

# ESG Factors and Portfolio Returns

## Abstract

We carefully studied the relationship between a wide variety of sustainability indicators and stock market returns. We used environmental, social and governance (ESG) data in combination with materiality guidelines developed by the Sustainability Accounting Standards Board (SASB) to construct ESG factors that separate firms that have concerns in sustainability areas from the firms that do not. First, we found that interacting ESG factors with SASB's definition of materiality was essential to understand firms' motivation to disclose sustainability information. Second, assuming all other factors are equal, we discovered that stocks exposed to ESG related risks do not significantly outperform or underperform stocks without this exposure. That is, we did not find evidence that returns of portfolios controlled for specific ESG factors would be different from returns of non-controlled portfolios on a risk adjusted basis.

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## 1 Introduction

The relationship between company environmental, social and corporate governance (ESG) characteristics and financial performance remains an open question despite significant efforts put into this subject by both academia and the financial industry. Traditionally, the performance of sustainable investing was perceived to be negative. Responsible corporate behavior was firmly associated with the company sacrificing profitability in the name of social or environmental interest.<sup>1</sup>

We believe there is a good investment case for adopting sustainable practices. First, issues such as environmental liabilities, supply chain risks, poor corporate governance or human resource mismanagement pose real risks to businesses both in the short and long term and may have material impact on share price. Consequently, share prices of sustainable companies may display lower idiosyncratic risks.<sup>2</sup> Second, some ESG externalities may not yet be fully priced by society.<sup>3</sup> Once the societal risk aversion towards a particular ESG issue grows, valuations of exposed companies may correct as the associated costs are internalized to the company's income statement (for example, in the form of a carbon tax).<sup>3</sup> Finally, performance of sustainable companies should benefit from positive feedback: the more investors consider ESG factors in asset allocation, the more profound effect they will have on the whole market. In fact, U.S. sustainable investing rose strongly in 2018, up 38% from 2016.<sup>4</sup> Demand for sustainable investments is being driven, in part, by millennials<sup>5</sup> who prefer to invest in alignment with personal values. Due to an imminent intergenerational wealth shift, sustainable investing is likely to grow in the years ahead.<sup>5</sup>

This paper explores the relationship between a company's sustainability profile and its stock performance. We construct sixteen binary factors representing stocks' exposure to major sustainability issues. We then test whether exposures to any of these factors are associated with negative risk premia. That is, this paper tests the hypothesis that sustainable firms achieve better risk-adjusted performance than non-sustainable firms.

There are multiple challenges researchers face when trying to assess the financial impact of ESG investing. First, there is little agreement over what constitutes a sustainable

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<sup>1</sup>This view is perhaps best expressed by Milton Friedman in his 1970 article ("The Social Responsibility of Business is to Increase its Profits". Milton Friedman. The New York Times Magazine. September 13, 1970).

<sup>2</sup>Interestingly, a recent survey of institutional asset owners' attitude towards sustainable investing conducted by the Morgan Stanley Institute for Sustainable Investing ("Sustainable Signals: Asset Owners Embrace Sustainability", 2018) demonstrates that a majority of surveyed investors listed risk management as an important factor driving their adoption of sustainable investing.

<sup>3</sup>Daniel, Kent, Robert Litterman, and Gernot Wagner. "Applying Asset Pricing Theory to Calibrate the Price of Climate Risk." Columbia Business School, February 2015.

<sup>4</sup>"US SIF Foundation Releases 2018 Biennial Report On US Sustainable, Responsible And Impact Investing Trends" The Forum for Sustainable and Responsible Investment. <http://www.ussif.org/>

<sup>5</sup>"Sustainable Signals: The Individual Investor Perspective". Morgan Stanley, 2017.

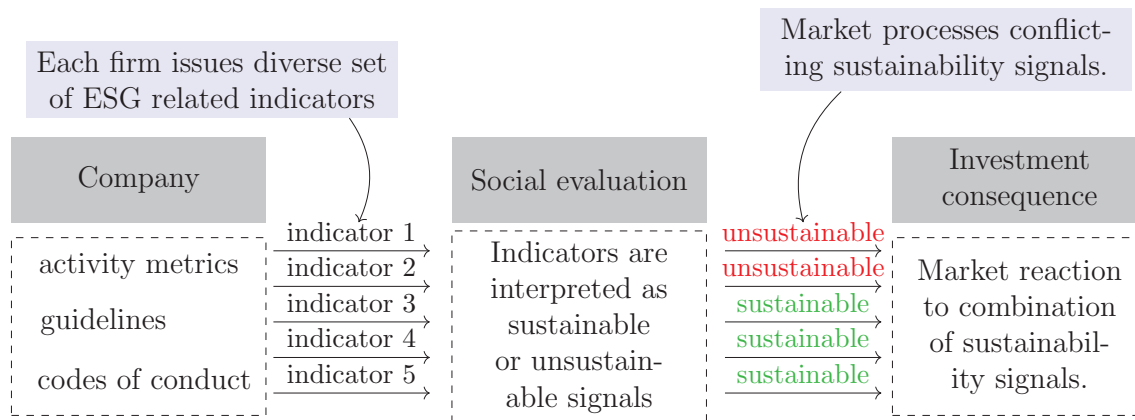


Figure 1: Flow of ESG information from the company to the market. Examples of ESG related indicators include activity metrics such as the level of greenhouse gas (GHG) emissions or the amount of toxic waste. ESG indicators also include codes of conduct such as the Extractive Industries Transparency Initiative, and guidelines such as ISO 14001.

firm. Figure 1 illustrates this challenge. While financial performance indicators are well defined and relatively easy to measure (for example, return on assets or level of corporate indebtedness), there is no easy way to measure the exposure to ESG risks. Investors rely on a variety of indicators to assess the sustainability profile of the company. These indicators, each of which is evaluated as a sustainable or unsustainable signal, are combined to measure the company’s sustainability level. The problem is that due to the heterogeneous nature of ESG indicators, the same company can be measured as both sustainable or unsustainable, depending on the metric used. For example, how should we approach a company that faces significant fines due to a recent oil spill and at the same time adopts strict enterprise-level environmental management guidelines? One investor could argue that the oil spill better reflects a company’s commitment (or lack thereof) to environmental protection and therefore the company should be rated as unsustainable. Another investor could consider environmental policies as a more important indicator of **future** sustainability performance and therefore assign a sustainable rating. Our paper handles the conflicting nature of sustainability indicators by measuring the premium attributed to each indicator separately. In our example, we consider the oil spill and environmental management policies to be two independent risk factors that affect the company’s stock performance in independent ways.

The second challenge in ESG research is the strong correlation between ESG characteristics and other sources of equity risk premium, such as market capitalization or industry exposure. Any conclusions about the relationship between the sustainability profile of the firm and its financial performance should consider which relevant variables may have been omitted from the analysis (see further discussion in Section 5).

We have drawn a few conclusions from our research. First, we discovered a strong

correlation between a company's financial metrics and its sustainability profile (see discussion in Section 4.4). This result has implications for ESG-conscious investors: it is very important, for the purposes of building a well diversified portfolio, to consider other systematic risk factors in addition to ESG risks. Otherwise, seeking ESG exposures may result in large unintended bets on systematic risk factors.

We also found that ESG data largely tends to reflect differences between industries rather than sustainability differences between firms. All ESG information should be evaluated through the lens of materiality to distinguish **material**<sup>6</sup> sustainability areas where the company's business or products have a significant negative impact on environment or society from the non-material sustainability issues that pose less risk. In Section 4, we show that interacting ESG factors with materiality is essential to understanding firms' motivations to disclose sustainability information. In particular, we found that a majority of non-disclosures do not indicate unsustainable behavior, but rather indicate immateriality of the corresponding ESG issue. In addition, we found that once adjusted for materiality, ESG factors become less correlated with each other. This finding necessitates consideration of each ESG risk separately, rather than merging all sustainability information into a single score.

Finally, we found that none of the sixteen ESG factors delivered statistically significant non-zero premium. That is, assuming all other equity risk factors are equal, we discovered that stocks exposed to ESG-related risks do not significantly outperform or underperform stocks without this exposure. This result is not surprising considering our ESG dataset only covers the time period from May 2015 to September 2018. Less than four years of history puts a significant limit on our ability to draw conclusions about the investment performance as we are unable to test our model through a full market cycle. Still, taken with a grain of salt, this result has important implications for ESG conscious investors: the returns of diversified portfolios, controlled for exposures to ESG themes, are not different from the returns of non-controlled portfolios on a risk adjusted basis.

## 2 ESG Data

Availability and consistency of sustainability information represent the biggest issues for ESG research. Even though sustainable investing has its roots in the mid-20th century, it has only recently become a mainstream topic. Standards in sustainability reporting have changed dramatically over the last few decades, meaning that comparing ESG metrics across time is a challenging task.

For research purposes, we limit our equity universe to the constituents of the S&P 1500 index. This approach has two advantages. First, we believe that the S&P 1500 index

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<sup>6</sup>Materiality is discussed in Section 4.

provides a good representation of the US equity market.<sup>7</sup> Second, using an exogenously defined research universe means that our decision to include or exclude a company is not governed by the availability of ESG information for the company. This helps us to avoid the non-reporting bias that would occur were we to treat the companies that choose to report ESG related information as a good representative sample of the whole equity universe.

Our ESG data is sourced from ESG Workstation, a platform for flagging or rating companies based on user-defined environmental, social and governance criteria. ESG Workstation was originally managed by IW Financial. In 2017 ISS<sup>8</sup> acquired IW Financial.<sup>9</sup> Since the acquisition, ESG Workstation has been managed by ISS. To collect ESG data, each month Advisor Partners provided ISS (IW Financial) a universe of securities for which ESG data was needed. Using this universe, ISS provided Advisor Partners with ESG data from their ESG Workstation. See the list of data points used in this paper in Appendix A. For this paper, we refer to this collection of monthly ESG data points as the ESG dataset.

Table 1: Snapshot of ESG dataset.

Number of months	41
Number of unique firms	1,773
Number of firm-months	61,382
Number of ISS flags	77
Companies from the S&P 1500 index not covered in the ESG dataset	0%
Missing firm-months-flags	17.2%
Number of ESG factors	16
Missing firm-months-factors	4.3%

Number of unique firms includes all firms that were ever included in the S&P 1500 index over the researched 41-month period. The number is different from 1,500 due to corporate actions and regular index revisions. Number of firm-months represents the cumulative number of observations for all firms in the S&P 1500 index over the researched 41-month period. There are 77 ESG data points provided for each firm-month in the ESG dataset. We refer to these data points as ISS flags. Due to corporate actions or other events, the dataset may not contain information for certain flags for a time period. Missing firm-months-flags shows the percentage of missing values for all 77 ISS flags for each firm-month. We describe the process of converting 77 flags into 16 ESG factors in Section 3. Missing firm-months-factors shows the percentage of all missing values for all 16 ESG factors for each firm-month.

Our ESG dataset covers the time period from May 2015 to September 2018. Less than four years of history puts a significant limit on our ability to draw conclusions about investment performance. Still, the usefulness of history as a guide to the future is a function of the evolution of market participants. In the quickly emerging field of ESG

<sup>7</sup>According to S&P, the S&P 1500 index covers “approximately 90% of the U.S. market capitalization”. <https://us.spindices.com/indices/equity/sp-composite-1500>

<sup>8</sup>While ISS provided us with permission to use ISS data in preparing this report, ISS does not endorse the report nor its conclusions.

<sup>9</sup><https://www.issgovernance.com/iss-announces-acquisition-iw-financial/>

investing, data from the distant past may serve as a poor guide to the future.

We exclude all flags related to corporate governance from our analysis. ISS upgraded their coverage of corporate-governance-related issues at the beginning of 2017, halfway through our research period.<sup>10</sup> To accommodate this change we would need to either build separate models for both time periods or discard corporate governance data altogether. Due to an already short research time interval, we decided to proceed only with E (environmental) and S (social) data, leaving G (governance) for a future study.

### 3 ESG factors

#### 3.1 Reducing the dimensionality of ESG data

Our ESG dataset is designed as a binary system which is comprised of value-based sustainability flags. Each flag indicates the presence or absence of a particular firm attribute. These can be grouped into two categories:

- **Disclosure flags** indicate the presence or absence of reporting of various sustainability policies and standards.
- **Action flags** assess a company's involvement in either sustainable or unsustainable operations.

Each attribute can be interpreted as a sustainability strength or as a sustainability concern.<sup>11</sup> While action flags mean the company has definitive concerns or strengths in corresponding sustainability areas, the relationship between disclosure flags and the company's sustainability performance is more subtle. Coming back to Figure 1, the social evaluation (the middle point of the flow of ESG information between the company and the market) of ESG disclosure indicators as sustainability strengths or weaknesses is not straightforward. We discuss this important topic in greater detail in Section 4.

ISS groups flags across 14 themes (see Appendix A for a detailed allocation of flags across themes). For example, there are four flags grouped under the animal testing theme (see Table 2).

The task of studying the effect of all of 77 flags on stock returns does not seem feasible considering the size of our dataset. To tackle this problem, we group the original 77 ISS flags into a fewer number of composite variables (see Figure 2). Then we study the relationship between stock returns and these new composite variables. To ensure our new composite variables are meaningful, we base the grouping for all flags on ISS-defined themes. The only exception is the environmental performance theme, a wide theme that covers multiple flags related to the implementation of environmental policies. We split

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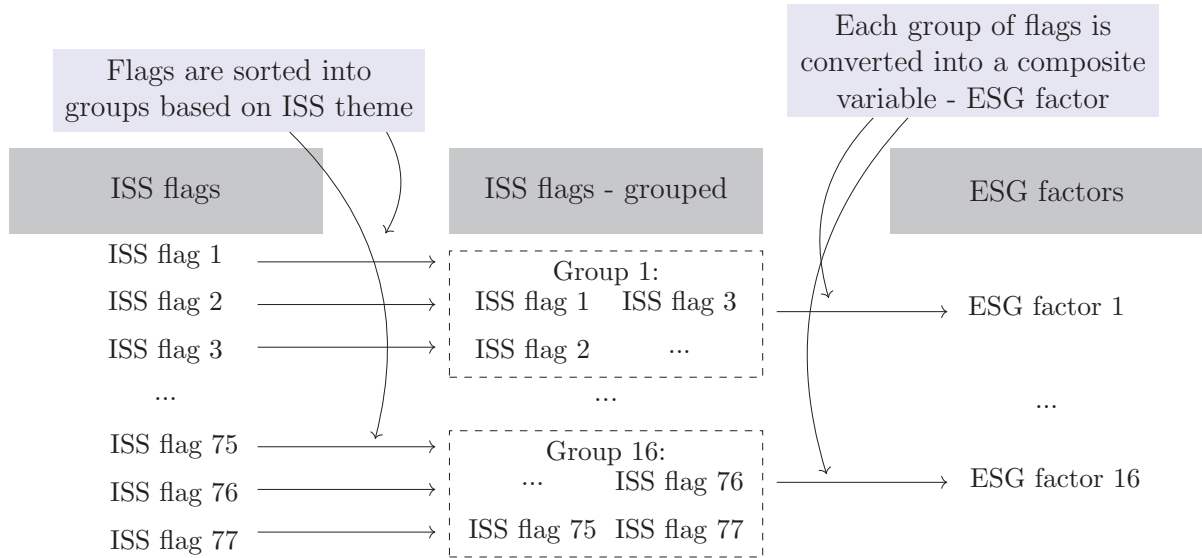
<sup>10</sup>ISS, email to clients, March 3, 2017.

<sup>11</sup>Please see Appendix A for the full list of ISS flags and concern/strength interpretations.

Table 2: Example of company animal testing profile

Flag	Flag description	Value
On PETA’s test- ing list	Company is in the list compiled by the People for the Ethical Treatment of Animals organization of companies conducting animal testing	True
On USDA’s test- ing list	Company has been found by the United States Department of Agriculture to be in violation of the Animal Welfare Act during the past three calendar years.	False
Non- pharmaceutical testing Any	Company uses live animal testing as part of the development of non-pharmaceutical products.	False
Pharmaceutical testing Any	Company uses live animal testing as part of the development of pharmaceutical products	Information not available

Figure 2: Converting ISS flags into ESG factors.



this theme into three areas: energy use, water use, and toxic and hazardous waste; that is, we expand the ISS theme list from 14 to 16 themes. After allocating all 77 flags across the 16 themes, we then represent each theme through a combination of strength and concern flags with two possible values.<sup>12</sup> We aggregate these combinations of concern and strength flags to form a new set of variables. We use a “bad apple algorithm” as an aggregation technique: a concern triggered by at least one sustainability flag triggers a concern for the whole theme. The majority of flags in our research universe are defined in such a way that 1 (or True) equals unsustainable behavior. For simplicity, we redefine those flags

<sup>12</sup>Please note, even though all flags are designed to be binary, there may be no ESG coverage for some flags due to corporate actions or for other reasons. This means each flag has three possible values: 1 (True), 0 (False) and NA (Information not available).

that identify sustainable behavior into concern flags and change the values accordingly. Now, if at least one of the flags in the theme is True (indicates concern), we assign a True (concern) value to the whole theme. We assign False (no concern) in all other cases. We apply a conservative approach in the treatment of unavailable information: we assume that unavailable information (NA) does not indicate unsustainable behavior. That is, if all flags for a particular theme have NA values, that specific theme is assigned False (no concern). To illustrate the algorithm, we come back to the animal testing example (Table 2). The company is assigned a concern value due to its presence on the PETA list, irrespective of what other animal testing flags indicate. We call these 16 composite values the ESG factors. The final list of factors is as follows:

**hazardous\_waste.** Company demonstrates increasing trend in environmental fines, toxic emissions, toxic waste, chemical or oil spills.

**energy\_use.** Company does not disclose energy use.

**environmental\_management.** Company does not disclose environmental policy or compliance with ISO 14001 environmental management systems.

**ghg\_emiss.** Company does not disclose direct or indirect greenhouse gas emissions.

**water\_use.** Company does not disclose water use.

**diversity.** Company does not disclose the percentage of women and minorities in management and their total workforce.

**sexual\_orientation.** Company does not provide benefits for same-sex couples or does not include sexual orientation in its non-discrimination policy.

**workforce.** Company does not disclose employee benefits or their workforce policy. Also includes companies on the AFL-CIO boycott list or companies subject to EEOC (U.S. Equal Employment Opportunity Commission) disciplinary actions or fines.

**community\_and\_politics.** Company does not disclose community investment programs or political policies or is involved in predatory lending.

**human\_rights.** Company does not disclose human rights policies. Also includes companies with ties to oppressive regimes.

**adult\_entertainment.** Company is involved in adult entertainment including internet, live performance, software or video games.

**alcohol.** Company is involved in the production, marketing or distribution of alcohol.

**animal\_testing.** Company is involved in animal testing or is present on one of PETA or USDA lists.

**gambling.** Company is involved in gambling or online gaming.



**military\_and\_weapons.** Company is involved in the production of civilian firearms, weapons, systems, or on the top 100 contractors of DOD list.

**nuclear\_power.** Company is involved in nuclear power generation or sales.

### 3.2 Not all ESG factors are the same: disclosures vs action metrics

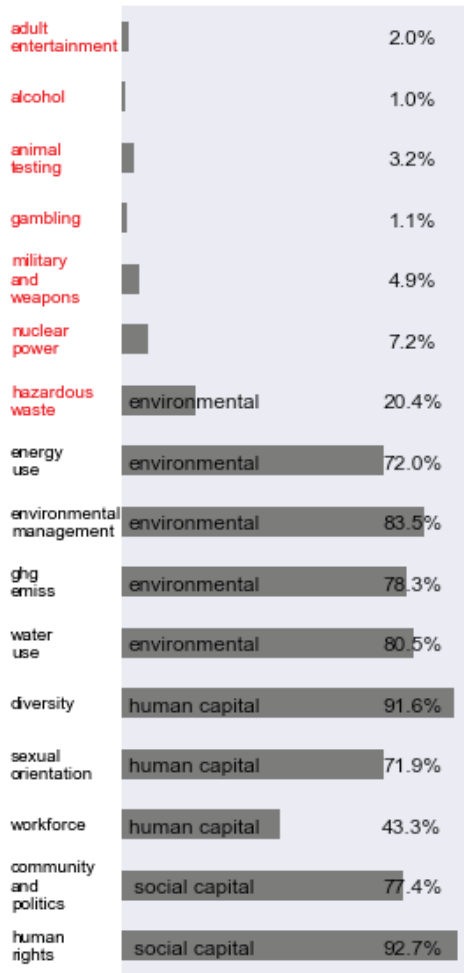


Figure 3: Fraction of firm-months in which ESG factor is True. Red labels indicate action factors; black labels indicate disclosure factors.

Figure 3 plots the percentage of companies in our universe having concerns in each ESG area. Like ISS flags, our ESG factors can be split into two groups: action and disclosure factors. Action factors are composed solely of action flags. If at least one disclosure flag entered the calculation of the factor, we refer to it as a disclosure factor. Please see detailed classification in Appendix A. We label action factors in red and disclosure factors in black.

Not surprisingly, there is a striking difference in coverage between activity and disclosure factors. Figure 3 confirms our suspicion that disclosures may not be an unbiased measure of actual company performance in the corresponding ESG area. We find it difficult to believe that more than 90% of our universe engages in discrimination or human rights violations. A more likely scenario is that companies lacking certain disclosures consider such reporting irrelevant to their bottom line (see detailed discussion in Section 4).

### 3.3 Variability of ESG information

Figure 4 demonstrates pairwise correlations of ESG factors.

	adult entertainment	alcohol	animal testing	gambling	military and weapons	nuclear power	hazardous waste	energy use	environmental management	ghg emiss	water use	diversity	sexual orientation	workforce	community and politics	human rights
adult entertainment		-1%	-3%	28%	-0%	-4%	-6%	-7%	1%	-8%	0%	-9%	-12%	4%	-13%	2%
alcohol	-1%		-2%	7%	-1%	-0%	7%	-10%	-4%	-6%	-8%	-12%	-2%	-3%	-9%	-4%
animal testing	-3%	-2%		-2%	-1%	0%	7%	-12%	-8%	-12%	-13%	-10%	-11%	-5%	-13%	5%
gambling	28%	7%	-2%		-0%	-2%	-5%	-3%	3%	-3%	3%	-1%	-3%	-0%	-6%	2%
military and weapons	-0%	-1%	-1%	-0%		24%	12%	-8%	-12%	-8%	-7%	-1%	-13%	-7%	-12%	2%
nuclear power	-4%	-0%	0%	-2%	24%		18%	-12%	-16%	-11%	-15%	-9%	-10%	-6%	-13%	-3%
hazardous waste	-6%	7%	7%	-5%	12%	18%		-19%	-28%	-18%	-22%	-9%	-4%	-6%	-16%	2%
energy use	-7%	-10%	-12%	-3%	-8%	-12%	-19%		48%	79%	69%	43%	53%	26%	59%	7%
environmental management	1%	-4%	-8%	3%	-12%	-16%	-28%	48%		43%	47%	19%	25%	19%	34%	-3%
ghg emiss	-8%	-6%	-12%	-3%	-8%	-11%	-18%	79%	43%		65%	46%	52%	25%	62%	8%
water use	0%	-8%	-13%	3%	-7%	-15%	-22%	69%	47%	65%		44%	41%	26%	54%	6%
diversity	-9%	-12%	-10%	-1%	-1%	-9%	-9%	43%	19%	46%	44%		39%	16%	44%	9%
sexual orientation	-12%	-2%	-11%	-3%	-13%	-10%	-4%	53%	25%	52%	41%	39%		23%	49%	7%
workforce	-4%	-3%	-5%	-0%	-7%	-6%	-6%	26%	19%	25%	26%	16%	23%		26%	5%
community and politics	-13%	-9%	-13%	-6%	-12%	-13%	-16%	59%	34%	62%	54%	44%	49%	26%		8%
human rights	2%	-4%	5%	2%	2%	-3%	2%	7%	-3%	8%	6%	9%	7%	5%	8%	

Figure 4: Correlations among ESG factors.

At a first glance, we observe a strong dependency among all disclosure factors (high-

lighted with black font on the chart). We find it difficult to explain the 62% correlation between exposure to community\_and\_politics and ghg\_emissions or the 53% correlation between energy\_use and sexual\_orientation, given that each of these factors represent different sustainability dimensions. This finding suggests there is another (hidden) variable that could explain such a strong interdependence. We will see in the next section that the high correlation between disclosures is actually an industry effect.

## 4 ESG Factors and Materiality

### 4.1 Materiality Data

Each industry has a separate and unique impact on society and the environment. An ESG issue which is crucial to valuation in one industry may be irrelevant in another. Coming back to Figure 1, the social evaluation of ESG disclosure indicators is not straightforward. Depending on the industry exposure of the company, the presence or absence of certain disclosures can be interpreted as a sustainable or unsustainable signal, and, hence, have a potential impact on the stock return. In other cases, the presence or absence of certain disclosures can be ignored as non-material information.

We follow guidance from the Sustainability Accounting Standards Board<sup>13</sup> (SASB) to separate material ESG signals from non-material ones. SASB was founded in 2011 as an independent standards-setting organization. SASB’s mission is to develop industry-specific sustainability accounting standards to assist public corporations in disclosing material information to investors. One of the goals of SASB is to determine whether performance on a given sustainability topic would affect the financial condition and operating performance of the company which in turn would likely affect the investment decision of reasonable investors.

SASB’s sustainability topics are organized under five broad dimensions:

- environment
- human capital
- leadership and governance
- social capital
- business model and innovation

SASB provides materiality guidance in the form of a materiality map (Appendix B) that identifies material sustainability topics for 77 SICs industries.<sup>14</sup> To apply the SASB materiality guidance to our ESG dataset, we first mapped each of our ESG factors to a SASB sustainability topic.<sup>15</sup> The mapping is provided in Appendix C. Action factors

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<sup>13</sup>See [www.sasb.org](http://www.sasb.org)

<sup>14</sup>SASB developed the Sustainable Industry Classification System (SICS) to group companies based on their sustainability-related risks and opportunities. For more information please see [www.sasb.org](http://www.sasb.org).

<sup>15</sup>We are using the procedure suggested in Khan, Mozaffar N., George Serafeim, and Aaron Yoon. “Corporate Sustainability: First Evidence on Materiality.” Harvard Business School Working Paper,

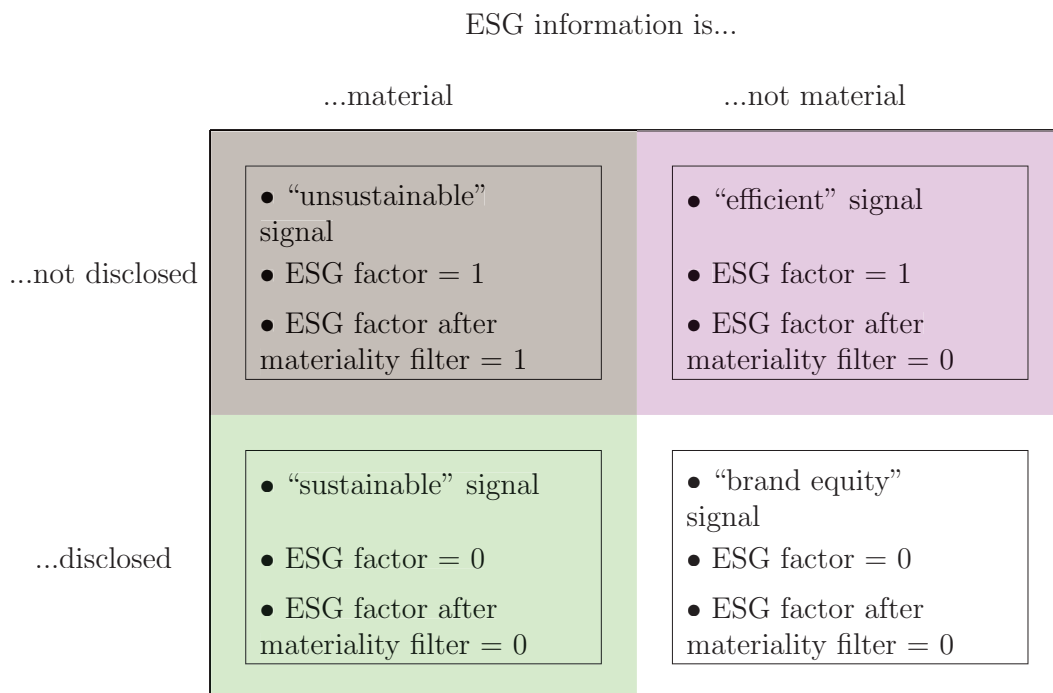


Figure 5: Classification of firms based on ESG information and materiality.

have no clear SASB counterparts, so we assumed all action factors to be material, irrespective of the industry. SASB excludes political disclosure from community relations, which prevented the mapping of `community_and_politics`, but all other disclosure factors are mapped. All mapped ESG factors fall under the first three SASB dimensions: environment, social and human capital. After we mapped each ESG factor, we then mapped each company in our universe to a SASB-defined industry. This methodology gives a materiality measure for each ESG factor / company combination.

## 4.2 ESG factors and materiality

Each disclosure factor generates two types of signals: concern signal or no concern signal. Alternatively, each disclosure factor takes on two types of values: concern (ESG factor = 1) if ESG information is not disclosed or no concern (ESG factor = 0) otherwise. Using ESG information and the SASB materiality guidance together, we are able to classify all signals generated by ESG factors into four broad categories. Figure 5 shows how the interpretation of ESG factors changes as we apply the materiality guidance for each signal category.

The top right quadrant corresponds to an ESG factor that indicates non-disclosure of information that SASB deems non-material. Non-material ESG information is unlikely to impact a company’s financial condition or operating performance. We call these sig-

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No. 15-073, March 2015.

nals efficient because the firm’s decision to not disclose this information may reflect its judgment that the economic benefit of reporting non-material information is not worth the cost of assembling an accurate and timely disclosure. Therefore, we believe that an efficient signal should not impact stock returns: the company should not be penalized for prioritizing material ESG issues over non-material ones. To further illustrate this point, consider a generic consumer products manufacturing company. While the consumer manufacturing industry may be responsible for some amount of GHG emissions, the major environmental impact of the industry lies in the area of water management.<sup>16</sup> Consumer manufacturing companies may operate in areas of scarce water supply. Consequently, they could face increased operating costs or even risk of losing access to water if water management is neglected. We believe an efficient manufacturing company would likely invest in sustainable water management protocols to address its environmental impact in the long term. We believe addressing GHG emissions would only provide short-term benefits (in the form of minor regulatory relief or good publicity). In the case of efficient signals, we override the concern values assigned to ESG factor exposures with no concern values.

The second category in Figure 5 considers the failure to disclose material ESG information as an unsustainable signal. The relationship between unsustainable signals and stock returns is a focus of our research. We assume that the omission of material information could be a sign of trouble. In the previous example, the lack of water use disclosure for the consumer products manufacturer could indicate the company does not evaluate the impact its water use practice may have on communities or ecosystems. Lack of meaningful water conservation policies could create business risks which could have a significant negative impact on the stock price.

For the third category, we consider firms that disclose material ESG information as sustainable. We acknowledge there could be a gap between a company’s sustainability disclosures and the actual actions directed to reduce negative externalities imposed on the environment or society. Going back to water use, the measurement of water use alone is not an adequate indicator of a company’s water-related social and environmental impact. The water measurement does not consider the context from which the water is withdrawn. This metric does not reflect whether production facilities are located in water-stressed regions. For research purposes, we assume the presence of material disclosures serves as a good proxy for actual sustainability performance.

The fourth category consists of firms that provide disclosures regarding non-material information. We call this category brand equity. Considering the costs that come with each ESG disclosure, sustainability policies for this category of companies could serve as a form of brand management — protection of brand equity — rather than a form of business risk management. Whatever the company’s motivation is to disclose non-

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<sup>16</sup> “Household & Personal Products. Sustainability Accounting Standards.” [www.sasb.org](http://www.sasb.org)

material information, it is unlikely to be a sign of trouble. We assume that brand equity signals do not have negative consequences for the firm’s stock performance.

Once we apply the materiality filter to each ESG factor in our dataset, the exposure to action factors and community\_and\_politics remains unchanged. The other disclosure factors are redefined in such a way that a concern now means the failure to disclose material ESG information. Figure 6 provides the distribution of ESG signals in our dataset across the four categories.

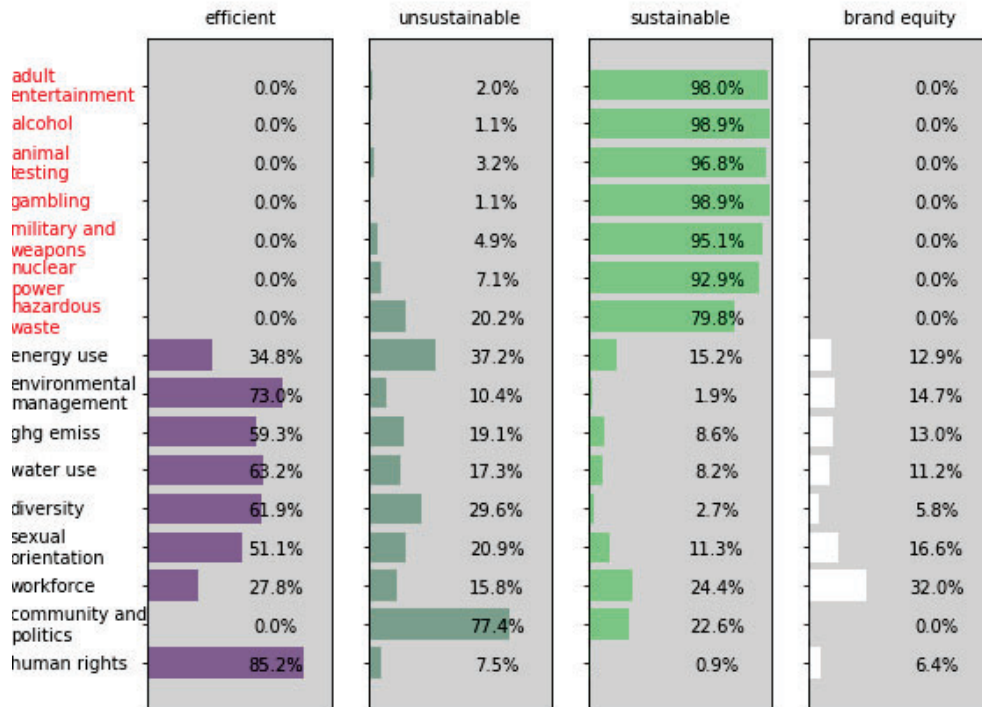


Figure 6: Number of companies flagged by corresponding factors (compare to Figure 3). Red labels indicate action factors; black labels indicate disclosure factors.

### 4.3 Variability of ESG information

Applying the SASB materiality filter reduces the noise coming from non-material ESG information and improves the quality of our ESG data: we see a significant decrease in correlations across disclosure factors in Figure 7 compared to Figure 4.

Although most correlations decrease, we see increased correlation between diversity and sexual\_orientation factors (79%). Diversity and sexual\_orientation factors are in the same SASB sustainability topic; that is, if diversity presents a material sustainability

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animal testing	-3%	-2%		-2%	-1%	0%	7%	-13%	-5%	-6%	-5%	1%	2%	-6%	-13%	19%
gambling	28%	7%	-2%		-0%	-2%	-5%	3%	9%	-5%	4%	4%	2%	0%	-6%	-3%
military and weapons	-0%	-1%	-1%	-0%		24%	12%	6%	-3%	-3%	-5%	-3%	-6%	-1%	-12%	-0%
nuclear power	-4%	-0%	0%	-2%	24%		18%	-1%	-4%	-0%	-5%	-11%	-9%	4%	-13%	-3%
hazardous waste	-6%	7%	7%	-5%	12%	18%		6%	5%	11%	11%	-20%	-15%	10%	-16%	7%
energy use	-9%	-3%	-13%	3%	6%	-1%	6%		25%	31%	31%	14%	20%	26%	26%	5%
environmental management	-4%	1%	-5%	9%	-3%	-4%	5%	25%		31%	54%	-22%	-17%	25%	-2%	37%
ghg emiss	-7%	2%	-6%	-5%	-3%	-0%	11%	31%	31%		50%	6%	9%	34%	9%	20%
water use	-7%	3%	-5%	4%	-5%	-5%	11%	31%	54%	50%		-17%	-11%	26%	8%	23%
diversity	6%	-4%	1%	4%	-3%	-11%	-20%	14%	-22%	6%	-17%		79%	3%	10%	3%
sexual orientation	2%	-2%	2%	2%	-6%	-9%	-15%	20%	-17%	9%	-11%	79%		6%	19%	7%
workforce	-6%	-1%	-6%	0%	-1%	4%	10%	26%	25%	34%	26%	3%	6%		5%	5%
community and politics	-13%	-9%	-13%	-6%	-12%	-13%	-16%	26%	-2%	9%	8%	10%	19%	5%		-7%
human rights	-4%	-3%	19%	-3%	-0%	-3%	7%	5%	37%	20%	23%	3%	7%	5%	-7%	

Figure 7: Correlations among ESG factors adjusted for materiality. Compare to Figure 4.

issue for the company, sexual orientation is a material issue as well. A strong correlation between these two factors implies that if a company does not implement sustainable policies with respect to workforce diversity, it likely does not provide benefits to same sex couples. From a regression standpoint, such a strong dependence between factors represents a multicollinearity problem which makes it difficult to measure the effect of the two factors independently. The typical solution to multicollinearity (when factors plausibly represent the same risk) is merging both variables into one.

Running principal component analysis (PCA) on our dataset helps to find the combinations of ESG factors that best distinguish one firm from another. Figure 8 shows the first three principal components and their positive and negative loadings on each ESG

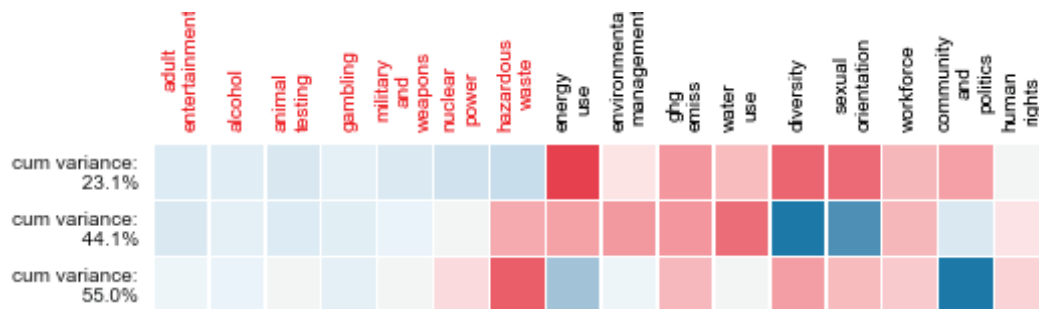


Figure 8: PCA decomposition: first three components. Darker colors represent higher absolute values (red for positive, blue for negative).

factor.<sup>17</sup> We can make two observations from this chart. First, the first component’s exposure to disclosure factors is higher compared to exposure to action factors. In other words, the chart identifies a single latent factor that distinguishes firms according to their general level of disclosure across several measures. Second, the first and second component have equally high (first component) or low (second component) exposure to diversity and sexual\_orientation factors. This confirms our intuition that both factors generally describe the same risk related to a company’s sustainability with respect to diversity and sexual orientation and should be combined into a single variable.

#### 4.4 ESG factors, materiality and other drivers of stock returns

What types of firms face ESG challenges? We answer this question by measuring correlations between ESG factors and other known drivers of equity risk. See Figure 9 for ESG factors’ correlations with market capitalization, earnings-to-price, revenue-to-price, dividend yield and twelve industry sectors.<sup>18</sup>

Figure 9 demonstrates that before applying the SASB-based materiality adjustment, large market capitalization companies are more likely to disclose ESG information. This means ESG investing may result in an unintended bet on company size if market capitalization is not controlled for in portfolio construction. Figure 9 also shows negative correlations between the disclosure ESG factors and both the price-earnings ratio and dividend yield. One could argue that companies with high positive exposure to these market factors might be in better financial shape and therefore be able to invest more in ESG measures that improve their sustainability reporting.

<sup>17</sup>PCA decomposition is done for all months pooled together. The reported cumulative variance and component loadings are calculated across the whole history. Thus, cumulatively, the first three components explain 55.0% of the variance in the ESG dataset.

<sup>18</sup>Source: sectors are GICS sectors. Market capitalization, earnings-to-price, revenue-to-price, dividend yield are provided by Northfield ([www.northinfo.com](http://www.northinfo.com))



	Market Cap	EP	R/P	Dividend yield	Communication Services	Consumer Discretionary	Consumer Staples	Energy	Financials	Health Care	Industrials	Information Technology	Materials	Real Estate	Telecommunication Services	Utilities
adult entertainment	16%	1%	0%	4%	59%	-2%	-3%	-4%	-6%	-5%	-6%	-2%	-4%	-4%	15%	-3%
alcohol	4%	2%	0%	-1%	-2%	4%	23%	-3%	-2%	-4%	-2%	-4%	-3%	-2%	-0%	1%
animal testing	14%	3%	-3%	5%	-3%	-4%	14%	-4%	-7%	31%	-5%	-6%	-3%	-5%	-1%	-4%
gambling	3%	-1%	-0%	-5%	16%	9%	-2%	-3%	-4%	-4%	-4%	3%	-3%	-3%	1%	-2%
military and weapons	10%	4%	6%	3%	-1%	-7%	-5%	-3%	-7%	-1%	23%	4%	0%	-6%	-1%	-4%
nuclear power	10%	1%	-2%	2%	-5%	-11%	-6%	-4%	-10%	-5%	25%	-2%	0%	-7%	-1%	31%
hazardous waste	15%	4%	-1%	7%	-8%	-10%	10%	2%	-20%	-2%	20%	-4%	29%	-11%	-2%	3%
energy use	-57%	-12%	6%	-19%	-1%	5%	-13%	2%	7%	2%	2%	-2%	-5%	3%	1%	-11%
environmental management	-33%	-6%	4%	-14%	6%	8%	-0%	4%	14%	3%	-9%	-14%	-16%	6%	2%	-1%
ghg emiss	-53%	-10%	6%	-18%	-1%	4%	-13%	-0%	6%	3%	0%	1%	-6%	6%	0%	-10%
water use	-44%	-10%	5%	-18%	5%	6%	-14%	0%	12%	-2%	1%	-2%	-8%	4%	2%	-12%
diversity	-33%	-6%	5%	-12%	-3%	3%	-15%	-5%	4%	0%	3%	5%	-0%	6%	1%	-12%
sexual orientation	-50%	-12%	-1%	-15%	-8%	-2%	-9%	6%	-1%	0%	2%	-3%	7%	11%	1%	-5%
workforce	-23%	-6%	3%	-8%	-0%	2%	-0%	-1%	6%	-3%	-2%	-6%	1%	9%	3%	-8%
community and politics	-50%	-9%	4%	-18%	-3%	5%	-12%	-8%	8%	-2%	3%	3%	-2%	8%	2%	-17%
human rights	-2%	-4%	-4%	-4%	2%	-11%	-10%	-2%	8%	6%	3%	7%	-2%	3%	-1%	-14%

Figure 9: Correlations: ESG factors vs other equity risk factors (before materiality filter).

It is also worth noting the positive correlations between both the financial and real estate sectors and a range of environmental disclosures. For example, exposure to the financial sector is correlated with having concerns in the areas of environmental management and water use. These artifacts result from using ESG information without accounting for materiality. Once we apply the SASB-based materiality adjustment, these counter-intuitive sector correlations reverse (please refer to Figure 10). As a result, environmental disclosures regarding GHG emissions, energy and water use along with the implementation of environmentally responsible policies become more correlated with the consumer staples, energy and materials sectors.

The materiality filter reduces, but does not eliminate, the negative correlation between

	Market Cap	EP	R/P	Dividend yield	Communication Services	Consumer Discretionary	Consumer Staples	Energy	Financials	Health Care	Industrials	Information Technology	Materials	Real Estate	Telecommunication Services	Utilities
adult entertainment	16%	1%	0%	4%	59%	-2%	-3%	-4%	-6%	-5%	-6%	-2%	-4%	-4%	15%	-3%
alcohol	4%	2%	0%	-1%	-2%	4%	23%	-3%	-2%	-4%	-2%	-4%	-3%	-2%	-0%	1%
animal testing	14%	3%	-3%	5%	-3%	-4%	14%	-4%	-7%	31%	-5%	-6%	-3%	-5%	-1%	-4%
gambling	3%	-1%	-0%	-5%	16%	9%	-2%	-3%	-4%	-4%	-4%	3%	-3%	-3%	1%	-2%
military and weapons	10%	4%	6%	3%	-1%	-7%	-5%	-3%	-7%	-1%	23%	4%	0%	-6%	-1%	-4%
nuclear power	10%	1%	-2%	2%	-5%	-11%	-6%	-4%	-10%	-5%	25%	-2%	0%	-7%	-1%	31%
hazardous waste	15%	4%	-1%	7%	-8%	-10%	10%	2%	-20%	-2%	20%	-4%	29%	-11%	-2%	3%
energy use	-31%	-5%	9%	-15%	-9%	14%	-2%	20%	-30%	-10%	4%	25%	13%	-19%	-3%	-14%
environmental management	-4%	-0%	0%	-5%	-6%	9%	21%	34%	-14%	-12%	1%	-14%	10%	-9%	-1%	-7%
ghg emiss	-12%	-1%	5%	-4%	-9%	-20%	11%	13%	-20%	6%	9%	-2%	33%	-12%	-2%	7%
water use	-11%	-1%	-2%	-7%	-8%	10%	13%	16%	-17%	-16%	-12%	-2%	34%	-9%	-2%	10%
diversity	-5%	-2%	4%	-3%	12%	13%	-14%	-16%	-11%	15%	-5%	31%	-17%	-17%	7%	-13%
sexual orientation	-20%	-6%	1%	-9%	9%	10%	-11%	-13%	-11%	16%	-2%	23%	-13%	-13%	6%	-10%
workforce	-7%	-2%	4%	-6%	-8%	13%	8%	2%	-18%	-4%	16%	-11%	12%	-11%	-2%	-1%
community and politics	-50%	-9%	4%	-18%	-3%	5%	-12%	-8%	8%	-2%	3%	3%	-2%	8%	2%	-17%
human rights	0%	0%	2%	-3%	-5%	-12%	-6%	39%	-12%	26%	-12%	-12%	19%	-7%	-1%	-6%

Figure 10: Correlations: ESG factors vs other equity risk factors (after materiality filter).

market capitalization and disclosure factors. Figure 10 still demonstrates the importance of controlling systematic risk factors alongside ESG risks in portfolios.

#### 4.5 “Brand Equity” signals

Brand equity signals refer to disclosures of non-material information. Many of the signals in our dataset belong to this category (see Figure 6).

Some researchers<sup>19</sup> argue that in a market environment where ESG investing is valued, but where ESG information is sparse, unstructured, and unregulated, ESG indicators may be significantly mispriced. For example, a company announcement of a new, but

<sup>19</sup>Orlitzky, M. (2013). Corporate social responsibility, noise, and stock market volatility. *Academy of Management Perspectives*, 27(3), 238-254. doi:10.5465/amp.2012.0097

non-material sustainability initiative may lead to stock price appreciation. Conversely, failure to commit to well publicized, yet non-material issues (such as carbon emissions reduction) may result in negative sentiments towards the firm. In such an environment, publicly traded companies would have an economic incentive to transmit what we call brand equity signals.

We designed our analysis to measure the effect of detrimental ESG factors (unsustainability) on stock returns; we will not consider the possible benefit of brand equity signals in this study. Exploring brand equity signals could be a promising area for future research as it will help to better understand the interaction of materiality and corporate sustainability.

## 5 Model Estimation

To examine the relationship between stock returns and ESG factors, we need to first make sure that returns from other well known systematic risk factors, including market capitalization, momentum and industry exposure, are not mistakenly attributed to ESG factors.

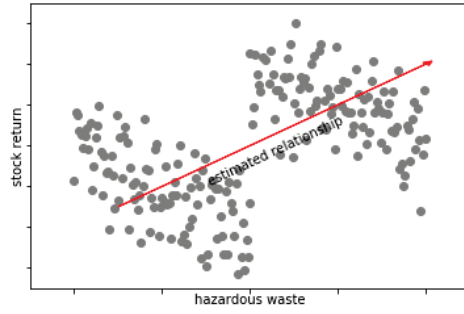
Figure 11 shows how ignoring exposure to industry, one of the strongest systematic risk factors, can lead to misleading results regarding the relationship between ESG factors and stock performance.

Consider a hypothetical sample of companies from the textile industry and the dye production industry. Both Figure 11(a) and Figure 11(b) are scatter plots of companies' stock returns versus their amounts of hazardous waste generated. Each data point represents a single company. In Figure 11(a), we ignore the industry each company belongs to and assign the same color to all data points. From this figure, one could conclude that a company that generates a greater amount of hazardous waste is associated with higher returns.

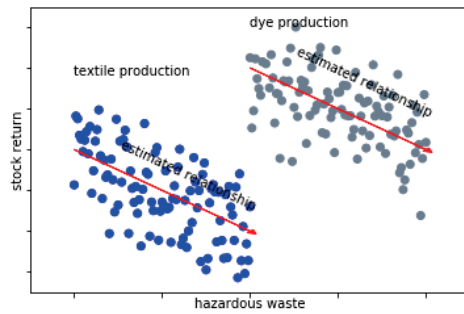
Figure 11(b) differentiates each company by the industry it belongs to. We assign either a blue color if the company belongs to the textile industry or a grey color if the company belongs to the dye production industry. This figure shows that companies in the dye production industry, on average, generate higher amounts of hazardous waste compared to companies in the textile industry. Figure 11(b) also shows that companies in the dye production industry, on average, have higher returns compared to companies in the textile industry. If we separate companies by their industry exposure, we discover that companies that are actually associated with lower returns generate higher amounts of hazardous waste, a conclusion different from an industry agnostic analysis.

We systemize the intuition of Figure 11 in a two step process:

1. Neutralize stock returns from any effect of the systematic risk factors.



(a) Industry blind approach



(b) Industry aware approach

Figure 11: Example: stock performance vs hazardous waste

2. Use stock return residuals (neutralized returns) from the previous step to estimate ESG premiums.

Our equity risk model for neutralization is based on the Northfield<sup>20</sup> US Fundamental factor model. We use 66 factors: 55 industry dummy variables and 11 fundamental and technical variables. See Appendix D for a detailed explanation of Northfield factors. We work with the following multi-factor specification:

$$r_{it} = \sum_{n=1}^{N_1} f_{nt} X_{int} + u_{it} \quad (\text{step 1})$$

$$u_{it} = \sum_{n=1}^{N_2} g_{nt} Y_{int} + \epsilon_{it} \quad (\text{step 2})$$

where:

- $r_{it}$  is the return in excess of the risk free rate for stock  $i$  over month  $t$ ,

<sup>20</sup>Source: Northfield (2015), U.S. Fundamental Equity Risk Model. Retrieved from <http://www.northinfo.com/documents/8.pdf>

- $X_{int}$  is the exposure of stock  $i$  to systematic risk factor  $n$  at the beginning of month  $t$ ,
- $N_1 = 65$  is the total number of systematic risk factors,
- $Y_{int}$  is the exposure of stock  $i$  to ESG factor  $n$  at the beginning of month  $t$ ,
- $N_2 = 16$  is the total number of ESG factors
- regression coefficient  $f_{nt}$  represents the amount of return over month  $t$  associated with a unit exposure to systematic risk factor  $n$ .
- regression coefficient  $g_{nt}$  represents the amount of return over month  $t$  associated with a unit exposure to ESG factor  $n$ .

When formulating our ESG model (step 2), we recall that our PCA analysis (see Section 4.3) demonstrated a strong correlation between the diversity and sexual\_orientation factors, suggesting that diversity and sexual\_orientation may, in fact, represent exposures to the same risk. To avoid collinearity issues, we combine<sup>21</sup> both factors into one, assuming:

$$\text{diversity and sexual\_orientation} = \frac{(\text{diversity} + \text{sexual\_orientation})}{2}$$

The regressions assume the neutralized returns  $u_{it}$  and the specific returns  $\epsilon_{it}$  to be independent normal random variables. Both regressions (step 1 and step 2) are estimated monthly with a generalized least squares method.<sup>22</sup> Please see Table 1 for the description of the investment universe. This two step process ensures that we always look at the sustainability profile in the proper industry context. The alternative approach of combining all the variables into a single regression would make the situation ambiguous due to the presence of multicollinearity (see Section 4.3). Instead our two step process conservatively assumes that returns are better described by systematic risk factors. After all the risk that could be attributed to the systematic risk is captured in the regressions in step 1, we explore the effect of ESG factors' exposures on neutralized returns in the regressions in step 2.

We compound the monthly returns to ESG factors  $g_{nt}$  to calculate a return time series for each ESG factor. It is these time series that represent the returns to ESG investing.

After the returns for each ESG factor are estimated, we can finally address two major questions:

1. Are ESG factors good risk factors? In other words, do ESG factors improve the prediction of portfolio risk?

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<sup>21</sup>diversity and sexual\_orientation are the only factors adjusted following the PCA analysis discussion.

<sup>22</sup>The generalized least squares method weights observations by the square root of market capitalization. This is an industry standard approach. Please see "Risk and Return of Factor Portfolios: The Impact of Regression Weighting" by Jose Menchero and Zoltan Nagy. MSCI Research Insight.

- Are ESG factors good alpha factors? Alternatively, do ESG factors improve the prediction of portfolio returns?

### 5.1 Are ESG factors good risk factors?

To answer this question, Figure 12 shows the adjusted  $R$ -squared time series for both of our monthly cross-sectional regressions. We also plotted the CBOE Volatility Index to put the fluctuation of adjusted  $R$ -squared into perspective.

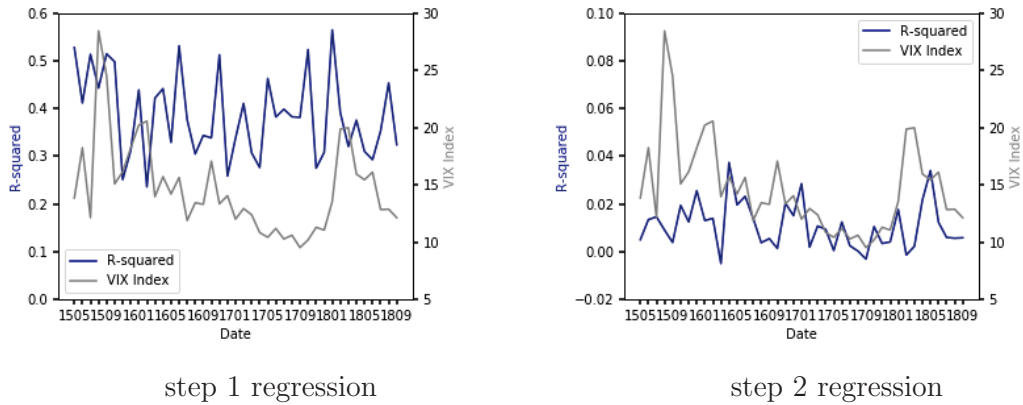


Figure 12: Monthly adjusted coefficient of determination ( $R^2$ ) of both (1) and (2) regressions alongside CBOE Volatility Index (VIX)

The risk regression has an adjusted  $R$ -squared fluctuating around 40%, which is typical of a fundamental equity risk model. After we remove the effect of traditional equity risk factors, the adjusted  $R$ -squared of residual returns regressed against ESG factors drops to an average of 1.1%.

This low coefficient of determination implies that ESG factors are unlikely to be useful in risk modeling because they do not explain enough of the variance of stock returns. However, interpreting  $R$ -squared as the squared correlation between the predicted and realized neutralized returns from step 2 regressions suggests an information coefficient  $\approx 0.1$  which may be relevant to alpha. This brings us to the next question.

### 5.2 Are ESG factors good alpha factors?

Table 3 summarizes average returns and Sharpe ratios estimated for each ESG factor. We also provide Figure 13 to put monthly estimated ESG premiums in the context of ESG premiums' volatility. The Sharpe ratios are not high enough to conclude that returns delivered by any of the ESG factors are enough to compensate for the corresponding factor volatility.<sup>23</sup> That is, there is no statistical evidence for positive or negative ESG alphas.

<sup>23</sup>We provide information about Northfield factors premiums in Appendix E.

To summarize our estimation results, the jury is still out as to whether integrating ESG factors into an investment process impacts portfolio risk and return. While we did not find conclusive evidence that ESG factors increase the risk adjusted return of a portfolio, we also did not find any evidence to the contrary. This has important consequences for ESG conscious investors.

Table 3: Step two regression results.

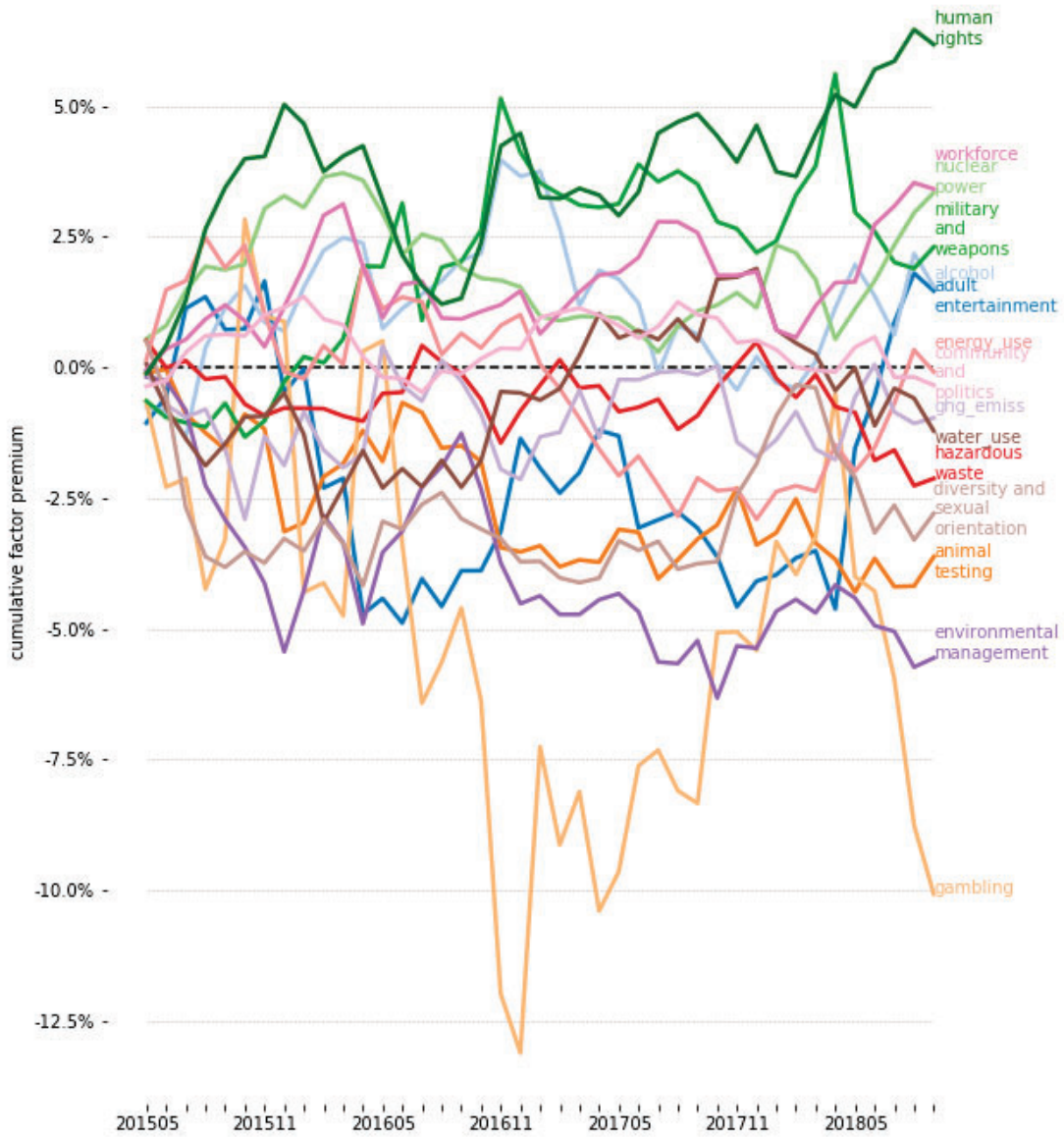
Factor	Average:		
	Premium	Sharpe ratio	VIF
adult_entertainment	0.43%	0.11	1.11
alcohol	0.45%	0.16	1.03
animal_testing	(1.08%)	(0.47)	1.10
gambling	(3.06%)	(0.33)	1.14
military_and_weapons	0.67%	0.22	1.13
nuclear_power	0.97%	0.59	1.17
hazardous_waste	(0.63%)	(0.40)	1.33
energy_use	(0.02%)	(0.01)	2.18
environmental_management	(1.66%)	(0.61)	1.92
ghg_emiss	(0.28%)	(0.11)	1.90
water_use	(0.36%)	(0.16)	2.18
diversity_and_sexual_orientation	(0.83%)	(0.35)	1.68
workforce	0.99%	0.54	1.44
community_and_politics	(0.10%)	(0.09)	2.11
human_rights	1.77%	0.76	1.40

Average premium is calculated as the annualized cumulative return of each ESG factor. Sharpe ratio is the factor annualized return divided by its annualized standard deviation. VIF quantifies the severity of multicollinearity in regression. It measures the factor by which the error in estimating the regression coefficient, in our case the ESG premium, is increased because of collinearity. Generally, values of VIF much larger than unity indicate that the ESG premium cannot be estimated properly. That is, because two ESG factors are so correlated that their affect on returns cannot be clearly separated. VIF factor is estimated for each regression separately and reported as an average.

## 6 Final thoughts on integrating ESG information into the investment process

Although the industry has no generally accepted techniques for the application of ESG factors to the investment process, we make several recommendations. First, sustainability information is best understood in the context of a firm's motivation for disclosing it. In this paper, we employ SASB's materiality guidance map to separate companies' material disclosures from non-material disclosures. We argue that only material disclosures have

Figure 13: Cumulative ESG premiums.





investment value. Second, ESG factor exposures contain industry and size effects that could lead to unintended bets in portfolios. By interacting materiality information with ESG factors, we create a new signal that corrects such spurious correlations. Using these signals, we find no evidence that ESG factors are important to risk modeling nor that ESG premia drive stock returns.

Any conclusions drawn from our analysis are constrained by at least two considerations. First, less than four years of data limits our ability to draw conclusions about investment performance. We could benefit from a longer data history. Second, our results may suffer from the imprecision of ESG factors as a measure of corporate sustainability. As discussed in Section 4, the presence or absence of a sustainability disclosure does not automatically imply that the company is sustainable or unsustainable with respect to that specific ESG factor. This imprecision represents an error-in-variables problem that could bias our estimation of factor returns and Sharpe ratios downward.

Aware of these constraints, our analysis suggests that returns of a portfolio controlled for ESG factors would not differ from the returns of a non-controlled portfolio on a risk adjusted basis. This result has implications for investors considering the integration of sustainability information into their investment process. Since exposures to ESG factors yield neither positive nor negative risk premia, this implies you can do good and do as well as before.

## Disclosures

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# Appendices

## A List of ISS flags

Allocation of ISS flags across themes

ESG theme	ISS flags <sup>1</sup>	Interpretation <sup>2</sup>
adult entertainment	Adult entertainment revenue band > 5%	concern
	Adult media Any	concern
	Sexually explicit internet operations Any	concern
	Sexually explicit live performance Any	concern
	Adult software or video games Any	concern
alcohol	Alcohol manufacturing or branding Any	concern
	Alcohol manufacturing or wholesale revenue band > 5%, > 10%	concern
	Alcohol production or sales revenue > 10%	concern
	Alcohol production revenue > 0%, > 10%	concern
	Alcohol wholesale distribution Any	concern
animal testing	On PETA's testing list	concern
	On USDA's testing list	concern
	Non-pharmaceutical testing Any	concern
	Pharmaceutical testing Any	concern
GHG emissions	Climate change disc: No disclosure	concern
	Direct GHG emissions: No disclosure	concern
	Indirect GHG emissions: No disclosure	concern
community and politics	Community investment policies and programs: No policy attributes	concern
	Community Reinvestment Act: Has subsidiary	concern
	Political policies and disclosures: No disclosure	concern
	Predatory lending Any	concern
diversity	Senior management % minorities: No disclosure	concern
	Senior management % women: No disclosure	concern
	Total workforce % minorities: No disclosure	concern
	Total workforce % women: No disclosure	concern
	Flag > 25% of management comprised of women	strength
	Flag > 25% of management comprised of minorities	strength
environmental management	Environmental disclosures: No disclosure	concern
	Environmental policy: No policy attributes	concern
	ISO 14001 environmental management systems: No certification	concern

<sup>1</sup> For more information please check <https://www.issgovernance.com/esg/>

<sup>2</sup> The majority of flags are defined in a way that 1 (or True) equals unsustainable behavior. For simplicity, we redefine sustainable behavior flags into concern flags and change the values accordingly. See discussion in Section 3.

Allocation of ISS flags across themes (continued)

ESG theme	ISS flags <sup>1</sup>	Interpretation <sup>2</sup>
energy use	Energy use: No disclosure	concern
hazardous waste	Chemical or oil spills trend : Increasing trend	concern
	Environmental fines trend : Increasing trend	concern
	Toxic emissions trend: Increasing trend	concern
	Toxic production waste trend : Increasing trend	concern
water use	Water use: No disclosure	concern
gambling	Gambling revenue > 10%	concern
	Online gaming Any	concern
human rights	Human rights policy: No policy attributes	concern
	Ties to oppressive regimes or Any involvement	concern
military and weapons	Civilian Firearms production Any	concern
	Firearms or ammunition manufacturing Any	concern
	Civilian firearms revenue band > 1%	concern
	Conventional weapons Any	concern
	Conventional weapons revenue band > 10%, > 20%	concern
	DOD Top 100 Contractors: On list	concern
	Firearms or ammunition manufacturing retail revenue band > 1%, > 5%	concern
	Landmines and cluster munitions Any	concern
	Landmines and cluster munitions revenue band > 5%	concern
	Military equipment revenue band : > 10%, > 20%	concern
	Nuclear weapons Any	concern
	Nuclear weapons revenue band > 10%, 5%	concern
	Nuclear weapons systems: Creation of entire systems	concern
	Nuclear weapons systems: Creation of non-strategic parts	concern
	Nuclear weapons systems: Creation of strategic parts	concern
	Weapons systems: Creation of entire systems	concern
	Weapons systems: Creation of non-strategic parts	concern
	Weapons systems: Creation of strategic parts	concern

<sup>1</sup> For more information please check <https://www.issgovernance.com/esg/>

<sup>2</sup> The majority of flags are defined in a way that 1 (or True) equals unsustainable behavior. For simplicity, we redefine sustainable behavior flags into concern flags and change the values accordingly. See discussion in Section 3.

Allocation of ISS flags across themes (continued)

ESG theme	ISS flags	Interpretation <sup>2</sup>
nuclear power	Nuclear electricity generation revenue band > 10%	concern
	Nuclear goods or services Any	concern
	Nuclear power generation or sales Any	concern
	Nuclear electricity sales: Any	concern
	Nuclear power association member: Member	concern
	Nuclear power stations: Any	concern
sexual orientation	Non-discriminatory policy does not include sexual orientation	concern
workforce	Same sex benefits: No benefits	concern
	On AFL-CIO boycott list	concern
	EEOC: Fines or disciplinary action	concern
	Employee benefits: No disclosure	concern
	Strikes or labor actions Any	concern
	Workforce disc/policy: No policy attributes	concern

<sup>1</sup> For more information please check <https://www.issgovernance.com/esg/>

<sup>2</sup> The majority of flags are defined in a way that 1 (or True) equals unsustainable behavior. For simplicity, we redefine sustainable behavior flags into concern flags and change the values accordingly. See discussion in Section 3.

## B SASB Materiality Map

Dimension	General Issue Category	Consumer Goods	Extractives & Minerals Processing	Financials	Food & Beverage	Health Care	Infrastructure	Renewable Resources & Alternative Energy	Resource Transformation	Services	Technology & Communications	Transportation
GHG Emissions	GHG Emissions											
	Air Quality											
Environment	Energy Management											
	Water & Wastewater Management											
	Waste & Hazardous Materials Management											
	Ecological Impacts											
	Human Rights & Community Relations											
	Customer Privacy											
Social Capital	Data Security											
	Access & Affordability											
	Product Quality & Safety											
	Customer Welfare											
	Selling Practices & Product Labeling											
	Labor Practices											
Human Capital	Employee Health & Safety											
	Employee Engagement, Diversity & Inclusion											
	Product Design & Lifecycle Management											
Business Model & Innovation	Business Model Resilience											
	Supply Chain Management											
	Materials Sourcing & Efficiency											
Leadership & Governance	Physical Impacts of Climate Change											
	Business Ethics											
	Competitive Behavior											
	Management of the Legal & Regulatory Environment											
	Critical Incident Risk Management											
	Systemic Risk Management											

Source: [www.sasb.org](http://www.sasb.org). Note: Dark gray color means that the corresponding issue is likely to be material for more than 50% of the industries in that sector. Light gray color means that the corresponding issue is likely to be material for less than 50% of the industries in that sector. White color means that the corresponding issue is likely to not be material for any of the industries in that sector. A more detailed industry level map is available on [sasb.org](http://sasb.org)

## C Mapping of ESG factors to SASB Materiality Map topics

ESG factor	SASB topic <sup>1</sup>	SASB dimension <sup>1</sup>
ghg_emiss	GHG Emissions	Environment
hazardous_waste	unmapped	unmapped
energy_use	Energy Management	Environment
water_use	Water and Wastewater management	Environment
environmental_management	Ecological Impacts	Environment
diversity	Employee Engagement, Diversity and Inclusion	Human Capital
sexual_orientation	Employee Engagement, Diversity and Inclusion	Human Capital
workforce	Labor Practices	Human Capital
human_rights	Human Rights and Community Relations	Social Capital
community_and_politics	unmapped	unmapped
adult_entertainment	unmapped	unmapped
alcohol	unmapped	unmapped
animal_testing	unmapped	unmapped
gambling	unmapped	unmapped
military_and_weapons	unmapped	unmapped
nuclear_power	unmapped	unmapped

<sup>1</sup> For more information about SASB topics please check <https://www.sasb.org/>

## D Northfield U.S. Fundamental Equity Risk Model

### Factors description

Factor	Name	Description
E/P	earnings-to-price ratio	The ratio of earnings per share to the most recent month-end market price. EPS is defined as trailing twelve-month earnings as reported on the most recent quarterly report.
B/P	book-to-price	The ratio of book value per share as reported on the most recent quarterly report to the most recent month-end market price.
YIELD	dividend yield	The trailing twelve-month cash dividends paid per share divided by the most recent month-end market price.
TRADE	trading activity	The ratio of the average daily trading volume during the past year divided by shares outstanding as reported in the most recent quarterly report.
RST	12-month relative strength	The ratio of (1 + the decimal fraction price change for the security) to the average of (1 + the decimal fraction price change) for all stocks in the universe, measured over the last 12 months.
CAP	logarithm of market capitalization	The logarithm (base 10) of total market value of common shares outstanding, using the most recent month end market price, and the shares outstanding as reported on the most recent quarterly report.
EVAR	earnings variability	The numerical value “one” minus the <i>R</i> -squared statistic for a trend line of the most recent five years of fiscal year earnings per share.

<sup>1</sup> Source: Northfield (2015), U.S. Fundamental Equity Risk Model. Retrieved from <http://www.northinfo.com/documents/8.pdf>



Factors description (continued)

Factor	Name	Description
EGR	EPS growth rate	The annual compound percentage growth rate, consisting of a blend of 50% historic earnings per share growth rate over the past five fiscal years, 25% our expected long term earnings growth rate, and 25% the “sustainable earnings growth rate” (FY1 Return on Equity $\times$ FY1 Retention Ratio).
R/P	revenue-to-price ratio	The ratio of trailing twelve-month revenues per share as reported on the most recent quarterly report to the most recent month-end market price.
DEBT/EQ	debt-to-equity	The ratio of long-term debt outstanding to corporate net worth (total book value) as reported on the most recent quarterly report.
PR VOL	price volatility	A price volatility index calculated as the (52 week high price minus 52 week low price) divided by the (52 week high price plus the 52 week low price).

<sup>1</sup> Source: Northfield (2015), U.S. Fundamental Equity Risk Model. Retrieved from <http://www.northinfo.com/documents/8.pdf>

Factors description (continued): industries

Factor	Name	Factor	Name
ETRON	Electronics	CPU	Computers
SOFT	Computer Software	EE	Electrical Equipment
MACH	Machinery	CHEMB	Chemicals Basic
CHEMS	Chemicals Specialty	GOLD	Precious Metals
FE	Iron and Steel	MINE	Metals and Mining
PAPER	Paper	MFG	General Manufacturing
MBANK	Major Banks	WASTE	Environmental and Waste
RBANK	Regional Banks	TRANS	Railroads and Shipping
S&L	Savings and Loans	AERO	Aerospace
FINSRV	Financial Services	SRVB	Services Business
FINMSC	Financial Misc.	SRVC	Services Consumer
LIFE	Insurance Life	PARTS	Auto Aftermarket
INSPC	Insurance Other	TOBC	Tobacco
CONST	Building Construction	SOAP	Soaps and Toiletries
BMAT	Building Materials	DRINK	Beverages
FOREST	Forest Products	FOODB	Foods Basic
AIR	Airlines	FOODP	Foods Packaged
AUTO	Auto and Truck	RETF	Retail Food and Drugs
TRUCK	Trucking	RX	Drugs
CLOTH	Apparel and Textiles	MEDSUP	Medical Supplies
RETSG	Retail Soft Goods	HOSP	Medical Services
RETHG	Retail Hard Goods	PHONE	Telecommunications
BROAD	Broadcasting	EUTIL	Electric and Water Utilities
PUB	Publishing	GUTIL	Gas Utilities
HOTEL	Lodging and Restaurant	OILBIG	Oil Integrated Majors
CONS	Consumer Products	PUMP	Oil Refining and Sales
LEIS	Leisure	WELL	Oil Extraction
OILSRV	Oil Services		

<sup>1</sup> Source: Northfield (2015), U.S. Fundamental Equity Risk Model. Retrieved from <http://www.northinfo.com/documents/8.pdf>

## E Northfield U.S. Fundamental Equity Risk Model: Premiums

Step one regression results - orthogonalizing stock returns vs conventional equity factors.

Factor	Average:		
	Premium	Sharpe ratio	VIF
E/P	-4.04%	-2.49	1.35
B/P	10.24%	3.53	1.57
YIELD	0.38%	0.15	1.20
TRADE	3.51%	1.25	1.42
RST	48.74%	8.59	1.43
CAP	-0.31%	-0.13	1.44
EVAR	-0.75%	-0.70	1.55
EGR	-0.19%	-0.11	1.30
R/P	-2.38%	-1.06	1.39
DEBT/EQ	1.38%	1.17	1.15
PR VOL	-9.23%	-1.38	2.06
MBANK	11.93%	0.64	1.00
RBANK	13.31%	0.68	1.00
S&L	15.18%	0.84	1.00
FINSRV	14.66%	0.89	1.00
FINMSC	5.61%	0.45	1.00
LIFE	9.28%	0.51	1.00
INSPC	16.77%	1.69	1.00
CONST	11.52%	0.63	1.00
BMAT	14.05%	0.80	1.00
FOREST	17.52%	0.87	1.00
AIR	12.23%	0.55	1.00
AUTO	6.27%	0.36	1.00
TRUCK	13.88%	0.63	1.00
CLOTH	3.02%	0.21	1.00
RETSG	1.77%	0.12	1.00
RETHG	4.85%	0.28	1.00
BROAD	11.67%	0.62	1.00
PUB	6.06%	0.39	1.00
HOTEL	10.92%	0.93	1.00

Average premium is calculated as the annualized cumulative return of each factor. Sharpe ratio is the factor annualized return divided by its annualized standard deviation. VIF quantifies the severity of multicollinearity in regression. It measures the factor by which the error in estimating the regression coefficient, in our case the ESG premium, is increased because of collinearity. Generally, values of VIF much larger than unity indicate that the ESG premium cannot be estimated properly. This is because two ESG factors are so correlated that their affect on returns cannot be clearly separated. VIF factor is estimated for each regression separately and reported as an average.

Step one regression results - orthogonalizing stock returns vs conventional equity factors (continued).

Factor	Average:		
	Premium	Sharpe ratio	VIF
CONS	5.34%	0.34	1.00
LEIS	11.35%	0.82	1.00
ETRON	18.97%	1.15	1.00
CPU	17.58%	1.13	1.00
SOFT	17.12%	1.47	1.00
EE	20.45%	1.37	1.00
MACH	13.12%	0.72	1.00
CHEMB	3.19%	0.16	1.00
CHEMS	14.43%	0.96	1.00
GOLD	4.12%	0.11	1.00
FE	12.7%	0.40	1.00
MINE	4.64%	0.11	1.00
PAPER	2.36%	0.13	1.00
MFG	7.77%	0.61	1.00
WASTE	4.36%	0.34	1.00
TRANS	12.13%	0.67	1.00
AERO	20.84%	1.54	1.00
SRVB	13.23%	0.92	1.00
SRVC	13.11%	1.02	1.00
PARTS	6.75%	0.43	1.00
SOAP	6.02%	0.54	1.00
DRINK	10.86%	1.11	1.00
FOODB	4.61%	0.33	1.00
FOODP	7.05%	0.61	1.00
RETF	-2.42%	-0.13	1.00
RX	12.86%	0.77	1.00
MEDSUP	25.94%	2.22	1.00
HOSP	16.85%	1.19	1.00
PHONE	12.5%	0.95	1.00
EUTIL	12.03%	1.00	1.00
GUTIL	6.04%	0.37	1.00
OILBIG	7.42%	0.34	1.00
PUMP	19.23%	0.96	1.00
WELL	-14.36%	-0.40	1.00
OILSRV	-8.61%	-0.27	1.00
TOBC	11.62%	0.72	1.00

Average premium is calculated as the annualized cumulative return of each factor. Sharpe ratio is the factor annualized return divided by its annualized standard deviation. VIF quantifies the severity of multicollinearity in regression. It measures the factor by which the error in estimating the regression coefficient, in our case the ESG premium, is increased because of collinearity. Generally, values of VIF much larger than unity indicate that the ESG premium cannot be estimated properly. This is because two ESG factors are so correlated that their affect on returns cannot be clearly separated. VIF factor is estimated for each regression separately and reported as an average.