

Exploring the Impact of ESG Score on Firm Performance

FINE 460 Group 6

Alex DaSilva, Mariel Yacolca Maguiña, Alessandro Bozzi

Agenda

i. Motivation

- a. What is ESG, and is there a link with Firm Performance?
- b. Our Research Question

ii. Our Process

- a. Key Variables and Data Collection
- b. Panel Regression Overview
- c. Implementation

iii. Results

- a. Main Findings
- b. Extensions

iv. Potential Caveats

v. Appendix

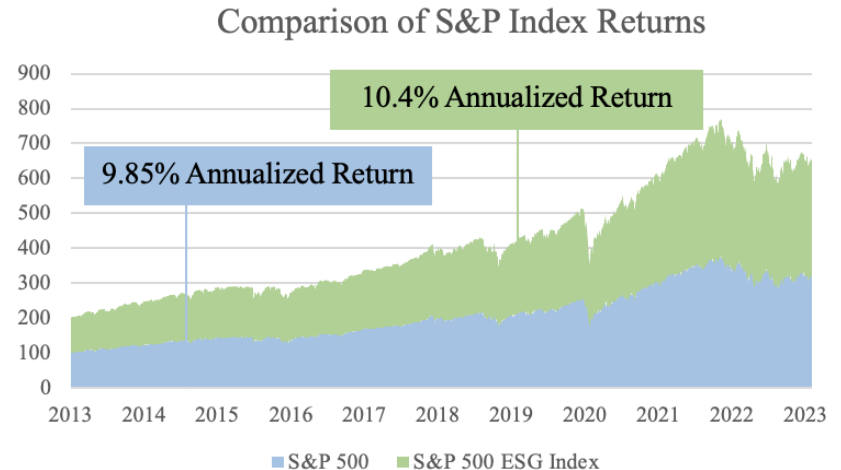
Motivation

- **ESG** has become a **buzzword** in finance news as sustainable investing becomes more popular.



The American right has gone to war with 'woke capitalism' – here's what they get wrong

Published: February 24, 2023 12:24pm EST



PERSONAL FINANCE

Money invested in ESG funds more than doubles in a year

PUBLISHED THU, FEB 11 2021-12:44 PM EST UPDATED THU, FEB 11 2021-1:15 PM EST



The New York Times

SUBSCRIBE FOR \$0.50 (USD)/A

YOUR MONEY

The Rush to E.S.G., With or Without Elon Musk

Mr. Musk trashed E.S.G. investing. The S.E.C. is investigating Goldman Sachs's move into the sector. In a falling market, what should investors consider?





What is ESG?

- Corporate Social Responsibility refers to the expectation of firms to operate in ways that enhance rather than degrade their external environment.
- ESG encompasses these external impacts of a firm's financial interests and operations in three pillars.



What is ESG Investing?

ESG Impacts on Firm Performance

-  Reduced cost of capital
-  Less exposure to climate risks
-  Increased talent acquisition prospects
-  Improved reputation

ESG Rating Agencies

MSCI 

Bloomberg



SUSTAINALYTICS

STANDARD
& POOR'S

REFINITIV 



But how do ESG factors actually affect firms?

- How we arrived at our ultimate research question.

What effects does ESG have that justify the attention it has gotten?

Through what channels do ESG concerns affect firms?

Which firms are more impacted by the increasing focus on ESG?



Do we find that ESG scores have an impact on firms' financial performance?

Data Collection and Variable Selection

Data Collection

- 221 companies in the S&P 500.
- Data available on a yearly-basis since 2008.
- In total we had $15 \times 221 = 3\,315$ observations.
- Data sourced from Refinitiv using Eikon Datastream.

Variable Selection

- Dependent Variables:

Tobin's Q (TQ) : Market value/assets at replacement value.

Return on Equity (ROE): Net income/shareholders' equity

Return on Assets (Return on Equity) : Net income/total assets.

- Explanatory Variables: **E (Environmental Score)**, **S (Social Score)**, **G (Government Score)**, **ESG (Overall score)**.
- Control Variables: **Total Assets (TA)**, **Leverage (LEV)**, **Asset Turnover (AT)**, **Asset Growth (AG)**

Source: Refinitiv

Refinitiv ESG Scores Methodology

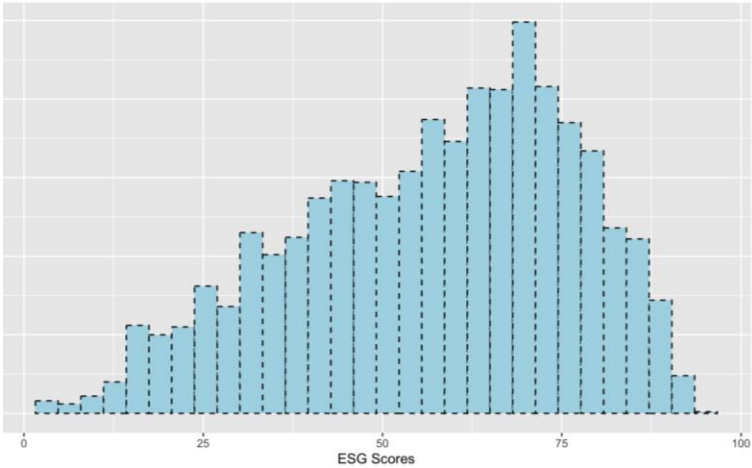
- Company's performance across E, S, and G factors. Factors broken down into 450+ indicators, weighted based on their relevance to the company's industry and region.
- Calculation incorporates the company's disclosures and external data sources (news articles and NGO reports).
- Resulting scores **range from 0-100**, with **higher scores indicating better ESG performance**.

Preliminary Results: Summary Statistics and Plots

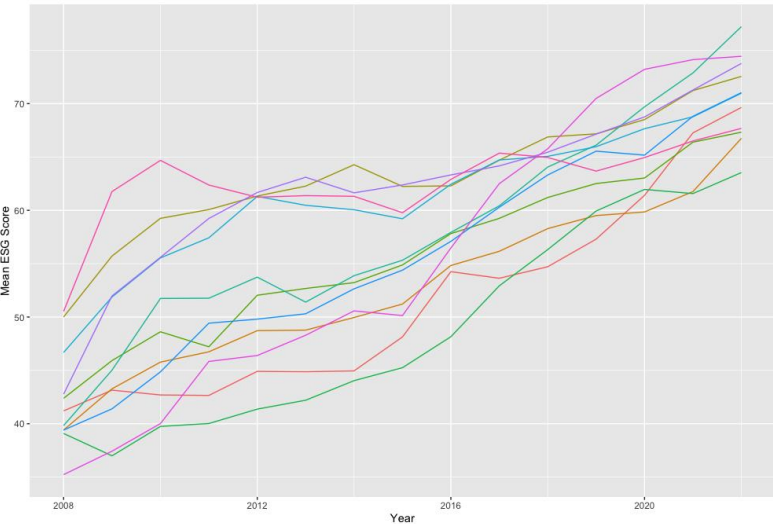
Summary Statistics

Statistic	Min	Mean	Max	St. Dev.	Pctl(25)	Median	Pctl(75)
ESG	1.901	57.045	93.836	19.464	43.006	59.914	72.066
E	0.000	51.056	98.546	28.159	29.633	57.408	74.808
S	1.924	59.480	97.875	21.596	42.619	61.769	77.138
G	0.699	58.532	99.622	21.386	43.293	60.918	75.752
AT	0.013	0.784	5.912	0.662	0.389	0.613	0.941
TA	0.545	40.472	958.784	76.376	8.251	17.890	38.359
LEV	0.000	0.287	2.439	0.180	0.167	0.275	0.387
TQ	0.017	1.936	23.052	1.937	0.790	1.401	2.356
ROA	-1.341	0.084	0.532	0.104	0.030	0.075	0.134
ROE	-16.867	0.045	0.609	0.362	0.035	0.061	0.091

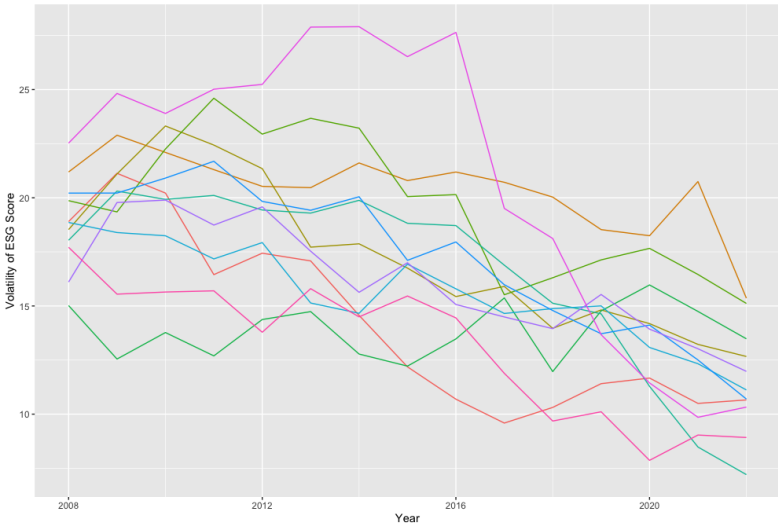
Distribution of ESG Scores



Evolution of ESG Mean



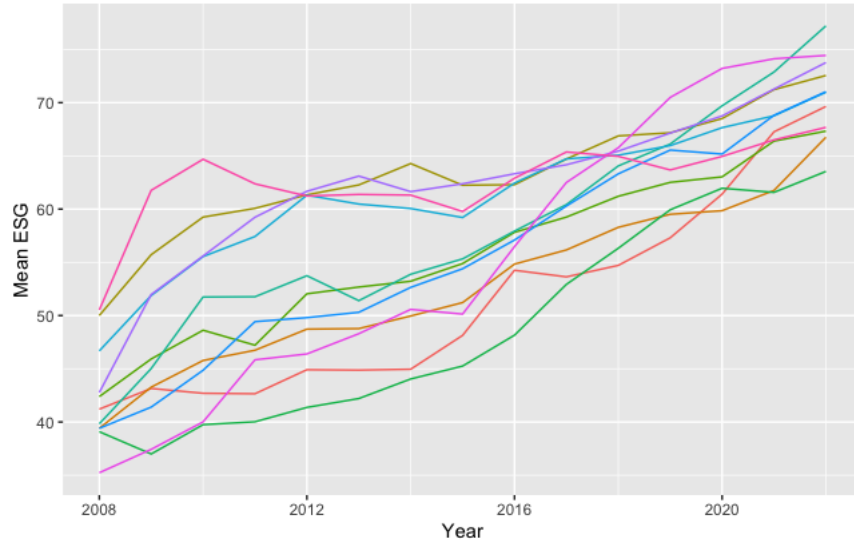
Evolution of ESG Volatility



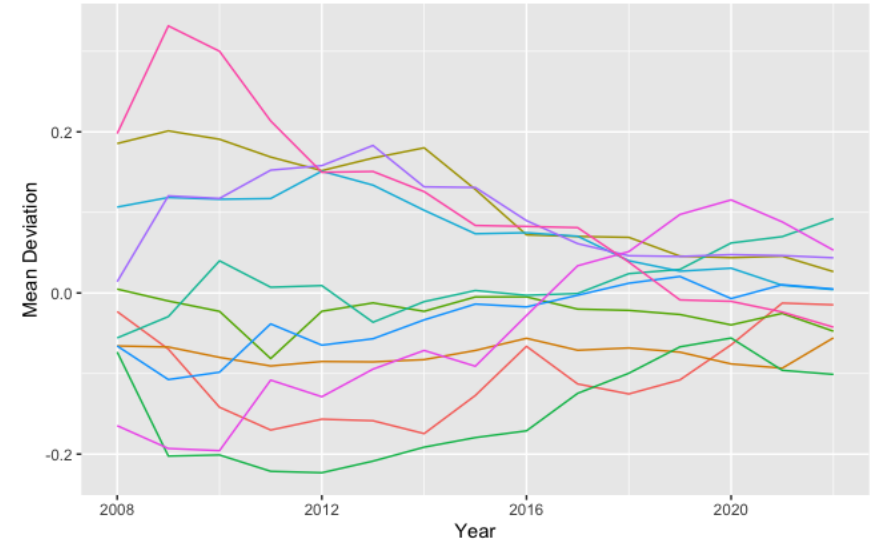
Data Visualized and Adjusted for Non-Stationarity

- To control for stationarity, we adjusted ESG scores and TQ to be the percent deviation from the annual mean.

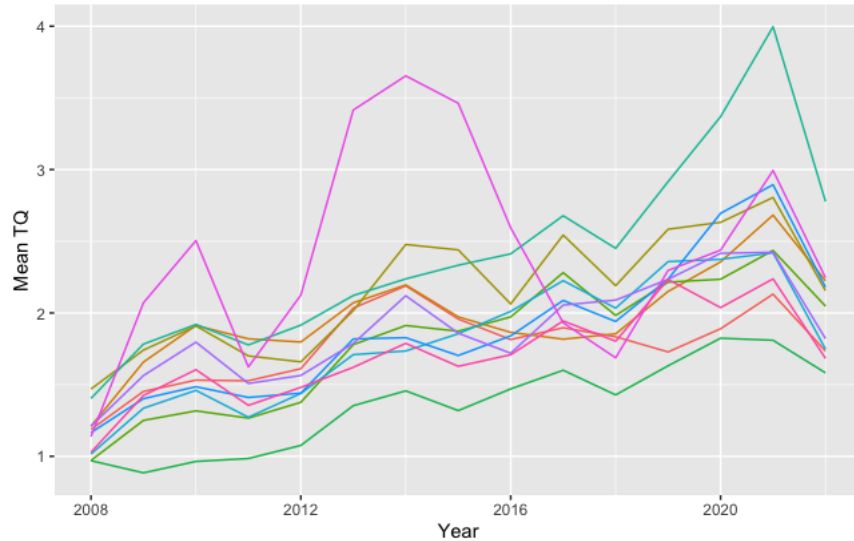
Evolution of Average ESG



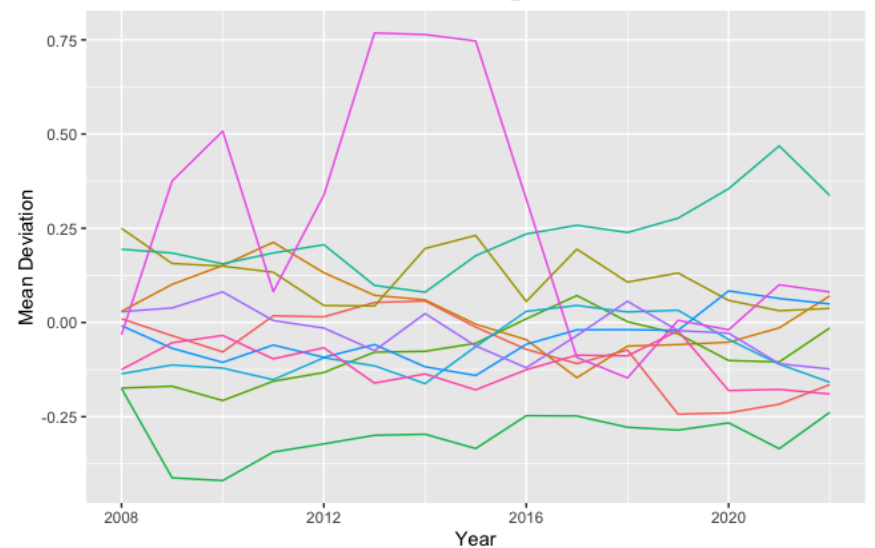
Evolution of ESG Deviations



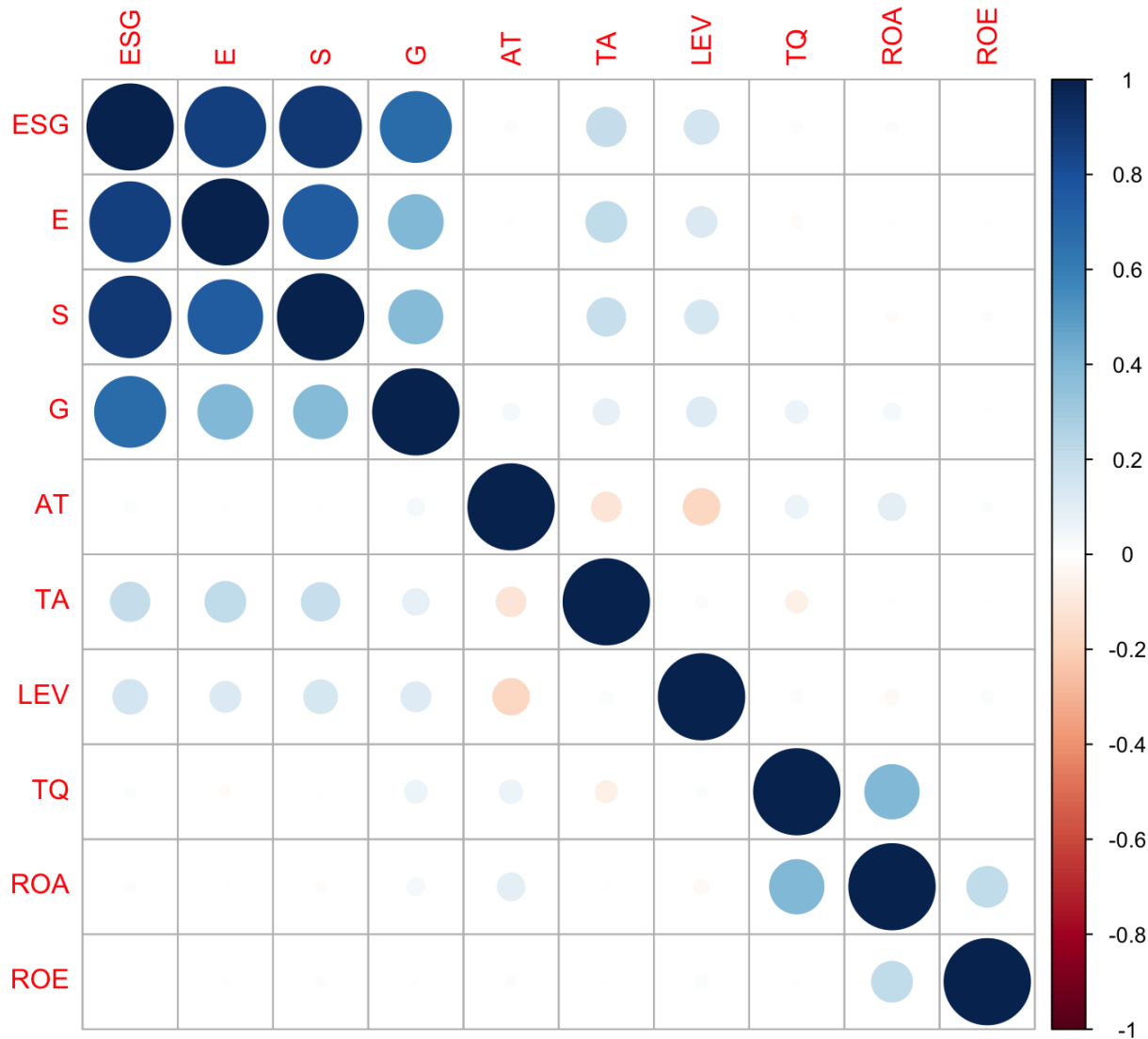
Evolution of Average TQ



Evolution of TQ Deviations



Preliminary Results: Correlation Matrix



➤ ESG is highly correlated with E, S, and G. To avoid **multicollinearity**, we decided we would run the regressions with ESG or E, S, and G, but not both.

➤ ESG, and E, S and G seem to have no correlation with TQ, ROA and ROE

Panel Regression

- **Goal :** examine the relationship between ESG scores and Tobin's Q, Return on Assets, and Return on Equity.

$$y_{i,t} = \alpha_{i,t} + \beta'_i X_{i,t} + \epsilon_{i,t}$$

- **Problem:** small number of time-series observations for ESG scores, and such a model will give poor identification of our parameters.
- **Panel regression with fixed effects:**
- Estimate the relationship between a firm's performance and our explanatory variables, **regardless of the period t**.
 - **Fixed effects:** control for differences over firms or industries that are constant over time (unobserved heterogeneity).

$$y_{i,t} = \alpha_i + \beta' X_{i,t} + \epsilon_{i,t}$$

- **Implementation**
- Use the **plm()** function from the plm package in R, specifying the **model = "within"** option to estimate fixed effects.
-

The Impact of Overall ESG Score on Financial Performance

ROA increases with ESG

- A percentage point increase in the proportional deviation from the mean increases a firm's Return on Assets by 2.5 basis points.
- Higher than average ESG score positively impacts the company's ability to **generate more net income per unit of assets**.

No impact on TQ

Potential reasons for TQ

- Lack of consensus on ESG metrics.
- Conflicting priorities when evaluating investments.

Potential reasons for ROE insignificant

- More immediate ESG impact on ROA as it reflects the company's ability to generate profits from all its assets, not only equity investments.

Panel Regression - ESG and controls - Normalized by Year

	Dependent variable:		
	TQnorm (1)	ROA (2)	ROE (3)
ESG_normPY	-0.042 (0.049)	0.025*** (0.008)	0.022 (0.035)
AT	0.048 (0.046)	-0.020*** (0.007)	-0.041 (0.032)
TA	-0.001*** (0.0003)	-0.0001*** (0.00004)	-0.0001 (0.0002)
Lev	0.128 (0.088)	0.007 (0.014)	-0.063 (0.062)
AG	-0.008 (0.020)	0.001 (0.003)	0.013 (0.014)
Observations	3,315	3,315	3,315
R2	0.009	0.008	0.001
Adjusted R2	-0.063	-0.065	-0.072
F Statistic (df = 5; 3089)	5.715***	4.680***	0.724

Note:

*p<0.1; **p<0.05; ***p<0.01

> |

The Impact of Individual Pillar Scores on Financial Performance

ROA Increases with S Score

- A one percentage point increase in the proportional deviation of S from the mean increases a firm's Return on Assets by 2.4 basis points.
- A company **stakeholders' satisfaction** impacts financial performance more than E or G.

No Impact on TQ

- *Stroebel and Wurgler* (2021): survey of 861 finance professionals on climate finance.
- Their results show an **overwhelming belief** among finance professionals that **asset prices underestimate climate risks**.

Panel Regression - E,S,G, and controls - Normalized by Year

	Dependent variable:		
	TQnorm (1)	ROA (2)	ROE (3)
E_normPY	0.038 (0.031)	-0.005 (0.005)	-0.036 (0.022)
S_normPY	-0.005 (0.053)	0.024*** (0.008)	0.093** (0.038)
G_normPY	-0.055 (0.034)	0.009* (0.005)	-0.004 (0.024)
AT	0.049 (0.046)	-0.021*** (0.007)	-0.042 (0.032)
TA	-0.001*** (0.0003)	-0.0001*** (0.00004)	-0.0002 (0.0002)
Lev	0.143 (0.088)	0.005 (0.014)	-0.064 (0.063)
AG	-0.006 (0.020)	0.001 (0.003)	0.013 (0.014)
Observations	3,315	3,315	3,315
R2	0.010	0.009	0.003
Adjusted R2	-0.063	-0.064	-0.070
F Statistic (df = 7; 3087)	4.486***	3.836***	1.394
Note:	*p<0.1; **p<0.05; ***p<0.01		

For what Firm Size does ESG have the greatest impact?

ESG factors matter more for small firms' financial performance

- For small firms, a one percentage point increase in ESG deviation from the mean leads to a 4.3 basis point increase in ROA

Small firms are potentially :

- More **vulnerable to reputational risks** and more **dependent on specific customer segments**.
- More **resource-constrained** and therefore **vulnerable to regulatory changes regarding ESG**, which could impact their financial performance.

Panel Regression - ESG and controls - Normalized by Year, with Firm Size Buckets

	Dependent variable:		
	TQnorm (1)	ROA (2)	ROE (3)
ESG_normPY	-0.092 (0.088)	0.027* (0.014)	-0.024 (0.063)
FirmSizeSmall	-0.143*** (0.041)	-0.015** (0.006)	-0.007 (0.029)
FirmSizeBig	-0.071 (0.053)	0.002 (0.008)	0.007 (0.038)
FirmSizeBiggest	-0.269*** (0.069)	-0.013 (0.011)	0.039 (0.049)
AT	-0.015 (0.048)	-0.025*** (0.007)	-0.041 (0.034)
TA	-0.001*** (0.0003)	-0.0001*** (0.00004)	-0.0002 (0.0002)
Lev	0.047 (0.090)	0.001 (0.014)	-0.046 (0.064)
AG	-0.001 (0.020)	0.0001 (0.003)	0.010 (0.014)
ESG_normPY:FirmSizeSmall	0.104 (0.103)	0.043*** (0.016)	0.103 (0.074)
ESG_normPY:FirmSizeBig	0.111 (0.116)	-0.014 (0.018)	-0.005 (0.083)
ESG_normPY:FirmSizeBiggest	0.114 (0.123)	-0.027 (0.019)	0.064 (0.088)
Observations	3,315	3,315	3,315
R2	0.020	0.020	0.003
Adjusted R2	-0.054	-0.053	-0.072
F Statistic (df = 11; 3083)	5.696***	5.812***	0.822
Note:	*p<0.1; **p<0.05; ***p<0.01		

For firms in which sector does ESG have the greatest impact?

ESG and Stakeholders' satisfaction at the core of Energy and Health Care

Main Drivers for Energy

- **Under scrutiny** (direct responsibility of physical risks associated with climate change)
- Must adapt to inevitably harshening climate policies (**transition risks**)
- Face significant pressure from stakeholders (**activist investors**)

Main Drivers for Health Care

- Huge importance of **brand integrity**.
- Significant externalities of the sector (energy consumption, waste)
- Demonstrate **commitment to the health outcomes of their community**.
- **Highly regulated sector** that must adapt to dynamic policies.

Panel Regression - ESG and controls - Normalized by Year, with Sector

	Dependent variable:		
	TQnorm (1)	ROA (2)	ROE (3)
ESG_normPY	-0.463** (0.218)	-0.076** (0.034)	-0.013 (0.156)
AT	0.040 (0.046)	-0.021*** (0.007)	-0.043 (0.033)
TA	-0.001*** (0.0003)	-0.0001** (0.00004)	-0.0001 (0.0002)
Lev	0.132 (0.088)	0.002 (0.014)	-0.062 (0.063)
AG	-0.010 (0.020)	-0.0001 (0.003)	0.012 (0.014)
ESG_normPY:SectorConsumer Discretionary	0.243 (0.256)	0.069* (0.040)	0.028 (0.183)
ESG_normPY:SectorConsumer Staples	0.313 (0.277)	0.149*** (0.043)	0.158 (0.198)
ESG_normPY:SectorEnergy	0.905*** (0.315)	0.120** (0.049)	0.105 (0.225)
ESG_normPY:SectorFinancials	0.554* (0.297)	0.074 (0.046)	0.053 (0.213)
ESG_normPY:SectorHealth Care	0.802*** (0.265)	0.105** (0.041)	0.006 (0.189)
ESG_normPY:SectorIndustrials	0.579** (0.258)	0.092** (0.040)	-0.007 (0.184)
ESG_normPY:SectorInformation Technology	0.196 (0.243)	0.048 (0.038)	-0.019 (0.174)
ESG_normPY:SectorMaterials	0.508* (0.301)	0.112** (0.047)	0.058 (0.215)
ESG_normPY:SectorReal Estate	0.275 (0.277)	0.305*** (0.043)	0.124 (0.198)
ESG_normPY:SectorUtilities	0.714** (0.299)	0.104** (0.046)	0.036 (0.213)
Observations	3,315	3,315	3,315
R2	0.017	0.034	0.002
Adjusted R2	-0.058	-0.040	-0.074
F Statistic (df = 15; 3079)	3.648***	7.265***	0.412
Note:	*p<0.1; **p<0.05; ***p<0.01		

How does ESG competition impact the significance of ESG Scores?

- Firms in sectors with high ESG scores are pressured by investors to keep up with sustainability competition.

Bucketing the Firms

- Separated the data by firms in the top three sectors and the bottom three sectors.
- We find **ESG impacts ROA more in high-scoring sectors** as firms are expected to keep up with sustainability initiatives made standard by competitors.

Ranking the Sectors

Panel Regression - ESG and controls - Best Three Sectors

		Dependent variable:		
		TQnorm (1)	ROA (2)	ROE (3)
Sector	mean_ESG	ESG_normPY	0.021 (0.114)	0.037** (0.018) 0.091*** (0.028)
1 Financials	48.9	AT	0.110 (0.083)	-0.057*** (0.013) 0.019 (0.021)
2 Communication Services	51.4	TA	0.0001 (0.001)	-0.0004** (0.0002) 0.0001 (0.0003)
3 Consumer Discretionary	52.7	Lev	0.255 (0.242)	-0.092** (0.038) -0.177*** (0.060)
4 Real Estate	55.4	AG	-0.012 (0.055)	-0.004 (0.009) -0.010 (0.014)
5 Information Technology	55.6	Observations	675	675
6 Energy	55.6	R2	0.004	0.046
7 Health Care	58.1	Adjusted R2	-0.074	-0.028
8 Industrials	61.2	F Statistic (df = 5; 625)	0.488	6.084***
9 Materials	62.1	Note:	*p<0.1; **p<0.05; ***p<0.01	

Panel Regression - ESG and controls - Worst Three Sector

		Dependent variable:		
		TQnorm (1)	ROA (2)	ROE (3)
Sector	mean_ESG	ESG_normPY	-0.163* (0.083)	-0.016 (0.013) 0.017 (0.027)
10 Utilities	62.6	AT	-0.112* (0.066)	-0.016 (0.011) -0.009 (0.021)
11 Consumer Staples	63.2	TA	-0.002*** (0.0003)	-0.0001** (0.0001) -0.00002 (0.0001)
		Lev	-0.149 (0.117)	-0.006 (0.019) -0.034 (0.037)
		AG	-0.022 (0.025)	-0.001 (0.004) 0.009 (0.008)
		Observations	840	840
		R2	0.050	0.010
		Adjusted R2	-0.023	-0.066
		F Statistic (df = 5; 779)	8.283***	1.615
		Note:	*p<0.1; **p<0.05; ***p<0.01	

Overall, we found very inconsistent results.

Weak Results

- Significance of our explanatory variables varied greatly when introducing new variables (size, industries) and making numerical adjustments for stationarity.
- TQ and ROE rarely significantly related to ESG variables.
 - Suggest a complex relationship between ESG factors and financial performance.
 - Investigation of non-linearities (tree), failed to improve our results.

Potential Causes and Problems

- **Data Issues** : small sample size, limited observation frequency
- **ESG Scores Issue** : No standardization or required disclosure

Further Research

- Expand dataset, include scores provided by various rating agencies.
-

Inconsistencies with ESG Scoring

Review of Finance, 2022, 1315–1344
https://doi.org/10.1093/rof/rfac033
Advance Access Publication Date: 23 May 2022



As Berg et al. Argue on their paper, ESG ratings from different raters are inconsistent and the correlation between the ratings is highly variable.

Aggregate Confusion: The Divergence of ESG Ratings*

Florian Berg¹, Julian F. Kölbel^{1,2}, and Roberto Rigobon¹

¹MIT Sloan, USA, ²University of Zurich, Switzerland

However, ESG ratings from different providers disagree substantially, as previously shown in Chatterji *et al.* (2016). We confirm this finding in our data set, where the correlations between ESG ratings range from 0.38 to 0.71. This is based on ESG ratings from six different raters: KLD, Sustainalytics, Moody’s ESG (previously Vigeo-Eiris), S&P Global (previously RobecoSAM), Refinitiv (previously Asset4), and MSCI. This disagreement has

ESG Ratings Comparison: Correlations

	MSCI	S&P	Sustainalytics	CDP	ISS	Bloomberg
MSCI		35.7%	35.1%	16.3%	33.0%	37.4%
S&P	35.7%		64.5%	35.0%	13.9%	74.4%
Sustainalytics	35.1%	64.5%		29.3%	21.7%	58.4%
CDP	16.3%	35.0%	29.3%		7.0%	44.1%
ISS	33.0%	13.9%	21.7%	7.0%		21.3%
Bloomberg	37.4%	74.4%	58.4%	44.1%	21.3%	

Image courtesy of BDO USA, LLP

Thank You!

Happy Birthday Professor!



Appendix

Is ESG significance dependent on buckets of relative performance?

Assigning a Score Quartile Variable

- We assigned dummy variables from Worst to Best based on their ESG score percentile.
- The resulting regression includes the dummy variables and their interactions.

Dummies Lack Significance

We expected that scoring in the lowest and highest percentiles would have more significance than middle scores.

Potential reasons

- Lack of consensus on ESG metrics and missing data.
- More granular score offers more information.

Panel Regression - ESG and controls - Normalized by Year, with ESG Score Bucket

	Dependent variable:		
	TQnorm (1)	ROA (2)	ROE (3)
ESG_normPY	1.731 (6.679)	0.197 (1.041)	-0.128 (4.767)
ESGScoreBucketBad	0.606 (6.328)	-0.074 (0.986)	0.337 (4.516)
ESGScoreBucketGood	-1.478 (6.217)	-0.150 (0.969)	0.149 (4.437)
ESGScoreBucketBest	-1.565 (6.216)	-0.177 (0.969)	0.144 (4.436)
AT	0.055 (0.046)	-0.018*** (0.007)	-0.040 (0.033)
TA	-0.001*** (0.0003)	-0.0001*** (0.00004)	-0.0001 (0.0002)
Lev	0.092 (0.089)	0.0001 (0.014)	-0.067 (0.063)
AG	-0.007 (0.020)	0.001 (0.003)	0.013 (0.014)
ESG_normPY:ESGScoreBucketBad	1.271 (6.858)	0.042 (1.069)	0.442 (4.894)
ESG_normPY:ESGScoreBucketGood	-1.478 (6.683)	-0.096 (1.042)	0.175 (4.769)
ESG_normPY:ESGScoreBucketBest	-1.873 (6.680)	-0.192 (1.041)	0.138 (4.767)
Observations	3,315	3,315	3,315
R2	0.013	0.015	0.001
Adjusted R2	-0.061	-0.059	-0.074
F Statistic (df = 11; 3083)	3.682***	4.271***	0.361
Note:	*p<0.1; **p<0.05; ***p<0.01		

Does ESG have a more significant impact on smaller or bigger firms?

Grouping Firms Above and Below the Mean

- We separated the data into two buckets of firms smaller and bigger than the mean firm size.
- We didn't find any significance. This was our inspiration to create dummy variables of firm size quartiles instead.

Panel Regression - E,S,G, and controls - Small TA

	Dependent variable:		
	TQnorm (1)	ROA (2)	ROE (3)
E_normPY	0.050 (0.032)	-0.003 (0.005)	-0.036 (0.025)
S_normPY	0.025 (0.057)	0.028*** (0.009)	0.105** (0.045)
G_normPY	-0.030 (0.038)	0.019*** (0.006)	0.012 (0.029)
AT	-0.014 (0.055)	-0.025*** (0.009)	-0.025 (0.043)
TA	-0.005** (0.002)	0.0001 (0.0003)	0.0002 (0.002)
Lev	0.097 (0.097)	0.002 (0.016)	-0.043 (0.076)
AG	-0.007 (0.022)	0.0003 (0.004)	0.007 (0.018)
Observations	2,531	2,531	2,531
R2	0.004	0.015	0.003
Adjusted R2	-0.084	-0.072	-0.085
F Statistic (df = 7; 2325)	1.317	4.933***	0.988
Note:	*p<0.1; **p<0.05; ***p<0.01		

Panel Regression - E,S,G, and controls - Big TA

	Dependent variable:		
	TQnorm (1)	ROA (2)	ROE (3)
E_normPY	0.029 (0.081)	-0.007 (0.017)	-0.006 (0.034)
S_normPY	-0.168 (0.102)	0.024 (0.022)	0.025 (0.042)
G_normPY	-0.126** (0.058)	-0.025** (0.012)	0.010 (0.024)
AT	-0.071 (0.088)	-0.027 (0.019)	-0.055 (0.036)
TA	-0.001*** (0.0002)	-0.0001*** (0.00004)	-0.0002** (0.0001)
Lev	0.494*** (0.174)	0.024 (0.037)	-0.067 (0.072)
AG	0.024 (0.033)	0.001 (0.007)	0.007 (0.014)
Observations	784	784	784
R2	0.060	0.019	0.013
Adjusted R2	-0.059	-0.106	-0.112
F Statistic (df = 7; 695)	6.373***	1.879*	1.261
Note:	*p<0.1; **p<0.05; ***p<0.01		

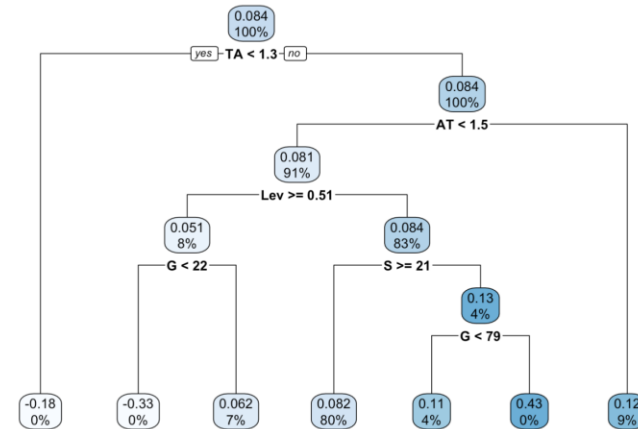
Regression Trees using Level Data

- We found that our regression trees did not add much interpretation for the significance of E, S, and G scores.

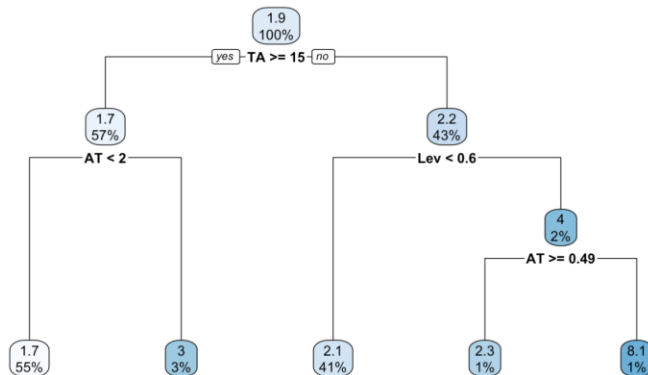
Reaffirms Significance of S on ROA

- S scores positively impact ROA for firms with S score greater than 21.
- Our explanatory variables seem to have very little impact on TQ and ROE

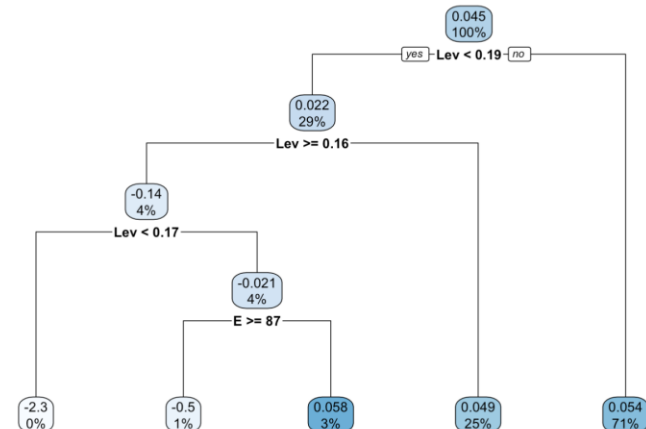
E, S, G on ROA



E, S, G on TQ



E, S, G on ROE



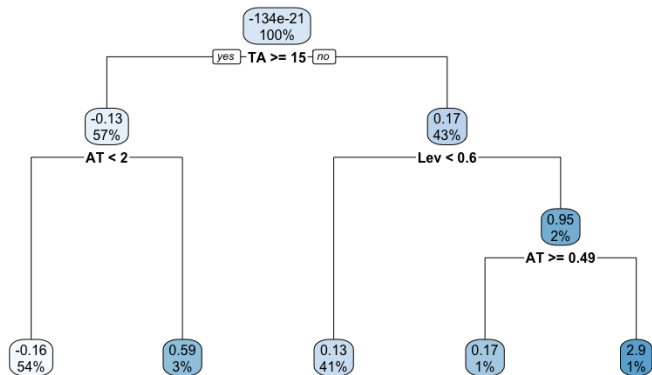
Regression Trees using Percent Deviation Data

- Found confusing results when attempting to include our explanatory variables as percent deviations from the mean.

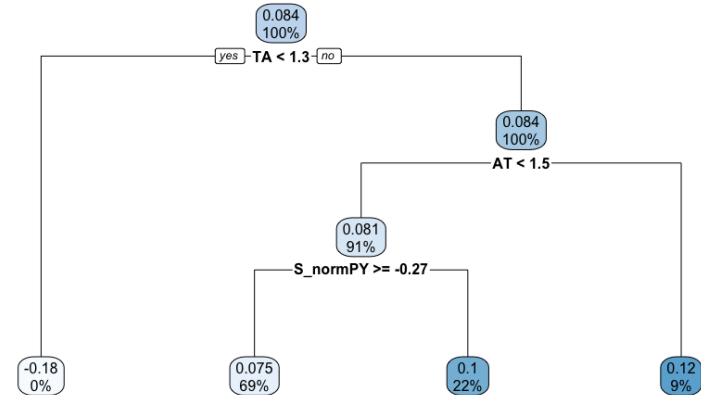
Trees Offer Counter-Intuitive Results

- For example, greater impact on ROA when S scores are lower than the given threshold.
- Our ESG factors are not present in our TQ.
- The ROE tree offers correlations that we never found in our regressions so we cannot verify its validity.

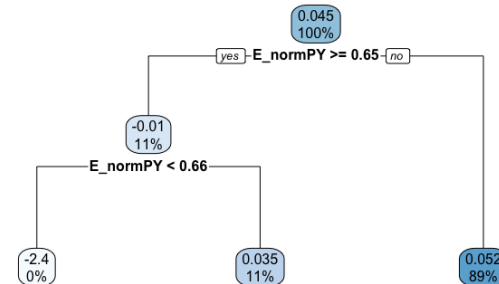
E, S, G on TQ



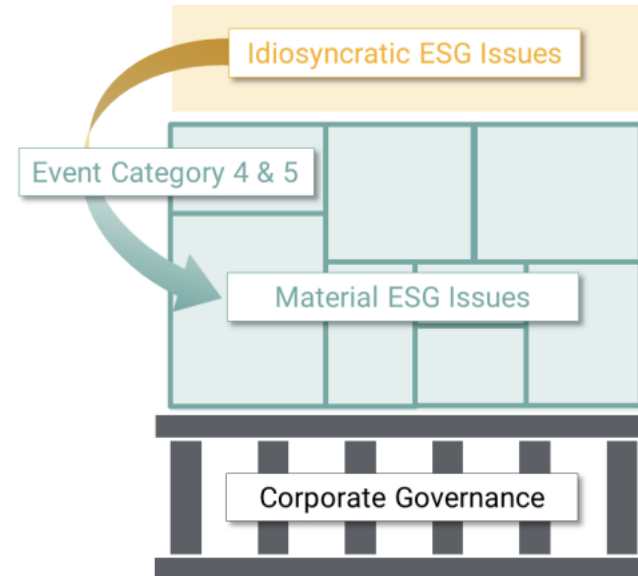
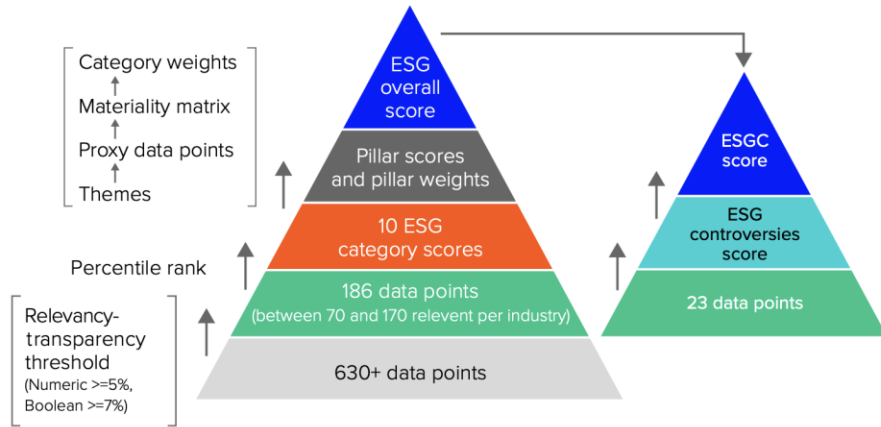
E, S, G on ROA



E, S, G on ROE



An Example of Differing ESG Rating Methodologies



Source: Sustainalytics

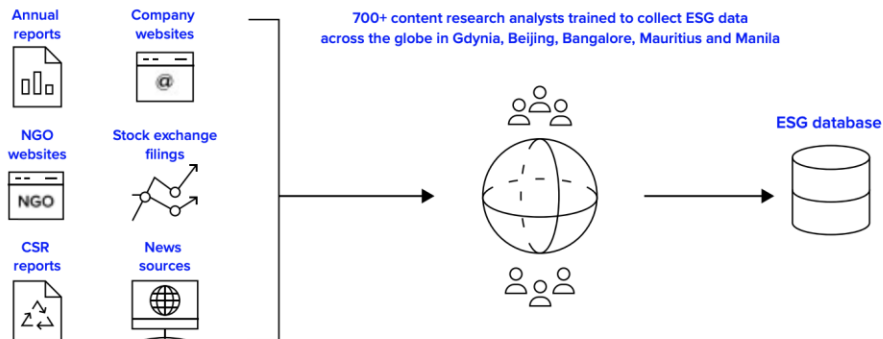


Exhibit 4: Model for calculating issue betas



Source: Sustainalytics

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