 + e^2\sigma_E^2}\right)$$

$$V_E = \frac{\bar{D}_E - 2k\Sigma_E\sigma^2}{\bar{D}_E + \bar{D}_D - 2k\sigma^2(1+\Gamma)}, \qquad V_D = \frac{\bar{D}_D - 2k\sigma^2(\Sigma_D + \Gamma)}{\bar{D}_E + \bar{D}_D - 2k\sigma^2(1+\Gamma)}$$

Using these, the expected returns can be written as a function of the market betas of the two portfolios: $\beta_D^m = \frac{\Sigma_D}{V_D}$ and $\beta_E^m = \frac{\Sigma_E}{V_E}$:

$$\bar{R}_E = \bar{R} + 2k\sigma^2(\beta_E^m - (1+\Gamma)), \qquad \bar{R}_D = \bar{R} + 2k\sigma^2(\beta_D^m - (1 - \Gamma\frac{V_E}{V_D}))$$

$$\implies \Delta\bar{R} = \bar{R}_E - \bar{R}_D = 2k\delta^2(\beta_D^m - \beta_E^m + \frac{\Gamma}{V_D})$$

Equilibrium without ESG investors

Standard CAPM: all investors hold the market portfolio (mean-variance efficient)

$$V_E^* = \frac{\bar{D}_E - 2k\Sigma_E\sigma^2}{\bar{D}_E + \bar{D}_D - 2k\sigma^2}, \qquad V_D^* = \frac{\bar{D}_D - 2k\sigma^2(\Sigma_D + \Gamma)}{\bar{D}_E + \bar{D}_D - 2k\sigma^2}$$

$$\bar{R}_E^* = \bar{R} - 2k\sigma^2(1 - \frac{\Sigma_E}{V_E^*})), \qquad \bar{R}_D^* = \bar{R} - 2k\sigma^2(1 - \frac{\Sigma_D}{V_D^*}))$$

The difference in the cost of capital between clean and dirty stocks is

$$\Delta\bar{R}^* = \bar{R}_D^* - \bar{R}_E^* = 2k\sigma^2(\beta_D^* - \beta_E^*)$$

where $\beta_D^m = \frac{\Sigma_D}{V_D^*}$ and $\beta_E^m = \frac{\Sigma_E}{V_E^*}$ are the market betas of the portfolios.

ESG investors' effect on the cost of capital (1)

Key assumption: (1) all investors are initially identical and hold the market portfolio → (2) some of them then acquire ESG preferences and trade to the ESG equilibrium.

The **initial (1)** difference in the cost of capital between clean and dirty stocks:

$$\Delta\bar{R}^* = \bar{R}^*_D - \bar{R}^*_E = 2k\sigma^2(\beta^*_D - \beta^*_E), \tag{1}$$

and the **later (2)** difference after some investors become ESG investors:

$$\Delta\bar{R} = \bar{R}_E - \bar{R}_D = 2k\delta^2(\beta^m_D - \beta^m_E + \frac{\Gamma}{V_D}). \tag{2}$$

The effect of ESG invesotrs on the cost of capital is thus

$$\begin{aligned}\Delta\bar{R} - \Delta\bar{R}^* &\approx (\text{a second order difference}+)\ 2k\sigma^2\frac{\Gamma}{V_D} \\ &= 2k\sigma^2 V_D\frac{\gamma}{1-\gamma}(1-\rho^2)\frac{\sigma^2_{R_D}}{\sigma^2} \quad (\text{last term} = \frac{var(R_D)}{var(R)}) \\ &\approx 2k\sigma^2 V_D\frac{\gamma}{1-\gamma}(1-\rho^2) \quad \text{with the term above assumed to be approximately 1}\end{aligned}$$

ESG investors' effect on the cost of capital (2)

In a standard CAPM equilibrium, $2k\sigma^2$ equals the market risk premium (i.e., a measure of investors' risk appetite)

Assuming that risk preferences have not changed over time $\longrightarrow$ set $2k\sigma^2$ equal to the historical market risk premium (MRP).

$$(1)-(2) \Longrightarrow \quad \Delta\bar{R}-\Delta\bar{R}^* \approx 2k\sigma^2 V_D \frac{\gamma}{1-\gamma}(1-\rho^2) \tag{3}$$

$$\approx MRP\ V_D \frac{\gamma}{1-\gamma}(1-\rho^2) \tag{4}$$

Interpretation of this first-order approximation

Three conditions for impact investing to materially change prices

- Dirty stocks cannot be easily substituted for clean stocks (measured by $1-\rho^2$)
- Impact investors must make up a significant fraction of investors ($\frac{\gamma}{1-\gamma}$ measures the influence of ESG investors)
- (Given that non-ESG investors have limited wealth and must hold the dirty stocks in equilibrium) the greater the fraction of the economy that dirty stocks make up, the greater the price impact (measured by V_D).

Impact investing in the United States

Use the approximation to infer to what extent impact investing has altered the cost of capital in the US:

- Identify the clean portfolio using the Vanguard FTSE Social Index Fund (VFTSX) which replicates the FTSE USA 4 Good Select Index
- Assume that the dirty portfolio consist of only dirty stocks in their normalized market weights: (dec 2015 - dec 2020) $V_D = 27\%$
- the correlation between the clean (FTSE USA 4 Good Select) and the dirty (the other stocks in FTSE USA) portfolio over this 5-year period is measured: $\rho = 0.93$
- use a historical market risk premium of 6%
- fraction of wealth controlled by ESG investors: in 2021 less than 1% of mutual fund wealth invested in ESG mutual funds $\rightarrow$ take 2% for possible misclassification error.

Then the effect on the cost of capital is about 0.44 b.p.; this difference cannot meaningfully affect the capital budgeting decision, let alone real investment decision making.

Altering some assumptions: estimates range between 0.35 to 10.6 b.p. (Even the clearly overestimated result is till too small under rather lax assumptions)

Impact investing in the United States: how many ESG investors needed?

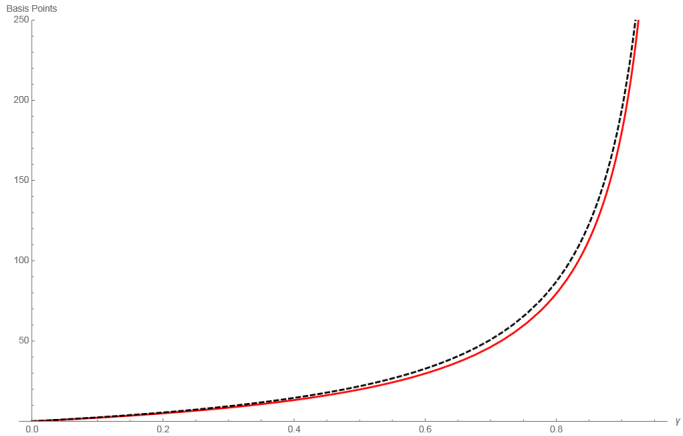

Figure 2: **Effect on the Cost of Capital of Introducing ESG Investors into the Economy:** The curves plot the change in the cost of capital, $\Delta\bar{R} - \Delta\bar{R}^*$, as a function of the fraction of wealth ESG investors comprise. The red curve is the exact effect on the cost of capital, that is, (41). The dashed black curve is the first order approximation, that is, (10).

Key implications

- To impact the cost of capital by at least 1% requires at leat 48% of investors to hold only clean stocks.
- if a large investor decided to divest all dirty stocks, say Blackrock, the fraction of clean shareholders would rise from 2% to at most 19%, and the impact is just 4.6 b.p.
- The first order approximation is very accurate at current values of the parameters $\rightarrow$ the fraction of ESG investors, the fraction of dirty stocks,the risk premium demanded by investors and the correlation between clean and dirty stocks are the primary determinants of the impact od divestiture on the cost of capital.
- To first order, the last three variables are not under the control of ESG investors!! Under current estimation, the product of the three estimates gives 0.0021 only.

The low effectiveness of impact investing mainly comes from two factors:

1. high correlation: clean and dirty stocks are close substitutes
2. most stocks are clean: to induce non-ESG investors to hold dirty stocks does not require much price adjustment

Empirical evaluation

- Using index inclusion changes (FTSE USA 4 Good Select / Index): when ESG investors react to the change in status, we should observe a change in the cost of capital.
  I_{it}: 1 for inclusion, -1 for exclusion, 0 for no change.
- Measuring the concurrent change in the firm's price because average realized returns are a noisy measure of the expected return. If the actions of investors actually do materially affect the cost of capital, it would lead to an even larger price impact.
- regression specification:

$$\underbrace{R_{it}}_{\text{monthly stock return incl. dividend}} = c + \gamma I_{it} + \delta \Delta I_{it} + \gamma_{4G} I_{it}^{4G} + \delta_{4G} \Delta I_{it}^{4G} + \varepsilon_{it}$$

Negative γ_{4G}: the average return difference between clean and dirty FTSE USA stocks $\rightarrow$ the impact of ESG investors on the cost of capital of the average stock in the index

Positive δ_{4G}: the instantaneous price reaction of an inclusion or exclusion event $\rightarrow$ the capitalized value of the implied change in the cost of capital

Test result

	(1) 4Good	(2) 4Good Select
I_{it}	-0.0010	-0.0009
	(-0.64)	(-0.50)
$I_{it}^{4G(Select)}$	0.0004	0.0001
	(0.27)	(0.02)
ΔI_{it}	0.0131	0.0117
	(1.55)	(1.34)
$\Delta I_{it}^{4G(Select)}$	0.0021	0.0048
	(0.38)	(0.43)
Constant	0.0098***	0.0101***
	(2.60)	(2.65)
Observations	1376792	1365666
R^2	0.00	0.00

t-statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The end!