

# RESPONSIBLE INVESTING: THE ESG-EFFICIENT FRONTIER

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# PRESENTATION

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# Responsible Investing: The ESG-Efficient Frontier

**Private and Confidential**

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# Motivation

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## ESG investing is becoming a large part of global markets

- Principles for Responsible Investments (PRI): signatories manage close to \$90 trillion in assets
- Cf. global equities about \$85 trillion, global bonds about \$100 trillion (SIFMA Fact Book 2018)

## Questions:

- How to invest using ESG information?
- Does ESG investing raise or lower returns?

## Heavily debated issue:

- Some believe ESG must necessarily *lower* expected returns
- ESG proponents believe that ESG investing must *raise* returns

## What we do:

- Theory and empirical evidence



Source: Sifma Fact Book, 2018. Bloomberg reports on 2/8/2019 that Europe alone has “some \$12 trillion committed to sustainable investing”. The Global Sustainable Investment Review 2018 reports over \$30 trillion invested with explicit ESG goals as of the beginning of 2018. The 2017/18 annual report of the Principles for Responsible Investments (PRI), a proponent of ESG supported by the United Nations, reports that its signatories manage close to \$90 trillion in assets.  
References: The price of sin: The effects of social norms on markets (Hong, Kacperczyk, 2009)

# Main results

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New way to solve Markowitz portfolio problem when ESG is both information and affects preferences

- Investor's problem characterized by **ESG-efficient frontier**

Equilibrium: **ESG-adjusted CAPM**

- ESG *information*: may or may not raise expected returns
- ESG *preferences*: lower expected returns

Empirical findings

- Empirical ESG-efficient frontier **quantifies the costs and benefits of ESG investing**
  - ESG information can significantly raise the ESG-SR frontier
  - Further increasing the ESG score comes at modest cost
- Theory helps reconcile empirical evidence



Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# Model: Markowitz Meets Sustainability Goals

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## Assets:

- Risk-free asset with return  $r^f$
- $n$  risky assets with excess returns  $r = (r^1, \dots, r^n)'$  and ESG scores  $s = (s^1, \dots, s^n)'$

## Investors

- **Type-U (ESG-unaware):** Use unconditional excess returns  $E(r)$  with risk given by  $\text{var}(r)$
- **Type-A (ESG-aware):** use ESG scores to update their views,  $\mu = E(r|s)$ , and  $\Sigma = \text{var}(r|s)$
- **Type-M (ESG-motivated):** use ESG information and also have preferences for high ESG

## Portfolio of type-M investor

- Investor M starts with a wealth of  $W_0^M$
- Chooses a portfolio of risky assets,  $x = (x^1, \dots, x^n)'$ , where  $x^i W_0^M$  value of position in security  $i$ .



# Markowitz's Portfolio Problem with ESG

The investor's future wealth is

$$W = W_0^M(1 + r^f + x'r)$$

Average ESG score

$$\bar{s} = \frac{x's}{x'1}$$

Utility of type-M investor:

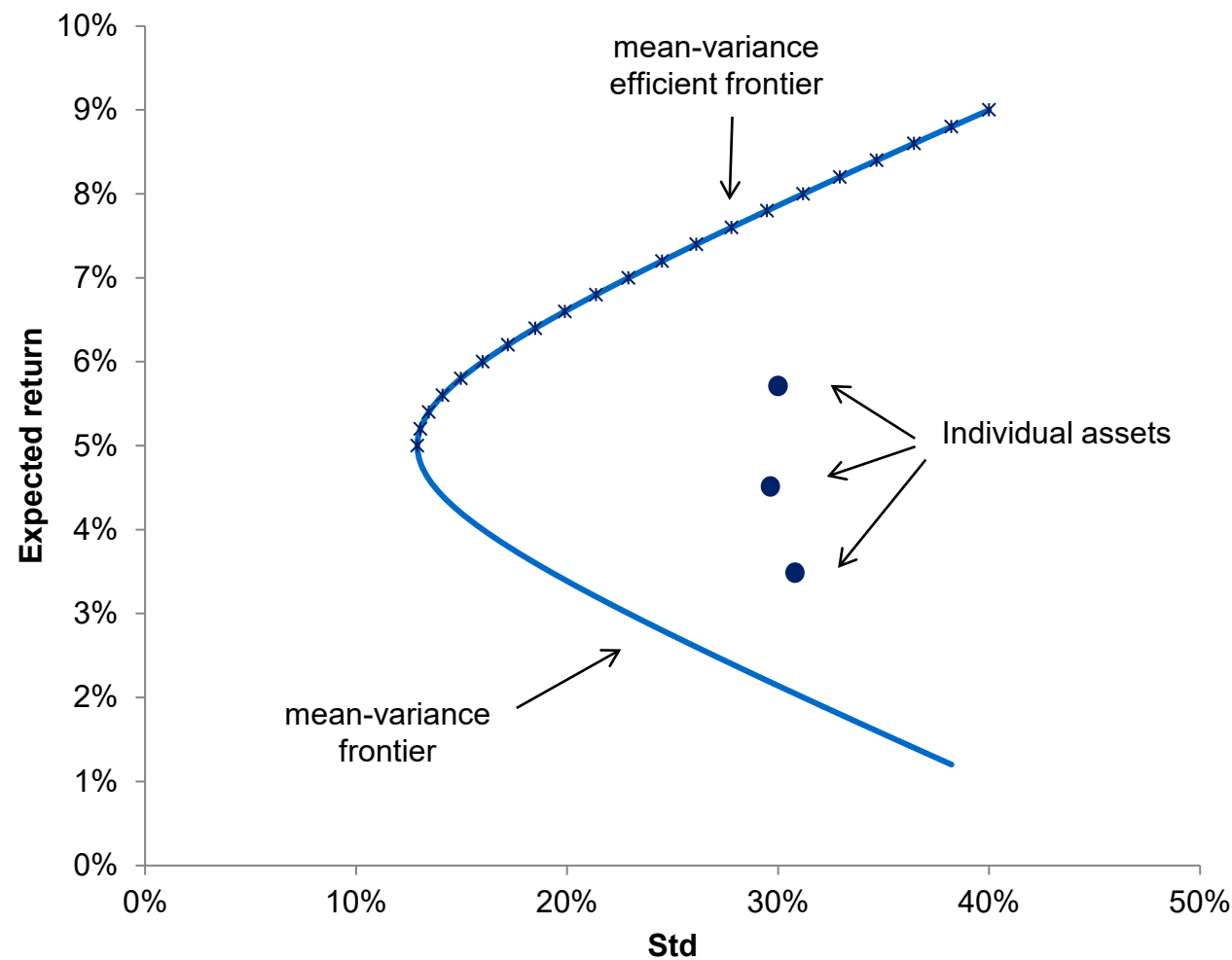
- mean-variance with absolute risk aversion  $\bar{\gamma}$  and relative risk aversion  $\gamma = \bar{\gamma}W_0^M$
- ESG preference function  $f$

$$\begin{aligned} U &= E(W|s) - \frac{\bar{\gamma}}{2} \text{Var}(W|s) + W_0^M f(\bar{s}) \\ &= W_0^M(1 + r^f + x'\mu) - \frac{\bar{\gamma}}{2} (W_0^M)^2 x'\Sigma x + W_0^M f\left(\frac{x's}{x'1}\right) \\ &= W_0^M \left( 1 + r^f + x'\mu - \frac{\gamma}{2} x'\Sigma x + f\left(\frac{x's}{x'1}\right) \right) \end{aligned}$$

Objective function

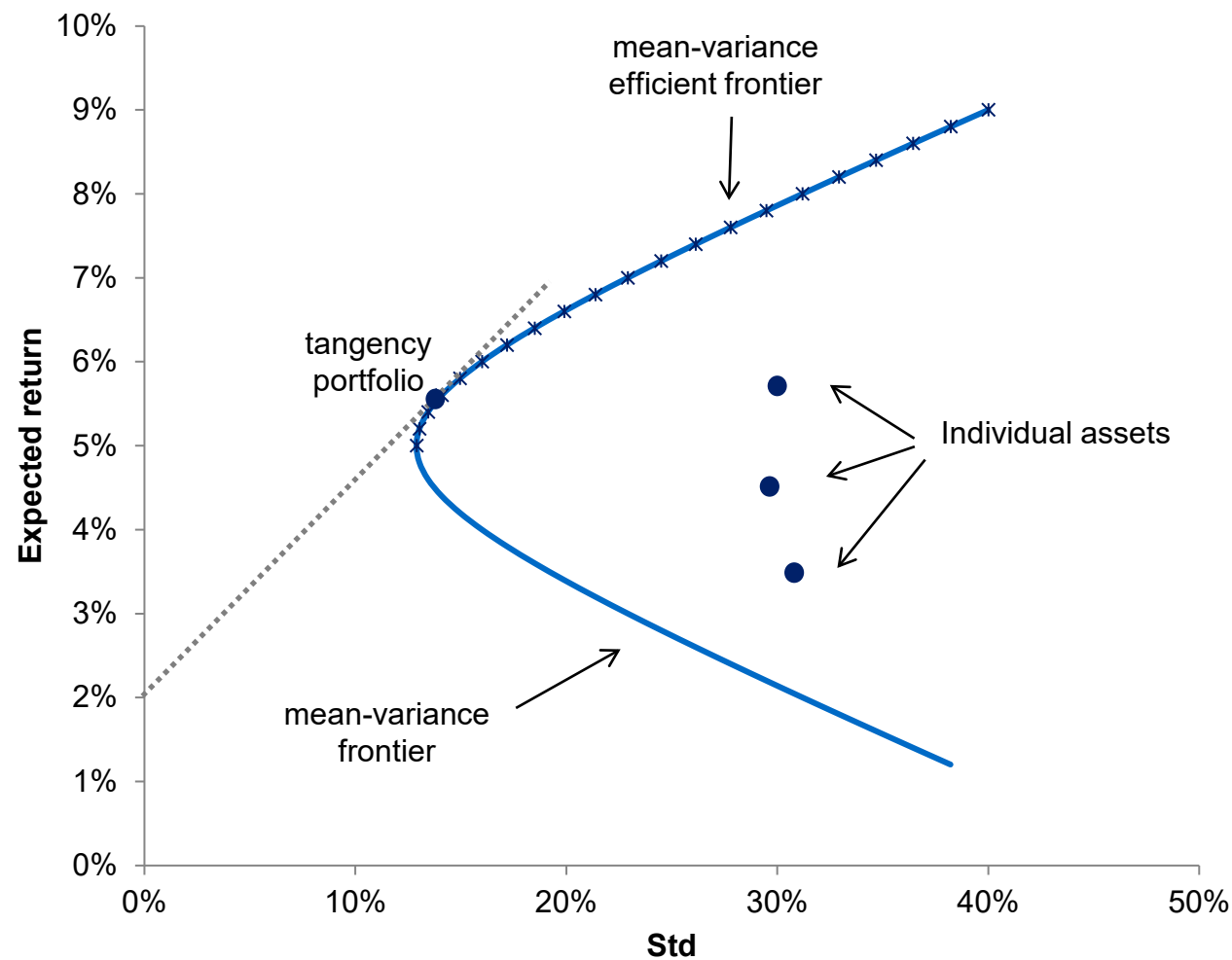


# Standard Mean-Variance Efficient Frontier



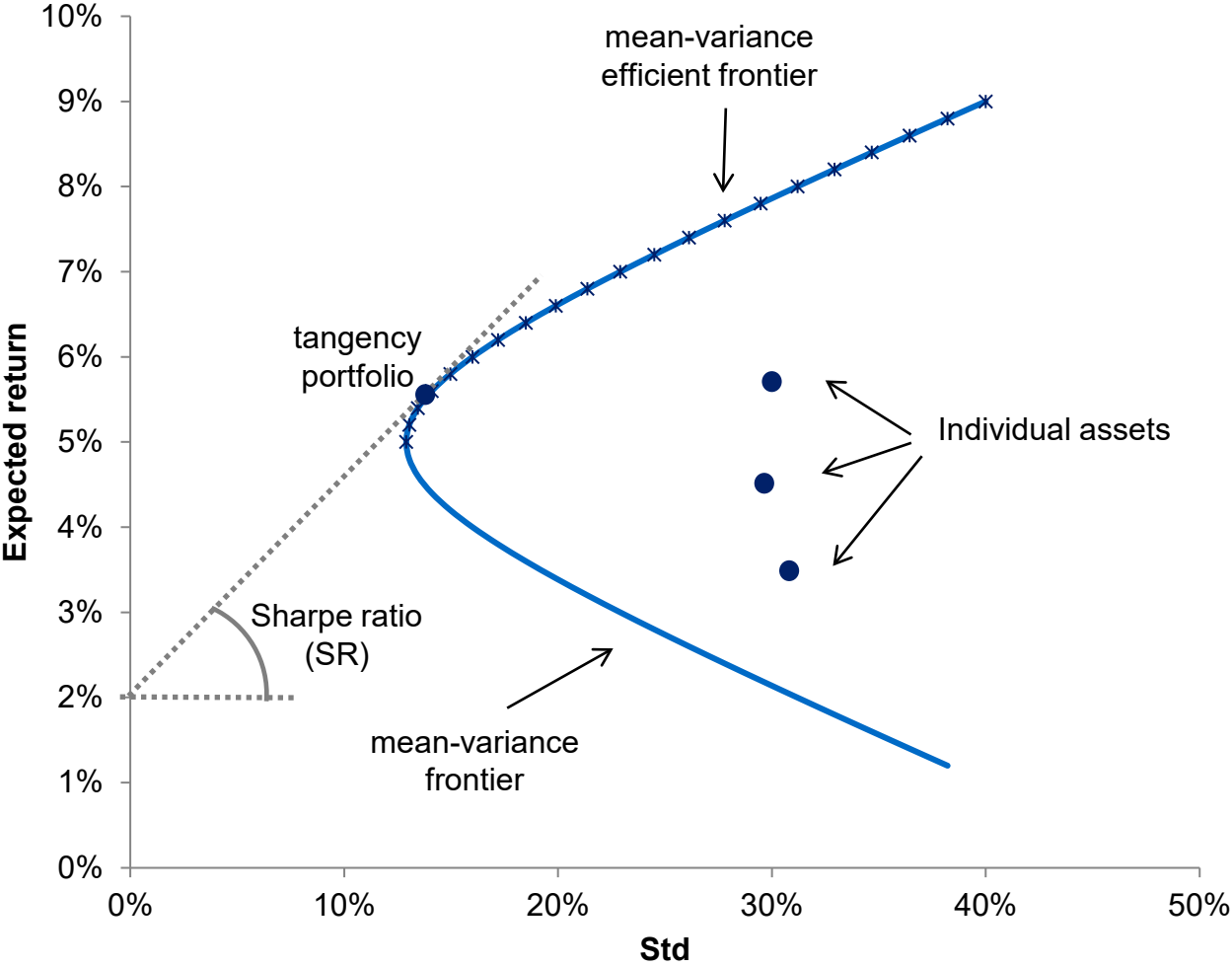
Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. For further details please refer to appendix description for Figure 1. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# Standard Mean-Variance Efficient Frontier



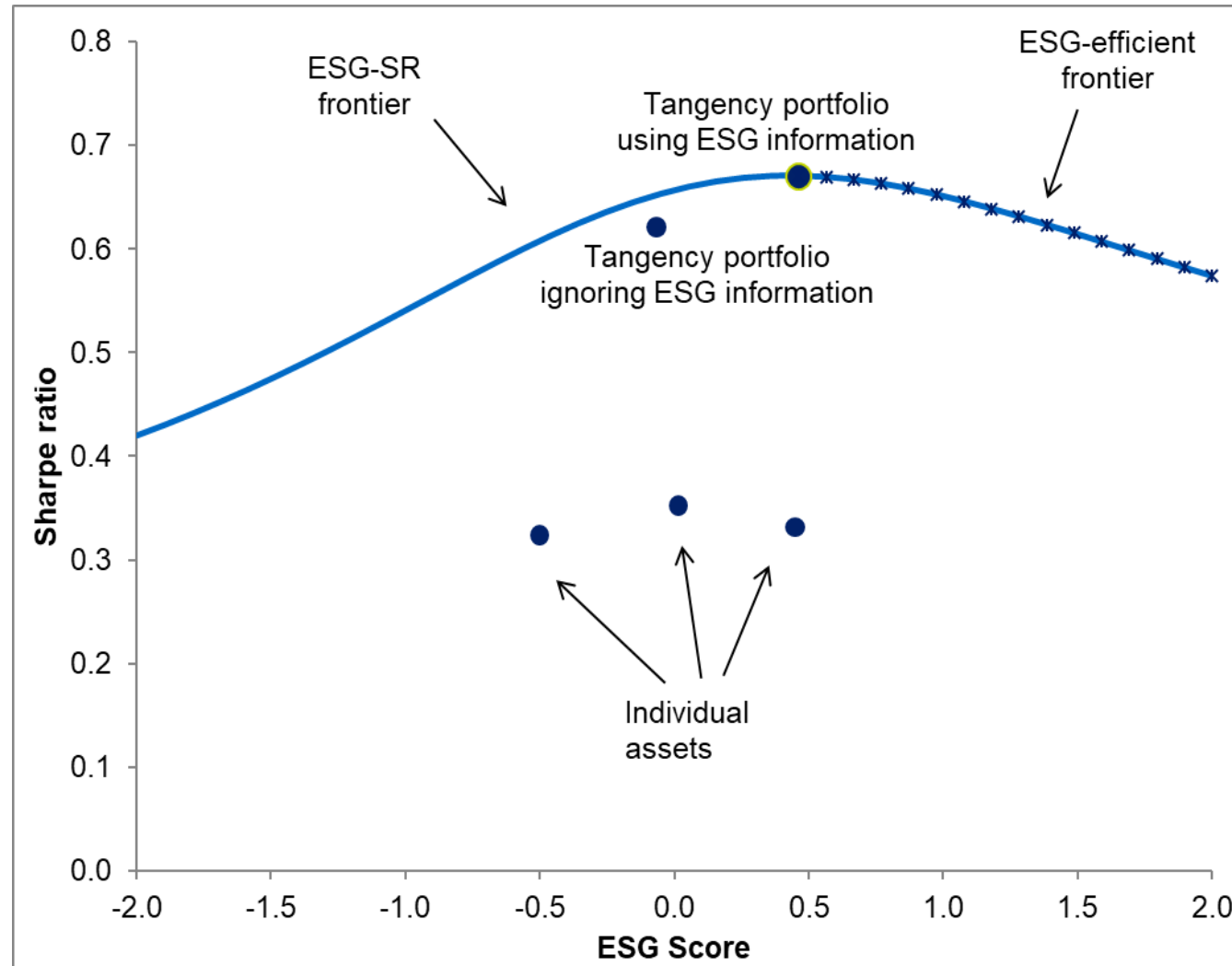
Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. For further details please refer to appendix description for Figure 1. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# Standard Mean-Variance Efficient Frontier



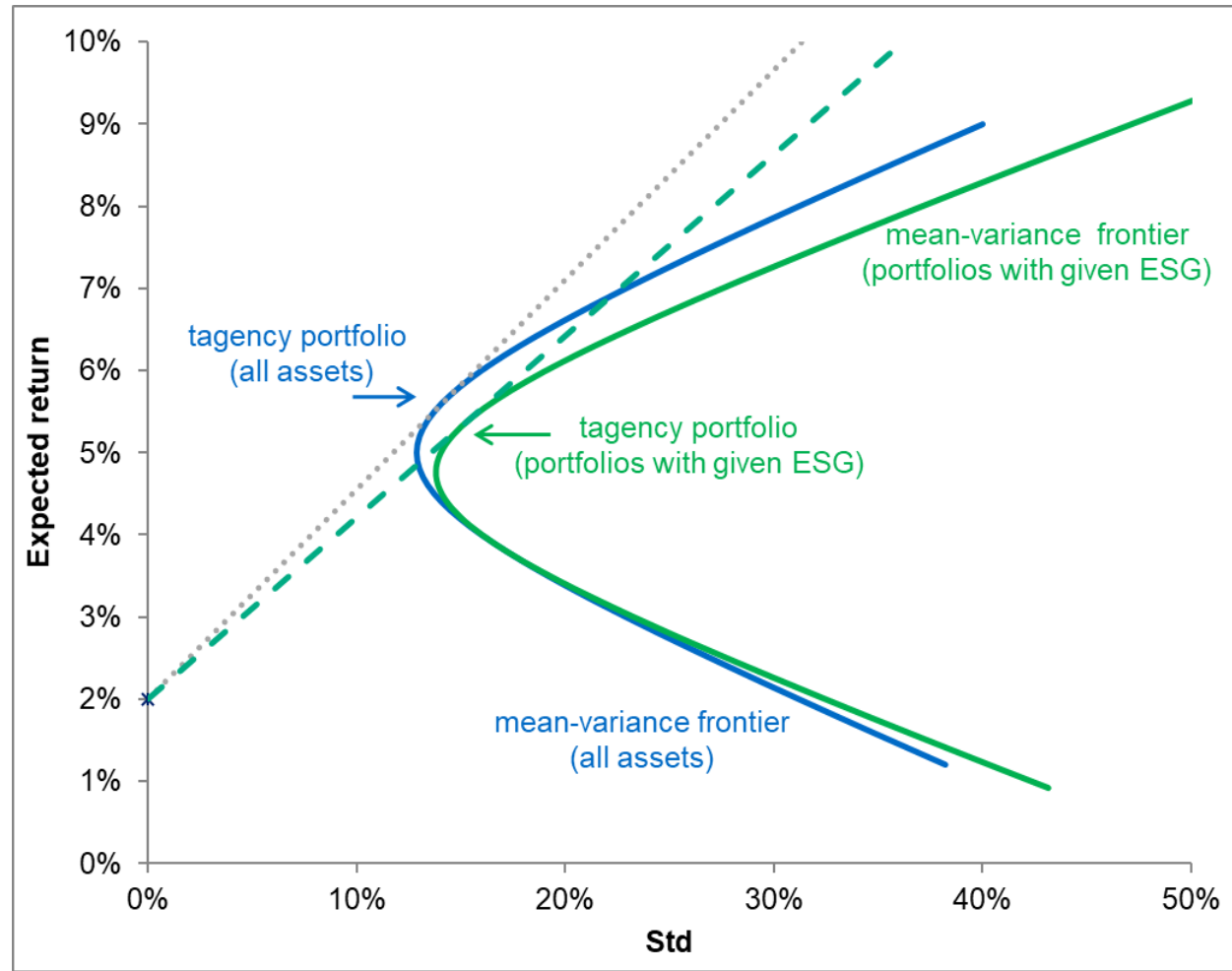
Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. For further details please refer to appendix description for Figure 1. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# ESG-Efficient Frontier



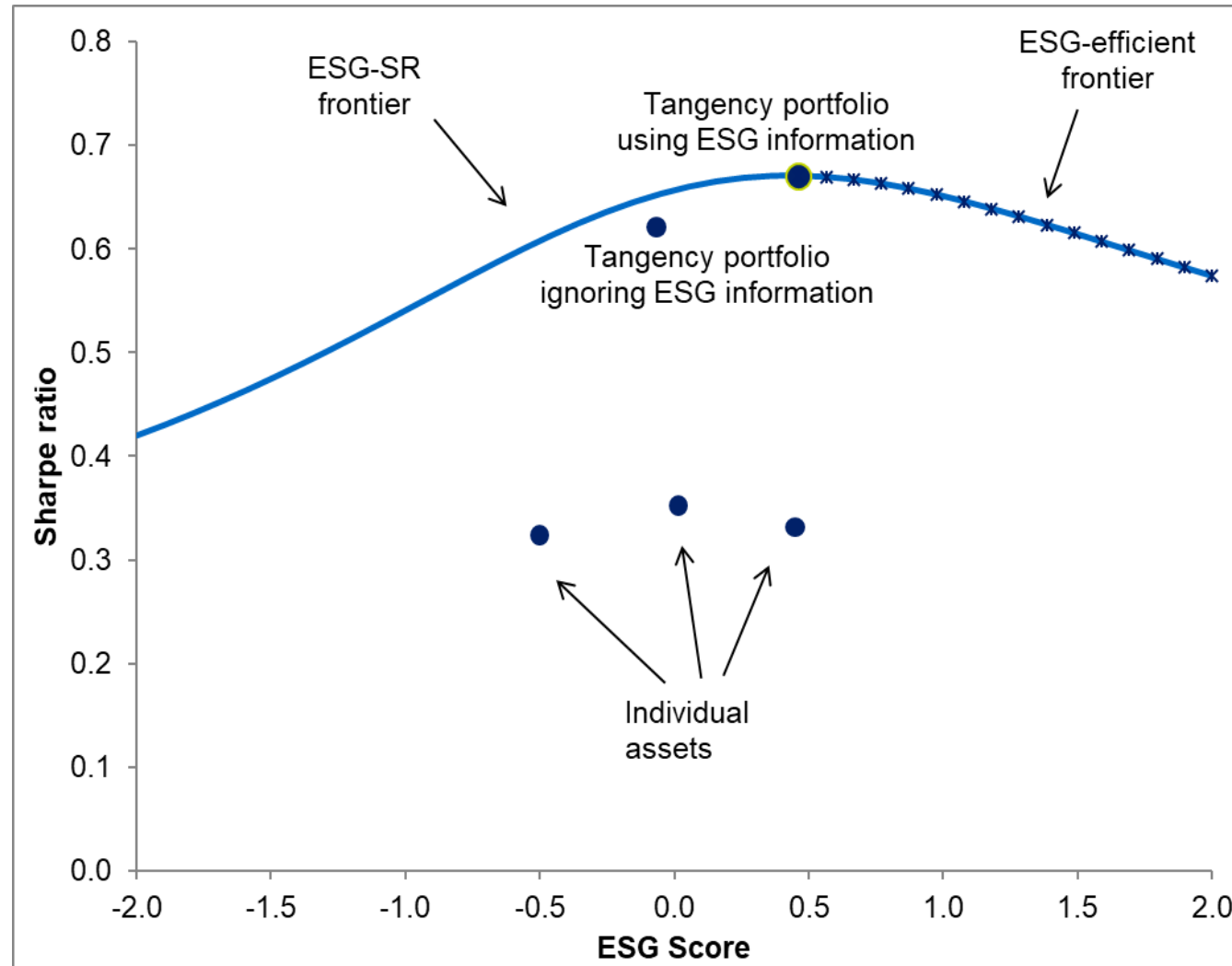
Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. For further details please refer to appendix description for Figure 1. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# ESG-Efficient Frontier: Link to Standard Mean-Std Frontier



Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. For further details please refer to appendix description for Figure 1. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# ESG-Efficient Frontier



Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. For further details please refer to appendix description for Figure 1. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# ESG-SR Frontier

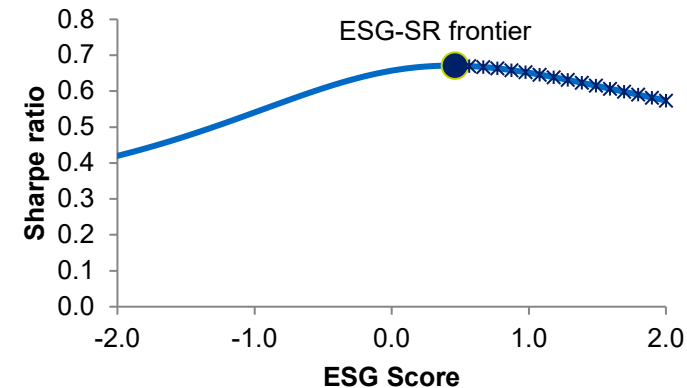
**Proposition 1 (ESG-SR Trade-off).** *The investor should choose her average ESG score  $\bar{s}$  to maximize :*

$$\max_{\bar{s}} \left[ \frac{(SR(\bar{s}))^2}{2\gamma} + f(\bar{s}) \right]$$

**Proposition 2 (ESG-SR Frontier).** *The maximum Sharpe ratio,  $SR(\bar{s})$ , that can be achieved with an ESG score of  $\bar{s}$  is*

$$SR(\bar{s}) = \sqrt{c_{\mu\mu} - \frac{(c_{s\mu} - \bar{s}c_{1\mu})^2}{c_{ss} - 2\bar{s}c_{1s} + \bar{s}^2c_{11}}}$$

where  $c_{ab} := a'\Sigma^{-1}b \in \mathbb{R}$  for any vectors  $a, b \in \mathbb{R}^n$



Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. For further details please refer to appendix description for Figure 1. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# Four-Fund Separation

**Proposition 3 (Four-fund separation).** Given an average ESG score  $\bar{s}$ , the optimal portfolio is

$$x = \frac{1}{\gamma} \Sigma^{-1} (\mu + \pi(s - 1\bar{s}))$$

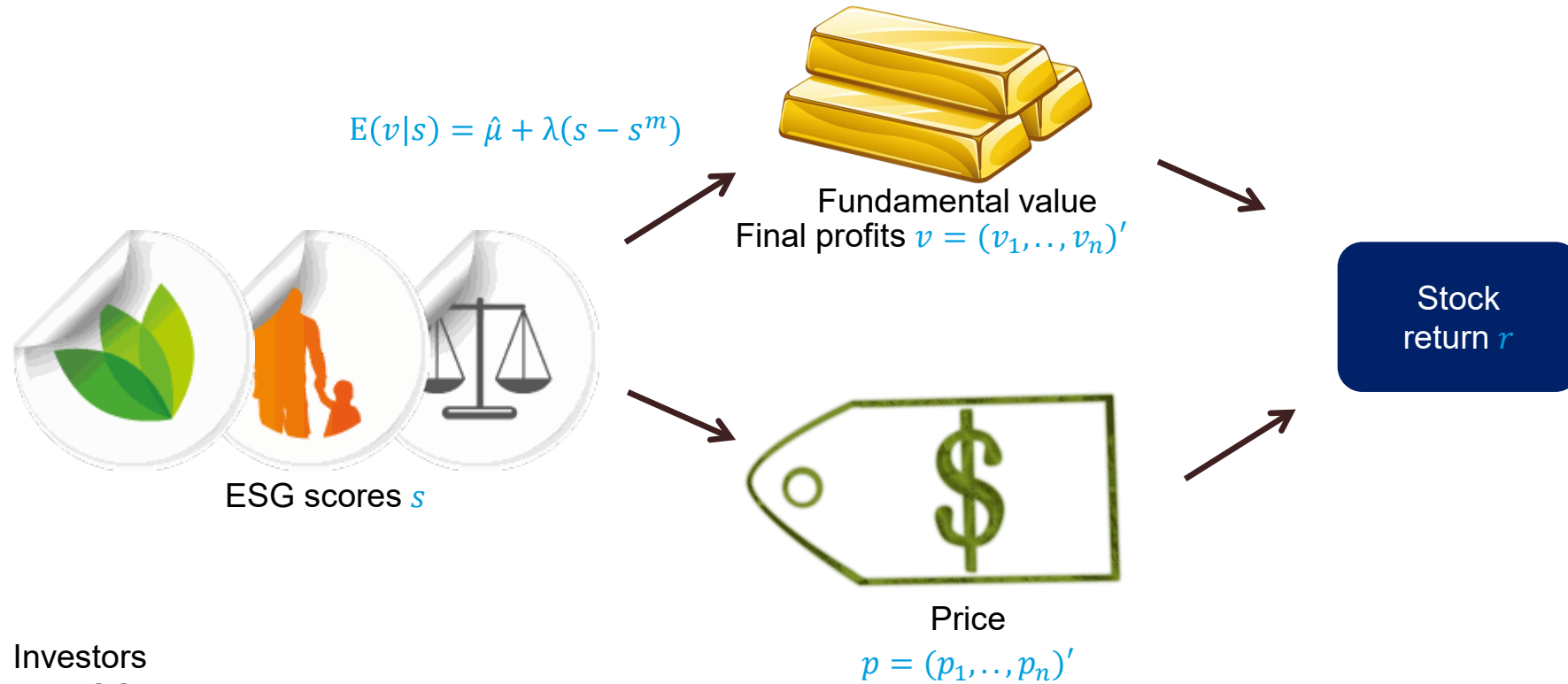
where  $\pi = \frac{c_{1\mu}\bar{s} - c_{s\mu}}{c_{ss} - 2c_{1s}\bar{s} + c_{11}\bar{s}^2}$ . The optimal portfolio is therefore a combination of

1. the risk-free asset
2. the tangency portfolio,  $\Sigma^{-1}\mu$
3. the minimum-variance portfolio,  $\Sigma^{-1}1$
4. the “ESG-tangency portfolio,”  $\Sigma^{-1}s$ .

- Can be seen as a theoretical foundation for “ESG-integration”. ESG matters in two ways:
  - ESG preferences leads investors to hold the ESG-tangency portfolio
  - ESG scores can affect conditional expected risk and return,  $\Sigma$  and  $\mu$



# How ESG Affects Stock Prices and Returns



## Investors

- ESG-unaware: use  $\hat{\mu} = E(v)$
- ESG-aware: use ESG scores,  $\bar{\mu} = E(v|s)$
- ESG-motivated: ESG information+preferences

# ESG and Firm Profits

$$E(v|s) = \hat{\mu} + \lambda(s - s^m)$$

ESG and Firm Profits

$$E(v|s) = \hat{\mu} + \lambda(s - s^m)$$



## Environmental

- Reducing waste is economical
- Consumers will pay more for responsible products
- Reduces legal and other risks



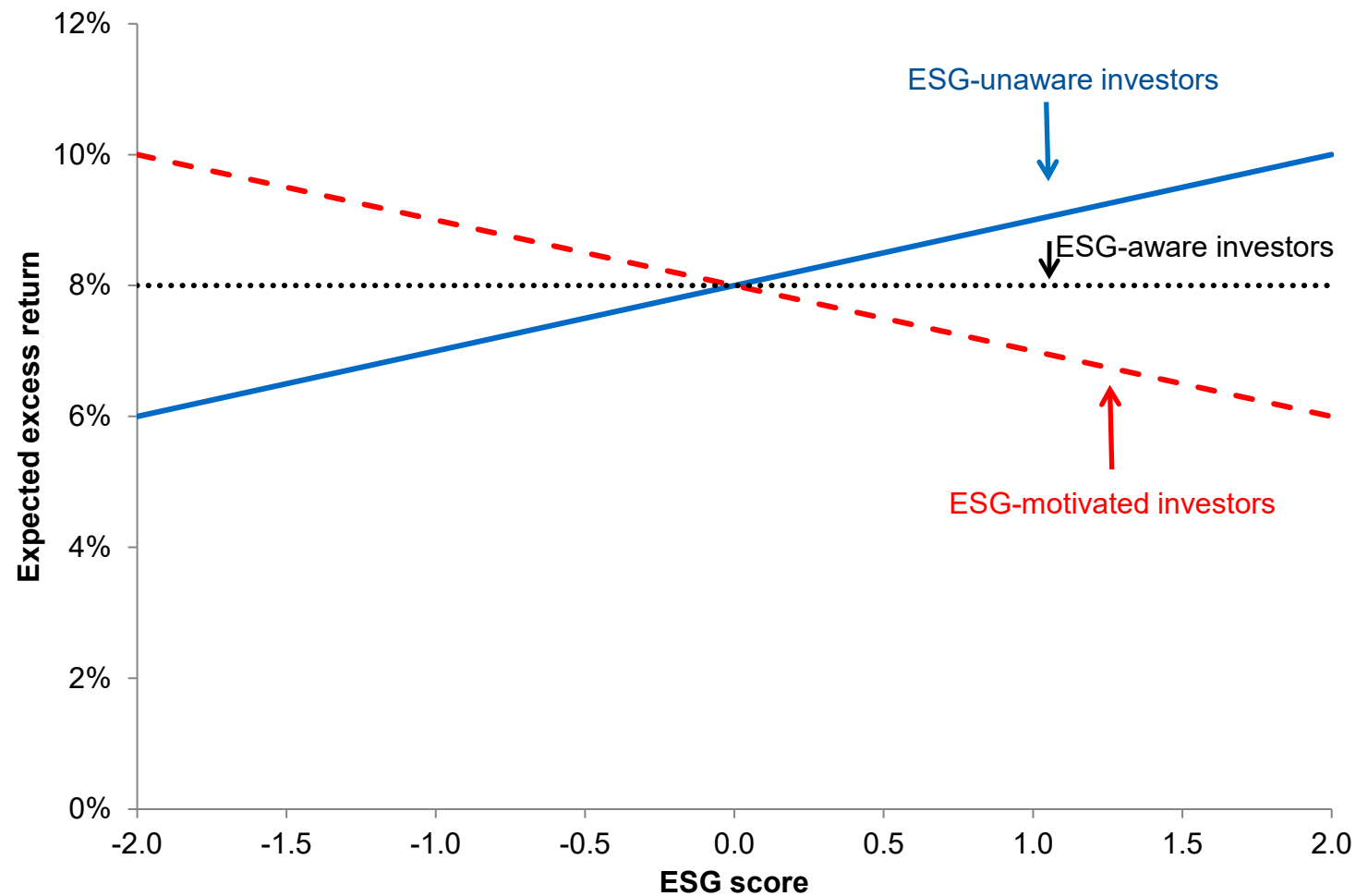
## Social

- Good working conditions make employees more productive and attracts talent
- Firms who don't discriminate attract more diverse talent (Becker 1957)
- Stocks with higher employee satisfaction perform better (Edmans 2011)

## Governance

- Well governed firms perform better
- Accruals: Sloan (1996), Richardson, Sloan, Soliman, and Tuna (2006)
- Further evidence: Gompers, Ishii, and Metrick (2003)

# ESG-Adjusted CAPM



Source: AQR. Pedersen, Fitzgibbons, Pomorski, “The ESG-Efficient Frontier”, 2019. For further details please refer to appendix description for Figure 2. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# Empirical ESG Measures

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## **E. Environmental: measured as CO2 (negated)**

- Carbon intensity defined as the ratio of carbon emissions in tons over sales in millions of dollars
- Use the sum of “scope 1 carbon emissions” (a firm’s direct emissions, e.g., from the firm’s own fossil fuel usage) and “scope 2 carbon emissions” (indirect emissions from the use of electricity), January 2009 through March 2019.

## **S. Social: measured as non-sin stocks**

- Alcohol, tobacco, and gaming, defined as in Hong and Kacperczyk (2009), January 1963 through March 2019.

## **G. Governance: measured using accruals (negated)**

- Seen as measure of governance (the “G” pillar of ESG)
- Can be computed based on accounting information, January 1963 through March 2019

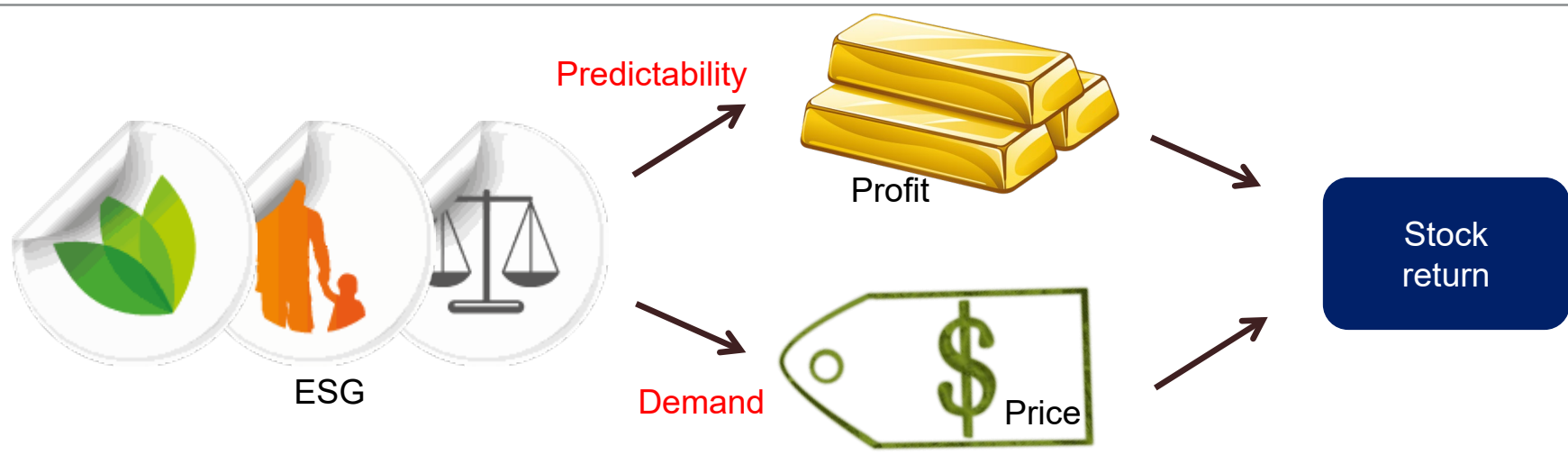
## **ESG. Overall ESG: measured as the overall MSCI ESG score**

- One of the most widely used ESG scores by institutional investors, January 2007 through March 2019



# Summary of Empirical Findings on Valuation and Returns

## ESG Measures Differ



	Strong demand	Weak demand
Strongly predicts fundamentals		Governance (low accruals) → Cheap and high return
Weak predictability	MSCI ESG, low-CO2 → expensive? Non-sin → lower return than sin(?)	



Source: AQR. Pedersen, Fitzgibbons, Pomorski, “The ESG-Efficient Frontier”, 2019. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures. The use of the logos and pictures is for informational purposes only and is not authorized by, sponsored by or associated with the trademark owners.

# Does ESG Predict Firm Profits?

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	RNOA (t+12)							
E (low CO2)	0.006*** (4.91)	0.006*** (7.34)						
S (non-sin)			-0.008* (-1.94)	-0.006*** (-2.88)				
G (low accruals)					0.208*** (23.26)	0.193*** (28.64)		
ESG (MSCI)							0.0001 (0.15)	0.0001 (0.24)
Beta	-0.068*** (-17.90)	-0.068*** (-10.24)	-0.064*** (-33.77)	-0.067*** (-20.69)	-0.060*** (-31.79)	-0.062*** (-19.43)	-0.052*** (-11.62)	-0.040*** (-4.40)
Ln market cap	0.011*** (12.45)	0.011*** (23.91)	0.015*** (32.71)	0.015*** (26.55)	0.014*** (30.14)	0.014*** (26.85)	0.008*** (6.54)	0.006*** (4.89)
Ln(P/B)	0.014*** (6.72)	0.015*** (6.98)	0.027*** (22.59)	0.028*** (22.01)	0.028*** (23.73)	0.028*** (22.11)	0.026*** (9.27)	0.038*** (11.94)
RNOA(t)	0.763*** (88.59)	0.765*** (97.48)	0.710*** (167.53)	0.707*** (118.95)	0.725*** (169.65)	0.720*** (128.80)	0.756*** (63.53)	0.734*** (61.25)
Constant	0.020*** (2.78)	0.021** (2.32)	-0.005 (-0.95)	0.003 (0.47)	-0.019*** (-6.59)	-0.009 (-1.56)	0.002 (0.19)	0.001 (0.06)
Observations	239,440	239,440	1,374,620	1,374,620	1,354,499	1,354,499	116,130	116,130
R-squared	0.708	0.712	0.631	0.631	0.636	0.635	0.723	0.727
Estimation method	Pooled	FM	Pooled	FM	Pooled	FM	Pooled	FM

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Gross profit over assets (t+12)							
E (low CO2)	-0.005 (-0.96)	-0.006* (-1.79)						
S (non-sin)			-0.002 (-0.89)	-0.003* (-1.79)				
G (low accruals)					0.061*** (7.66)	0.070*** (14.46)		
ESG (MSCI)							0.001** (2.49)	0.001*** (3.02)



Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# Does ESG Predict Investor Demand?

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Institutional holdings (t+3)							
E (low CO2)	2.206*** (3.37)	2.284*** (14.65)						
S (non-sin)			6.128** (2.43)	7.037*** (11.50)				
G (low accruals)					1.060 (0.74)	3.208*** (2.98)		
ESG (MSCI)							0.343** (2.55)	0.420*** (6.98)
Beta	5.774*** (8.50)	5.912*** (21.96)	5.698*** (14.13)	6.905*** (20.76)	1.610*** (3.37)	3.038*** (11.91)	6.371*** (7.05)	5.512*** (11.27)
Ln market cap	10.079*** (50.48)	10.057*** (108.99)	9.662*** (62.30)	9.691*** (64.95)	9.599*** (53.67)	9.650*** (85.18)	0.846*** (3.32)	-1.265*** (-2.67)
Ln(P/B)	-0.321 (-1.20)	-0.354*** (-5.08)	-1.759*** (-11.05)	-1.264*** (-8.39)	2.282*** (-13.90)	1.931*** (-13.83)	1.136*** (3.86)	1.642*** (9.22)
Constant	10.649*** (-6.77)	10.400*** (-17.28)	17.176*** (-6.40)	19.342*** (-18.11)	3.402*** (-3.00)	5.076*** (-9.55)	62.372** (24.56)	82.049** (18.45)
Observations	378,623	378,623	962,867	962,867	737,865	737,865	180,326	180,326
R-squared	0.454	0.450	0.470	0.424	0.475	0.422	0.033	0.083
Estimation method	Pooled	FM	Pooled	FM	Pooled	FM	Pooled	FM

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ln #trades (t+1)				buy volume/total volume (t+1)			
E (low CO2)	-0.063*** (-3.46)				-0.069*** (-4.07)			
S (non-sin)		-0.061 (-0.97)				0.321 (1.27)		
G (low accruals)			0.282*** (3.44)				0.767* (1.95)	
ESG (MSCI)				0.004 (0.61)				-0.015* (-1.67)

Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.



# ESG and Valuation

Dependent variable	(1)	(2)	(3)	(4)
	Ln(P/B)			
E (low CO2)	0.086*** (7.25)			
S (non-sin)		0.020 (0.30)		
G (low accruals)			-0.470*** (-11.59)	
ESG (MSCI)				0.058*** (8.25)
Beta	-0.449*** (-16.39)	0.402*** (28.48)	0.338*** (21.13)	-0.348*** (-8.56)
Constant	1.391*** (38.32)	0.366*** (5.48)	0.514*** (27.37)	1.245*** (21.81)
Observations	427,857	2,120,679	1,708,222	203,502
R-squared	0.050	0.073	0.077	0.046
Estimation method	Pooled	Pooled	Pooled	Pooled



Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# Does ESG Predict Returns?

	E (low CO2)	S (non-sin)	G (low accruals)	ESG (MSCI)
<b>Panel A: Equal-weighted returns</b>				
Average excess return	5.15% (1.59)	0.50% (0.35)	7.84%*** (4.41)	0.38% (0.28)
CAPM alpha	7.02%** (2.09)	-0.42% (-0.30)	7.87%*** (4.39)	1.29% (1.00)
Three-factor (FF) alpha	5.03% (1.63)	0.06% (0.05)	7.30%*** (4.03)	0.74% (0.60)
Five-factor (FF) alpha	5.98%* (1.92)	1.28% (0.94)	8.85%*** (4.91)	0.28% (0.22)
Six-factor (FF+Mom) alpha	5.12%* (1.73)	1.03% (0.74)	8.71%*** (4.76)	0.27% (0.22)
<b>Panel B: Value-weighted returns</b>				
Average excess return	4.88%* (1.89)	-3.04%** (-2.07)	3.01%** (2.30)	0.02% (0.01)
CAPM alpha	4.13% (1.52)	-4.12%*** (-2.85)	4.00%*** (3.12)	1.34% (0.70)
Three-factor (FF) alpha	3.02% (1.14)	-3.69%** (-2.58)	3.22%*** (2.64)	0.84% (0.45)
Five-factor (FF) alpha	4.71%* (1.85)	-0.20% (-0.15)	3.32%*** (2.76)	-0.58% (-0.31)
Six-factor (FF+Mom) alpha	4.33%* (1.72)	-0.36% (-0.26)	3.07%** (2.52)	-0.59% (-0.32)

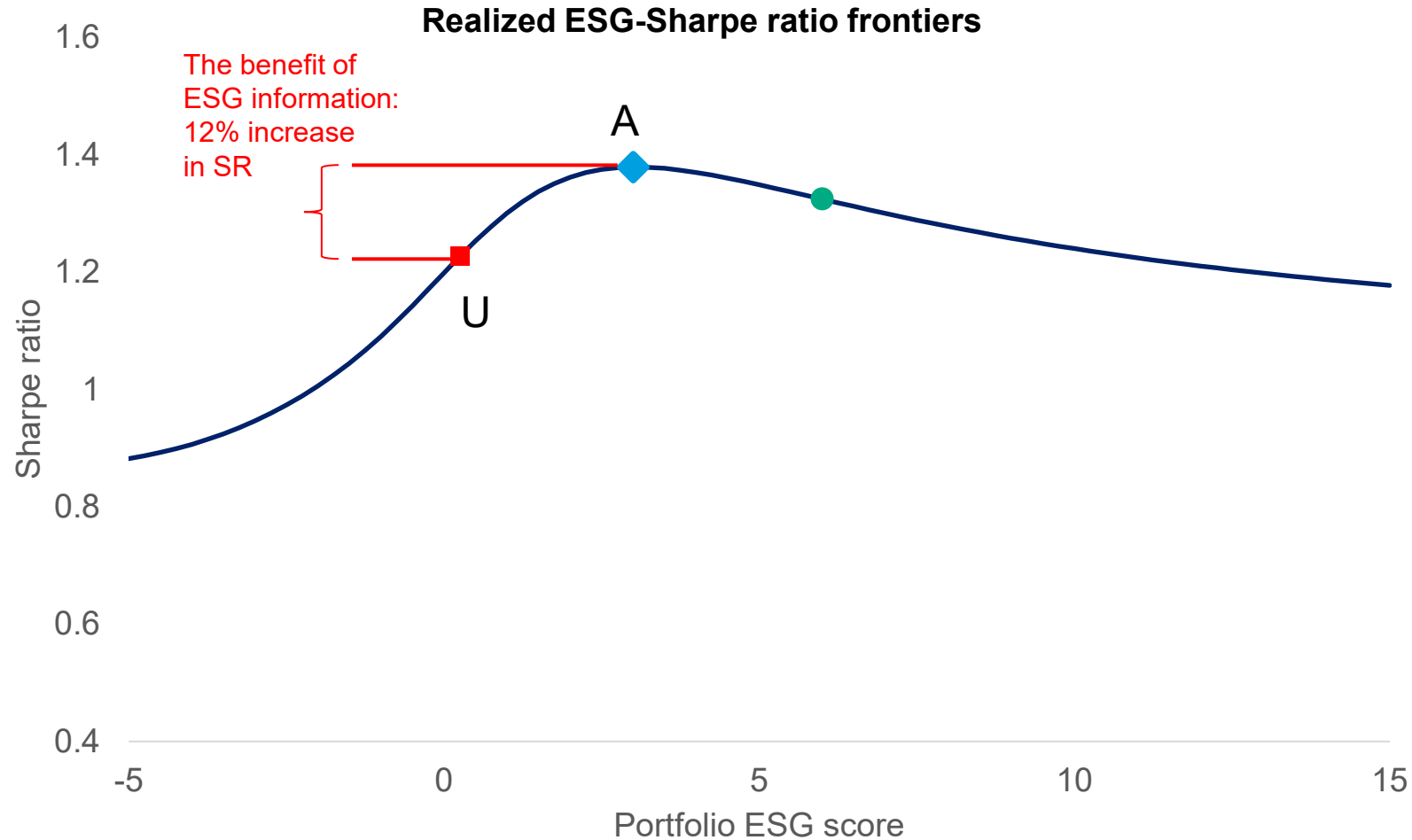


Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# Empirical ESG-Efficient Frontier

## Quantifying the Potential Benefit of ESG Information

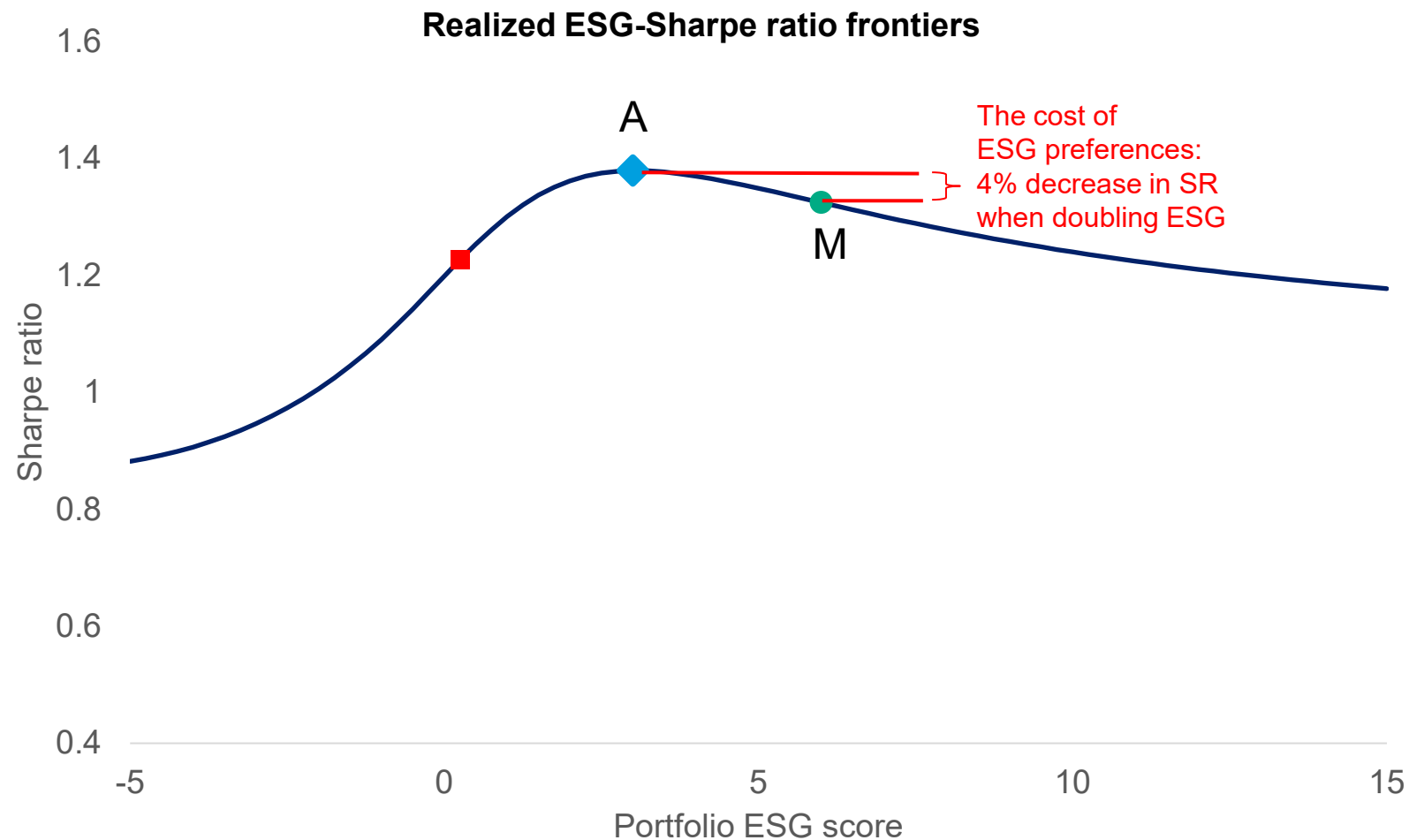
ESG measured as governance based on accruals; non-ESG information: equity risk premium and B/M



Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. For details please refer to appendix description of Figure 5, Panel B. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# Empirical ESG-Efficient Frontier

## Quantifying the Potential Cost of ESG Preferences



Source: AQR. Pedersen, Fitzgibbons, Pomorski, "The ESG-Efficient Frontier", 2019. For details please refer to appendix description of Figure 5, Panel B. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only. Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# Conclusion

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## ESG-efficient frontier:

- **New framework to optimize portfolio's risk, return, and ESG**
- **Evaluate cost and benefits of ESG investing**
  - Benefit of ESG information: quantified as increase in maximum SR
  - Cost of ESG preferences: quantified as drop in SR as you move out of the ESG-efficient frontier
- **Theoretical foundation for “ESG integration”**
  - Markowitz portfolio problem with ESG exhibits 4-fund separation
- **ESG constraints can have surprising effects**

## Theory explains how a high ESG score relates to expected returns:

- *higher* returns when investors don't take into account that ESG predicts future profits
- *lower* returns when investors do take this into account and have a preference for ESG

## Different ESG measures are different

- in what they measure, whether it predicts profits, relation to valuation and returns



Source: AQR. Pedersen, Fitzgibbons, Pomorski, “The ESG-Efficient Frontier”, 2019. Not representative of any portfolio that AQR currently manages. For educational and illustrative purposes only Hypothetical performance data has inherent limitations, some of which are discussed in the disclosures.

# RESPONSIBLE INVESTING: THE ESG-EFFICIENT FRONTIER

## Q & A Session



**Lasse Pedersen,**  
Principal,  
AQR Capital Management and  
Finance Professor, Copenhagen  
Business School



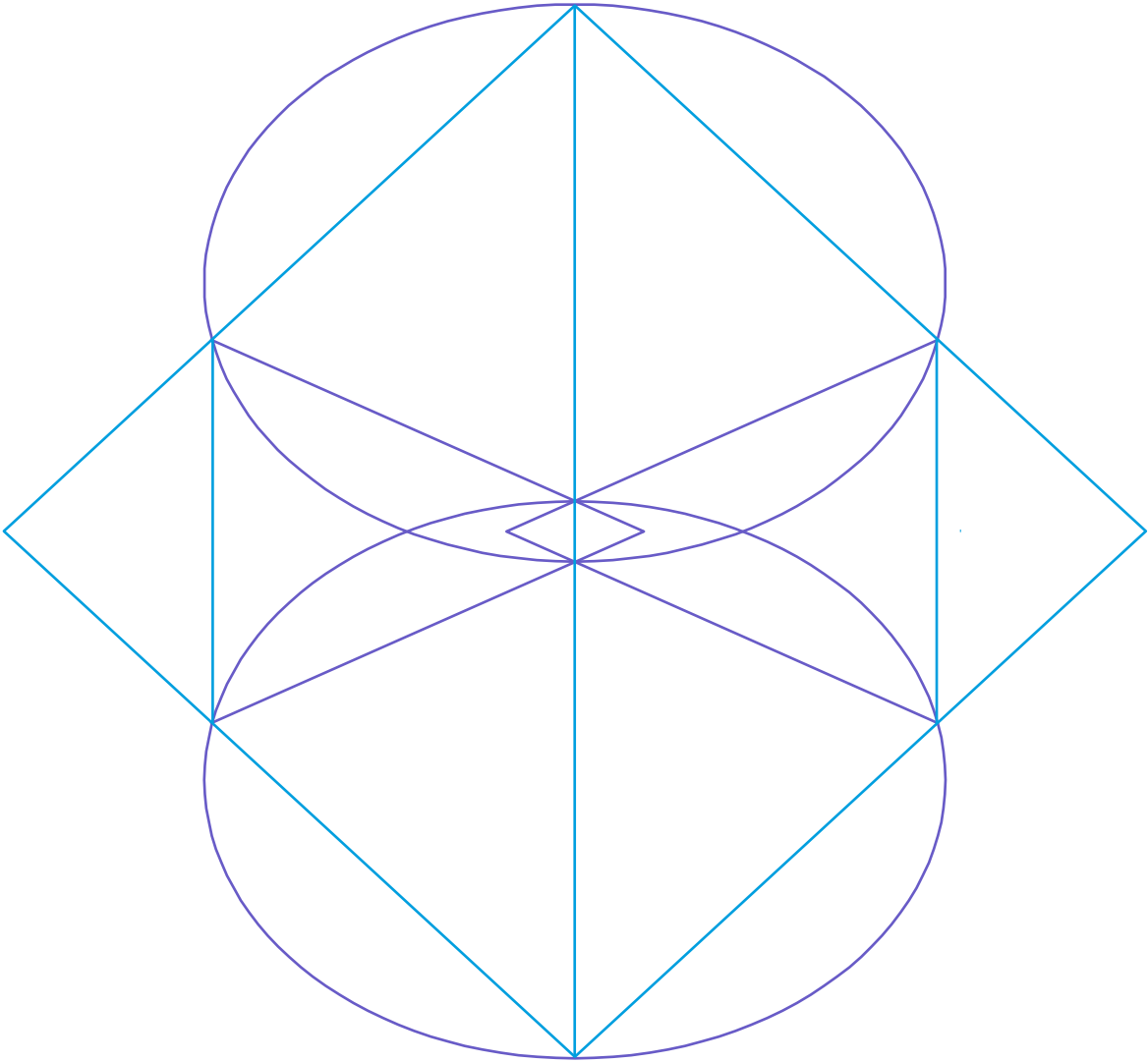
**Tristen Huupponen, CFA**  
CFA Society Sydney



**THANK YOU**



**Appendix**



# The ESG-Efficient Frontier - A working paper by Lasse H. Pedersen, Shaun Fitzgibbons, and Lukasz Pomorski

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**Risk-free rate** is measured by the BofAML 3-month Treasury Bill Index.

## ESG Measures and Data

ESG is a very broad umbrella term and consequently we chose four different proxies, each motivated differently and possibly followed by different investor clienteles. Our goal is not a horse race between them, but rather a broad discussion of how different elements of ESG may be priced in the market, and an illustration of how our theory guides empirical tests for investors who want to incorporate some ESG metric into their portfolios. Our four proxies for ESG are:

- (i) **Accruals (negated).** Our longest time series is a measure of governance (the “G” pillar of ESG) that can be computed based on accounting information. Specifically, we look at each firm’s accruals over assets with a sample period spanning January 1963 through March 2019. We negate accruals so that higher values indicate better ESG. The idea, coming from the accounting literature, is that low accruals indicates that a firm is conservative in its accounting of profits (e.g., Sloan, 1996) and better governed companies tend to adopt more conservative accounting processes (e.g., Kim et al., 2012). Indeed, research shows companies that are subject to SEC enforcement actions tend to have abnormally high accruals prior to such actions (e.g., Richardson, Sloan, Soliman, and Tuna, 2006) and companies with high accruals also have a higher likelihood of earnings restatements (e.g., Richardson, Tuna, and Wu, 2002; Bradshaw, Richardson, and Sloan, 2001).
- (ii) **MSCI ESG.** One of the most widely used ESG scores by institutional investors is computed by MSCI, and our sample for this variable is from January 2007 through March 2019. The MSCI score is a comprehensive assessment of each company’s ESG profile. We use the top-level ESG score that summarizes each company’s E, S, and G characteristics, on an industry-adjusted basis, as a numerical score from 0 (worst ESG) to 10 (best ESG).
- (iii) **CO2 (negated).** As a measure of how “green” a company is (the E in ESG), we compute its carbon intensity (CO2), defined as the ratio of carbon emissions in tons over sales in millions of dollars. Carbon emissions can be measured in different ways, but we use the sum of “scope 1 carbon emissions” (a firm’s direct emissions, e.g., from the firm’s own fossil fuel usage) and “scope 2 carbon emissions” (indirect emissions from the use of electricity); we do not include “scope 3” (other indirect emissions) since these are rarely reported by companies and are at best noisily estimated and inconsistent across different data providers (e.g., Busch, Johnson, and Pioch, 2018). Similarly to accruals, we negate the CO2 variable so that higher values indicate better ESG (less carbon intensive, “greener” companies). This data is obtained from Trucost and is available from January 2009 through March 2019.
- (iv) **Non-sin stock.** Stocks in certain “sin” industries are shunned by some ESG-conscious investors, for example tobacco, gambling, or controversial weapons (related to the S in ESG). We consider a “non-sin stock” indicator, taking the value of 0 for sin stocks and the value of 1 otherwise, so that its higher values indicate better ESG. Sin industries are defined as in Hong and Kacperczyk (2009) and this indicator is available for our longest sample, January 1963 through March 2019.

The investment universe for table 1-4 is defined as all stocks within the CRSP database.



# The ESG-Efficient Frontier - A working paper by Lasse H. Pedersen, Shaun Fitzgibbons, and Lukasz Pomorski

To minimize confusion the numbering of figures in this deck corresponds to the numbering of figures in the "ESG Efficient Frontier" paper (from which these figures are pulled). Note however that we don't reference all 6 figures from the paper in this presentation (i.e. figures 3, 4 and 5 are not included). Note also that slides 7-13 show different versions of the same figure (Figure 1) from the paper.

**Figure 1. ESG Efficient Frontier.** We consider three types investors. Type-U ("ESG-unaware") investors are unaware of ESG scores and simply seek to maximize their unconditional mean–variance utility. Type-A ("ESG-aware") investors also have mean–variance preferences, but they use assets' ESG scores to update their views on risk and expected return. Lastly, type-M ("ESG-motivated") investors use ESG information and also have preferences for high ESG scores. In other words, M investors seek a portfolio with an optimal tradeoff between a high expected return, low risk, and high average ESG score. While trading off three characteristics may seem challenging, we show that the investor's problem can be reduced to a tradeoff between ESG and the risk-adjusted return. Specifically, for each level of ESG, we compute the highest attainable Sharpe ratio (SR). We denote this connection between ESG scores and the highest SR by the "ESG-SR frontier". To understand why the ESG-SR frontier is hump shaped, consider first the tangency portfolio known from the standard mean–variance frontier: The tangency portfolio has the highest SR among all portfolios, so its ESG score and SR define the peak in the ESG-SR frontier. Further, the ESG-SR frontier is hump shaped, because restricting portfolios to have any ESG score other than that of the tangency portfolio must yield a lower maximum SR.

**Figure 2. ESG-CAPM.** We also derive the equilibrium security prices and returns. In particular, we show that expected returns are given by an ESG-adjusted CAPM. When there are many type-U investors and when high ESG predicts high future profits, we show that high-ESG stocks deliver high expected returns. This is because high-ESG stocks are profitable, yet their prices are not bid up by type-U investors, leading to high future returns. In contrast, when the economy has many type-A investors, then these investors bid up the prices of high ESG stocks to exactly reflect their expected profits, thus eliminating the connection between ESG and expected returns. Further, if the economy has many type-M investors, then high ESG stocks actually deliver low expected returns, because ESG-motivated investors are willing to accept a lower return for a higher ESG portfolio.

**Figure 3. ESG-Efficient Frontier and Indifference Curves for a ESG-motivated Investor.** This figure shows an example of an ESG-Sharpe ratio frontier for a ESG-motivated investor M (solid line). The investor's utility increases in both the Sharpe ratio and the ESG score of her portfolio, yielding a tradeoff illustrated by the downward-sloping indifference curves (dashed lines).

**Figure 4. ESG-Efficient Frontier and Indifference Curves for an ESG-Aware Investor.** This figure shows an ESG-Sharpe ratio frontier (solid line) and an ESG-aware investor's indifference curves (dashed lines), which are horizontal because this type of investor does not derive direct utility from ESG.

**Figure 5. Empirical ESG-Efficient Frontier.** We estimate the ESG-Sharpe ratio frontier for S&P 500 stocks, with returns driven by valuation (measured by each stock's book-to-market ratio) and ESG (measured by each stock's accruals to assets ratio, a measure related to governance). The figure shows annualized maximum Sharpe ratios attainable for each level of ESG constraint. The ESG-unaware investor U (solid blue line) solely utilizes book-to-market to estimate expected returns; The ESG-aware investor A (dashed line) uses both book-to-market and a measure of governance (the "G" in ESG) based on accruals to estimate expected returns. Panel A presents the perceived frontier, built using the ex ante estimates from each investor. Panel B presents the realized frontier, constructed using the portfolios from Panel A and computing their ex post performance.

**Figure 6. Impact of screening on the ESG-Sharpe ratio frontier.** This figure shows an ESG-aware investor's perceived ESG-Sharpe ratio frontier (solid blue line, the same as the solid line in Figure 4A) as well as two frontiers for an investor who only allows herself to use a screened investment universes: removing 10% of stocks with the lowest ESG scores (dashed green line), or removing 20% of stocks (dotted red line).



# The ESG-Efficient Frontier - A working paper by Lasse H. Pedersen, Shaun Fitzgibbons, and Lukasz Pomorski

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**Table 1: Does ESG Predict Firm Profits?** This table reports the regression of future profitability on current ESG scores, where profitability is measured 12 months into the future. Profitability is computed as the accounting return (return on net operating assets, RNOA) in Panel A and as gross profit over assets in Panel B. We consider four ESG metrics and three control variables (market beta, the logarithm of market capitalization, and the logarithm of the book-to-price ratio). The ESG metrics are a measure of governance labelled “accruals (negated)”, the overall “MSCI ESG” score, a measure of low carbon usage labelled “CO2 (negated)”, and a “non-sin stock” indicator (all signed so that higher values are better ESG). The estimation method is either a pooled regression with month fixed effects (“pooled”) or Fama-MacBeth (“FM”), as indicated. Robust t-statistics are in parentheses, which are clustered at the stock level in pooled regressions, or adjusted using Newey-West weighting scheme in Fama-MacBeth regressions.

**Table 2: Does ESG Predict Investor Demand?** This table reports the regression of investor demand on measures of ESG. Investor demand is measured as institutional ownership (obtained from 13f reports, leaded three months) in Panel A, trading activity in Panel B (log number of trades in the next month), and signed order flow (dollar buy volume over total dollar volume) in Panel C. The ESG proxies and control variables are as in Table 1. The estimation method is either a pooled regression with month fixed effects (“pooled”) or Fama-MacBeth (“FM”), as indicated. Robust t-statistics are in parentheses, which are clustered at the stock level in pooled regressions, or adjusted using Newey-West weighting scheme in Fama-MacBeth regressions.

**Table 3: ESG and Valuation.** We regress each firm’s valuation ratio (the logarithm of price to book) on the contemporaneous ESG score, controlling for the market beta. The ESG proxies are as in Table 1. Robust t-statistics are in parentheses, clustered at the stock level in these pooled regressions.

**Table 4: Does ESG Predict Returns?** This table reports the performance of high-ESG minus low-ESG portfolios. Specifically, each month, stocks are sorted into portfolios based on quintiles of their ESG scores proxies, and we then compute the return over the following month of the quintile with the best ESG scores minus that with the lowest scores. Stocks are equal-weighted in Panel A and value-weighted in Panel B. The ESG proxies are as in Table 1. We report the portfolios’ excess return, 1-factor CAPM alpha, 3-factor alpha that also controls for the Fama-French (FF) factors related to size and value, 5-factor alpha that further controls for the FF factors related to profitability and investment, and 6-factor alphas that also controls for momentum. T-statistics are reported in parenthesis.



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