

# Aggregate Confusion: The Divergence of ESG Ratings.\*

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## Abstract

This paper investigates the divergence of environmental, social, and governance (ESG) ratings. Based on data from six prominent rating agencies, namely KLD (MSCI Stats), Sustainalytics, Vigeo-Eiris (Moody's), RobecoSAM (S&P Global), Asset4 (Refinitiv), and MSCI, we decompose the divergence into three sources: Different scope of categories, different measurement of categories, and different weights of categories. We find that scope and measurement divergence are the main drivers, while weights divergence is less important. In addition, we detect a rater effect where the assessment of independent categories is correlated by rater.

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Environmental, social, and governance (ESG) rating providers<sup>1</sup> have become influential institutions. Investors with over \$80 trillion in combined assets have signed a commitment to integrate ESG information into their investment decisions (PRI, 2018). Many institutional investors expect corporations to manage ESG issues (Krueger et al., 2020) and monitor their holdings' ESG performance (Dyck et al., 2019). Sustainable investing is growing fast and mutual funds that invest according to ESG ratings experience sizable inflows (Hartzmark and Sussman, 2019). Due to these trends, more and more investors rely on ESG ratings to obtain a third-party assessment of corporations' ESG performance. There is also a growing number of academic studies that rely on ESG ratings for their empirical analysis (see for example Liang and Renneboog (2017), Servaes (2013), Hong and Kostovetsky (2012), and Lins et al. (2017)). As a result, ESG ratings increasingly influence financial decisions, with potentially far-reaching effects on asset prices and corporate policies.

However, ESG ratings from different providers disagree substantially (Chatterji et al., 2016). In our data set of ESG ratings from six different raters, namely KLD (MSCI Stats), Sustainalytics, Vigeo-Eiris (Moody's), RobecoSAM (S&P Global), Asset4 (Refinitiv), and MSCI, the correlations between the ratings are on average 0.54, and range from 0.38 to 0.71. This means that the information that decision-makers receive from rating agencies is relatively noisy. Three major consequences follow: First, ESG performance is less likely to be reflected in corporate stock and bond prices, as investors face a challenge when trying to identify out-performers and laggards. Investor tastes can influence asset prices (Fama and French, 2007; Hong and Kacperczyk, 2009), but only when a large enough fraction of the market holds and implements a uniform non-financial preference. Therefore, even if a large fraction of investors have a preference for ESG performance, the divergence of the ratings disperses the effect of these preferences on asset prices. Second, the divergence hampers the ambition of companies to improve their ESG performance, because they receive mixed signals from rating agencies about which actions are expected and will be valued by the market. Third, the divergence of ratings poses a challenge for empirical research as using one rater versus another may alter a study's results and conclusions. Taken together, the ambiguity around ESG ratings represents a challenge for decision-makers trying to contribute to an environmentally sustainable and socially just economy.

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<sup>1</sup>ESG ratings are also called sustainability ratings or corporate social responsibility ratings. We use the terms ESG ratings and sustainability ratings interchangeably.

This paper investigates why sustainability ratings diverge. In the absence of a reliable measure of “true ESG performance,” the next best thing is to understand what drives the differences of existing ESG ratings. To do so, we specify the ratings as consisting of three basic elements: (1) a scope which denotes all the attributes that together constitute the overall concept of ESG performance; (2) indicators that yield numerical measures of the attributes; and (3) an aggregation rule that combines the indicators into a single rating.

On this basis, we identify three distinct sources of divergence. *Scope divergence* refers to the situation where ratings are based on different sets of attributes. For instance, attributes such as greenhouse gas emissions, labor practices, and lobbying may be included in the scope of a rating. One rating agency may include lobbying, while another might not, causing the two ratings to diverge. *Measurement divergence* refers to the situation where rating agencies measure the same attribute using different indicators. For example, a firm’s labor practices could be evaluated on the basis of workforce turnover, or by the number of labor related court cases against the firm. Both capture aspects of the attribute labor practices, but they are likely to lead to different assessments. Indicators can focus on policies, such as the existence of a code of conduct, or outcomes, such as the frequency of incidents. The data can come from various sources such as company reports, public data sources, surveys, or media reports (Kotsantonis and Serafeim, 2019). Finally, *weights divergence* emerges when rating agencies take different views on the relative importance of attributes. For example, the labor practices indicator may enter the final rating with greater weight than the lobbying indicator. The contributions of Scope, Measurement, and weights divergence are all intertwined, which makes it difficult to interpret the divergence of aggregate ratings. Our goal is to estimate to what extent each of the three sources drives the overall divergence of ESG ratings.

Methodologically, we approach the problem in three steps. First, we categorize all 709 indicators provided by different data providers into a common taxonomy of 65 categories. This categorization is a critical step in our methodology, as it allows us to observe the scope of categories covered by each rating as well as to contrast measurements by different raters within the same category. The taxonomy is an approximation, because most raters do not share their raw data, making a matching between indicators with the exact same units impossible. However, restricting the analysis to perfectly identical indicators would yield that the entire divergence is due to scope, i.e., that there is zero common ground between ESG raters, which does not reflect the real situation. Thus, we use a taxonomy that matches indicators

by attribute. We created the taxonomy starting from the population of 709 indicators and establishing a category whenever at least two indicators from different rating agencies pertain to the same attribute. Indicators that do not pertain to a shared attribute remain unclassified. As such, the taxonomy approximates the population of common attributes as granular as possible and across all raters. Based on the taxonomy, we calculate rater-specific category scores by averaging indicators that were assigned to the same category. Second, we regress the original rating on those category scores, using a non-negative least squares regression, where coefficients are constrained to be equal to or larger than zero. The results are fitted versions of the original ratings which are comparable in terms of scope, measurement, and aggregation rule. Third, we calculate the contribution of divergence in scope, measurement, and weights to the overall ratings divergence using two different decomposition methods.

Our study yields three results. First, we show that it is possible to estimate the implied aggregation rule used by the rating agencies with an accuracy of 79 to 99 percent on the basis of our common taxonomy. This demonstrates that although rating agencies take very different approaches, it is possible to fit them into a consistent framework that reveals in detail how much and for what reason the ratings differ. We used linear regressions, neural networks, and random forests to estimate aggregation rules, but it turned out that a simple linear regression was in almost all cases the most efficient method. Second, we find that measurement divergence is the main driver of rating divergence, closely followed by scope divergence, while weights divergence plays a minor role. This means that users of ESG ratings, for instance financial institutions, cannot easily resolve discrepancies between two raters by re-adjusting the weights of individual indicators. Instead, rating users have to deal with the problem that the divergence is driven both by what is measured as well as by how it is measured. Scope divergence implies that there are different views about the set of relevant attributes that should be considered in an ESG rating. This is not avoidable and perhaps even desirable, given the various interpretations of the concept of corporate sustainability (Liang and Renneboog, 2017). However, measurement divergence implies that even if two raters were to agree on a set of attributes, different approaches to measurement would still lead to diverging ratings. Since both types of divergence are important, it is difficult to understand what it means when two ratings diverge. Our methodology, however, shows that it is possible to determine with precision how scope, measurement, and weights explain the difference between two ratings for a particular firm. Third, we find that measurement

divergence is in part driven by a *Rater Effect*. This means that a firm that receives a high score in one category is more likely to receive high scores in all the other categories from that same rater. Similar effects have been shown for credit rating agencies (e.g. Fong et al. (2014)) and in many other kinds of performance evaluations (see e.g. Shrout and Fleiss (1979); Mount et al. (1997)). Our results hint at the existence of structural reasons for measurement divergence, for example that ESG rating agencies usually divide labour among analysts by firm rather than by category.

Our methodology relies on two critical assumptions and we evaluate the robustness of each of them. First, indicators are assigned to categories based on our judgment. To evaluate the sensitivity of the results to this assignment, we also sorted the indicators according to a taxonomy provided by the Sustainability Accounting Standards Board (SASB)<sup>2</sup>. The results based on this alternative taxonomy are virtually identical. Second, our linear aggregation rule is not industry-specific, while most ESG rating agencies use industry-specific aggregation rules. This approximation, however, seems to be relatively innocuous, since even a simple linear rule achieves a very high quality of fit. In addition to our analysis for 2014, the year that maximizes our common sample, we test whether our results are similar for the year 2017. Data from KLD is not available for 2017, but for all other raters our results are completely robust to this alternative setting.

Our paper complements research documenting that there is a real and growing expectation from investors that companies perform well in terms of ESG performance (Liang and Renneboog, 2017; Riedl and Smeets, 2017; Amel-Zadeh and Serafeim, 2018; Gibson and Krueger, 2018; Dyck et al., 2019), especially with regard to risks associated with climate change (Krueger et al., 2020). Investors rely on ESG ratings to translate their expectations into capital allocation decisions, thus understanding ESG ratings is essential to evaluate how changing investor expectations influence financial markets and corporate strategy. We extend prior research that has documented the divergence of ESG ratings (Chatterji et al., 2016, 2009; Semenova and Hassel, 2015; Dorfleitner et al., 2015; Delmas and Blass, 2010). Our contribution is to explain the divergence between ESG ratings in quantitative terms by contrasting the underlying data and methodologies in detail and attributing the divergence to distinct sources. Our study is also related to research on credit rating agencies (Fong

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<sup>2</sup>Founded in 2011, SASB works to establish disclosure standards on ESG topics that are comparable across companies on a global basis.

et al., 2014; Bolton et al., 2012; Alp, 2013; Bongaerts et al., 2012; Jewell and Livingston, 1998), in the sense that we also investigate why ratings from different providers differ. Similar to Griffin and Tang (2011) and Griffin et al. (2013), we estimate the underlying rating methodologies to uncover how rating differences emerge.

The paper is organized as follows: Section 1 describes the data, section 2 documents the divergence in the sustainability ratings from different rating agencies. Section 3 explains the way in which we develop the common taxonomy and estimate the aggregation procedures, in section 4 we decompose the overall divergence into the contributions of *Scope*, *Measurement*, and *weights* and document the rater effect. Finally, we conclude in section 5 and highlight the implications of our findings.

## 1 Data

ESG ratings first emerged in the 1980s as a service for investors to screen companies not purely on financial characteristics, but also on characteristics relating to social and environmental performance. The earliest ESG rating agency Vigeo-Eiris was established in 1983 in France and five years later Kinder, Lydenberg & Domini (KLD) was established in the US (Eccles and Strohle, 2018). While initially catering to a highly-specialized investor clientele, such as faith-based organizations, the market for ESG ratings has widened dramatically, especially in the past decade. There are over 1500 signatories to the Principles for Responsible Investing (PRI, 2018), who together own or manage over \$80 trillion. As PRI signatories, these financial institutions commit to integrating ESG information into their investment decision-making. While the growth of sustainable investing was initially driven by institutional investors, also retail investors display an increasing interest, leading to substantial inflows for mutual funds that invest according to ESG criteria. Since ESG ratings are an essential basis for most kinds of sustainable investing, the market for ESG ratings grew in parallel to the interest in sustainable investing. Due to this growth from niche to mainstream, many early ESG rating providers were acquired by established financial data providers, e.g. MSCI bought KLD in 2010, Morningstar bought Sustainalytics in 2010 (Eccles and Strohle, 2018), Moody's bought Vigeo-Eiris in 2019, and S&P Global bought RobecoSAM in 2019.

ESG rating agencies offer investors a way to screen companies for ESG performance in

a similar way credit ratings allow investors to screen companies for creditworthiness. Yet, there are at least three important differences. First, while creditworthiness is relatively clearly defined as the probability of default, the definition of ESG performance is less clear. It is a concept based on values that is (still) evolving. Thus, an important part of the service that ESG rating agencies offer is an interpretation of what ESG performance means. Second, while financial reporting standards have matured and converged over the past century, ESG reporting is in its infancy. There are competing reporting standards for ESG disclosure and almost none of the reporting is mandatory, giving corporations wide discretion regarding whether and what to report. Thus, ESG ratings provide a service to investors by collecting and aggregating information across a spectrum of sources and reporting standards. These two differences serve to explain why ESG rating divergence is so much more pronounced than credit rating divergence, which is around 99%<sup>3</sup>. Third, ESG raters are paid by the investors who use them, not by the companies who get rated, as is the case with credit raters. As a result, the problem of ratings shopping that is discussed as a potential reason for diverging credit ratings (see, e.g. Bongaerts et al. (2012)) does not apply to ESG rating providers.

We use the data of six different ESG rating providers: KLD<sup>4</sup>, Sustainalytics, Vigeo-Eiris, Asset4 (Refinitiv), MSCI, and RobecoSAM. Together, these providers represent most of the major players in the ESG rating space as reviewed in Eccles and Strohle (2018) and cover a substantial part of the overall market for ESG ratings. We approached each provider and requested access to not only the ratings, but also the underlying indicators, as well as documentation about the aggregation rules and measurement protocols of the indicators. We requested that the data set be as granular as possible.

Table 1 provides descriptive statistics of the aggregate ratings<sup>5</sup> and their sample characteristics. The baseline year for our analysis is 2014, which is the year with the greatest common sample, when also including KLD. Since most of the academic literature to date

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<sup>3</sup>Since credit ratings are expressed on an ordinal scale, researchers usually do not report correlations. However, for the sake of illustration we used the data from Jewell and Livingston (1998), and calculated a Pearson correlation by replacing the categories with integers.

<sup>4</sup>KLD, formerly known as Kinder, Lydenberg, Domini & Co., was acquired by RiskMetrics in 2009. MSCI bought RiskMetrics in 2010. The dataset was subsequently renamed to MSCI KLD Stats as a legacy database. We keep the original name of the dataset to distinguish it from the MSCI dataset.

<sup>5</sup>The KLD dataset does not contain an aggregate rating, it only provides binary indicators of "strengths" and "weaknesses". However, it is frequently used in academic studies in aggregate form. We created an aggregate rating for KLD by following the procedure that is chosen in most academic studies, namely summing all strengths and subtracting all weaknesses (See e.g. Lins et al. (2017)).

relies on KLD data, we think it is important to have it in our study. We also test whether our results are specific to the year of study, by re-running the analysis for the year 2017 without KLD. As we show in the internet appendix, the results are similar. Panel A of table 1 shows the full sample, where the number of firms ranges from 1665 to 9662. Panel B of table 1 shows the common sample of 924 firms. The mean and median ESG ratings are higher in the balanced sample for all providers, indicating that the balanced sample tends to drop lower performing companies. Panel C shows the normalized common sample, in which ESG ratings are normalized in the cross-section to have zero mean and unit variance. Throughout the paper, we refer to these three samples.

## 2 Measurement of Divergence

To motivate our analysis, we illustrate the extent of divergence between the different rating agencies. First, we compute correlations between the ratings themselves as well between their environmental, social, and governance dimensions. Second, we evaluate the heterogeneity of divergence across firms. Simple correlations, although easy to understand, can mask important heterogeneity in the data. To explore this, we analyze the mean absolute distance (MAD) to the average rating for each firm. Third, we explore disagreement in rankings. We illustrate that there is a very small set of firms that are consistently in the top or bottom quintile in all ratings. We then expand this approach to a thorough analysis for different quantiles using a simple statistic that we call the Quantile Ranking Count (QRC).

### 2.1 Correlations of Aggregate Ratings

Table 2 shows the Pearson correlations between the aggregate ESG ratings, as well as between their environmental, social, and governance dimensions. Correlations between ESG ratings are on average 0.54, and range from 0.38 to 0.71. Sustainalytics and Vigeo-Eiris have the highest level of agreement between each other, with a correlation of 0.71. The correlations of the environmental dimension are slightly lower than the overall correlations with an average of 0.53. The social dimension is on average correlated at 0.42, and the governance dimension has the lowest correlation with an average of 0.30. KLD and MSCI clearly exhibit the lowest correlations with other raters, both for the rating and for the

individual dimensions. These results are largely consistent with prior findings by Semenova and Hassel (2015), Chatterji et al. (2016), Dorfleitner et al. (2015), and Bouten et al. (2017).

## 2.2 Heterogeneity in the Disagreement

Correlations may obscure firm level differences. For example, a weak correlation between two ratings can be driven either by similar disagreement for every firm or by extremely large disagreement for only a few firms. To analyze the heterogeneity of disagreement, we use the normalized common sample and compute the mean absolute distance (MAD) to the average rating for each firm. This yields a firm-specific measure of disagreement. Table 3 shows how the MAD measure is distributed and how it differs across sectors and regions. Panel A shows that the average MAD is 0.49, the median is 0.45, and the maximum 1.26, implying a slight positive skewness. Panel B and C of Table 3 show that there is no substantial variation along sectors or regions.

To illustrate what the rating disagreement looks like at the extremes, we focus on the 25 firms with the lowest and highest disagreement. Figure 1 shows the 25 firms with the lowest disagreement between raters. The average MAD for these 25 firms is 0.18. Among these 25 firms, agreement is not perfect, but generally all rating agencies share a common view. Companies such as Amcor Limited, the Bank of Nova Scotia, and Heineken NV have high average ratings, and all six rating agencies tend to agree. For firms such as Morgan Stanley and Apple Inc., all raters agree tightly on scores in the middle range. Firms such as Amphenol Corporation, Intuitive Surgical, Inc., and China Resources Land, Ltd. have low average ratings, and all rating agencies agree with such an assessment.

In Figure 2 we present a subset containing the 25 firms where the disagreement between raters is greatest. The average MAD for these firms is 0.99. It shows that there is disagreement at all rating levels, but also that the divergence is not driven by just a few extreme observations. On average, Intel Corporation and GlaxoSmithKline have high ratings, Barrick Gold Corporation and AT&T, Inc. have middle range ratings, and Porsche Automobil Holding and Philip Morris are among the worst rated. Yet in all cases, there is substantial disagreement around this assessment.

In summary, there is large heterogeneity in the level of disagreement across firms. Rating agencies agree on some firms, and disagree on others. However, there is no obvious driver of

this heterogeneity, it occurs for firms of all sectors and in all regions.

## 2.3 Quantile Analysis

Rankings can be more important than the individual score in many financial applications. Investors often want to construct a portfolio with sustainability leaders from the top quantile, or alternatively exclude sustainability laggards in the bottom quantile. With this approach, the disagreement in ratings would be less relevant than the disagreement in rankings.

Table 4 shows the number of common firms across all six raters for the top and bottom 20 percent of the firms in the common sample. The firms are sorted alphabetically within each group. The first column in Table 4 provides an idea of how a sustainable investment portfolio that is based on a strict consensus of six rating agencies would have looked like in 2014. There are only 15 companies that make it into the top 20 percent in all ratings, a small number considering that 20 percent of the sample equates to 184 companies. The second column of Table 4 lists 23 companies that are included in the bottom 20 percent in all ratings. These are companies that one would expect to be consistently avoided by most sustainable investment funds.

The results presented in Table 4 are sensitive to the size of the chosen quantile. To provide a more general description of the divergence, we devised a measure that we call the *Quantile Ranking Count*. First, we count how many identical firms are in the lower  $q\%$  of the common sample across all the rating agencies. We then calculate the ratio of this number to the total number of firms. If the ratings are perfectly aligned, then the exact same firms will be in the lower quantile ( $q\%$ ). If the ratings are random with respect to each other, then the probability that a firm is included in the quantile for all rating agencies is  $q^n$  ( $n$  is the number of rating agencies). Since we base our analysis on the common sample, when the quantile is 100 percent, then all the firms are common to all the rating agencies and the ratio is exactly one.

$$QRC_q = \frac{\text{Common Firms in the lower } q \text{ quantile}}{\text{Total Firms}} \quad (1)$$

In order to interpret the data, we simulated ratings with known and constant correlation. First, we simulated a random draw of  $924 \times 6$  uniform realizations between the values of 0 and 1. Denote these realizations as  $\epsilon_{k,f}$ , where  $k$  is the rater and  $f$  is the index for the

fictitious firm. Second, we created rankings for each rater and each firm as follows:

$$R_{kf} = \epsilon_{kf} + \alpha \times \sum_{x \neq k} \epsilon_{xf} \quad (2)$$

where the  $\alpha$  is calibrated to achieve an average correlation across all ratings. A value of  $\alpha = 0$  implies that all the ratings are perfectly uncorrelated, and  $\alpha = 1$  implies perfect correlation. We calibrated the  $\alpha$  to achieve an average correlation within sample of 10, 20, ..., 80, 90, and 95 percent. Finally, from the simulated data we computed the Quantile Ranking Counts (QRC) for each quantile  $q$ . We run this simulation a thousand times and take the average of each data point.

In Figure 3 we present the Quantile Ranking Count for the overall ESG rating for all rating agencies and firms in the common sample. The plots for the environmental, social, and governance dimensions are shown in the internet appendix in Figure A.1. The thick orange line indicates the counts of the actual data and the dashed gray lines reflect the counts of the simulated data. We begin by observing the 20 percent quantile, which corresponds to the case shown in Table 4. In Figure 3, the thick line is situated between the fourth and the fifth gray line. This corresponds to an implied correlation between 80 and 70 percent. In other words, the implied correlation in the count of common firms among all the rating agencies is of the same order of magnitude as the one we would expect from data that is derived from rankings that are correlated between 70 and 80 percent. At the 50 percent quantile the thick line crosses the fifth gray line that corresponds to the 70 percent implied correlation. Finally, at the 90 percent quantile the implied correlation nears the implied correlation of 40 percent. This indicates that there is more disagreement among the top rated firms.

In summary, this section has established the following stylized facts about ESG rating divergence. The divergence is substantial, since correlations between ratings are on average only 0.54. Disagreement varies by firm, but the overall correlations are not driven by extreme observations or firm characteristics such as sector or region. The disagreement is stronger for firms that are ranked near the top of the distribution. As a result, it is likely that portfolios that are based on different ESG ratings have substantially different constituents, and portfolios that are restricted to top performers in all ratings are extremely constrained to very few eligible companies.

### 3 Taxonomy and Aggregation Rules

ESG ratings are indices that aggregate a varying number of indicators into a score that is designed to measure a firm’s ESG performance. Conceptually, such a rating can be described in terms of scope, measurement, and weights. Scope refers to the set of attributes that describe a company’s ESG performance. Measurement refers to the indicators that are used to produce a numerical value for each attribute. Weights refer to the function that combines multiple indicators into one rating. Figure 4 provides an illustration of this schematic view.

The three elements — scope, measurement, and weights — translate into three distinct sources of divergence. Scope divergence results when two raters use a different set of attributes. For example, all rating agencies in our sample consider a firm’s water consumption, but only some include electromagnetic radiation or lobbying. Measurement divergence results when two raters use different indicators to measure the same attribute. For instance, the attribute of gender equality could be measured by the percentage of women in the board, or by the gender pay gap within the workforce. Both indicators are a proxy for gender equality, but they are likely to result in different assessments. Finally, weights divergence<sup>6</sup> results when raters use different aggregation functions to translate multiple indicators into one ESG rating. The aggregation function could be a simple weighted average, but it could also be a more complex function involving nonlinear terms or contingencies on additional variables such as industry affiliation. A rating agency that is more concerned with carbon emissions than electromagnetic fields will assign different weights than a rating agency that cares equally about both issues. Differences in the aggregation function lead to different ratings, even if scope and measurement are identical.

#### 3.1 Taxonomy

The goal of the paper is to decompose the overall divergence between ratings into the sources of scope, measurement, and weights. This is not trivial, because at the granular level, i.e., the most disaggregate data we have, the approach from each rating agency looks very

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<sup>6</sup>Technically, scope divergence and weights divergence could be treated as the same kind of divergence. The fact that a rating agency does not consider a particular attribute is equivalent to assuming that it sets the attribute’s weight to zero in the aggregation function. However, it is informative to separate scope divergence from weights divergence, because rating agencies do not collect data for attributes that are beyond their scope. As a result, scope divergence cannot be mitigated through an adjustment of weights.

different. Each rater chooses to break down the concept of ESG performance into different indicators, and organizes them in different hierarchies. For example, at the first level of disaggregation, Vigeo-Eiris, RobecoSAM, MSCI, and Sustainalytics have three dimensions (E, S and G), Asset4 has four, and KLD has seven. Below these first level dimensions, there are between one and three levels of more granular sub-categories, depending on the rater. At the lowest level, our data set contains between 38 and 282 indicators per rater, which often, but not always, relate to similar underlying attributes. These diverse approaches make it difficult to understand how and why different raters assess the same company in different ways.

In order to perform a meaningful comparison of these different rating systems, we impose our own taxonomy on the data, which is shown in Table 5. We developed this taxonomy using a bottom-up approach. First, we created a long list of all available indicators, including their detailed descriptions. In some cases, where the descriptions were not available (or were insufficient) we interviewed the data providers for clarification. We also preserved all additional information that we could obtain, such as to what higher dimension the indicator belongs or whether the indicator is industry-specific. In total, the list contained 709 indicators. Second, we grouped indicators that describe the same attribute in the same *category*. For example, we grouped together all indicators related to resource consumption or those related to community relationships. Third, we iteratively refined the taxonomy, following two rules: (a) each indicator is assigned to only one category, and (b) a new category is established when at least two indicators from different raters both describe an attribute that is not yet covered by existing categories. The decision is purely based on the attribute that indicators intend to measure, regardless of the method or data source that is used. For example, indicators related to forests were taken out of the larger category of biodiversity to form their own category. Indicators that are unique to one rater and could not be grouped with indicators from other raters were given each their own rater specific category. In Table 5 these indicators are summarized under "unclassified".

The resulting taxonomy assigns the 709 indicators to a total of 65 distinct categories. Asset4 has the most individual indicators with 282, followed by Sustainalytics with 163. KLD, RobecoSAM, and MSCI have 78, 80, and 68, respectively, and Vigeo-Eiris has 38. Some categories, e.g. forests, contain just one indicator from two raters. Others, such as supply chain, contain several indicators from all raters. Arguably, forests is much more

narrow a category than supply chain. The reason for this difference in broadness is that there were no indicators in supply chain that together represented a more narrow common category. Therefore, the comparison in the case of supply chain is at a more general level, and it may seem obvious that different raters take a different view of this category. Nevertheless, given the data, this broad comparison represents the most specific level possible.

Table 5 already reveals that there is considerable scope divergence. On the one hand, there are categories that are considered by all six raters, indicating some sort of lowest common denominator of categories that are included in an ESG rating. Those are biodiversity, employee development, energy, green products, health and safety, labor practices, product safety, remuneration, supply chain, and water. On the other hand, there are many empty cells, which show that by far not all categories are covered by all ratings. There are gaps not only for categories that could be described as specialized, such as electromagnetic radiation, but also for the category taxes, which could be viewed as a fundamental concern in the context of ESG. Also, the considerable number of unclassified indicators shows that there are many aspects of ESG that are only measured by one out of six raters. Asset4 has with 42 the most unclassified indicators, almost all of which stem from Asset4's economic dimension. This dimension contains indicators such as net income growth or capital expenditure, which are not considered by any other rating agency. MSCI has 34 unclassified indicators, these come from so-called "exposure scores" which MSCI has as a counterpart to most of their management scores. These exposure scores are a measure of how important or material the category is for the specific company. None of the other raters have indicators that explicitly measure such exposure.

The taxonomy imposes a structure on the data that allows a systematic comparison. Descriptively, it already shows that there is some scope divergence between different ESG ratings. Beyond that, it provides a basis to compare measurement and weights divergence, which we will do in the following sections. Obviously, the taxonomy is an important step in our methodology, and results may be sensitive to the particular way in which we built our taxonomy. To make sure our results are not driven by a particular classification, we created an alternative taxonomy as a robustness check. Instead of constructing the categories from the bottom up, we produced a top-down taxonomy that relies on external categories established by the Sustainability Accounting Standards Board (SASB). SASB has identified 26 so-called 'general issue categories', which are the results of a comprehensive stakeholder

consultation process. As such, these categories represent the consensus of a wide range of investors and regulators on the scope of relevant ESG categories. We mapped all indicators against these 26 general issue categories, again requiring that each indicator can only be assigned to one category. This alternative taxonomy, along with results that are based on it, is provided in the internet appendix. All our results hold also for this alternative taxonomy.

### 3.2 Category Scores

On the basis of the taxonomy, we can study measurement divergence by comparing the assessments of different raters at the level of categories. To do so, we created category scores ( $C$ ) for each category, firm, and rater. Category scores were calculated by taking the average of the indicator values assigned to the category. Let us define the notations:

**Definition 1** *Category Scores, Variables and Indexes:*

*The following variables and indexes are going to be used throughout the paper:*

Notation	Variable	Index	Range
$A$	Attributes	$i$	$(1, n)$
$I$	Indicators	$i$	$(1, n)$
$C$	Categories	$j$	$(1, m)$
$N_{fkj}$	Indicators $\in C_{fkj}$	$i$	$(1, n_{fkj})$
$R$	Raters	$k$	$(1, 6)$
$F$	Firms	$f$	$(1, 924)$

*The category score is computed as:*

$$C_{fkj} = \frac{1}{n_{fkj}} \sum_{i \in N_{fkj}} I_{fki} \tag{3}$$

*for firm  $f$ , rating agency  $k$ , and category  $j$ .*

Category scores represent a rating agency’s assessment of a certain ESG category. They are based on different sets of indicators that each rely on different measurement protocols. It follows that differences between category scores stem from differences in *how* rating agencies choose to measure, rather than what they choose to measure. Thus differences between

the same categories from different raters can be interpreted as measurement divergence. Furthermore, rating agencies may employ different sets of indicators depending on the firms' industries. Therefore, the category scores may consist of a different set of indicators for different firms even for the same rating agency. In our procedure, the different views at this level of granularity will be measured as disagreement about measurement instead of scope. This also implies that our linear estimations in the following sections are allowing for sectoral differences in so far that the average measure within each category captures the industry specific indicators.

Table 6 shows the correlations between the categories. The correlations are calculated on the basis of complete pairwise observations per category and rater pair. They range from -0.5 for responsible marketing between KLD and Sustainalytics to 0.92 for Global Compact membership between Sustainalytics and Asset4. When comparing the different rater pairs, KLD and MSCI have the highest average correlation with 0.69, and the pairs including KLD ex MSCI have all relatively low correlations ranging from 0.12 to 0.21.

Beyond these descriptive observations, Table 6 offers two insights. First, correlation levels are heterogeneous. Environmental policy, for instance, has an average correlation level of 0.55. This indicates that there is at least some level of agreement regarding the existence and quality of the firms' environmental policy. But even categories that measure straightforward facts that are easily obtained from public records do not all have high levels of correlation. Membership in the UN Global Compact and CEO/Chairman separation, for instance, show correlations of 0.92 and 0.59, respectively. Health and safety is correlated at .30, taxes at 0.04. There are also a number of negative correlations, such as lobbying between Sustainalytics and Vigeo-Eiris or indigenous rights between Sustainalytics and Asset4. In these cases, the level of disagreement is so severe that rating agencies reach not just different, but opposite conclusions.

The second insight is that correlations tend to increase with granularity. For example, the correlations of the categories water and energy are on average of 0.36 and 0.38. This is substantially lower than the correlation of the environmental dimension with an average of 0.53 reported in Table 2. This implies that divergences compensate each other to some extent during aggregation. There are several potential reasons for this observation and we do not explore them exhaustively in this paper. One reason might be that category scores behave like noisy measures of a latent underlying quality, so that the measurement

disagreement on individual categories cancels out during aggregation. It may also be the case that rating agencies assess a firm relatively strict in one categories and relatively lenient another one. A concern might be that the low correlations at the category level result from misclassification in our taxonomy, in the sense that highly correlated indicators were sorted into different categories. While we cannot rule this out completely, the alternative taxonomy based on SASB criteria mitigates this concern. It is a much less granular classification, which therefore should decrease the influence of any misclassification. However, the level of correlations remains stable across different taxonomies. Focusing on the average correlation per rater pair, which are comparable, the largest change is a decrease of -0.06 for the pair Sustainalytics-MSCI. Across all rater pairs, there is a negligible average increase of only 0.004. This provides reassurance, that the observed correlation levels are not an artefact of misclassification in our taxonomy<sup>7</sup>.

In sum, this section has shown that there is substantial measurement divergence, indicated by low levels of correlations between category scores. Furthermore, the section has revealed that measurement divergence is heterogeneous across categories. Next, we turn to weights divergence, the third and final source of divergence.

### 3.3 Aggregation Rule Estimation

Based on the category scores we can proceed to analyze weights divergence. To do so, we "reverse-engineer" the aggregation rule that transforms the category scores  $C_{fkj}$  into the rating  $R_{fk}$  for each rater  $k$ . It turns out that a simple linear function is sufficient. We perform a non-negative least square regression and present the resulting category weights in Table 7. In addition, we perform several robustness checks that relax assumptions related to linearity, treatment of missing values, and we explore the sensitivity to using alternative taxonomies and data from a different year.

Category scores, as defined in section 3.2, serve as independent variables. When there are no indicator values available to compute the category score for a given firm, the score is set to zero. This is necessary in order to run regressions without dropping all categories with missing values, which are numerous. Of course, this entails an assumption that missing data indicates poor performance. We relax this assumption in one of our robustness checks.

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<sup>7</sup>The correlations with the taxonomy based on SASB can be seen in table A.2 in the internet appendix.

Categories for which there are no values available for any firm in the common sample are dropped. After this treatment, category scores are normalized to zero mean and unit variance, corresponding to the normalized ratings, which serve as dependent variable. Each unclassified indicator is treated as a separate rater-specific category.

We perform a non-negative least square regression, which includes the constraint that coefficients cannot be negative. This reflects the fact that we know a priori the directionality of all indicators, and can thus rule out negative weights in a linear function. Thus, we estimate the weights ( $w_{kj}$ ) with the following specification:

$$R_{fk} = \sum_{j \in (1,m)} C_{fjk} \times w_{kj} + \epsilon_{fk}$$

$$w_{kj} \geq 0$$

Since all the data has been normalized, we exclude the constant term. Due to the non-negativity constraint we calculate the standard errors by bootstrap. We focus on the  $R^2$  as a measure of quality of fit.

The results are shown in Table 7. MSCI has the lowest  $R^2$  with 0.79. Sustainalytics the second lowest with 0.90. The regressions for KLD, Vigeo-Eiris, Asset4, and RobecoSAM have  $R^2$  values of 0.99, 0.96, 0.92, and 0.98, respectively. The high  $R^2$  values indicate that a linear model based on our taxonomy is able to replicate the original ratings quite accurately.

The regression represents a linear approximation of each rater’s aggregation rule, and the regression coefficients can be interpreted as category weights. Since all variables have been normalized, the magnitude of the coefficients is comparable and indicates the relative importance of a category. Most coefficients are highly significant. There are some coefficients that are not significant at the 5 percent threshold, which means that our estimated weight is uncertain. However, those coefficients are much smaller in magnitude in comparison to the significant coefficients, in fact most of them are close to zero.

There are substantial differences in the weights for different raters. For example, the three most important categories for KLD are climate risk management, product safety, and remuneration. For Vigeo-Eiris, they are discrimination and diversity, environmental policy, and labour practices. That means, there is no overlap in the three most important categories

for these two raters. In fact, only resource efficiency and climate risk management are among the three most important categories for more than one rater. At the same time, there are categories that have zero weight for all raters, such as clinical trials and environmental fines, GMOs, and ozone-depleting gases. It suggests these categories have no relevance for any of the the aggregate ratings. These observations highlight that different raters have substantially different views about which categories are most important. In other words, there is substantial weights divergence between raters.

The estimation of the aggregation function entails several assumptions. To ensure robustness of our results, we evaluated several other specifications. The results of these alternative specifications are summarized in Table 8. None of them offered substantial improvements in the quality of fit over the non-negative linear regression.

First, we run an ordinary least squares regression, in order to relax the non-negativity constraint. Doing so leads only to small changes and does not improve the quality of fit for any rater. Second, we run neural networks, in order to allow for a non-linear and flexible form of the aggregation function. As neural networks are prone to overfitting, we report the out-of-sample fit. We assign randomly 10 percent of the firms to a testing set, and the rest to a training set<sup>8</sup>. To offer a proper comparison, we compare their performance to the equivalent out-of-sample  $R^2$  for the non-negative least square procedure. We run a two-layer neural network with a linear activation function and one with a relu activation function. Both perform markedly better for MSCI, but at the same time worse for other raters. This implies that the aggregation rule of the MSCI rating is to some extent non-linear. In fact, the relatively simple explanation seem to be industry specific weights. In unreported tests, we confirm that the quality of fit for MSCI is well above 0.90 in industry sub-samples even for a linear regression. Third, we run random forests, to relax the assumption that missing values proxy for average performance. Random forests can process missing values without dropping the category. However, the random forest estimator has substantially lower  $R^2$  for most raters.

We also checked, whether the taxonomy that we imposed on the original indicators had an influence on the quality of fit. To this end, we replicated the non-negative least square

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<sup>8</sup>As aggregation rules are subject to change through time, we do not run tests where the in-sample belongs to a different year than the out-of-sample.

estimation of the aggregation rule using the SASB taxonomy<sup>9</sup>. The quality of fit is virtually identical. Finally, we run an ordinary least squares regression without any taxonomy, regressing each raters original indicators on the ratings. The quality of fit is also very similar, the most notable change being a small decrease of 0.03 for the MSCI Rating. Finally, we perform the regression using data from the year 2017 instead of 2014. In this case, the quality of fit is worse for MSCI and Asset4, indicating that their methodologies have changed over time. In sum, we conclude that none of the alternative specifications yields substantial improvements in the quality of fit over the non-negative least squares model.

## 4 Decomposition and Rater Effect

So far, we have shown that scope, measurement, and weights divergence exist. In this section, we aim to understand how these sources of divergence together explain the divergence of ESG ratings. Specifically, we decompose ratings divergence into the contributions of scope, measurement, and weights divergence. We also investigate the patterns behind measurement divergence and detect a rater effect, meaning that measurement differences are correlated within rating agencies.

### 4.1 Scope, Measurement and weights divergence

We developed two alternative approaches for the decomposition. First, we arithmetically decompose the difference between two ratings into differences due to scope, measurement, and weights. This approach identifies exactly the shift caused by each source of divergence. Yet, as these shifts are not independent of each other, the approach is not ideal to determine their relative contribution to the total divergence. Thus, in a second approach, we adopt a regression based approach to provide at least a range of the relative contributions of scope, measurement, and weights.

#### 4.1.1 Arithmetic Decomposition

The arithmetic variance decomposition relies on the taxonomy, the category scores, and the aggregation weights estimated in Section 3. It assumes that all ESG ratings are linear

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<sup>9</sup>See Table A.3 in the internet appendix for the coefficients.

combinations of their category scores. This assumption is reasonable based on the quality of fit of the linear estimations. The procedure identifies how scope, measurement, and weights divergence add up to the difference between two ESG ratings of a given firm. Scope divergence is partialled out by considering only the categories that are exclusively contained in one of the two ratings. Measurement divergence is isolated by calculating both ratings with identical weights, so that differences can only stem from differences in measurement. weights divergence is what remains of the total difference.

Let  $\hat{R}_{fk}$  (where  $k \in a, b$ ) be vectors of ratings provided by rating agency  $a$  and rating agency  $b$  for a common set of  $f$  companies.  $\hat{R}_{fk}$  denotes the fitted rating and  $\hat{w}_{kj}$  the estimated weights for rater  $k$  and category  $j$  based on the regression in Table 7. Thus, the decomposition is based on the following relationship:

$$\hat{R}_{fk} = C_{fkj} \times \hat{w}_{kj} \quad (4)$$

Common categories that are included in the scope of both raters are denoted as  $C_{fkj_{com}}$ . Exclusive categories that are included by only one rater are denoted as  $C_{faj_{a,ex}}$  and  $C_{fbj_{b,ex}}$ , where  $j_{a,ex}$  ( $j_{b,ex}$ ) is the set of categories that are measured by rating agency  $a$  but not  $b$  ( $b$  but not  $a$ ). Similarly,  $\hat{w}_{aj_{com}}$ , and  $\hat{w}_{bj_{com}}$  are the weights used by rating agencies  $a$  and  $b$  for the common categories.  $\hat{w}_{aj_{a,ex}}$  are the weights for the categories only measured by  $a$ , and analogously  $\hat{w}_{bj_{b,ex}}$  for  $b$ . We separate the rating based on common and exclusive categories as follows:

**Definition 2 *Common and Exclusive Categories***

For  $k \in \{a, b\}$  define:

$$\begin{aligned} \hat{R}_{fk,com} &= C_{fkj_{com}} \times \hat{w}_{kj_{com}} \\ \hat{R}_{fk,ex} &= C_{fkj_{k,ex}} \times \hat{w}_{kj_{k,ex}} \\ \hat{R}_{fk} &= \hat{R}_{fk,com} + \hat{R}_{fk,ex} \end{aligned} \quad (5)$$

On this basis, we can provide terms for the contribution of scope, measurement, and weights divergence to the overall divergence.

**Definition 3 *Scope, Measurement, and weights***

The difference between two ratings  $\Delta_{a,b}$  consists of three components:

$$\Delta_{fa,b} = \hat{R}_{fa} - \hat{R}_{fb} = \Delta_{scope} + \Delta_{meas} + \Delta_{weights} \quad (6)$$

The terms for scope, measurement and weights are given as follows:

$$\begin{aligned}
\Delta_{scope} &= C_{faj_{a,ex}} \times \hat{w}_{aj_{a,ex}} - C_{fbj_{b,ex}} \times \hat{w}_{bj_{b,ex}} \\
\Delta_{meas} &= (C_{faj_{com}} - C_{fbj_{com}}) \times \hat{w}^* \\
\Delta_{weights} &= C_{faj_{com}} \times (\hat{w}_{aj_{com}} - \hat{w}^*) - C_{fbj_{com}} \times (\hat{w}_{bj_{com}} - \hat{w}^*)
\end{aligned} \tag{7}$$

where  $\hat{w}^*$  are the estimates from pooling regressions using the common categories:

$$\begin{pmatrix} \hat{R}_{fa,com} \\ \hat{R}_{fb,com} \end{pmatrix} = \begin{pmatrix} C_{faj_{com}} \\ C_{fbj_{com}} \end{pmatrix} \times w^* + \begin{pmatrix} \epsilon_{fa} \\ \epsilon_{fb} \end{pmatrix} \tag{8}$$

Scope divergence  $\Delta_{scope}$  is the difference between ratings that are calculated using only mutually exclusive categories. Measurement divergence  $\Delta_{meas}$  is calculated based on the common categories and identical weights for both raters. Identical weights  $\hat{w}^*$  are estimated in Equation 8, which is a non-negative pooling regression of the stacked ratings on the stacked category scores of the two raters. Since the least squares make sure that we maximize the fit with  $\hat{w}^*$ , we can deduce that  $\Delta_{meas}$  captures the differences that are exclusively due to differences in the category scores. weights divergence ( $\Delta_{weights}$ ) is simply the remainder of the total difference, or more explicitly a rater's category scores multiplied with the difference between the rater specific weights  $\hat{w}_{aj_{com}}$  and  $\hat{w}^*$ . It must be noted that all these calculations are performed using the fitted ratings  $\hat{R}$  and the fitted weights  $\hat{w}$ , since the original aggregation function is not known with certainty.

To provide an example, Figure 5 shows the decomposition of the rating divergence between ratings from Asset4 and KLD for Barrick Gold Corporation. The company received a normalized rating of 0.52 by Asset4 vs. -1.10 by KLD. The resulting difference of 1.61 is substantial, considering that the rating is normalized to unit variance. The difference between our fitted ratings is slightly lower at 1.60, due to residuals of +0.09 and +0.10 for the fitted ratings of Asset4 and KLD Rating respectively. This remaining difference consists of 0.41 scope divergence, 0.77 measurement divergence, and 0.42 weights divergence. The three most relevant categories that contribute to scope divergence are Taxes, Resource Efficiency, and Board, all of which are exclusively considered by Asset4. The inclusion of the categories Resource Efficiency and Board make the Asset4 rating more favourable, but their effect is partly compensated by the inclusion of Taxes, which works in the opposite direction. The three most relevant categories for measurement divergence are Indigenous

Rights, Business Ethics, and Remuneration. KLD gives the company markedly lower scores for Business Ethics and Remuneration than Asset4, but a higher score for Indigenous Rights. The different assessment of Remuneration accounts for about a third of the overall rating divergence. The most relevant categories for weights divergence are Community and Society, Biodiversity, and Toxic Spills. Different weights for the categories Biodiversity and Toxic Spills drive the two ratings apart, while the weights of Community and Society compensate part of this effect. The combined effect of the remaining categories is shown for each source of divergence under the label "Other". This example offers a concrete explanation of why these two specific ratings differ.

Cross-sectional results of the decomposition are presented in Table 9, where Panel A shows the data for each rater pair, and Panel B shows averages per rater based on Panel A. The first three columns show the mean absolute values of scope, measurement, and weights divergence. The column "Fitted" presents the difference of the fitted ratings  $|\hat{R}_{fk_1} - \hat{R}_{fk_2}|$ , and the column "True" presents the difference of the original ratings  $|R_{fk_1} - R_{fk_2}|$ . Since the ratings have been normalized to have zero mean and unit variance, all values can be interpreted in terms of standard deviations.

Panel A shows that, on average, measurement divergence is the most relevant driver of ESG rating divergence, followed by scope and weights divergence. Measurement divergence causes an average shift of 0.54 standard deviations, ranging from 0.39 to 0.67. Scope divergence causes an average shift of 0.48 standard deviations ranging from 0.19 to 0.86. weights divergence causes an average shift of 0.34 standard deviations, ranging from 0.11 to 0.57.

Panel B highlights differences between raters. MSCI is the only rater where scope instead of measurement divergence causes the largest shift. With a magnitude of 0.85, the scope divergence of MSCI is twice as large than the scope divergence of any other rating. MSCI is also the only rater for which weights divergence is almost equally relevant as measurement divergence. KLD is noteworthy in that it has the highest value for measurement divergence of all raters. Thus, while measurement divergence is the key source of divergence for most raters, MSCI stands out as the only rater where scope divergence is even more important. The explanation lies partially in MSCI's so-called "Exposure Scores". As described in section 3, these scores essentially set company specific weights for each category and have no equivalent in the other rating methods. Therefore, these scores are unique to MSCI and increase the scope divergence of MSCI with respect to all other raters.

In both Panels, the fitted rating divergence is very similar to the true rating divergence, which corresponds to the quality of fit of the estimations in section 3.3. However, the sum of scope, measurement, and weights divergence exceeds the overall rating divergence in all cases. This suggests that the three sources of divergence are negatively correlated and partially compensate each other. This is not surprising, given that by construction measurement and weights divergence are related through the estimation of  $\hat{w}$ . However, the results are exact for any given firm, and show that on average measurement divergence tends to cause the greatest shift, followed by scope divergence, and finally weights divergence.

#### 4.1.2 Regression Based Decomposition

In this section we present an alternative decomposition methodology. We regress the ratings of one agency on the ratings of another and analyze the gain in explanatory power that is due to variables representing scope, measurement, and weights divergence. Doing so addresses the key shortcoming of the methodology from the previous section that the three sources of divergence do not add up to the total.

##### **Definition 4** *Measurement, Scope, and weights Variables*

$$Scope_{fa,b} = C_{fbjb,ex} \cdot \hat{w}_{bjb,ex} \quad (9)$$

$$Meas_{fa,b} = C_{fbjcom} \cdot \hat{w}_{ajcom} \quad (10)$$

$$Weight_{fa,b} = C_{fajcom} \cdot \hat{w}_{bjcom} \quad (11)$$

Similar to the prior decomposition, this approach also relies on the taxonomy, category scores, and the weights estimated in Section 3.3.  $Scope_{fa,b}$  consists of only the categories and the corresponding weights that are exclusive to rater  $b$ .  $Meas_{fa,b}$  consists of the category scores in rater  $b$  and rater  $a$ 's corresponding weights for the common categories. Finally, the variable  $Weight_{fa,b}$  consists of category scores from rater  $a$  and the corresponding weights from rater  $b$  for the common categories. Our purpose is to compute the linear regression in Equation 12 and to evaluate the marginal  $R^2$  of the three terms adding them to the regression one at a time.

$$\hat{R}_{fb} = \beta \cdot \hat{R}_{fa} + \beta_s \cdot Scope_{fa,b} + \beta_m \cdot Meas_{fa,b} + \beta_w \cdot Weight_{fa,b} + \epsilon \quad (12)$$

The fitted rating  $\hat{R}_{fb}$  is the outcome of the the dot product between the category scores  $C_{fbj}$  and rater  $b$ 's estimated weights  $\hat{w}_{bj}$ ; similarly for rating agency  $a$ . Let us recall that the fitted rating of rater  $a$  is  $\hat{R}_{fa} = C_{fa_{jcom}} \cdot \hat{w}_{ajcom} + C_{fa_{jex}} \cdot \hat{w}_{ajex}$ . It follows that  $\hat{R}_{fa}$  can be thought of as a control variable for the information that comes from rater  $a$  in the construction of the three variables  $Scope_{fa,b}$ ,  $Meas_{fa,b}$  and  $Weight_{fa,b}$ . Hence,  $Meas_{fa,b}$  can be attributed to measurement as we already control for the common categories and weights from rater  $a$  but not for the common categories from rater  $b$ . The same idea is behind  $Weight_{fa,b}$  where we already control for the common categories and weights of rater  $a$  but not for the weights from rater  $b$ . This variable can thus be attributed to weights.

Given that the three terms scope, measurement, and weights are correlated with each other, the order in which we add them as regressors to Regression 12 matters. We thus run partialing-out regressions in order to calculate a lower and an upper bound of the additional explanatory power of those terms. For example, to estimate the contribution of scope, we run different comparisons. We estimate two regressions, one with and another without  $Scope$  to compute the difference in the  $R^2$ 's. By changing the regressors in the baseline, the contribution of scope changes. We therefore run regressions in all possible combinations. For example, for scope we estimate the following 8 regressions:

$$\begin{aligned}
\hat{R}_{fb} &= \beta \cdot \hat{R}_{fa} && + \epsilon_0 \implies R_0^2 \\
\hat{R}_{fb} &= \beta \cdot \hat{R}_{fa} + \beta_s \cdot Scope_{fa,b} && + \epsilon_1 \implies R_1^2 \\
\hat{R}_{fb} &= \beta \cdot \hat{R}_{fa} && + \beta_m \cdot Meas_{fa,b} && + \epsilon_2 \implies R_2^2 \\
\hat{R}_{fb} &= \beta \cdot \hat{R}_{fa} + \beta_s \cdot Scope_{fa,b} + \beta_m \cdot Meas_{fa,b} && + \epsilon_3 \implies R_3^2 \\
\hat{R}_{fb} &= \beta \cdot \hat{R}_{fa} && + \beta_w \cdot Weight_{fa,b} + \epsilon_4 \implies R_4^2 \\
\hat{R}_{fb} &= \beta \cdot \hat{R}_{fa} + \beta_s \cdot Scope_{fa,b} && + \beta_w \cdot Weight_{fa,b} + \epsilon_5 \implies R_5^2 \\
\hat{R}_{fb} &= \beta \cdot \hat{R}_{fa} && + \beta_m \cdot Meas_{fa,b} + \beta_w \cdot Weight_{fa,b} + \epsilon_6 \implies R_6^2 \\
\hat{R}_{fb} &= \beta \cdot \hat{R}_{fa} + \beta_s \cdot Scope_{fa,b} + \beta_m \cdot Meas_{fa,b} + \beta_w \cdot Weight_{fa,b} + \epsilon_7 \implies R_7^2
\end{aligned}$$

The contribution of scope is the gain in explanatory power, given by the four differences  $\{R_1^2 - R_0^2, R_3^2 - R_2^2, R_5^2 - R_4^2, R_7^2 - R_6^2\}$ . Of these four, we report the minimum and the maximum value.

The results of the statistical decomposition are presented in Table 10, where Panel A shows the data for each rater pair, and Panel B shows averages per rater. The first column presents the baseline  $R^2$ , which for example in the first row is simply regressing the KLD

rating on the Vigeo-Eiris rating. The second column is the  $R^2$  from a regression that includes all four covariates, i.e., it includes rating  $a$  plus the scope, measurement, and weights variables. The next six columns indicate the minimum and maximum  $R^2$  gain of explanatory power due the inclusion of the scope, measurement, and weights variables.

The first column shows that the average explanatory power when trying to simply explain one rating with another is 0.34 and fluctuates between 0.16 and 0.56. The second column shows that when including the terms for scope, measurement, and weights, the  $R^2$  rises on average to 0.84 (ranging from 0.44 to 0.97). Thus, the additional variables improve the fit by 0.51 on average. Scope offers the greatest improvement in explanatory power, with an average minimum gain of 0.14 and an average maximum gain of 0.35. This is almost equal to measurement with an average gain of at least 0.14 and at most 0.35. The addition of weights leads to far lower gains of at least 0.01 and at most 0.04. These ranges indicate the relative contribution of the three sources of divergence to the total divergence.

The findings are consistent with the results from the previous decomposition. While scope divergence is slightly more relevant than measurement divergence in this decomposition, these two are clearly the dominant sources of divergence. weights divergence is less relevant in explaining the rating divergence. Looking at specific raters in Panel B also reaffirms the prior finding that scope divergence is much more relevant for MSCI than for any other rater. Asset4 has the lowest values for scope divergence, which is also consistent with the previous results. In sum, scope and measurement divergence are the predominant sources of ESG rating divergence, with weights divergence playing a minor role in comparison.

## 4.2 Rater Effect

One could argue that measurement divergence is the most problematic source of divergence. While scope and weights divergence represent disagreement on matters of definition and prioritization that one might reasonably disagree on, measurement divergence represents a disagreement about facts. Thus, to further investigate the underlying reasons for measurement divergence, we test in this section for the presence of a *Rater Effect*.

The rater effect describes a sort of bias, where performance in one category influences perceived performance in other categories. Also known as "halo effect", it is a phenomenon that has been extensively studied in sociology, management, and psychology, especially in

performance evaluation (See Shrout and Fleiss (1979), Mount et al. (1997)). The process of evaluating firms' ESG attributes seems prone to a rater effect. Evaluating firm performance in the categories human rights, community and society, labor practices etc. requires rating agencies to use some degree of judgment. The rater effect implies that when the judgement of a company is positive for one particular indicator, it is also likely to be positive for another indicator. We evaluate the rater effect using two procedures. First, we estimate fixed effects regressions comparing categories, firms, and raters. Second, we run rater-specific LASSO regressions to evaluate the marginal contribution of each category.

#### 4.2.1 Rater Fixed Effects

The first procedure is based on simple fixed effects regressions. A firm's category scores depends on the firm itself, on the rating agency, and on the category being rated. We examine to which extent those fixed effects increase explanatory power in the following set of regressions:

$$C_{fkj} = \alpha_f \mathbb{1}_f + \epsilon_{fkj,1} \quad (13)$$

$$C_{fkj} = \alpha_f \mathbb{1}_f + \gamma_{fk} \mathbb{1}_{f \times k} + \epsilon_{fkj,2} \quad (14)$$

$$C_{fkj} = \alpha_f \mathbb{1}_f + \gamma_{fj} \mathbb{1}_{f \times j} + \epsilon_{fkj,3} \quad (15)$$

$$C_{fkj} = \alpha_f \mathbb{1}_f + \gamma_{fk} \mathbb{1}_{f \times k} + \gamma_{fj} \mathbb{1}_{f \times j} + \epsilon_{fkj,4} \quad (16)$$

where  $\mathbb{1}_f$  are dummies for each firm,  $\mathbb{1}_{f \times k}$  is an interaction term between firm and rater fixed effects, and  $\mathbb{1}_{f \times j}$  is an interaction term between firm and category fixed effects.  $C_{fkj}$  is a vector that stacks all cross-sectional scores for all common categories across all raters. We drop pure category and rater fixed effects because of the normalization at the rating and category scores level. We only use the intersection of categories from all raters and the common sample of firms to reduce sample bias. We obtain very similar results by including all categories from all raters.

The baseline regression (eq 13) explains category scores with firm dummies. The second regression adds the firm  $\times$  rater fixed effects, i.e. a constant across categories that is specific to each firm-rater pair. The increment in  $R^2$  between the two regression is the rater effect. The third and fourth regression repeat the procedure, but with the additional inclusion of category  $\times$  firm fixed effects. The results of these regressions are shown in Table 11.

We detect a clear rater effect. Firm dummies alone explain 0.22 of the variance of the scores in equation 13. With firm *times* rater effect, however, the  $R^2$  increases to 0.38, a difference of 0.16. Similarly, the difference in  $R^2$  between equation 15 and equation 16 yields an increase of 0.15. Therefore, the rater effect explains about 0.15 to 0.16 of the variation in scores. The rater effect is relevant in comparison to the other dummies. Comparing the estimates of equation 15 versus 13, we find that including firm *times* categories improves the fit by 0.25. Similarly, comparing the outcomes of regressions 16 and 14 yields an increase of 0.24. Thus, firm dummies explain 0.22, firm *times* category dummies 0.24-0.25, and the firm *times* rater dummies 0.15-0.16. Even though the rater effect is smaller than the other two, it has a substantial influence on the category scores.

#### 4.2.2 LASSO Approach to Rater Effect

We explore the rater effect using an alternative procedure. Here, we concentrate exclusively on the within-rater variation. A rating agency with no rater effect is one in which the correlations between categories are relatively small, a rating agency with strong rater effect implies that the correlations are high. These correlations, however, cannot be accurately summarized by pairwise comparisons. Instead, we can test for the correlations across categories using LASSO regressions. The idea is that a strong rater effect implies that the marginal explanatory power of each category within a rater is diminishing when added one after another. This implies that one could replicate an overall rating with less than the full set of categories.

We test this by re-estimating the linear aggregation rules adding a LASSO penalty. The LASSO regression adds a regularization to the minimization problem of ordinary least squares. The objective is to reduce the number of  $w_{kj} \neq 0$  and find the best combination of regressors that maximize the explanatory power of the regression. The optimization is as follows:

$$\min_{w_{kj}} \sum_j (R_{fk} - C_{fkj} * w_{kj})^2 + \lambda \cdot \sum_j |w_{kj}|. \quad (17)$$

where  $\lambda$  controls the penalty. When  $\lambda = 0$  the estimates from OLS are recovered. As  $\lambda$  increases, the variables with the smallest explanatory power are eliminated. In other words, the first category that has the smallest explanatory  $R^2$  is dropped from the regression (or its coefficient is set to zero). When  $\lambda$  continues to increase, more and more coefficients are

set to zero, until there is only one category left.

Table 12 shows the rating agencies in the columns and the number of regressors in the rows. For example, the first row documents the  $R^2$  of the category that maximizes the  $R^2$  for a given rater. The second row indicates the  $R^2$  when two categories are included. As expected, the  $R^2$  increases. We proceed until all the categories are included in the regression. The larger the rater effect is, the steeper is the increase in the  $R^2$  explained by the first categories. This is because the initial categories incorporate the rater effect, while the last categories only contribute to the  $R^2$  by their orthogonal component.

In the computation of the aggregation rules (Table 7), the number of categories including the unclassified indicators covered by Vigeo-Eiris, RobeccoSAM, Asset4, KLD, MSCI and Sustainalytics are 28, 45, 95, 41, 61, and 63, respectively. 10 percent of the possible regressors therefore are 3, 5, 10, 4, 6, and 6, respectively. We have highlighted these fields in Table 12. Hence, 10 percent of the categories explain more than a fifth (0.21) of the variation in Vigeo-Eiris's ratings, 0.75 in RobeccoSAM, 0.63 in Asset4, 0.23 in KLD, 0.46 in Sustainalytics, and only 0.13 in MSCI. This illustrates the presence of a rater effect.

For completeness, in Figure 6, we present the increase in the  $R^2$  for each rating agency for all categories. The curves reflect the evolution of the  $R^2$ . The last part of the curve to the right coincides with an unrestricted OLS estimate where all variables are included. These figures provide the same message we obtained from the simple statistic of observing the  $R^2$  before. KLD and MSCI have the smallest cross-category correlation, judging by the slope in Figure 6(a) and 6(f). Sustainalytics is the second flattest, followed by Vigeo-Eiris and Asset 4, and leaving RobecoSAM as the rating agency where just a few categories already explain most of the ESG rating.

The rater effect of ESG rating agencies establishes an interesting parallel to finance research on credit rating agencies. A number of studies investigate rating biases in credit ratings. For example, Griffin and Tang (2011) and Griffin et al. (2013) study how credit ratings for collateralized debt obligations deviated from their own model, leading to overly optimistic credit ratings. Our paper is related to theirs in the sense that we also estimate the rating methodology in order to be able to identify a rater bias. Extending from the fact that there are biases, a lot of emphasis has been on understanding the structural drivers of credit rating bias (see e.g. Bolton et al. (2012); Bongaerts et al. (2012); Fong et al. (2014); Alp (2013)). This suggests a future avenue of research could be to also understand what

drives the rater effect of ESG rating agencies, and whether incentive structures play a role. Historically, the business model of ESG ratings has been different, as investors rather than the rated companies pay for the rating. However, this may change, as the established credit raters have bought several ESG rating services, e.g. Moody's has bought Vigeo-Eiris and S&P Global has bought RobecoSAM.

An potential explanation for the rater effect is that rating agencies are mostly organized by firms rather than indicators. A firm that is perceived as good may be seen through a positive lens and receive better indicator scores than the individual indicator would have allowed for, and vice versa. In discussions with RobecoSam we learned about another potential cause for such a rater effect. Some raters make it impossible for firms to receive a good indicator score if they do not give an answer to the corresponding question in the questionnaire. This happens regardless of the actual indicator performance. The extent to which the firms answer specific questions is very likely correlated across indicators. Hence, a firm's willingness to disclose might also explain parts of the rater effect.

## 5 Conclusions

The contribution of this article is to explain why ESG ratings diverge. We develop a framework that allows a structured comparison of very different rating methodologies. This allows us to separate the difference between ratings into the components scope, measurement, and weights divergence. We find that measurement divergence is the most important reason why ESG ratings diverge, i.e. different raters measure performance of the same firm in the same category differently. Human Rights and Product Safety are categories where such measurement disagreement is particularly pronounced. Slightly less important is scope divergence, i.e. that raters consider certain categories that others do not consider. For example, a company's lobbying activities are considered only by two out of the six raters in our sample. The least important one is weights divergence, i.e. disagreement about the relative weights of categories that are commonly considered. While raters have substantially different weights, it does not drive rating divergence as much as scope and measurement divergence.

In addition, we document a rater effect. Raters' assessments are correlated across categories, so that when a rating agency gives a company a good score in one category, it tends

to give that company good scores in other categories too. Hence, measurement divergence is not only due to random measurement error, but is partly driven by some form of rater specific bias. It also implies that some ESG ratings could be replicated with a reduced set of categories, since category assessments are partially redundant in a statistical sense. Although we do not conclusively identify the cause of the rater effect, one possible explanation is that ESG rating agencies divide analyst labor by firm and not by category, so that an analyst's overall view of the company could propagate into the assessments in different categories. Yet, further research is needed to fully understand the reasons behind the rater effect.

Our findings demonstrate that ESG rating divergence is not merely driven by difference in opinions, but also by disagreement about facts. Scope and weights divergence both represent disagreement about what the relevant categories of ESG performance are, and how important they are relative to each other. It is legitimate that different raters take different views on these questions. In fact, a variety of opinions may be desirable, given that the users of ESG ratings also have heterogeneous preferences for scope and weights. In particular, different investors will hold different views regarding which categories they deem material, i.e. relevant for the firm's business success. However, measurement divergence is problematic, if one accepts the view that ESG ratings should ultimately be based on facts that can be ascertained. Currently, different raters do not agree on how well a company performs with regard to Human Rights, product safety, or climate risk management. The reason is that different raters use different indicators and different measurement approaches. As long as there are no consistent standards for ESG disclosure, or data and measurement approaches become more transparent, measurement divergence is likely to remain an important driver of ESG rating divergence.

The results have important implications for researchers, investors, companies, and rating agencies. Researchers should carefully choose the data that underlies future studies involving ESG performance. Some results that have been obtained on the basis of one ESG rating might not be replicable with the ESG ratings of another rating agency. In particular, the results indicate that the divergence is very pronounced for KLD, the data on which the majority of existing academic research in ESG is based so far. Basically, researchers have three options to deal with the divergence of ESG ratings. One option is to include several ESG ratings in the analysis (see e.g. (Liang and Renneboog, 2017)). This is reasonable, when the intention is to measure the "consensus ESG performance" as it is perceived by financial

markets in which several ratings are used. Second, researchers may use one particular ESG rating to measure a specific company property (see e.g. Lins et al. (2017), where KLD ratings were used as a proxy for a corporation’s social capital.) In this case it is not necessary to expect that the same result will be obtained when using another ESG rating, however researchers need to carefully explain why both the measurement approach and the aggregation procedure are appropriate for their study. Third, researchers can construct hypotheses around attributes that are more narrowly defined than ESG performance and rely on verifiable and transparent measures of greenhouse gas emissions or labor conditions. In this case, it would be important to include alternative measures of these attributes to avoid the uncertainty in measurement, but the uncertainty around the weighting of different categories would be avoided.

For investors, our methodology allows to understand why a company received different ratings from different rating agencies. The example in Figure 5 illustrates how a company can disentangle the various sources of divergence and trace down to specific categories. For instance, investors could reduce the discrepancy between raters by about 50 percent by obtaining indicator level data and impose their own scope and weights on the data. Remaining differences can be traced to the indicators that are driving the discrepancy, potentially guiding an investor’s additional research. Averaging indicators from different providers is an easy way to reduce uncertainty - however the rater effect suggests that this approach may be problematic, because the discrepancies are not randomly distributed. Thus, in the medium term, investors might consider supporting initiatives that seek to harmonize disclosure and create transparent data sources.

For companies, the results highlight that there is substantial disagreement about their ESG performance. The divergence happens not only at the aggregate level but is actually even more pronounced in specific sub-categories of ESG performance, such as human rights or energy. This situation presents a challenge for companies, because improving scores with one rating provider will not necessarily result in improved scores at another. Thus, currently, ESG ratings do not play a role as important as potentially possible in guiding companies towards improvement. To change the situation, companies should work with rating agencies to establish open and transparent disclosure standards and ensure that the data is publicly accessible. If companies fail to do so, the demand for ESG information will push rating agencies to base the creation of the data on other sources prone to divergence.

For rating agencies, our results call for greater transparency. First, ESG rating agencies should clarify how their definition of ESG performance differs from others in terms of scope of attributes and aggregation rule. Second, rating agencies should become much more transparent about their measurement practices and methodologies. Greater transparency on methods would allow investors and other stakeholders such as rated firms, NGOs, and academics to evaluate the quality of measurement. As a result, ESG Raters as well as data providers that specialise on specific attributes, can compete on measurement quality, ultimately improving measurement. Furthermore, rating agencies should seek to understand what drives the rater effect to avoid potential biases. By taking these steps, rated firms would have clearer signals on what is expected of them, and investors could choose ratings that are aligned with their values and based on reliable methods.

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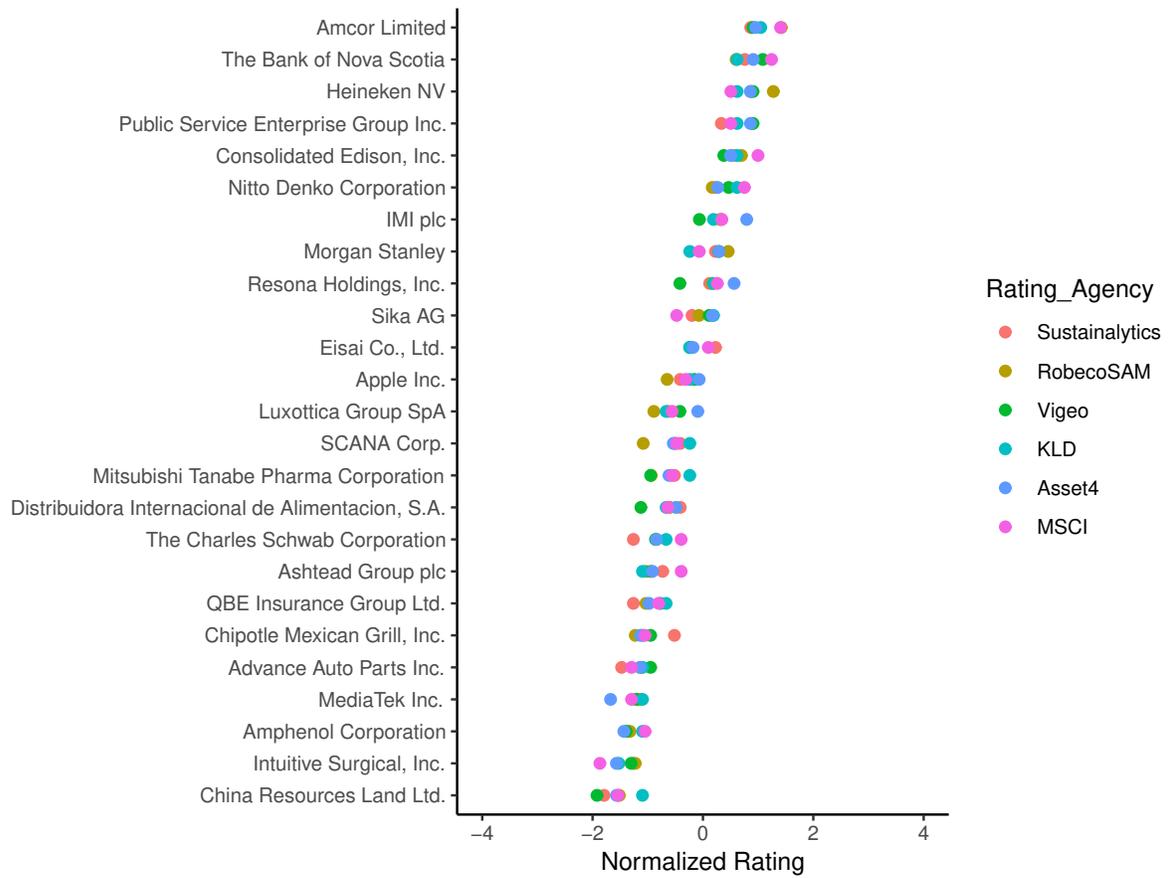
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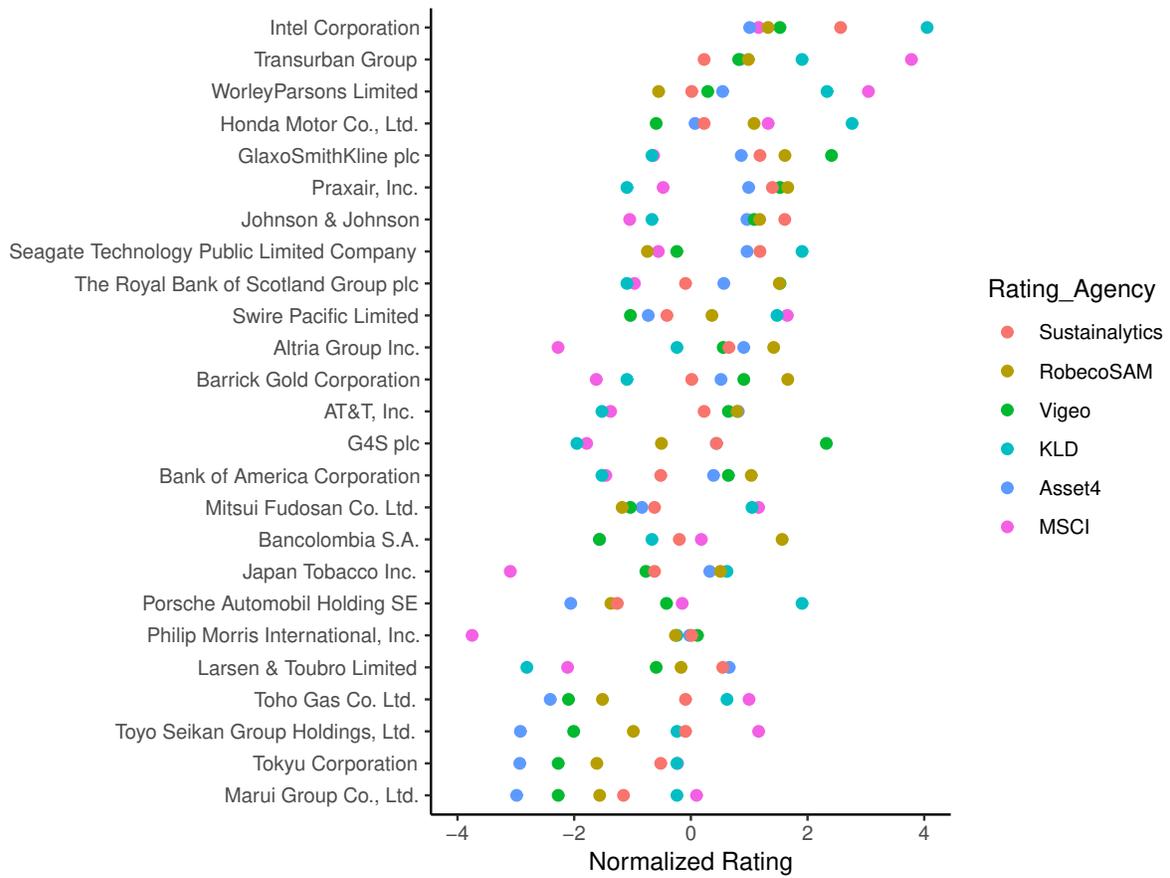
**Figure 1**  
**Firms with low Disagreement**

Normalized ratings for the 25 firms with the lowest mean absolute distance to the average rating (MAD) within the normalized common sample (n=924). Firms are sorted by their average rating. Each rating agency is plotted in a different color.



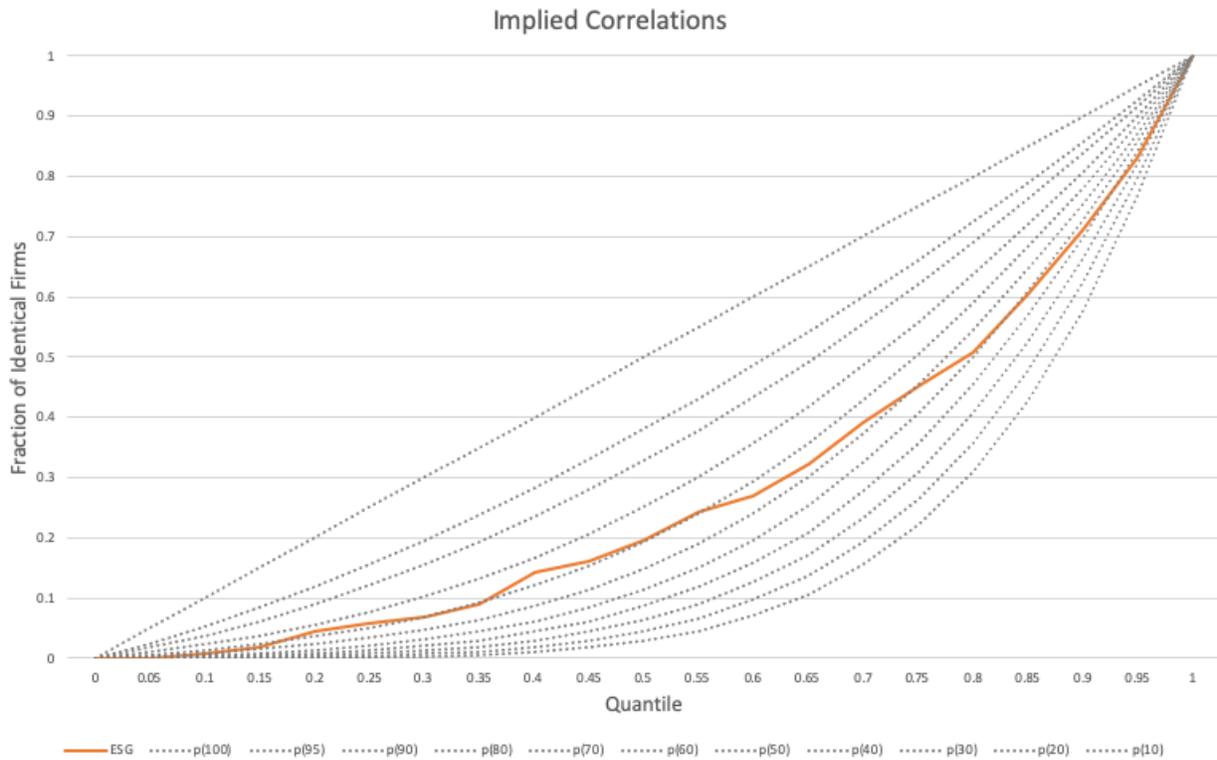
**Figure 2**  
**Firms with high Disagreement**

Normalized ratings for the 25 firms with the highest mean absolute distance to the average rating (MAD) within the normalized common sample (n=924). Firms are sorted by their average rating. Each rating agency is plotted in a different color.



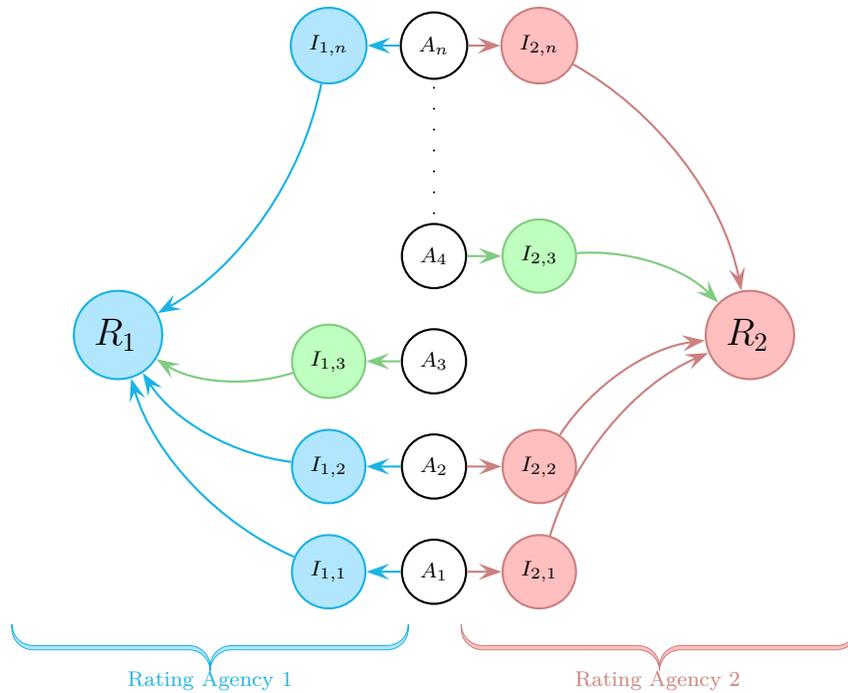
**Figure 3**  
**Quantile Ranking Count (QRC)**

The orange line shows the QRC of the ESG ratings in the common sample and the dashed gray lines show the QRCs of simulated data. The QRC evaluates how many identical firms are included in the rating quantile across all six providers over the total number of firms. The size of the quantile is displayed on the x-axis and ranges from 5 to 100 percent in increments of 5 percent. The implied correlations are depicted by the gray lines where the diagonal line reflects an implied correlation of 1 and the lowermost line reflects an implied correlation of 0.1. Implied correlations are shown for the values 1, 0.95, 0.9, and from then on in increments of 0.1.



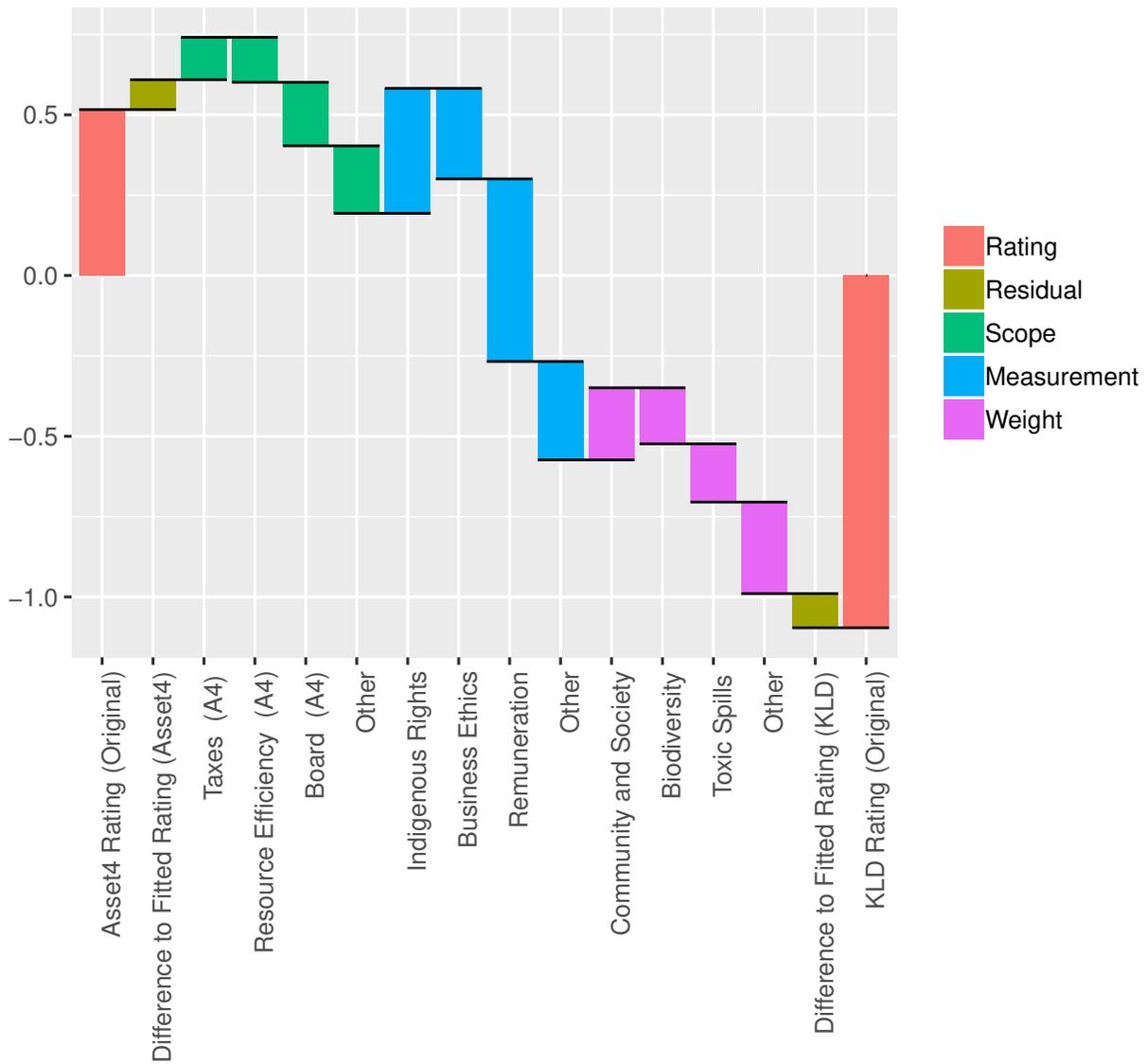
**Figure 4**  
**The Sources of Divergence**

Our schematic representation of an ESG rating consists of the elements scope, measurement, and weights. Scope is the set of attributes  $A_n$  that describe a company's ESG performance. Measurement determines the indicators  $I_{k,1} \dots I_{k,n}$ , which produce numerical values for each attribute and are specific to rating agency  $k$ . Weights determine how indicators are aggregated into a single ESG rating  $R_k$ . Scope divergence results from two raters considering a different set of attributes. Measurement divergence results from two raters using different indicators to measure the same attribute. weights divergence results from two raters aggregating the same indicators using different weights.



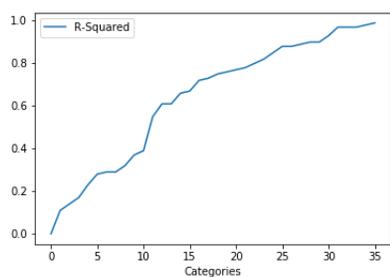
**Figure 5**  
**Decomposition Example**

Arithmetic decomposition of the difference between two ESG ratings provided by Asset4 and KLD for Barrick Gold Corporation in 2014. The normalized ratings are on the left and right. The overall divergence is separated into the contributions of scope divergence, measurement divergence, and weights divergence. Within each source the three most relevant categories in absolute terms are shown in descending order, with the remainder of the total value of each source labeled as "Other". The residual between the original rating and our fitted rating is shown in the second bar from the left and from the right respectively.

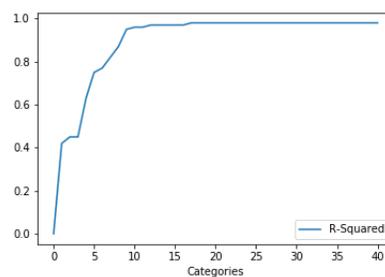


## Figure 6 Lasso Regressions

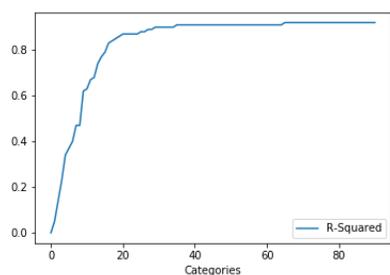
$R^2$  of a series of lasso regressions of the aggregate rating (ESG) of the different rating agencies on the categories of the same rater. The x-axis shows how many indicators are used as covariates and the y-axis how much of the variance of the ESG rating they explain.



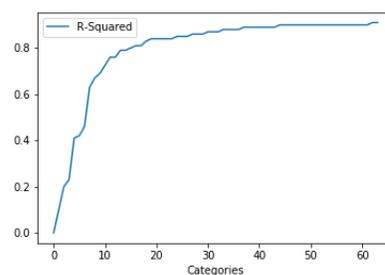
(a) KLD



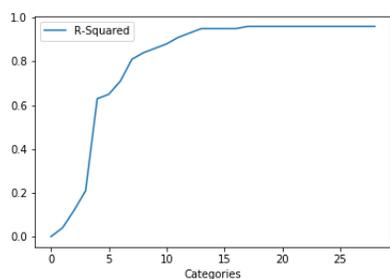
(b) RobecoSAM



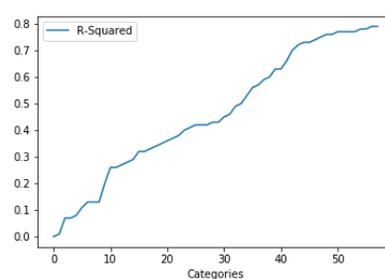
(c) Asset4



(d) Sustainalytics



(e) Vigeo-Eiris



(f) MSCI

**Table 1**  
**Descriptive Statistics**

Descriptive statistics of the aggregate rating (ESG) in 2014 for the six rating agencies. Panel A shows the data for the full sample, panel B for the common sample, and Panel C for the normalized common sample.

<b>Panel A: Full Sample</b>							
	Sustainalytics	RobecoSAM	Vigeo-Eiris	KLD	Asset4	MSCI	
Firms	4531	1665	2304	5053	4013	9662	
Mean	56.4	47.19	32.23	1.16	50.9	4.7	
Standard Dev.	9.46	21.06	11.78	1.76	30.94	1.19	
Minimum	29	13	5	-6	2.78	0	
Median	55	40	31	1	53.15	4.7	
Maximum	89	94	67	12	97.11	9.8	
<b>Panel B: Common Sample</b>							
Firms	924	924	924	924	924	924	
Mean	61.86	50.49	34.73	2.56	73.47	5.18	
Standard Dev.	9.41	20.78	11.31	2.33	23.09	1.22	
Minimum	37	14	6	-4	3.46	0.6	
Median	62	47	33	2	81.48	5.1	
Maximum	89	94	66	12	97.11	9.8	
<b>Panel C: Normalized Common Sample</b>							
Firms	924	924	924	924	924	924	
Mean	0.00	0.00	0.00	0.00	0.00	0.00	
Standard Dev.	1.00	1.00	1.00	1.00	1.00	1.00	
Minimum	-2.64	-1.76	-2.54	-2.81	-3.03	-3.75	
Median	0.01	-0.17	-0.15	-0.24	0.35	-0.07	
Maximum	2.89	2.09	2.76	4.05	1.02	3.78	

**Table 2**  
**Correlations between ESG Ratings**

Correlations between ESG ratings at the aggregate rating level (ESG) and at the level of the environmental dimension (E), the social dimension (S) and the governance dimension (G) using the common sample. The results are similar using pairwise common samples based on the full sample. SA, RS, VI, A4, KL, and MS are short for Sustainalytics, RobecoSAM, Vigeo-Eiris, Asset4, KLD, and MSCI respectively.

	KL SA	KL VI	KL RS	KL A4	KL MS	SA VI	SA RS	SA A4	SA MS	VI RS	VI A4	VI MS	RS A4	RS MS	A4 MS	Average
ESG	0.53	0.49	0.44	0.42	0.53	0.71	0.67	0.67	0.46	0.7	0.69	0.42	0.62	0.38	0.38	0.54
E	0.59	0.55	0.54	0.54	0.37	0.68	0.66	0.64	0.37	0.73	0.66	0.35	0.7	0.29	0.23	0.53
S	0.31	0.33	0.21	0.22	0.41	0.58	0.55	0.55	0.27	0.68	0.66	0.28	0.65	0.26	0.27	0.42
G	0.02	0.01	-0.01	-0.05	0.16	0.54	0.51	0.49	0.16	0.76	0.76	0.14	0.79	0.11	0.07	0.30

**Table 3**  
**Mean Absolute Distance (MAD)**

This table shows how the mean absolute distance to the average rating (MAD) is distributed, based on the normalized common sample for the six rating agencies KLD, Sustainalytics, Vigeo-Eiris, RobecoSAM, Asset4, and MSCI. Panel A shows the distribution across regions, and panel B shows the distribution across Industries.

<b>Panel A: Distribution of Divergence</b>	
<b>MAD</b>	
Minimum	0.14
1st Quantile	0.36
Median	0.45
Mean	0.49
3rd Quantile	0.59
Maximum	1.26

<b>Panel B: Average Divergence across Regions</b>		
	<b>MAD</b>	<b>No. of Firms</b>
Africa	0.43	15
Americas	0.58	17
Asia	0.52	89
Canada	0.51	20
Europe	0.49	274
Japan	0.50	175
Oceania	0.47	53
USA	0.46	281

<b>Panel C: Average Divergence across Industries</b>		
	<b>MAD</b>	<b>No. of Firms</b>
Basic Materials	0.51	65
Consumer Discretionary	0.47	149
Consumer Staples	0.48	63
Energy	0.45	19
Financials	0.46	151
Healthcare	0.47	64
Industrials	0.50	173
Real Estate	0.52	47
Technology	0.51	79
Telecommunications	0.52	40
Utilities	0.50	49

**Table 4**  
**Common Sets of Firms in Quantiles**

The firms in this list are consistently included in the 20 per cent (184) best and worst rated firms across all rating agencies, i.e., KLD, Sustainalytics, Vigeo-Eiris, RobecoSAM, Asset4, and MSCI using the common sample of 924 firms in 2014.

<b>Common among Top quantile</b>	<b>Common among Bottom quantile</b>
Akzo Nobel NV	Advance Auto Parts Inc.
Allianz SE	Affiliated Managers Group Inc.
Aviva plc	Amphenol Corporation
AXA Group	Anhui Conch Cement Co. Ltd.
Bayerische Motoren Werke Aktiengesellschaft	Cencosud S.A.
Dexus Property Group	China Development Financial Holding Corporation
Diageo plc	China Resources Land Ltd.
Industria de Diseno Textil SA	Credit Saison Co. Ltd.
Intel Corporation	Crown Castle International Corp.
Kingfisher plc	DR Horton Inc.
Koninklijke Philips N.V	Expedia Inc.
SAP SE	Helmerich & Payne, Inc.
Schneider Electric S.A.	Hengan International Group Company Limited
STMicroelectronics NV	Intuitive Surgical, Inc.
Wipro Ltd.	Japan Real Estate Investment Corporation
	MediaTek Inc.
	NEXON Co., Ltd.
	Nippon Building Fund Inc.
	Ralph Lauren Corporation
	Shimano Inc.
	Sumitomo Realty & Development Co. Ltd.
	Sun Pharmaceutical Industries Limited
	Wynn Resorts Ltd.

**Table 5**  
**Number of Indicators per Rater and Category**

This table shows how many indicators are provided by the different Sustainability Rating Agencies per category.

	Sustainalytics	RobecoSAM	Asset4	Vigeo-Eiris	MSCI	KLD
Access to Basic Services	2		1		1	1
Access to Healthcare	6	3	1		1	1
Animal Welfare	2		1			
Anti-Competitive Practices			2	1	1	1
Audit	4		5	1		
Biodiversity	1	1	3	1	1	2
Board	6		25	1	1	
Board Diversity	2		1			3
Business Ethics	4	2	1		1	1
Chairman Ceo Separation	1		1			
Child Labor			1	1		1
Climate Risk Mgmt.		2	1		1	2
Clinical Trials	1		1			
Collective Bargaining	2		1	1		
Community and Society	3	6	10	1		1
Corporate Governance		1			1	
Corruption	2		1	1	1	1
Customer Relationship	1	1	7	1		2
Diversity	2		9	1		3
ESG incentives	1	1				
Electromagnetic Fields	1	1				
Employee Development	1	2	13	1	1	3
Employee Turnover	1		1			
Energy	3	6	5	1	2	1
Environmental Fines	1		1			1
Environmental Mgmt. System	2		1			1
Environmental Policy	4	2	4	2		
Environmental Reporting	2	1	1			
Financial Inclusion	1				1	1
Forests	1	1				
GHG Emissions	5		5	1		1
GHG Policies	3	2	4			
GMOs	1	1	1			
Global Compact Membership	1		1			
Green Buildings	5	2	1		1	1
Green Products	7	1	20	1	2	1
HIV Programmes	1		1			
Hazardous Waste	1	1	1		1	
Health and Safety	7	1	7	1	1	2
Human Rights	2	1	5	1		5
Indigenous Rights	1		1			1
Labor Practices	3	1	16	4	1	3
Lobbying	3	1		1		
Non-GHG Air Emissions	1		2			
Ozone Depleting Gases	1		1			
Packaging		1			1	1
Philanthropy	3	1	2	1		1
Privacy and IT	1	3			1	2
Product Safety	2	2	13	3	2	6
Public Health	1	3			1	2
Recycling					1	
Remuneration	4	1	15	2	1	4
Reporting Quality	3		5			1
Resource Efficiency	1	3	6			
Responsible Marketing	3	3	1	1		1
Shareholders			16	1		
Site Closure	1	1				
Supply Chain	21	3	4	4	3	6
Sustainable Finance	9	5	3		3	4
Systemic Risk		1			1	1
Taxes	2	1	1			
Toxic Spills	1		2			1
Unions			1			1
Waste	3	2	4	1		3
Water	2	2	3	1	1	2
Unclassified	7	7	42	1	34	2
Sum	163	80	282	38	68	78

**Table 6**  
**Correlation of Category Scores**

Correlations between the different categories from different rating agencies. We calculate a value for each criterion on the firm level by taking the average of the available indicators for firm  $f$  and rater  $k$ . The panel is unbalanced due to differences in scope of different ratings agencies and categories being conditional on industries.

	KL SA	KL VI	KL RS	KL A4	KL MS	SA VI	SA RS	SA A4	SA MS	VI RS	VI A4	VI MS	RS A4	RS MS	A4 MS	Average
Access to Basic Services	0.08			0.13	0.85			0.49	0.15						0.16	0.31
Access to Healthcare	0.66		0.57	0.49	0.85		0.67	0.56	0.74				0.44	0.71	0.7	0.64
Animal Welfare								0.44								0.44
Anti-Competitive Practices		-0.06		0.56	0.76						0	-0.05			0.56	0.30
Audit						0.57		0.66			0.62					0.62
Biodiversity		0.06	-0.08	0.06	0.66					0.61	0.41	0.47	0.47	0.01	0.2	0.29
Board						0.37		0.58			0.51					0.49
Board Diversity								0.8								0.80
Business Ethics	0.04		-0.11	0.4	0.6		0.33	0.03	0.01				-0.1	-0.15	0.38	0.14
Chairman Ceo Separation								0.59								0.59
Child Labor				0.49												0.49
Climate Risk Mgmt.			0.44	0.42	0.8								0.54	0.54	0.5	0.54
Clinical Trials								0.73								0.73
Collective Bargaining						0.59		-0.04			0					0.18
Community and Society	-0.15	0.25	0.2	0.11		-0.1	-0.19	-0.13		0.51	0.5		0.56			0.16
Corporate Governance														0.08		0.08
Corruption	0.26	0.24		-0.18	0.7	0.54		-0.19	0.37		-0.15	0.33			-0.12	0.18
Customer Relationship	0.38	-0.08	-0.09	0		-0.04	-0.13	-0.05		0.49	0.47		0.41			0.14
Diversity	-0.06	-0.02		0.03		0.61		0.52			0.56					0.27
ESG incentives																
Electromagnetic Fields							0.68									0.68
Employee Development	0.22	0.29	0.37	0.37	0.73	0.23	0.19	0.36	0.34	0.39	0.29	0.31	0.55	0.45	0.51	0.37
Employee Turnover								0.4								0.40
Energy	0.22	0.13	0.49	0.25	0.8	0.4	0.27	0.27	0.4	0.32	0.41	0.59	0.2	0.4	0.48	0.38
Environmental Fines								0.05								0.05
Env. Mgmt. System	0.65			-0.09				0.46								0.34
Environmental Policy						0.52	0.46	0.46		0.63	0.61		0.62			0.55
Environmental Reporting							0.52	0.25					0.36			0.38
Financial Inclusion	0.29				0.7				0.51							0.50
Forests																
GHG Emissions	0	-0.03		-0.06		0.28		0.31			0.5					0.17
GHG Policies							0.48	0.62					0.41			0.50
GMOs							0.38	0.43					0.25			0.35
Global Compact Member								0.92								0.92
Green Buildings	0.54		0.59	0.21	0.83		0.25	0.26	0.55				-0.02	0.66	0.28	0.42
Green Products	0.23	0.07	0.27	0.34	0.76	0.1	0.37	0.47	0.32	0.31	0.29	-0.05	0.53	0.44	0.53	0.33
HIV Programmes																
Hazardous Waste								0.22	0.13	0.34				0.59	0.1	0.28
Health and Safety	0.01	0.27	0.27	0.35	0.73	-0.1	-0.16	-0.16	-0.05	0.63	0.67	0.5	0.57	0.44	0.6	0.30
Human Rights	0	0.19		0.08		-0.01		-0.08			0.42					0.10
Indigenous Rights	0.26			-0.11				-0.46								-0.10
Labor Practices	0.21	-0.04	-0.14	0.07	0.1	0.2	0.14	0.32	0.27	0.54	0.45	0.43	0.35	0.34	0.37	0.24
Lobbying						-0.28										-0.28
Non-GHG Air emissions								0.28								0.28
Ozone Depleting Gases								0.44								0.44
Packaging																
Philanthropy						0.42	0.39	0.32		0.48	0.19		0.17			0.33
Privacy and IT	0.48		0.27		0.75		0.17		0.45					0.42		0.42
Product Safety	-0.05	0.06	0.16	0	0.63	-0.14		-0.03	0.07	0.46	0.21	0.11	0.38	-0.03	0.1	0.14
Public Health			0.6		0.74			0.38						0.63		0.59
Recycling																
Remuneration	0.15	0.09	-0.21	0.17		0.71	0.22	0.83		0.25	0.75		0.37			0.33
Reporting Quality								0.48								0.48
Resource Efficiency							0.35	0.42					0.57			0.45
Responsible Marketing	-0.5	-0.06	-0.38	0.24		0.38	0.68	0		0.49	0.05		-0.1			0.08
Shareholders											0.39					0.39
Site Closure																
Supply Chain	0.15	0.17	0.13	0.16	0.62	0.57	0.53	0.56	0.61	0.66	0.62	0.6	0.53	0.34	0.48	0.45
Sustainable Finance	0.58		0.47	0.46	0.52		0.7	0.74	0.7				0.59	0.61	0.59	0.60
Systemic Risk			0.24		0.65									0.24		0.38
Taxes							0.1	0.02					0.01			0.04
Toxic Spills				0.21												0.21
Unions				0.68												0.68
Waste		0.34		0.23							0.33					0.30
Water	0.36	0.36	0.23	0.23	0.67	0.47	0.29	0.31	0.45	0.48	0.32	0.5	-0.02	0.24	0.44	0.36
Average	0.20	0.12	0.20	0.21	0.69	0.29	0.32	0.33	0.37	0.48	0.38	0.34	0.35	0.37	0.38	

**Table 7**  
**Non Negative Least Squares Regression**

Non-negative linear regressions of the most aggregate rating (ESG) on the categories of the same rater. As categories depend on industries we fill missing values of the independent variables with zeros. \*\*\*,\*\* and \* denote statistical significance at the one, five and ten percent level, respectively. As the data was previously normalized, we exclude the constant term. The standard errors are bootstrapped. Non-existent categories are denoted as dashes.

	Sustainalytics	RobecoSAM	Asset4	Vigeo-Eiris	MSCI	KLD
Access to Basic Services	0.019	-	0	-	0.138***	0.065***
Access to Healthcare	0.051***	0.004	0	-	0.079***	0.051***
Animal Welfare	0.05***	-	0	-	-	-
Anti-Competitive Practices	-	-	0.05***	0.023***	0	0.131***
Audit	0	-	0.026*	0.084***	-	-
Biodiversity	0	0	0	0.028***	0.366***	0.076***
Board	0.072***	-	<b>0.196***</b>	0.113***	0	-
Board Diversity	0.043***	-	0	-	-	0
Business Ethics	0.097***	0.046***	0.008	-	0	0.148***
Chairman Ceo Separation	0.039***	-	0.016	-	-	-
Child Labor	-	-	0.008	0	-	0.046***
Climate Risk Mgmt.	-	<b>0.137***</b>	0.064***	-	0.069**	<b>0.234***</b>
Clinical Trials	0	-	0	-	-	-
Collective Bargaining	0.051***	-	0.011*	0.072***	-	-
Community and Society	0.079***	0.086***	0.03*	0.001	-	0.14***
Corporate Governance	-	0.048***	-	-	0.198***	-
Corruption	0.049***	-	0.022*	0.072***	<b>0.388***</b>	0.124***
Customer Relationship	0.127***	0.097***	0.086***	0.027***	-	0.104***
Diversity	0.108***	-	0.066***	<b>0.159***</b>	-	0.04***
ESG incentives	0.006	0	-	-	-	-
Electromagnetic Fields	0.021**	0	-	-	-	-
Employee Development	0.018*	<b>0.221***</b>	0.116***	0.067***	<b>0.406***</b>	0.149***
Employee Turnover	0.024*	-	0	-	-	-
Energy	0.032**	0.016***	0.029**	0.103***	0.194***	0.046***
Environmental Fines	0	-	0	-	-	0
Environmental Mgmt. System	<b>0.199***</b>	-	0.009	-	-	0.205***
Environmental Policy	0.091***	0.098***	0.012	<b>0.187***</b>	-	-
Environmental Reporting	0.043**	0.039***	0.007	-	-	-
Financial Inclusion	0	-	-	-	0.089***	0.061***
Forests	0.008	0.016*	-	-	-	-
GHG Emissions	0.048***	-	0.002	0.033***	-	0.021**
GHG Policies	0.086***	0.008**	0.047**	-	-	-
GMOs	0	0	0	-	-	-
Global Compact Membership	0.029**	-	0	-	-	-
Green Buildings	0.072***	0.071***	0	-	0.304***	0.072***
Green Products	<b>0.167***</b>	0.037***	0.093***	0.024**	0.351***	0.129***
HIV Programmes	0	-	0.003	-	-	-
Hazardous Waste	0.021*	0	0	-	0.09***	-
Health and Safety	0.049***	0.042***	0.049***	<b>0.125***</b>	0.148***	0.174***
Human Rights	0.072***	0	0.066***	0	-	0.14***
Indigenous Rights	0.033*	-	0.006	-	-	0.087***
Labor Practices	0.005	0.063***	0.067***	0.153***	0.166***	0.129***
Lobbying	0.091***	0	-	0.013	-	-
Non-GHG Air emissions	0.014	-	0	-	-	-
Ozone Depleting Gases	0	-	0	-	-	-
Packaging	-	0	-	-	0.128**	0.033***
Philanthropy	0.028*	0.075***	0.039***	0.073***	-	0
Privacy and IT	0.022*	0.039***	-	-	0.276***	0.124***
Product Safety	0.048***	0.002	0.059***	0.062***	<b>0.429***</b>	<b>0.216***</b>
Public Health	0.022**	0.011*	-	-	0.029	0.074***
Recycling	-	-	-	-	0.119***	-
Remuneration	0	0.054***	<b>0.117***</b>	0.113***	0	<b>0.223***</b>
Reporting Quality	0.123***	-	0.107***	-	-	0
Resource Efficiency	0.014	<b>0.114***</b>	<b>0.135***</b>	-	-	-
Responsible Marketing	0	0.033***	0	0.002	-	0.081***
Shareholders	-	-	0.111***	0.089***	-	-
Site Closure	0.008	0	-	-	-	-
Supply Chain	<b>0.253***</b>	0.061***	0.042**	0.05***	0.188***	0.128***
Sustainable Finance	0.108***	0.079***	0.063***	-	0.275***	0.098***
Systemic Risk	-	0.053***	-	-	0.349***	0.103***
Taxes	0.052***	0.01	0.03**	-	-	-
Toxic Spills	0	-	0.001	-	-	0.113***
Unions	-	-	0.013	-	-	0.158***
Waste	0	0.005	0.035***	0.009	-	0.186***
Water	0.03**	0.016***	0.028**	0	0.035	0.175***
Unclassified Indicators	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.90	0.98	0.92	0.96	0.79	0.99
Firms	924	924	924	924	924	924

**Table 8**  
**Quality of Fit**

Comparison of the quality of fit in terms of  $R^2$  for the estimation of rater-specific aggregation functions using different specifications. NNLS stands for non-negative least squares. OLS for ordinary least squares. NN stands for for neural network with linear activation function, and NN Relu for a neural network with a non-linear relu activation function. RF stands for random forest. \* indicates that the  $R^2$  is reported for a testing set consisting of a randomly chosen 10 percent of the sample. The three last lines report results from the original method, but with different underlying data. For NNLS SASB category scores were calculated based on the SASB taxonomy, for NNLS indicators the original indicators were used without any taxonomy, and for NNLS 2017 the underlying data is of 2017 instead of 2014. Given that KLD does not offer any data for 2017, no value is reported.

Specification	KLD	Vigeo-Eiris	RobecoSAM	Sustainalytics	MSCI	Asset4
NNLS	0.99	0.96	0.98	0.90	0.79	0.92
OLS	0.99	0.96	0.98	0.91	0.79	0.92
NNLS*	0.98	0.94	0.98	0.89	0.74	0.83
NN*	0.98	0.94	0.98	0.88	0.83	0.83
NN Relu*.	0.96	0.96	0.98	0.83	0.85	0.80
RF*	0.73	0.91	0.97	0.85	0.56	0.86
NNLS SASB	0.98	0.96	0.98	0.87	0.76	0.92
NNLS indicators	1	0.96	0.99	0.90	0.82	0.94
NNLS 2017		0.96	0.98	0.91	0.68	0.82

**Table 9**  
**Arithmetic Decomposition**

Results from the arithmetic decomposition. First, we use the weights from table 7 for a given rater pair  $a$  and  $b$ . Second, we construct two different ratings for rater  $a$  and  $b$  by only taking mutually exclusive categories and using the weights from step 1. The mean absolute deviation of the differences of those two ratings reflects the differences in scope between the two rating agencies. Third, we stack the two firm-by-categories matrices of the common categories as well as the two fitted ratings using the common categories of rater  $a$  and  $b$  on each other and calculate a new set of weights that is thus common to both raters using ordinary least squares. We then subtract the newly fitted ratings based on the common weights of rater  $b$  from rater  $a$  and calculate the mean absolute deviation to determine the divergence in measurement. Fourth, we calculate the divergence stemming from the aggregation weight by subtracting the residuals from the previous step of rater  $b$  from rater  $a$  and calculate the mean absolute deviation. The column “Fitted” shows the mean absolute deviation of the differences of the fitted values and “True” the differences of the actual ESG scores.

**Panel A: Rater Pairs**

		Scope	Measurement	Weight	Fitted	True
KLD	Sustainalytics	0.27	0.6	0.29	0.73	0.76
KLD	Vigeo	0.4	0.6	0.27	0.78	0.79
KLD	RobecoSAM	0.28	0.67	0.31	0.8	0.81
KLD	Asset4	0.33	0.6	0.45	0.8	0.86
KLD	MSCI	0.85	0.51	0.51	0.71	0.77
Sustainalytics	Vigeo	0.39	0.51	0.24	0.54	0.6
Sustainalytics	RobecoSAM	0.32	0.55	0.16	0.58	0.64
Sustainalytics	Asset4	0.19	0.45	0.32	0.53	0.65
Sustainalytics	MSCI	0.86	0.52	0.53	0.76	0.82
Vigeo	RobecoSAM	0.3	0.39	0.11	0.6	0.61
Vigeo	Asset4	0.33	0.5	0.19	0.55	0.64
Vigeo	MSCI	0.78	0.55	0.43	0.81	0.85
RobecoSAM	Asset4	0.26	0.51	0.14	0.62	0.71
RobecoSAM	MSCI	0.86	0.6	0.57	0.83	0.89
Asset4	MSCI	0.85	0.57	0.56	0.78	0.89
Average		0.48	0.54	0.34	0.69	0.75

**Panel B: Rater Averages**

	Scope	Measurement	Weight	Fitted	True
KLD	0.43	0.60	0.37	0.76	0.80
Sustainalytics	0.41	0.53	0.31	0.63	0.69
Vigeo	0.44	0.51	0.25	0.66	0.70
RobecoSAM	0.40	0.54	0.26	0.69	0.73
Asset4	0.39	0.53	0.33	0.66	0.75
MSCI	0.84	0.55	0.52	0.78	0.84

**Table 10**  
**Range of Variance Explained**

The first column presents the baseline  $R^2$  for a regression of one rating onto another. The second column is the  $R^2$  from a regression that includes all four covariates, i.e., it includes rating  $a$  plus the scope, measurement, and weight variables. The remaining columns indicate the minimum and maximum  $R^2$  gain of explanatory power due the inclusion of the scope, measurement, and weight variables.

Panel A: Rater Pairs								
	Baseline	All	Scope		Measurement		Weight	
			Min	Max	Min	Max	Min	Max
KLD on Sustainalytics	0.272	0.692	0.151	0.159	0.258	0.267	0	0.003
KLD on Vigeo-Eiris	0.232	0.788	0.306	0.363	0.191	0.234	0.001	0.020
KLD on RobecoSAM	0.198	0.749	0.193	0.223	0.328	0.357	0	0.005
KLD on Asset4	0.207	0.745	0.02	0.052	0.443	0.502	0.012	0.056
KLD on MSCI	0.289	0.830	0.187	0.299	0.123	0.238	0.036	0.186
Sustainalytics on KLD	0.272	0.857	0.225	0.452	0.13	0.353	0.004	0.009
Sustainalytics on Vigeo-Eiris	0.556	0.876	0.173	0.277	0.043	0.124	0	0.026
Sustainalytics on RobecoSAM	0.506	0.874	0.18	0.311	0.054	0.173	0.001	0.022
Sustainalytics on Asset4	0.545	0.796	0.008	0.025	0.125	0.176	0.064	0.105
Sustainalytics on MSCI	0.202	0.92	0.408	0.649	0.06	0.259	0.005	0.103
Vigeo-Eiris on KLD	0.232	0.95	0.123	0.615	0.102	0.594	0	0.008
Vigeo-Eiris on Sustainalytics	0.556	0.888	0.053	0.093	0.237	0.269	0.001	0.015
Vigeo-Eiris on RobecoSAM	0.489	0.954	0.152	0.382	0.083	0.313	0	0.001
Vigeo-Eiris on Asset4	0.561	0.903	0.001	0.039	0.297	0.341	0	0.012
Vigeo-Eiris on MSCI	0.156	0.960	0.189	0.758	0.044	0.608	0	0.105
RobecoSAM on KLD	0.198	0.936	0.094	0.661	0.074	0.641	0.003	0.006
RobecoSAM on Sustainalytics	0.506	0.925	0.054	0.282	0.131	0.364	0	0.011
RobecoSAM on Vigeo-Eiris	0.489	0.979	0.101	0.400	0.089	0.386	0	0.014
RobecoSAM on Asset4	0.476	0.948	0.009	0.052	0.358	0.461	0.001	0.070
RobecoSAM on MSCI	0.155	0.962	0.157	0.774	0.032	0.649	0	0.049
Asset4 on KLD	0.207	0.953	0.141	0.579	0.167	0.605	0	0.001
Asset4 on Sustainalytics	0.545	0.885	0.066	0.161	0.147	0.268	0.005	0.040
Asset4 on Vigeo-Eiris	0.561	0.955	0.069	0.222	0.169	0.323	0.002	0.009
Asset4 on RobecoSAM	0.476	0.971	0.102	0.334	0.16	0.392	0	0.009
Asset4 on MSCI	0.178	0.887	0.179	0.692	0.011	0.514	0.004	0.117
MSCI on KLD	0.289	0.701	0.198	0.374	0.018	0.118	0.020	0.119
MSCI on Sustainalytics	0.202	0.443	0.153	0.218	0.021	0.077	0.003	0.014
MSCI on Vigeo-Eiris	0.156	0.706	0.304	0.479	0.071	0.243	0	0.004
MSCI on RobecoSAM	0.155	0.63	0.126	0.371	0.104	0.349	0	0.010
MSCI on Asset4	0.178	0.573	0.171	0.312	0.075	0.215	0.004	0.017
<b>Average</b>	0.335	0.841	0.142	0.354	0.138	0.347	0.006	0.039

Panel B: Rater Averages								
	Baseline	All	Scope		Measurement		Weight	
			Min	Max	Min	Max	Min	Max
KLD	24.0	82.0	16.4	37.8	18.3	39.1	0.8	4.1
Sustainalytics	41.6	81.6	14.7	26.3	12.1	23.3	0.8	3.5
Vigeo	39.9	89.6	14.7	36.3	13.2	34.4	0.0	2.1
RobecoSAM	36.5	89.3	11.7	37.9	14.1	40.9	0.0	2.0
Asset4	39.4	86.2	7.7	24.7	19.5	38.0	0.9	4.4
MSCI	19.6	76.1	20.7	49.3	5.6	32.7	0.7	7.2

**Table 11**  
**Investigation of Category and Rater Effect**

The dependent variable is a vector that stacks all the common category scores for all raters using the common sample.

<b>Dummies</b>	$R^2$
Firm	0.22
Firm + Firm-Rater	0.38
Firm + Firm-Category	0.47
Firm + Firm-Category + Firm-Rater	0.62

**Table 12**  
**Lasso Regressions**

This table shows the  $R^2$  of a series of lasso regressions of aggregate rating (ESG) of the different rating agencies on the categories of the same rater. The column is the number of indicators that are used as covariates to obtain the corresponding  $R^2$ . The highlighted cells represent the number of categories that constitute 10 percent of the indicators of the particular rating agency.

<b>Categories</b>	<b>Vigeo-Eiris</b>	<b>RobecoSAM</b>	<b>Asset4</b>	<b>KLD</b>	<b>Sustainalytics</b>	<b>MSCI</b>
<b>1</b>	0.04	0.42	0	0.11	0.1	0.01
<b>2</b>	0.12	0.45	0.05	0.14	0.2	0.06
<b>3</b>	0.21	0.45	0.14	0.17	0.23	0.07
<b>4</b>	0.63	0.63	0.23	0.23	0.41	0.08
<b>5</b>	0.65	0.75	0.34	0.28	0.42	0.11
<b>6</b>	0.71	0.77	0.37	0.29	0.46	0.13
<b>7</b>	0.81	0.82	0.4	0.29	0.63	0.13
<b>8</b>	0.84	0.87	0.47	0.32	0.67	0.13
<b>9</b>	0.86	0.95	0.47	0.37	0.69	0.20
<b>10</b>	0.88	0.96	0.63	0.39	0.69	0.26
<b>15</b>	0.95	0.97	0.79	0.67	0.8	0.32
<b>20</b>	0.96	0.98	0.87	0.77	0.84	0.36

## Internet Appendix

**Table A.1**  
**Number of Indicators per Rater and Category (SASB)**

Calculation procedure and data is equivalent to Table 5, except that the underlying taxonomy is based on the 26 General Issue Categories provided by SASB.

	KLD	Sustainalytics	Vigeo-Eiris	RobecoSAM	Asset4	MSCI
Access & Affordability	3	9		3	2	3
Air Quality		2			3	
Business Ethics	6	11	3	3	18	3
Competitive Behavior	1		1		2	1
Critical Incident Risk Mgmt.	1	1			2	
Customer Privacy	2	1		3		1
Customer Welfare	4	3	1	5	7	1
Ecological Impacts	3	11	3	6	9	1
Employee Engagement, Diversity & Inclusion	9	5	2	2	23	1
Employee Health & Safety	2	8	1	1	8	1
Energy Mgmt.	1	3	1	6	5	2
GHG Emissions	1	8	1	2	9	
Human Rights & Community Relations	7	6	2	7	16	
Labor Practices	5	6	6	1	20	1
Mgmt. of the Legal & Regulatory Env.	1	3		1	2	
Materials Sourcing & Efficiency		1		3	6	
Physical Impacts of Climate Change	2			2	1	1
Product Design & Lifecycle Mgmt.	3	16	1	6	23	4
Product Quality & Safety	6	2	3	2	13	2
Selling Practices & Product Labeling	1	3	1	3	1	
Supply Chain Mgmt.	6	21	4	3	4	3
Systemic Risk Mgmt.	1			1		1
Waste & Hazardous Materials Mgmt.	3	4	1	3	5	1
Water & Wastewater Mgmt.	2	2	1	2	3	1
Unclassified	8	37	6	15	100	40
Sum	78	163	38	80	282	68

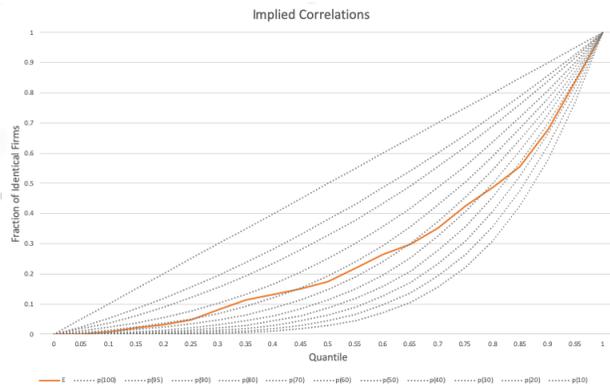
**Table A.2**  
**Correlation of Category Scores (SASB)**

Calculation procedure and data is equivalent to Table 6, except that the underlying taxonomy is based on the 26 General Issue Categories provided by SASB.

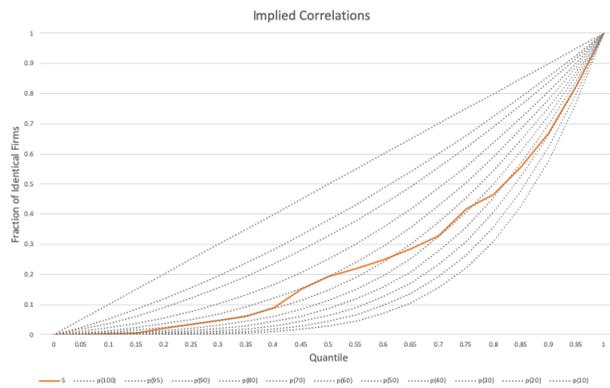
	KL SA	KL VI	KL RS	KL A4	KL MS	SA VI	SA RS	SA A4	SA MS	VI RS	VI A4	VI MS	RS A4	RS MS	A4 MS	Average
Access & Affordability	0.41		0.57	0.25	0.78		0.67	0.47	0.56				0.55	0.71	0.43	0.54
Air Quality								0.27								0.27
Business Ethics	0.1	0.05	0.05	0.09	0.35	0.68	0.43	0.73	0.08	0.43	0.69	0.05	0.25	0.17	0.01	0.28
Competitive Behavior		-0.06		0.56	0.76						0	-0.05			0.56	0.30
Critical Incident Risk Mgmt.				0.21												0.21
Customer Privacy	0.48		0.27		0.75		0.17		0.45					0.42		0.42
Customer Welfare	0.31	-0.08	-0.06	0.02	0.67	-0.03	-0.11	-0.04	-0.07	0.48	0.47		0.42	0.4	0.38	0.20
Ecological Impacts	0.48	0.4	0.41	0.39	0.65	0.67	0.7	0.65	0.29	0.71	0.58	0.48	0.69	0.21	0.26	0.50
Employee Engagement, Diversity & Inclusion	0.17	0.2	0.15	0.2	0.72	0.57	0.4	0.54	0.45	0.51	0.55	0.42	0.58	0.45	0.55	0.43
Employee Health & Safety	0.01	0.27	0.27	0.34	0.73	-0.11	-0.16	-0.14	-0.06	0.63	0.66	0.5	0.55	0.44	0.59	0.30
Energy Mgmt.	0.22	0.13	0.49	0.25	0.8	0.4	0.27	0.27	0.4	0.32	0.41	0.59	0.2	0.4	0.48	0.38
GHG Emissions	0	-0.03		-0.06		0.32	0.63	0.59			0.56		0.36			0.30
Human Rights & Community Relations	-0.13	0.25	0.15	0.11		-0.03	-0.14	-0.09		0.54	0.49		0.64			0.18
Labor Practices	0.26	0.28	0.11	0.2	0.34	0.59	0.45	0.42	0.41	0.56	0.48	0.43	0.38	0.34	0.4	0.38
Mgmt. of the Legal & Regulatory Environment							0.05	-0.05					0.01			0.00
Materials Sourcing & Efficiency							0.35	0.42					0.57			0.45
Physical Impacts of Climate Change			0.44	0.42	0.8								0.54	0.54	0.5	0.54
Product Design & Lifecycle Mgmt.	0.29	0.07	0.31	0.29	0.78	0.31	0.47	0.35	0.42	0.35	0.3	-0.05	0.56	0.48	0.48	0.36
Product Quality & Safety	-0.05	0.06	0.16	0	0.63	-0.14		-0.03	0.07	0.46	0.21	0.11	0.38	-0.03	0.1	0.14
Selling Practices & Product Labeling	-0.5	-0.06	-0.38	0.24		0.38	0.68	0		0.49	0.05		-0.1			0.08
Supply Chain Mgmt.	0.15	0.17	0.13	0.16	0.62	0.57	0.53	0.56	0.61	0.66	0.62	0.6	0.53	0.34	0.48	0.45
Systemic Risk Mgmt.			0.24		0.65									0.24		0.38
Waste & Hazardous Materials Mgmt.	0.25	0.34	0.22	0.23	0.78	0.43	0.22	0.36	0.33	0.48	0.32	0.39	0.12	0.23	0.3	0.33
Water & Wastewater Mgmt.	0.36	0.36	0.23	0.23	0.67	0.47	0.29	0.31	0.45	0.48	0.32	0.5	-0.02	0.24	0.44	0.36
Average	0.17	0.15	0.21	0.22	0.68	0.34	0.33	0.29	0.31	0.51	0.42	0.33	0.38	0.35	0.40	

# Figure A.1 Quantile Ranking Counts for Subdimensions

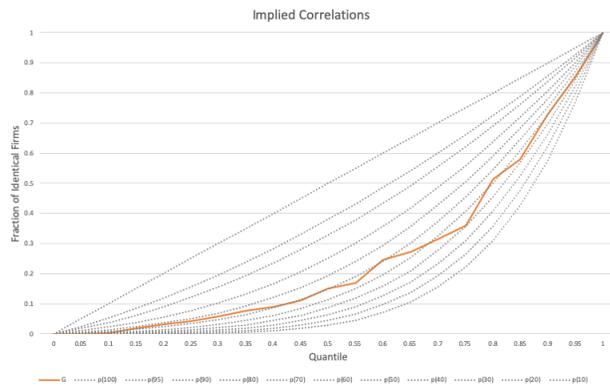
Analogous to Figure 3, but calculated separately for the Environmental, Social, and Governance Dimension of the ratings.



(a) Environment



(b) Social



(c) Governance

**Table A.3**  
**Non Negative Least Squares Regression (SASB)**

Calculation procedure and data is equivalent to Table 7, except that the underlying taxonomy is based on the 26 General Issue Categories provided by SASB.

	Sustainalytics	RobecoSAM	Asset4	Vigeo-Eiris	MSCI	KLD
Access & Affordability	0.032**	0	0	-	0.207***	0.099***
Air Quality	0.022*	-	0	-	-	-
Business Ethics	0.12***	0.059***	0.098***	0.186***	0.055*	0.273***
Competitive Behavior	-	-	0.049***	0.01	0	0.134***
Critical Incident Risk Mgmt.	0	-	0	-	-	0.106***
Customer Privacy	0.033***	0.04***	-	-	0.27***	0.122***
Customer Welfare	0.131***	0.072***	0.089***	0.031***	0.031	0.118***
Ecological Impacts	0.322***	0.156***	0.007	0.19***	0.419***	0.216***
Employee Engagement, Diversity & Inclusion	0.08***	0.226***	0.152***	0.198***	0.406***	0.139***
Employee Health & Safety	0.019	0.056***	0.051***	0.133***	0.174***	0.178***
Energy Mgmt.	0.037***	0.004	0.028*	0.101***	0.211***	0.054***
GHG Emissions	0.144***	0.01***	0.03	0.036***	-	0.024***
Human Rights & Community Relations	0.101***	0.084***	0.079***	0.03***	-	0.31***
Labor Practices	0.075***	0.064***	0.072***	0.189***	0.149***	0.209***
Mgmt. of the Legal & Regulatory Environment	0.023*	0.004	0.005	-	-	0
Materials Sourcing & Efficiency	0.013	0.095***	0.133***	-	-	-
Physical Impacts of Climate Change	-	0.14***	0.069***	-	0.089***	0.238***
Product Design & Lifecycle Mgmt.	0.05***	0.052***	0.101***	0.01	0.484***	0.138***
Product Quality & Safety	0.065***	0	0.064***	0.064***	0.427***	0.219***
Selling Practices & Product Labeling	0	0.031***	0	0	-	0.086***
Supply Chain Mgmt.	0.245***	0.053***	0.049***	0.037***	0.163***	0.122***
Systemic Risk Mgmt.	-	0.059***	-	-	0.362***	0.106***
Waste & Hazardous Materials Mgmt.	0.059***	0.016*	0.032**	0.001	0.077**	0.193***
Water & Wastewater Mgmt.	0.066***	0.017**	0.029**	0	0.039*	0.176***
Unclassified Indicators	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.87	0.98	0.92	0.96	0.76	0.98
Observations	924	924	924	924	924	924

**Table A.4**  
**Arithmetic Decomposition (SASB)**

Calculation procedure and data equivalent to Table 9, except that the underlying taxonomy is based on the 26 General Issue Categories provided by SASB.

		Scope	Measurement	Weights	Residuals	Fitted	True
<b>KLD</b>	<b>Sustainalytics</b>	0.25	0.66	0.29	0.3	0.72	0.76
<b>KLD</b>	<b>Vigeo</b>	0.33	0.72	0.31	0.18	0.79	0.79
<b>KLD</b>	<b>RobecoSAM</b>	0.23	0.71	0.42	0.15	0.81	0.81
<b>KLD</b>	<b>Asset4</b>	0.36	0.6	0.48	0.25	0.8	0.86
<b>KLD</b>	<b>MSCI</b>	0.8	0.58	0.45	0.4	0.71	0.77
<b>Sustainalytics</b>	<b>Vigeo</b>	0.21	0.47	0.19	0.32	0.53	0.6
<b>Sustainalytics</b>	<b>RobecoSAM</b>	0.18	0.48	0.21	0.3	0.57	0.64
<b>Sustainalytics</b>	<b>Asset4</b>	0.29	0.39	0.25	0.36	0.52	0.65
<b>Sustainalytics</b>	<b>MSCI</b>	0.75	0.62	0.44	0.48	0.76	0.82
<b>Vigeo</b>	<b>RobecoSAM</b>	0.28	0.45	0.16	0.18	0.59	0.61
<b>Vigeo</b>	<b>Asset4</b>	0.31	0.41	0.2	0.28	0.55	0.64
<b>Vigeo</b>	<b>MSCI</b>	0.72	0.72	0.41	0.4	0.81	0.85
<b>RobecoSAM</b>	<b>Asset4</b>	0.26	0.47	0.1	0.26	0.62	0.71
<b>RobecoSAM</b>	<b>MSCI</b>	0.8	0.68	0.52	0.39	0.83	0.89
<b>Asset4</b>	<b>MSCI</b>	0.84	0.55	0.54	0.46	0.79	0.89
<b>Average</b>		0.44	0.57	0.33	0.31	0.69	0.75

**Table A.5**  
**Range of Variance Explained (SASB)**

Calculation procedure and data equivalent to Table 10, except that the underlying taxonomy is based on the 26 General Issue Categories provided by SASB.

	Baseline	All Covariates	Scope		Measurement		Weight	
			Min	Max	Min	Max	Min	Max
KLD on Sustainalytics	0.2778	0.7569	0.0949	0.1184	0.3562	0.3811	0.0001	0.005
KLD on Vigeo	0.2246	0.7552	0.0908	0.1351	0.366	0.4212	0.0143	0.0379
KLD on RobecoSAM	0.1928	0.7454	0.0227	0.0452	0.5056	0.5254	0.0003	0.0058
KLD on Asset4	0.2003	0.8029	0.0345	0.047	0.5252	0.5569	0.0053	0.0429
KLD on MSCI	0.2853	0.7866	0.1054	0.1166	0.2133	0.3422	0.0477	0.1822
Sustainalytics on KLD	0.2778	0.8621	0.1017	0.3194	0.2614	0.481	0.0011	0.0076
Sustainalytics on Vigeo	0.5635	0.8712	0.0296	0.1016	0.1746	0.2472	0.0197	0.041
Sustainalytics on RobecoSAM	0.5083	0.8858	0.0364	0.1383	0.2248	0.3331	0.007	0.015
Sustainalytics on Asset4	0.5604	0.8564	0.0482	0.1375	0.1247	0.2043	0.0239	0.0499
Sustainalytics on MSCI	0.191	0.8912	0.1321	0.5337	0.1489	0.5628	0.0019	0.0935
Vigeo on KLD	0.2246	0.9524	0.0871	0.3137	0.4138	0.6384	0	0.0035
Vigeo on Sustainalytics	0.5635	0.9502	0.0826	0.141	0.2437	0.2798	0	0.0317
Vigeo on RobecoSAM	0.499	0.9677	0.0789	0.1898	0.2789	0.3895	0	0.0011
Vigeo on Asset4	0.5551	0.9457	0.0501	0.0826	0.2642	0.3395	0.0003	0.0469
Vigeo on MSCI	0.1445	0.944	0.1344	0.4224	0.3602	0.6612	0.0001	0.0719
RobecoSAM on KLD	0.1928	0.9735	0.0449	0.6455	0.1351	0.7346	0	0.0229
RobecoSAM on Sustainalytics	0.5083	0.9682	0.0929	0.3113	0.1462	0.366	0.0009	0.0133
RobecoSAM on Vigeo	0.499	0.9842	0.0412	0.3803	0.1032	0.4437	0	0.0289
RobecoSAM on Asset4	0.479	0.9866	0.0271	0.1548	0.2646	0.4799	0	0.1008
RobecoSAM on MSCI	0.1439	0.9572	0.0964	0.7603	0.0529	0.7142	0	0.0622
Asset4 on KLD	0.2003	0.9846	0.1245	0.6323	0.1519	0.6596	0	0.0002
Asset4 on Sustainalytics	0.5604	0.9628	0.1387	0.2675	0.1347	0.2634	0.0002	0.0152
Asset4 on Vigeo	0.5551	0.9747	0.1007	0.3318	0.087	0.3159	0	0.004
Asset4 on RobecoSAM	0.479	0.9792	0.1151	0.3188	0.1803	0.3841	0.0009	0.0064
Asset4 on MSCI	0.1605	0.9722	0.229	0.738	0.0722	0.5789	0	0.0773
MSCI on KLD	0.2853	0.6714	0.2148	0.3439	0.0153	0.1094	0.0249	0.0645
MSCI on Sustainalytics	0.191	0.5199	0.1746	0.3035	0.0238	0.1436	0.0009	0.0109
MSCI on Vigeo	0.1445	0.538	0.1795	0.3078	0.0827	0.2093	0.0024	0.0052
MSCI on RobecoSAM	0.1439	0.6177	0.1417	0.3622	0.1084	0.3289	0.0003	0.0107
MSCI on Asset4	0.1605	0.6941	0.1904	0.4304	0.0954	0.3368	0.0034	0.0145
<b>Average</b>	<b>0.3324</b>	<b>0.8586</b>	<b>0.1014</b>	<b>0.3044</b>	<b>0.2038</b>	<b>0.4144</b>	<b>0.0052</b>	<b>0.0358</b>

**Table A.6**  
**Correlations between ESG Ratings (2017)**

Calculation procedure and data equivalent to Table 10, except that the underlying data is from 2017 instead of 2014.

	SA VI	SA RS	SA A4	SA MS	VI RS	VI A4	VI MS	RS A4	RS MS	A4 MS	Average
ESG	0.77	0.65	0.53	0.53	0.62	0.6	0.49	0.42	0.4	0.37	
E	0.7	0.66	0.59	0.33	0.69	0.59	0.35	0.61	0.26	0.19	
S	0.67	0.57	0.52	0.29	0.62	0.58	0.27	0.55	0.27	0.28	
G	0.55	0.48	0.36	0.34	0.7	0.7	0.43	0.68	0.38	0.34	

**Table A.7**  
**Correlation of Category Scores (2017)**

Calculation procedure and data equivalent to Table 6, except that the underlying data is from 2017 instead of 2014.

	SA VI	SA RS	SA A4	SA MS	VI RS	VI A4	VI MS	RS A4	RS MS	A4 MS	Average
Access to Basic Services			0.44	-0.08						0.23	0.20
Access to Healthcare		0.58	0.73	0.67				0.4	0.55	0.7	0.61
Animal Welfare			0.62								0.62
Anti-Competitive Practices						0.01	0.08			0.44	0.18
Audit	0.46		0.66			0.41					0.51
Biodiversity	0.61	0.7	0.34	0.41	0.55	0.35	0.4	0.36	0.33	0.27	0.43
Board	0.35		0.61	0.36		0.45	0.43			0.34	0.42
Board Diversity			0.75								0.75
Business Ethics		0.31	0.06	0.2				-0.05	-0.04	0.39	0.15
Chairman Ceo Separation			0.59								0.59
Child Labor											
Climate Risk Mgmt.								0.42	0.5	0.32	0.41
Clinical Trials			0.5								0.50
Collective Bargaining	0.62		-0.05			0					0.19
Community and Society	-0.06	-0.14	-0.07		0.5	0.43		0.52			0.20
Corporate Governance									0.39		0.39
Corruption	0.53		-0.22	0.39		-0.1	0.47			-0.07	0.17
Customer Relationship	-0.07	-0.09	-0.06		0.49	0.43		0.42			0.19
Diversity	0.66		0.56			0.56					0.59
ESG incentives		0.48									0.48
Electromagnetic Fields		0.41									0.41
Employee Development	-0.15	0.29	0.34	0.29	0.32	0.26	0.17	0.49	0.37	0.42	0.28
Employee Turnover			0.46								0.46
Energy	0.4	0.22	0.26	0.37	0.19	0.33	0.05	0.02	0.17	0.36	0.24
Environmental Fines			0.28								0.28
Environmental Mgmt. System			0.5								0.50
Environmental Policy	0.53	0.5	0.46		0.6	0.54		0.54			0.53
Environmental Reporting		0.52	0.25					0.37			0.38
Financial Inclusion				0.43							0.43
Forests											
GHG Emissions	0.25		0.28			0.47					0.33
GHG Policies		0.31	0.64					0.2			0.38
GMOs		0.46	0.61					0.01			0.36
Global Compact Membership			0.83								0.83
Green Buildings		0.22	0.19	0.55				0.18	0.34	0.34	0.30
Green Products	0.46	0.42	0.53	0.34	0.22	0.31	0.22	0.46	0.36	0.5	0.38
HIV Programmes			0.75								0.75
Hazardous Waste		0.16	0.05	0.37					0.27	0.1	0.19
Health and Safety	-0.06	-0.07	-0.13	0	0.54	0.66	0.55	0.49	0.39	0.6	0.30
Human Rights	0.02	0.01	-0.04		0.43	0.41		0.45			0.21
Indigenous Rights			-0.22								-0.22
Labor Practices	0.43	0.28	0.24	0.16	0.53	0.35	0.3	0.24	0.19	0.36	0.31
Lobbying	-0.28	-0.34			0.41						-0.07
Non-GHG Air emissions			0.45								0.45
Ozone Depleting Gases			0.41								0.41
Packaging											
Philanthropy					0.42	0.27		0.16			0.28
Privacy and IT		0.16		0.33					0.31		0.27
Product Safety	-0.11	-0.12	-0.01	0.04	0.27	0.19	0.23	0.21	0.33	0.31	0.13
Public Health		0.55		0.13					0.26		0.31
Recycling											
Remuneration	0.65	-0.03	0.8	0.2	0.2	0.7	0.27	-0.02	0.1	0.26	0.31
Reporting Quality			0.47								0.47
Resource Efficiency		0.2	0.27					0.5			0.32
Responsible Marketing	0.39	0.53	-0.15		0.19	-0.02		-0.12			0.14
Shareholders						0.35					0.35
Site Closure		0.73									0.73
Supply Chain	0.6	0.53	0.56	0.54	0.56	0.55	0.46	0.51	0.34	0.34	0.50
Sustainable Finance		0.58	0.71	0.7				0.55	0.46	0.53	0.59
Systemic Risk									0.14		0.14
Taxes		0.25	0.02					0.03			0.10
Toxic Spills			0.21								0.21
Unions											
Waste					0.47	0.33		-0.24			0.19
Water	0.43	0.33	0.32	0.46	0.42	0.3	0.46	0.07	0.2	0.37	0.34
Average	0.30	0.29	0.34	0.33	0.41	0.34	0.31	0.27	0.30	0.36	

**Table A.8**  
**Non Negative Least Squares Regression (2017)**

Calculation procedure and data equivalent to Table 7, except that the underlying data is from 2017 instead of 2014.

	Sustainalytics	RobecoSAM	Asset4	Vigeo-Eiris	MSCI
Access to Basic Services	0.026**	-	0	-	0.117***
Access to Healthcare	0.062***	0.013**	0	-	0.08***
Animal Welfare	0.034***	-	0	-	-
Anti-Competitive Practices	-	-	0.037	0.019**	0
Audit	0	-	0	0.062***	-
Biodiversity	0	0	0	0.019***	0.244***
Board	0.093***	-	0.21***	0.112***	0.028
Board Diversity	0	-	0.02	-	-
Business Ethics	0.104***	0.097***	0	-	0
Chairman Ceo Separation	0.048***	-	0	-	-
Child Labor	-	-	0	0	-
Climate Risk Mgmt.	-	0.151***	0.012	-	0.146***
Clinical Trials	0	-	0.006	-	-
Collective Bargaining	0.081***	-	0	0.068***	-
Community and Society	0.072***	0.057***	0.029	0.014**	-
Corporate Governance	-	0.037***	-	-	0.265***
Corruption	0.029***	-	0.039**	0.088***	0.476***
Customer Relationship	0.093***	0.044***	0.059***	0.03***	-
Diversity	0.087***	-	0.027	0.126***	-
ESG incentives	0.01	0.061***	-	-	-
Electromagnetic Fields	0.004	0	-	-	-
Employee Development	0	0.193***	0.118***	0.062***	0.437***
Employee Turnover	0.044***	-	0.043***	-	-
Energy	0.028***	0.021***	0.062***	0.133***	0.194***
Environmental Fines	0	-	0	-	-
Environmental Mgmt. System	0.194***	-	0	-	-
Environmental Policy	0.071***	0.069***	0.029*	0.18***	-
Environmental Reporting	0.04***	0.058***	0.003	-	-
Financial Inclusion	0	-	-	-	0.086***
Forests	0	0.006*	-	-	-
GHG Emissions	0.044***	-	0	0.042***	-
GHG Policies	0.086***	0	0	-	-
GMOs	0	0	0	-	-
Global Compact Membership	0.044***	-	0	-	-
Green Buildings	0.089***	0.039***	0.006	-	0.169***
Green Products	0.158***	0.017***	0.049***	0.055***	0.227***
HIV Programmes	0	-	0	-	-
Hazardous Waste	0.013	0	0	-	0.016
Health and Safety	0.094***	0.008	0.016	0.108***	0.104***
Human Rights	0.017**	0.039***	0.048***	0.018**	-
Indigenous Rights	0.03**	-	0	-	-
Labor Practices	0.019**	0.03***	0.023	0.147***	0.131***
Lobbying	0.093***	0.03***	-	0.005	-
Non-GHG Air emissions	0.011	-	0.006	-	-
Ozone Depleting Gases	0	-	0	-	-
Packaging	-	0	-	-	0.14***
Philanthropy	0	0.069***	0.101***	0.068***	-
Privacy and IT	0.018*	0.026***	-	-	0.356***
Product Safety	0.047***	0	0.039	0.025***	0.094***
Public Health	0.005	0	-	-	0
Recycling	-	-	-	-	0.07***
Remuneration	0	0.026***	0.129***	0.101***	0
Reporting Quality	0.134***	-	0.1***	-	-
Resource Efficiency	0.003	0.114***	0.137***	-	-
Responsible Marketing	0	0.025***	0	0	-
Shareholders	-	-	0.119***	0.084***	-
Site Closure	0	0.031***	-	-	-
Supply Chain	0.229***	0.049***	0.031**	0.069***	0.15***
Sustainable Finance	0.107***	0.077***	0.052*	-	0.206***
Systemic Risk	-	0.032***	-	-	0.321***
Taxes	0.044***	0.015***	0	-	-
Toxic Spills	0.029***	-	0.015	-	-
Unions	-	-	0.005	-	-
Waste	0	0	0.059***	0	-
Water	0.013	0.01**	0.038***	0	0.057**
Unclassified Indicators	Yes	Yes	Yes	Yes	Yes
R2	0.91	0.98	0.82	0.96	0.69
Observations	1375	1375	1375	1375	1375

**Table A.9**  
**Arithmetic Decomposition (2017)**

Calculation procedure and data equivalent to Table 9, except that the underlying data is from 2017 instead of 2014.

		Scope	Measurement	Weights	Residuals	Fitted	True
Sustainalytics	Vigeo	0.42	0.5	0.19	0.26	0.49	0.53
Sustainalytics	RobecoSAM	0.32	0.53	0.16	0.24	0.6	0.65
Sustainalytics	Asset4	0.19	0.45	0.35	0.36	0.64	0.76
Sustainalytics	MSCI	0.8	0.44	0.47	0.48	0.7	0.76
Vigeo	RobecoSAM	0.39	0.38	0.17	0.18	0.66	0.68
Vigeo	Asset4	0.28	0.54	0.21	0.32	0.6	0.71
Vigeo	MSCI	0.69	0.5	0.35	0.44	0.72	0.8
RobecoSAM	Asset4	0.3	0.56	0.15	0.29	0.79	0.9
RobecoSAM	MSCI	0.83	0.6	0.54	0.43	0.82	0.88
Asset4	MSCI	0.77	0.45	0.47	0.51	0.71	0.86
<b>Average</b>		<b>0.5</b>	<b>0.5</b>	<b>0.31</b>	<b>0.35</b>	<b>0.67</b>	<b>0.75</b>

**Table A.10**  
**Range of Variance Explained (2017)**

Calculation procedure and data equivalent to Table 10, except that the underlying data is from 2017 instead of 2014.

	Baseline	All Covariates	Scope		Measurement		Weight	
			Min	Max	Min	Max	Min	Max
Sustainalytics on Vigeo	62.26%	91.90%	20.36%	23.04%	6.57%	8.79%	0.00%	0.93%
Sustainalytics on RobecoSAM	47.16%	88.39%	22.30%	37.62%	3.57%	18.79%	0.00%	0.52%
Sustainalytics on Asset4	35.54%	69.20%	1.80%	5.00%	11.85%	15.54%	15.56%	17.80%
Sustainalytics on MSCI	28.38%	92.65%	39.24%	58.38%	4.52%	23.81%	0.82%	3.21%
Vigeo on Sustainalytics	62.26%	89.93%	2.65%	6.96%	20.27%	24.82%	0.00%	1.94%
Vigeo on RobecoSAM	40.07%	94.71%	17.29%	45.72%	8.89%	37.27%	0.02%	0.09%
Vigeo on Asset4	42.18%	87.75%	0.11%	4.38%	39.60%	45.01%	0.43%	1.95%
Vigeo on MSCI	25.56%	96.56%	13.30%	65.47%	4.94%	57.15%	0.17%	9.31%
RobecoSAM on Sustainalytics	47.16%	93.62%	6.56%	39.41%	6.94%	39.80%	0.01%	0.19%
RobecoSAM on Vigeo	40.07%	98.43%	15.14%	55.03%	3.31%	43.03%	0.01%	1.17%
RobecoSAM on Asset4	22.93%	94.16%	2.12%	51.86%	14.24%	68.68%	0.32%	20.07%
RobecoSAM on MSCI	17.04%	98.19%	13.55%	77.39%	3.51%	67.07%	0.01%	3.06%
Asset4 on Sustainalytics	35.54%	85.77%	16.61%	37.04%	11.51%	30.90%	0.40%	5.14%
Asset4 on Vigeo	42.18%	94.38%	4.49%	34.92%	16.54%	46.50%	0.26%	3.73%
Asset4 on RobecoSAM	22.93%	95.58%	22.07%	59.12%	13.33%	50.51%	0.05%	0.65%
Asset4 on MSCI	16.27%	89.92%	24.82%	70.12%	1.20%	46.14%	2.20%	4.83%
MSCI on Sustainalytics	28.38%	53.45%	14.76%	19.48%	5.32%	8.21%	0.16%	2.67%
MSCI on Vigeo	25.56%	77.50%	29.76%	38.78%	13.08%	21.78%	0.05%	0.68%
MSCI on RobecoSAM	17.04%	74.02%	10.07%	40.74%	15.68%	44.84%	0.17%	3.75%
MSCI on Asset4	16.27%	60.31%	21.73%	24.23%	17.62%	20.12%	1.59%	2.87%
<b>Average</b>	<b>33.74%</b>	<b>86.32%</b>	<b>14.94%</b>	<b>39.74%</b>	<b>11.12%</b>	<b>35.94%</b>	<b>1.11%</b>	<b>4.23%</b>

## **Conflict-of-interest disclosure statement**

Sustainalytics, Vigeo-Eiris, and RobecoSAM had the right to read the paper prior to submission.

### **Florian Berg**

I have nothing to disclose.

### **Julian F. Koelbel**

I have nothing to disclose.

### **Roberto Rigobon**

I have nothing to disclose.