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Is History Repeating Itself? The (Un)predictable Past of ESG Ratings

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August 2021

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Keywords: ESG ratings, ESG investment, sustainable finance, CSR

JEL Classifications: G24, G30, G34

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The (Un)predictable Past of ESG Ratings*

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August 24, 2021

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1. Introduction

Research on environmental, social, and corporate governance (ESG) topics has exploded over the past decade, as has the importance of integrating ESG data into investment decisions in the asset management industry (often also referred to as responsible or sustainable investing). From 2010 to 2020, assets managed using ESG investing strategies by US-domiciled institutions grew from $3 trillion to more than $17 trillion, with one in three US dollars invested now being managed according to ESG principles (US-SIF, 2020).

A key challenge for researchers and investment professionals lies in the measurement of a firm's ESG quality, that is, in quantifying how well a firm performs with respect to ESG criteria. To address this challenge, empirical ESG analyses resort to ESG scores (or ratings) constructed by professional ESG data providers, with the leading vendors of such scores being MSCI, Refinitiv ESG (formerly ASSET4), Sustainalytics, S&P Global, and Vigeo-Eiris (SustainAbility, 2020). ESG scores matter for investors, as fund flows react strongly to the ESG ratings of mutual funds, which are constructed based on the ESG ratings of the funds' portfolio firms (Hartzmark and Sussman, 2019). The market for ESG data is expected to reach $1 billion in 2021.[1]

The growing importance of ESG scores has caused policymakers, investors, firms, and researchers to raise questions about their reliability, consistency, and overall quality. For example, Berg et al. (2021) and Gibson et al. (2019) document large disagreement across major ESG rating providers in their evaluations of firms' ESG quality, and Tang et al. (2020) show that MSCI gave higher ESG scores to firms connected to it through institutional ownership than to other firms. It is therefore not surprising that 26% of investment professionals surveyed by Amel-Zadeh and Serafeim (2018) indicate concerns with ESG rating reliability, though 82% use ESG data in the investment process. Concerns were also raised in the SEC's Asset Management Advisory Committee, where members stated

[1] See "ESG data market poised to hit $1 billion in 2021—report," *Pensions and Investment*, March 10, 2020.

that "ESG scores do not go back far in history and are often backfilled [...]."[2]

In this paper we document widespread and repeated changes to the *historical* ESG scores of Refinitiv ESG. Several tests demonstrate that this data rewriting has important implications for ESG research and investment practice: While there is a positive link between ESG scores and stock returns in the rewritten data, we fail to observe such a relationship in the initial data. We argue that the data rewriting plausibly originates from the rating vendor's incentive to retroactively strengthen the link between ESG scores and returns. A recommendation that follows from our analysis is that researchers and investment professionals using these data should verify whether the initial, originally-available data are needed to test their hypotheses, perform backtesting strategies, or develop new ESG-related investment strategies (though, in many cases, these data may not be available without previously saved point-in-time database snapshots). This consideration is important in light of the expected continued growth in ESG research and investing.

Refinitiv ESG is a key ESG rating provider offering "one of the most comprehensive ESG databases in the industry" (Refinitiv, 2020a), and its ESG scores have been used (or referenced) in more than 1,500 academic articles since 2003. The scores were initially constructed by ASSET4, a company acquired in 2009 by Thomson Reuters, which became Refinitiv in 2018. Refinitiv ESG data are employed by major asset managers, such as BlackRock, to manage ESG-related investment risks.[3]

The retroactive score rewriting originates from an announced one-off adjustment in Refinitiv ESG's scoring methodology and from ongoing unannounced score changes. To document effects of the one-time methodology-related rewriting, implemented on April 6, 2020, we downloaded and compared two versions of the *same* Refinitiv ESG data for *identical* firm-years; one version is from September 2018 and the other from September 2020 (both versions cover ESG scores from 2011 to 2017). The methodology change led

[2]See "ESG Subcommittee Update," *Report to the SEC Asset Management Advisory Committee*, May 27, 2020.

[3]See "BlackRock taps Thomson Reuters' ASSET4 for global ESG data," *Responsible Investor*, April 11, 2011. Refinitiv ESG data are also analyzed as one of the three key ratings providers in a recent OECD report (Boffo and Patalano, 2020) and referenced in a white paper featured at the World Economic Forum (WEF, 2019).

to large *retroactive* changes in firms' ESG scores as Refinitiv applied it to newly created *and* historical scores. The median overall ESG scores in the rewritten data are 18% lower than in the initial data, with the deviations amounting to -44%, -16%, and -7% for the E, S, and G subscores, respectively.

The score rewriting changed the ranking and classification of firms into ESG quantiles. Only 70% of firm-year observations overlap in the top-ESG score decile between the initial and rewritten data; the overlap numbers are even smaller, only 57%, if we consider the top-E&S score decile (based on the average of a firm's E and S subscore). Hence, the score rewriting leads to large changes in what are deemed to be high- or low-ESG firms. These changes matter, as the classification of firms into ESG (or E&S) quantiles is widely used in ESG research and the investment industry.[4]

We explore whether the data rewriting is related to the specific incentive structure in the ESG ratings industry. Notably, the industry follows an investor-pay model, whereby ESG data vendors compete on how useful their ratings are for ESG-related investment strategies. A key consideration for data users when selecting among ESG rating providers is how well the different ESG scores do in predicting returns.[5] This incentive structure contrasts with the credit ratings industry, which instead follows an issuer-pay model (Sangiorgi and Spatt, 2017).

When comparing the initial and rewritten ESG scores around the methodology change, we observe that the ex-post score changes have in part been "data-mined." Specifically, firms that performed better in a given year experienced upgrades in their E and S sub-

[4]For example, studies classify firms into top-and bottom-ESG quantiles to examine whether a portfolio that is long (short) in high-ESG stocks (low-ESG stocks) generates outperformance (Statman and Glushkov, 2009), or whether high-ESG firms (or high-E&S firms) performed better during crisis periods (Lins et al., 2017; Albuquerque et al., 2020).

[5]Industry studies demonstrating the relation between ESG scores and returns are abundant and produced for marketing purposes not just by ESG rating providers (Refinitiv, 2020b; Sustainalytics, 2020; MSCI, 2021) but also by banks (Deutsche Bank, 2016; UBS, 2018; Morgan Stanley, 2019; J.P. Morgan, 2021), investment companies (BlackRock, 2019; Fidelity, 2020) and index providers (FTSE Russell, 2020), all of whom can benefit (in the form of fund flows or fees) from showing a positive relation between ESG scores and investment returns.

scores for that year through the data rewriting.[6] Importantly, using predictive regressions, we demonstrate that investing in firms with higher E&S scores in the initial data would *not* have led to economically or statistically significant performance gains (coefficient estimate of 0.001 and t-statistic of 0.06). This is different in the rewritten data: For these data we find economically large, statistically significant (estimate of 0.031, t-statistic of 2.43) positive effects of Refinitiv's E&S score on firm's future stock returns. A one-standard deviation increase in the E&S score is associated with future returns that are 94 basis points higher per year. These large differences in results, depending on whether initial or rewritten data are used, have economic implications. Retrospectively, one would attribute a positive performance effect to high-E&S firms *if* one were to classify firms based on the rewritten data. However, this performance would not have been achievable with the data (or information) available to investors when constructing their investment strategies.[7] The effects that we document are hence of relevance for ESG research and the development of ESG (backtesting) strategies, as for such tests it is critical to verify that the original scores are being used.

If we consider the ESG score instead of the E&S score, we continue to find non-significant return effects in the initial data, and positive and significant return effects in the rewritten data. However, the magnitude of the return difference between the initial and rewritten data is much smaller. This indicates that it is E and S subscores and not the G subscore through which the positive return effect is retroactively introduced through the data rewriting. One reason may be that governance variables such as board independence or shareholder rights are relatively more objective and offer less wiggle room ex-post. Notably, governance data have been collected and analyzed for multiple decades already, and the literature has largely settled on the criteria for what comprises

[6]The details of the methodology change are largely a black box, with Refinitiv ESG only providing general information on two adjustments: i) it took into account that not all ESG input variables feeding into the ESG scores are of equal importance to every industry; and ii) while previously assigning a score of 0.5 to firms not reporting on certain input metrics, it now assigned a score of zero to such firms (Refinitiv, 2020c).

[7]Conceptually, as explained in Pástor et al. (2020), ESG strategies may be positively related to realized returns if the tastes of investors shift unexpectedly towards high ESG stocks or if the demand of consumers for sustainable products increases.

good governance (Gompers et al., 2003; Bebchuk et al., 2009).

The consequences of this data rewriting might be limited if the rewriting reflects a one-time event only. However, this is not the case; Refinitiv rewrites its historical ESG data on an ongoing basis without announcing these changes to the public. To demonstrate this ongoing rewriting, we compare ESG scores downloaded on February 9 and March 23, 2021, that is, from just six weeks apart. Across these two downloads we again discover ESG score rewritings for the years 2011 to 2017, affecting 86% of historical ESG scores. As would be expected from the relatively short time window, the score deviations are smaller in magnitude.[8] That said, the ongoing data rewriting continues to affect the classification of firms into ESG quantiles and the link between ESG scores and returns. Last but not least, we find that data rewriting has also been taking place *prior* to Refinitiv's ESG methodology change.

Where do these changes to 86% of firms' ESG scores over a period of just six weeks originate from? To address this question, we inspect the granular raw data from which the firms' ESG scores were built.[9] The ongoing data rewriting originated to a small extent from continuous, ex-post changes to the granular input variables that make up the ESG scores and to a large extent from changes in how the raw data were combined and aggregated into ESG scores. For example, though 86% of firms had their ESG score rewritten between February and March 2021, only 6% had a rewriting of any raw data item. These figures are consistent with the incentive channel: ESG score changes originating from the combination and aggregation of data are more difficult to verify and less likely to be challenged by outsiders.[10]

That said, in some cases the raw data rewriting can be material. We illustrate this for carbon emissions. For this variable, we are able to compare data downloads from i)

[8]It is likely that not all ESG analysts of Refinitiv review and update ESG scores for the firms they cover at the same point in time, so any ongoing score changes require some time to affect a broad set of firms.

[9]We use the downloads from February and March 2021 for this analysis as our downloads around the methodology change do not contain the granular raw data.

[10]We find little evidence that the ESG score changes are related to new information about negative ESG events (using data from RepRisk) or to the data vendor's incentive to increase or decrease ESG rating disagreement vis-a-vis other rating providers.

November 2019 and February 2021 (around the methodology change), and ii) February 2021 and March 2021 (for the ongoing data rewriting). For the first (second) comparison, 44% (0.4%) of firm-year observations on Scope 1 emissions between 2011 and 2017 have in some way been altered (i.e., added, deleted, or rewritten). The economic magnitudes are large: as per the November 2019 data, firms in the sample emitted 24.4 Gt CO_2 between 2011 and 2017. For the same period, in the rewritten data, this figure rose by 27% to 31.0 Gt CO_2. As a result, the assessment of firms' carbon footprints can vary significantly depending on when one downloaded the data.

Our paper is most directly related to Ljungqvist et al. (2009), who documented in a pioneering paper widespread data rewriting in the I/B/E/S analyst recommendations database. While the methodology-change-driven rewriting of the ESG scores was made public by Refinitiv ESG, the ongoing rewriting that we uncover shares similarities with the I/B/E/S rewriting. In fact, I/B/E/S is owned by the same data provider, Thomson Reuters or Refinitiv, that is, *history repeats itself*. More broadly, we relate to the large asset pricing literature that has highlighted the importance of accounting for look-ahead bias when examining returns (Ter Horst and Verbeek, 2007; Baquero et al., 2005). We show that asset managers could have been subject to the look-ahead bias in their performance assessment if their (benchmark) portfolios were constructed *ex post* conditioning on ESG ratings unavailable at the time of portfolio formation.

Refinitiv ESG's data rewriting, retroactively modifying scores as far back as 2011, is surprising given that in March 2020, when communicating the methodology change, it assured its users that it does not change data more than three years back in time.[11] This three-year cut-off date was changed in February 2021 to "Scores will be marked as "definitive" for all historical years excluding the five most recent. [...] Definitive scores remain unchanged, even if there are changes to the underlying data due to company restatements or data corrections" (Refinitiv, 2021a). That said, Refinitiv ESG has become

[11]Refinitiv ESG stated that "For historical scores calculated for completed fiscal years, we are introducing a cut-off date to make such scores definitive. Post the cut-off date, definitive scores remain unchanged even if there are changes to the underlying data due to company restatements or data corrections. The cut-off date will initially be set to June 30th of every year. For example: June 30th, 2020, fiscal year 2017 updates and scores will be marked as definitive."

aware of the challenges that these data changes can create. On January 14, 2021, possibly in response to an earlier version of our paper, Refinitiv introduced ESG point-in-time data as an additional subscription (Refinitiv, 2021b).

2. Data and ESG Score Rewriting

2.1. Refinitiv ESG Scores

Refinitiv's ESG scores attempt to measure a firm's ESG quality. The overall ESG scores, as well as the E, S, and G pillar subscores, are percentile rank scores, and are scaled to range between 0 (minimum) and 100 (maximum score). According to Refinitiv, the scores "are based on relative performance of ESG factors with the company's sector (for environmental and social) and country of incorporation (for governance)" (Refinitiv, 2020a). The scores were initially constructed by ASSET4, a company acquired in 2009 by Thomson Reuters. In 2017, Thomson Reuters enriched the database with thirteen new data items, with one of them being a new, modified overall ESG score. We use this ESG score for our analysis.[12] The overall ESG score is based on data metrics from ten different categories ("category scores"), which flow into the E, S, and G subscores (Thomson Reuters, 2017). In 2018, Thomson Reuters spun off the ESG ratings business into a separate subsidiary, Thomson Reuters Refinitiv, and renamed the ratings Refinitiv ESG.

ESG scores by Refinitiv are widely used in academic research and in the investment industry. Figure 1 shows that, by June 24, 2021, more than 1,500 academic articles have mentioned Refinitiv ESG data, using them in empirical tests or considering a reference to them important. In the figure, we use the cumulative count for the search term "ASSET4," instead of Refinitiv ESG, to be able to construct a time-series of the name

[12]This ESG score was made available for firm-years that also had an ASSET4 rating. Thomson Reuters referred to these changes as "an enhancement and replacement to the existing equally weighted ASSET4 ratings" (Thomson Reuters, 2017). The earliest mention of this score that we could find dates back to March 2017, when Thomson Reuters prompted its customers to migrate from the ASSET4 score to the new ESG score (Thomson Reuters, 2017). The correlation between the old ASSET4 score (data item A4IR) and the new Refinitiv ESG score (data item TRESGS) is 0.82.

mentions since 2003, the year ASSET4 was founded (most researchers continue to use the older name of the database after ASSET4 was acquired by Thomson Reuters). The figure also reports the cumulative count of academic articles mentioning ASSET4 in combination with ESG (since some data items in ASSET4 may be used in contexts unrelated to ESG). While the cumulative count of articles is slightly lower, the massive surge in the number of articles mentioning both ASSET4 and ESG is similar in both curves.

Table IA1 shows that ESG data from Refinitiv have been used in many articles published in leading finance journals, especially over the past few years. Refinitiv's ESG scores have also been used in many contemporaneous working papers (we list selected papers only).

2.2. One-Off ESG Score Rewriting

2.2.1. Downloads of 09/2018 and 09/2020 ESG Scores

We base our analysis of the one-off methodology-related data rewriting on two versions of the *same* Refinitiv ESG database, downloaded on September 25, 2018 and September 29, 2020. The first version covers the universe of firms in the database as of that date, and we downloaded data for the years 2011 to 2017. We refer to the first data version as the 09/2018 or "initial" version. The data contain 45,284 unique ISIN-year observations between 2011 and 2017, with 6,871 unique ISIN identifiers. Out of this grand total, an ESG score is available for 31,790 ISIN-year observations. To determine the number of firm-year observations, we merge the data to S&P's Compustat-Capital IQ Global and North America database (a firm can have multiple ISINs). After the merge, our sample contains 29,926 firm-year observations with an ESG score.

We refer to the second database as the 09/2020 or "rewritten" version. To construct this version, we downloaded the ESG scores for the 6,871 unique ISINs included in the initial download.[13] After merging the data again to Compustat-Capital IQ, we obtain

[13]The data item name for the overall ESG score was changed slightly from the initial to the rewritten version, from *TRESGS* to *TR.TRESGScore*. We verified with Refinitiv ESG that both data items capture the same variable.

30,619 firm-year observations with an ESG Score. These observations represent the 29,828 firm-year observations common to both data versions, plus 791 firm-year observations added through the 2020 version. The additions originate from firms included in the initial data (not new firms) for which an ESG score was initially missing in some years.

Table 1, Panel A, lists these two data downloads (09/2018 and 09/2020) together with the other downloads that we use in this paper (discussed below). The 09/2018 and 09/2020 data versions contain the overall ESG scores, as well the E,S, and G pillar subscores, but they do not contain the granular input variables and category scores that constitute the ESG scores (which are available in some of the other downloads).

Table 1, Panel B, reports the sample composition of the 09/2018 and 09/2020 downloads by year.[14] Column 1 shows that the observations common to both data versions increase over time, from 3,244 in 2011 to 5,962 in 2017. Columns 2 and 3 show that ESG scores for 791 (98) firm-year observations were added (deleted) in the 09/2020 version. As we downloaded the initial data in 2018, our sample period ends in 2017.

2.2.2. Deviations between 09/2018 and 09/2020 ESG Scores

When comparing the two data versions, we observe that the ESG scores for the *same* firm in the *same* year deviate between the 09/2018 (initial) and 09/2020 (rewritten) downloads, in some cases dramatically. Table 2, Panel A, reports means and medians of these ESG score deviations (by year and across all years), calculated as:

$$\Delta\, Score = \left(\frac{Score^{09/2020\ Data}}{Score^{09/2018\ Data}} - 1 \right) \times 100. \tag{1}$$

where $\Delta\, Score$ is the score deviation for the total ESG score, the E, S, and G subscores, and the E&S score (simply the average of a firm's E and S score), respectively. We calculate the deviations for firm-years common to both data versions.

[14] Formally, "years" refer to fiscal years (not calendar years) in the Refinitiv ESG and ASSET4 database (data item *clpactyear* in ASSET4 and *FinancialPeriodAbsolute* in Refinitiv ESG). The definition of a fiscal year in the Refinitiv ESG/ASSET4 data differs from Compustat, where a fiscal year corresponds to the year into which the majority of the months in the fiscal year fall. In Refinitiv ESG/ASSET4, the fiscal year is the year in which the fiscal year ends.

Table 2, Panel A, shows that the median ESG score deviation equals -18%, and the median deviations for the E, S, and G subscores are -44%, -16%, and -7%, respectively. Hence, the rewriting of the data caused large changes to firms' E scores, relatively large changes to their S scores, and more modest changes to their G scores. The rewriting of the overall ESG scores affected all years similarly, but there is year-by-year heterogeneity for the subscores: For example, the changes in the E score are larger in the more recent years, whereas the opposite holds true for the S score. The median G score changes mostly originate from the second half of the sample.

Table 3 presents further statistics comparing the 09/2018 and 09/2020 data. While the average and median ESG score in the initial version equals about 50, the average (median) score in the rewritten data is only 42 (40). The average E score (S score) in the initial version is 50 (50), while the corresponding rewritten score is 33 (42). In comparison, the drop in the average G score is lower (50 versus 48).[15] Our subsequent analysis relates the ESG rating deviations to firm characteristics, for which we also report summary statistics in Table 3. Variable definitions are reported in Table A1.

2.2.3. Quantile Overlaps between 09/2018 and 09/2020 ESG Scores

The ESG score deviations have implications for ESG-based rankings of firms. To illustrate this point, we calculate for each firm the ESG rank change from the 09/2018 (initial) to the 09/2020 (rewritten) data. Figure 2 describes the distribution of these rank changes by reporting the fraction of firms subject to different decile rank transitions. A value of 0 indicates no change in a firm's decile rank, while a decile rank change of plus (minus) five indicates that a firm's ranking moved up (down) by five deciles, respectively. A change in decile rank occurs in 59% of cases, and 16% of observations are subject to a shift of two or more decile ranks (a few firms saw changes of nine ranks).

Table 4, Panel A, reports the fraction of firm-year observations assigned to different extreme quantiles in the 09/2019 and 09/2020 data (deciles, quartiles, and terciles). For

[15] Since the ESG scores are percentile rank scores, one may expect median scores of about 50. However, the medians deviate from that number, especially for the rewritten data, as we are fixing the universe to its 09/2018 constituents and conditioning on having both the initial and rewritten scores available.

the ESG score, only 70% of firm-year observations are classified into the top decile in both the initial and the rewritten data. We find similar numbers when considering the bottom decile of the ESG score: only 69% of firm-year observations are common to both bottom deciles. The overlap is somewhat larger if we consider extreme quartiles or terciles, but substantial deviations remain. For example, only 82% of firm-year observations are common to the top-ESG quartile in both the initial and rewritten data. The patterns are similar if we consider the E, S, and G subscores or the combined E&S score.

The data rewriting also affects year-on-year (YoY) changes in firms' ESG scores. Such changes are important for investment strategies that select firms based on whether their ESG scores (or subscores) worsen or improve over time. To illustrate this point, Table IA2 reports the fraction of firms for which the YoY changes in the ESG score were modified at least once because of the data rewriting.[16] When comparing ESG score trends between the 09/2018 and 09/2020 data, 61.8% of firms see at least one change because of the data rewriting. Consequently, a strategy that invests in firms based on whether their ESG scores worsen or improve selects different firms depending on the data version used.

2.2.4. Methodology Changes to ESG Scores

The differences between data versions raise the question of how Refinitiv ESG explains the retroactive score changes. According to the data provider, the score deviations originate from a change in its methodology. This change came into effect on April 6, 2020, that is, between the 09/2018 and 09/2020 data downloads. The new methodology was not just applied to newly created ESG scores, but it also affected historical scores, consistent with Table 2, Panel A. The public was notified of the methodology change in a press release on April 15, 2020 (Refinitiv, 2020c).[17]

In a methodology document released on April 15, 2020 (Refinitiv, 2020c), Refinitiv

[16] We compute for each firm in each data version its ESG score YoY trend. If a consecutive firm-year has a higher (lower) score than the previous one, we flag it as an improvement (worsening). We then identify firms where the YoY trend changed across data versions in at least one instance (e.g., from improvement to worsening or from constant to improvement, etc.). We subsequently divide the number of affected firms by the total number of firms in the sample.

[17] According to Refinitiv, investors subscribing to the data were notified earlier on March 6, 2020.

ESG lists two major changes to explain its ESG score rewriting (details in Table IA3). First, Refinitiv ESG introduced a new proprietary model that takes into account that not all ESG metrics making up the ESG scores have the same importance to every industry. A new proprietary "magnitude matrix" assesses the materiality of different metrics and assigns industry-specific weights. Second, Refinitiv ESG changed the treatment of unreported data items covering qualitative/Boolean measures, that is, items that can be answered with "yes" or "no" (coded as 1 or 0 or vice versa). Previously, a score of 0.5 was allocated to firms which did not report information on a metric, essentially giving them the "benefit of the doubt." To encourage disclosure and transparency, the new methodology assigns to such firms a score of zero.

Our subsequent estimations suggest that this methodology change did not affect firms randomly. Instead, it affected some firms more than others, in a way that is consistent with Refinitiv ESG's incentive to introduce in its database a link between stock returns and ESG scores.

2.3. Ongoing ESG Score Rewriting

2.3.1. Downloads of 02/2021 and 03/2021 ESG Scores

Apart from the one-off methodology-related data rewriting in April 2020, Refinitiv has continued to adjust ESG scores ex-post, but without announcing its changes to the public. To document this ongoing data rewriting, on February 9, 2021 and March 23, 2021 we re-downloaded the ESG data for 6,871 ISINs included in the 09/2018 download (again for 2011 to 2017). We refer to these downloads as the 02/2021 and 03/2021 versions. As shown in Table 1, Panel A, these downloads now also contain the granular input variables that make up the aggregate ESG scores. The granular data include 184 indicators and nine so-called category scores. Category scores group together data from

the underlying indicators and are subsequently aggregated into E, S, and G subscores.[18] A total of 30,385 firm-year observations for the years 2011 to 2017 are common to these two data versions. Four firm-year observations are present only in the 02/2021 version and 19 firm-year observations only in the 03/2021 version.

Given that no methodology change took place between the February and March 2021 downloads, we would not expect to find any score differences. Table 2, Panel B, demonstrates that this is not the case: we continue to observe changes to firms' ESG scores; this time unexpected (and unannounced) ESG score rewritings. As would be expected given that the two downloads are only six weeks apart, the deviations are relatively smaller in magnitudes. That said, deviations can accumulate significantly if longer time periods are considered. Notably, it is likely that not all ESG analysts at Refinitiv will review and update ESG data of the firms they cover at the same time, so any ongoing score changes require some time to affect a broad set of firms.

Table 4, Panel B, shows the quantile overlaps between the 02/2021 and 03/2021 versions. The overlaps do not equal 100% as one might expect if no data rewriting were taking place. Instead, they range from 98.1% (top decile of the E score) to 99.6% (top tercile of the E&S score). Again, these gaps can aggregate to much larger differences over time.[19] We will later use granular data to explore where the ongoing ESG score rewriting originates from. Table IA2 shows that investment strategies and research papers that rely on YoY trends in ESG scores may also be affected by the ongoing data rewriting.

2.3.2. Downloads of 02/2020 ESG Scores and 11/2019 Granular Data

We have access to two other downloads that help us corroborate the importance of the data rewriting (see Table 1). One of these data sets was downloaded in February 27,

[18] We were unable to retrieve data for the score category "Product Responsibility" (likely due to a technical error attributable to the data provider as the query was correctly specified) as well as for the two indicators (out of a total of 186) "Executive Members Gender Diversity" (part of the category "Management") and "Critical Country" (part of the category "Community").

[19] When we consider the classification of firms into the ESG quantiles in the 09/2020 versus 03/2021 versions, now about six months apart, the ongoing data rewriting translates into overlaps for the ESG score of 94.7% (95.5%) in the top (bottom) decile, respectively. The decile overlap is the lowest for the E score, 89.5%.

2020 (02/2020 version), that is, two months prior to the methodology change in April 2020. The data set contains the overall ESG score, but neither the E, S, and G pillar subscores nor the granular raw data. Table IA4 shows for the 02/2020 version that the aggregate ESG score rewriting has been taking place even *prior* to the methodology change. Specifically, when comparing the 09/2018 and 02/2020 versions, the ESG score remained the same for only 85 firm-years (out of 29,658 ESG score observations common to both data sets for the years 2011 to 2017). This implies that also many of the 1,500+ academic papers listed in Figure 1 might potentially be impacted by these changes.

Our final download originates from November 2019 (11/2019 version) and contains only the granular input data. We use it to demonstrate the magnitude of the granular data rewriting (especially for carbon emissions) over time.

3. Economic Drivers of ESG Score Rewriting

3.1. One-off ESG Score Rewriting

As a first step towards examining the incentive channel for the data rewriting, we examine whether the methodology-related ESG score rewriting can be explained in part by a firm's stock returns. Specifically, we test whether firms that performed better experienced upgrades in their ESG scores through the data rewriting, after controlling for firm characteristics and fixed effects. For each firm i and year t, we estimate:

$$\Delta Score_{it} = \beta \; Stock \; Return_{i,t} + \gamma X_{it} + \delta_c + \delta_j \times \delta_t + \epsilon_{it} \tag{2}$$

where $\Delta \; Score_{it}$ is the score deviation in year t for the total ESG score, the E, S, and G subscores, and the E&S score, respectively. *Stock Return* is a firm's annual stock return measured over the year t. The vector X_{it} includes *Log(Assets)*, *Sales Growth*, *Capex/Assets*, *Cash/Assets*, *Debt/Assets*, *EBIT/Assets*, *PP&E/Assets*, and *R&D/Assets*. The variables δ_c, δ_j, and δ_t represent country, industry, and year fixed effects, respectively.

Table 5 presents estimates of equation (2). In Column 1, a firm's stock return is

unrelated to the overall ESG scores. However, the non-existent overall effect masks significant heterogeneity across the different subscores, possibly causing the overall effect to turn insignificant. Notably, stock return performance is an important driver of the E and S subscore deviations. In Columns 2 and 3, firms with higher returns during year t experience a positive rewriting of their E and S subscores for that year. The effects for E and S scores also translate into a positive effect for $\Delta\, E\&S\, Score$ in Column 5. At the same time, there is no relationship between returns and changes in the G score (Column 4). Overall, higher stock market performance seems to be one of the factors determining which firms retroactively obtained an improved E or S score in the rewritten data.[20]

Column 1 further shows that larger firms experience more ESG score improvements in the rewritten data, and Column 2 shows that this overall effect originates mostly from a better E score. In fact, the overall increase in the ESG score masks that both the S and the G subscores (Columns 3 and 4) of large firms decline in the rewritten data. Interestingly, the effect of the control variables is of the same direction across the different ESG score variables only in the case of *Stock Return*.[21]

3.2. Ongoing ESG Score Rewriting and Negative ESG Events

One reason for the ESG score rewriting could be newly uncovered ESG-related controversies (negative ESG events), which would lead Refinitiv to reconsider its historical ESG scores. For firms experiencing changes in their ESG scores through the ongoing data rewriting, we have data allowing us to examine whether these changes are related to new information about negative ESG events.[22] We identify negative ESG events based on information captured by RepRisk's ESG controversies score (RepRisk offers the key database for such events). We then calculate how changes in Refinitiv's ESG score be-

[20] We also examine whether the score changes may have been driven by the annualized returns over the entire five-year period before the data rewriting in 2020, that is, the total returns from 2014 to 2019. Table IA5 shows that this is not the case.

[21] In an unreported regression, we find that firms with higher ESG scores in the initial data experience stronger ESG score increases from the initial to the rewritten versions.

[22] We do not have corresponding data to examine the role of ESG-related events for the ESG score deviations around the methodology change.

tween the 02/2021 and 03/2021 data correlate with changes in RepRisk's score over the same period. We perform the same analysis for the E, S, and G subscores. Table IA6 shows that there is virtually no correlation between changes in Refinitiv's and RepRisk's scores. The data rewriting thus does not seem to originate from news about ESG controversies.

3.3. ESG Score Rewriting and Ratings Disagreement

Another possible motive for the ongoing data rewriting could be the intent to amend divergences in the assessment of firms' ESG quality across ESG data providers (Berg et al., 2021). To this end, we compare Refinitiv's ESG scores across different downloads with the ESG scores by MSCI and Sustainalytics, two of Refinitiv's major competitors. We then test whether the one-off and ongoing data rewriting leads to an increase or a decrease in the correlation of Refinitiv ESG scores with those of MSCI and Sustainalytics. Theoretically, it is unclear what to expect. Disagreement could serve as a differentiating marketing feature. However, Refinitiv ESG may instead also want to be closer to MSCI and Sustainalytics to gain validity (e.g., it may adjust the ratings towards the other providers to be less subject to criticism). That said, Table IA7 shows that the correlations of Refinitiv's ESG scores (and the subscores) with those of MSCI or Sustainalytics have changed little across data downloads. There is also no clear pattern across scores and raters in terms of whether such correlations have increased or decreased.

4. Return Implications of ESG Score Rewriting

We now turn to the question of whether the large and systematic data rewriting affects estimations of the relationship between ESG scores and future stock returns. As discussed above, ESG data vendors may compete on how useful their ratings are for ESG-related investment strategies, and a consideration for data users may be how well ESG scores of different data vendors do in predicting returns. Investment strategies based on ESG scores are widely examined in empirical ESG research, and industry studies that

market the success of sustainable investment are abundant.[23] Conceptually, as modelled in Pástor et al. (2020) ESG strategies may be positively related to realized returns i) if the tastes of investors shift unexpectedly towards high ESG stocks, pushing up their prices or ii) if the demand of consumers for sustainable products increases, driving up profits and stock prices.[24]

To examine the effect of the data rewriting on the relationship between ESG scores and returns, we estimate the following model for different ESG data versions:

$$Future\ Return_{it} = \beta\ Score_{i,t-1} + \gamma X_{i,t-1} + \delta_c + \delta_j + \delta_t + \epsilon_{it} \tag{3}$$

where *Future Return* (in % p.a.) captures a firm's cumulative stock performance from July t to June $t+1$, and *Score* is a firm's ESG or E&S score. Both scores are determined using either the 09/2018, 09/2020, 02/2021, or 03/2021 version of the data. We examine firms' ESG and E&S scores, as many investment strategies try to isolate E and S effects. We also report regressions in which we replace *Score* with *Score Q1*, a dummy variable indicating whether a firm ranks in the top-ESG (or top-E&S) quartile in a given year. X_{it} includes *Log(Assets)*, *Sales Growth*, *Capex/Assets*, *Cash/Assets*, *Debt/Assets*, *EBIT/Assets*, *PP&E/Assets*, and *R&D/Assets*. *Score* and the firm fundamentals are measured as of the most recent fiscal year (*t-1*) preceding the return calculation. The variables δ_c, δ_j, and δ_t represent country, industry, and year fixed effects, respectively. The sample consists of 20,874 firm-year observations between 2011 and 2017 for which we have the

[23] For example, studies often classify firms into top- and bottom-ESG quantiles to examine whether a portfolio that is long in high-ESG stocks and short in low-ESG stocks, generates outperformance (Statman and Glushkov, 2009; Allianz Global Investors, 2015). Other studies use ESG scores to examine whether high-ESG firms performed better during certain periods of time (Lins et al., 2017; Albuquerque et al., 2020).

[24] As pointed out in Pástor et al. (2020), high ESG stocks should have lower *expected* returns, as they provide hedges against climate shocks in comparison to low ESG stocks. In a related paper that highlights the gap between expected and realized returns, Pástor et al. (2021) show why high ESG returns realized in recent years are likely to be misleading predictors of the future.

09/2018, 09/2020, 02/2021, and 03/2021 data versions and control variables available.[25]

Table 6 reports estimates of equation (3). Panel A relates returns to the *E&S Score* and Panel B to the *ESG Score*. In each panel, Columns 1 to 4 use the continuous scores, and Columns 5 to 8 the top-quartile dummies. Column 1 of Panel A shows that investing in firms with a higher E&S score in the initial data (09/2018 version, before the methodology change) would not have led to economically or statistically significant performance gains, with the regression coefficient being equal to 0.001 (t-statistic of 0.06). If instead we consider in Column 2 the rewritten data (09/2020 version, after the methodology change), we observe a return effect that is not only much larger economically (coefficient estimate of 0.031), but also statistically significant (t-statistic of 2.43). This estimate would lead one to conclude that E&S investing is positively associated with higher stock returns.[26] In economic terms, the estimate in Column 2 implies that a one-standard deviation increase in the E&S score is associated with returns that are 94 basis points higher per year. We continue to observe positive return effects of similar magnitude in Columns 3 and 4, where we report results based on the 02/2021 and 03/2021 data versions, respectively.

In Column 5, we again find for the initial data that investing in high-E&S firms (now firms in the top-E&S quartile) would not have led to statistically significant performance gains. Yet, in Column 6, the estimates using data after the methodology change (09/2020 version) provide a different picture: they provide evidence for a positive and significant return effect. In economic terms, firms in the top-E&S quartile would have yielded returns that are 1.2 pp higher (p.a.) in comparison to other firms. The coefficients in Columns 7 and 8, computed based on the 02/2021 and 03/2021 version, even show that the positive return effect increases monotonically through the ongoing data rewriting. The effect in

[25] While this strategy reflects a common application of ESG scores in both research and backtesting in investment management, this strategy is not tradable. For a reflection of returns that were achievable based on ESG scores, one would have to be able to access point-in-time ratings (ASSET4 (for years up to 2017) and Refinitiv (for years post 2017)) each year at the time of portfolio formation. The look-ahead bias is thus inherent also to all analyses based on the backfilled Refinitiv ESG scores that include the time period since the rating's inception up to the year 2017.

[26] The difference between the coefficients of the initial and rewritten E&S scores is highly statistically significant, with a t-statistic of 156 in a paired t-test.

Column 7 (8) is almost 9% (14%) larger than the one in the first download after the methodology change (Column 6).

Turning in Panel B to the ESG score, we again find no statistically significant association between ESG scores and future returns in the initial data, while all data sets after the methodology change suggest a positive relation. Interestingly, the magnitude of the return difference between the initial and rewritten data is smaller for ESG score compared to the same difference in the E&S score in Panel A. This indicates that it is the E and S subscores, not the G subscore, through which the positive return effect is introduced through the data rewriting. One reason may be that governance variables offer less wiggle room ex-post. Indeed, governance data have already been collected and analyzed for multiple decades and the literature has largely settled on the criteria for what comprises good governance (Gompers et al., 2003; Bebchuk et al., 2009). In a "confidential" Refinitiv ESG document on the methodology change that we have access to, we find multiple instances that corroborate this finding. Notably, the document stresses that the methodology change is applied in particular to environmental and social metrics.

Overall, the evidence in Table 6 suggests that the benefits of investing in high-E&S/ESG firms is "introduced" with Refinitiv's data rewriting through its methodology change, and this relation is possibly even "reinforced" through an ongoing data rewriting. Our results can be interpreted in light of the specific incentive structure in the ESG ratings industry, as the industry follows an investor-pay model, whereby ESG data vendors compete on how useful their ratings are for ESG-related investment strategies. A key consideration for data users when selecting among ESG rating providers is how well their ESG scores do in explaining returns.

5. Evidence on Granular Raw Data Rewriting

5.1. Category Scores and Raw Data Items

From which parts of the ESG score constructions does the ongoing score rewriting originate from?[27] Ongoing ESG scores changes can originate from ongoing changes in firms' raw data that make up the scores (e.g., carbon emissions), from changes in how these raw data are combined and weighted to create the E, S, or G scores, or from statistical changes (e.g., rerankings or normalizations). To address this question, we make use of the granular ESG raw data obtained in the 02/2021 and 03/2021 downloads.

Table 7, Panel A, reports the percentage of firms experiencing an ESG score change between the 02/2021 (initial) and 03/2021 (rewritten) versions. In the six weeks between the two downloads, 86% of firm-year observations saw some ESG score rewriting.[28] Panel B further reveals that the S subscore is rewritten slightly more frequently compared to the E and G subscores (65% versus 50% and 54%, respectively). Importantly, Panel C reports changes to the nine category scores that make up the E, S, and G scores (and in turn the ESG score). Data rewriting happens most frequently to the category scores Workforce, Community, Management, Emissions, Resource Use, and Shareholders, with data changes affecting 54%, 53%, 40%, 37%, 36%, and 35% of firm-years, respectively. The categories Innovation, Human Rights, and CSR Strategy experience the fewest changes (17%, 15% and 14%, respectively). Panel D shows that the scores changes in Panels A to C originate only to a small extent from changes in the granular raw data themselves (the 184 data items underlying the category scores): Within the six weeks between our two downloads, raw data was changed for only 6% of firm-years.

Panel D reveals another interesting pattern; it shows that the raw data rewriting goes back several years in time. This is surprising, as Refinitiv ESG currently states

[27] We focus this analysis on the ongoing score rewriting, as we do not have granular raw data in the 09/2018 and 09/2020 data versions around the methodology change.

[28] As shown above, most of the score changes are modest in relative or absolute terms given the small time window.

that it only changes data up to five years back in time. Specifically, in a document that informed ESG rating subscribers in February 2021 it stated that "Scores will be marked as "definitive" for all historical years excluding the five most recent. [...] Definitive scores remain unchanged, even if there are changes to the underlying data due to company restatements or data corrections" (Refinitiv, 2021a).[29]

5.2. Raw Data Items: Carbon Emissions

The granular raw data rewriting does not explain large parts of the ongoing data rewriting, but it translates into economically meaningful raw data changes over longer time periods. To illustrate this, we examine changes to firms' Scope 1 carbon emissions, a key variable in many recent ESG papers. Carbon emissions are a granular raw input variable feeding into the Emissions category score, the E pillar subscore, and the overall ESG score. In Table 8, we document the rewriting of this variable due to the one-off methodology change (Panel A) and the ongoing data rewriting (Panel B). For the one-off rewriting, we compare granular emissions data downloaded on November 7/8, 2019 (11/2019 data) and February 9, 2021 (02/2021 data). For the ongoing data rewriting, we compare 02/2021 and 03/2021 data.[30]

In Panel A.1, across the two data versions around the methodology change, 44% of the observations on carbon emissions have in some way been altered. Specifically, 23.6% firm-years were added (i.e., data were missing in the 11/2019 download, but filled in for the 02/2021 download), 1.6% were deleted, and 18.4% were modified. The data rewriting affects all years and not just those closest to the end of the sample period.

Panel A.2 reports the magnitude of the data rewriting, calculated as the percentage change in emission affected by the data rewriting, with the yearly sum of emissions in the 11/2019 data being the standardizing variable. The amount of added emissions equals

[29]Several firms also experienced deletions of their raw data items, which often result in substantial changes of their ESG ratings. For example, Petropavlovsk plc had an average ESG rating of 30.8 between 2011 and 2016 in our 02/2021 download, whereas its score for the same years in the 03/2021 download was only 6.9.

[30]We round the emissions variable to the nearest integer to focus on changes other than those in decimals.

about 29.1% of annual emissions in the 11/2019 download, deleted emissions are 1.7%, and modified emissions 2.9%. We calculate that using the 11/2019 data, sample firms emitted 24.4 Gt CO_2 from 2011 to 2017 (not reported in the panel). In the rewritten data, this figure rose to 31.0 Gt CO_2 for the same period, an increase of 27%.[31]

For the ongoing data rewriting in Panel B.1, 0.4% of firm-years were added, 0.1% were deleted, and 0.4% were modified. While these changes appear minor, they could accumulate to much larger fractions over time. In Panel B.2, using the sum of carbon emissions by year in the 02/2021 data as the standardizing variable, the amount of added (modified) emissions equals about 0.3% (0.1%) of annual emissions. Overall, the table shows that the assessment of a firm's carbon footprint can differ significantly depending on when the historical emissions data were downloaded. As a result, the constituents of low-carbon or carbon-neutral portfolios and their weights are impacted.

6. Conclusion

The explosion in ESG research has led to a strong reliance on ESG rating providers. These data vendors have developed scores that evaluate how well a firm performs with respect to ESG criteria. In this paper we document widespread changes to the historical ESG scores of Refinitiv, a key rating provider. Across different data downloads, we observe retroactive ESG rating changes for identical firm-years. The changes were due to a modification in the ESG score calculation methodology and to ongoing unannounced data modifications. Depending on whether the original or rewritten data are used, firm rankings and classifications of firms into ESG quantiles change significantly.

Our analysis suggests that the score changes have in part been "data-mined" such that firms that performed better in a given year experienced ex-post upgrades in the scores for that year. Further, the data rewriting changes the results of predictive regressions relating ESG ratings to future stock returns: there is outperformance of stocks with

[31] We verify that the data additions are unlikely to originate from sudden data availability in the CDP database (e.g., originating from additional disclosures covering prior years). CDP is the main source of carbon emissions data around the world.

high E&S/ESG scores in the rewritten data, but not in the initial data. We argue that our results reflect the incentive of the data provider to introduce a positive relationship between ESG scores and returns in the data, in order to demonstrate that their ESG scores are useful for data users developing ESG-related investing strategies.

The large differences in results that we document have implications for empirical test strategies using Refinitiv ESG data. Moving forward, researchers and investment professionals need to verify whether the original or rewritten ESG scores are needed to perform their tests.

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Data Appendix

Table A1: Variable Definitions and Data Sources
This table defines the variables used in the analysis. CS-CIQ stands for "Compustat - Capital IQ" from Standard & Poor's.

Variable	Description	Source
ESG Variables		
ESG Score	Overall score of a firm's ESG performance. The score covers a firm's environmental (E), social (S) and corporate governance (G) performance. The score ranges between 0 (minimum) and 100 (maximum score). The score is constructed using data item $TRESGS$ in ASSET4 and data item $TR.TRESGScore$ in Refinitiv ESG.	Refinitiv ESG
E Score	Score of a firm's environmental performance. The score covers factors including a firm's resource use, emissions, and innovation. The score ranges between 0 (minimum) and 100 (maximum score). The score is constructed using data item $ENVSCORE$ in ASSET4 and data item $TR.EnvironmentPillarScore$ in Refinitiv ESG.	Refinitiv ESG
S Score	Score of a firm's social performance. The score covers factors including workforce, human rights, community, and product responsibility. The score ranges between 0 (minimum) and 100 (maximum score). The score is constructed using data item $SOCSCORE$ in ASSET4 and data item $TR.SocialPillarScore$ in Refinitiv ESG.	Refinitiv ESG
G Score	Score of a firm's corporate governance performance. The score covers factors including management, shareholders, and corporate social responsibility strategy. The score ranges between 0 (minimum) and 100 (maximum score). The score is constructed using data item $CGVSCORE$ in ASSET4 and data item $TR.GovernancePillarScore$ in Refinitiv ESG.	Refinitiv ESG
E&S Score	The score is calculated by averaging the *E Score* and the *S Score*.	Refinitiv ESG
Δ *ESG Score*	Percentage deviation in a firm's overall ESG score between two versions of the ESG data. For example, for the methodology-related rewriting, the score deviation is computed for each firm-year combination as $Score^{09/2020\ Data}$ divided by $Score^{09/2018\ Data}$ minus one, times 100.	Refinitiv ESG

Variable	Description	Source
Δ *E Score*	Percentage deviation defined as Δ *ESG Score* but for the *E Score*.	Refinitiv ESG
Δ *S Score*	Percentage deviation defined as Δ *ESG Score* but for the *S Score*.	Refinitiv ESG
Δ *G Score*	Percentage deviation defined as Δ *ESG Score* but for the *G Score*.	Refinitiv ESG
Δ *E&S Score*	Percentage deviation defined as Δ *ESG Score* but for the *E&S Score*.	Refinitiv ESG
ESG Score Q1	Dummy variable that equals one for firms in the top quartile according to the ESG score in a given fiscal year, and zero otherwise.	Refinitiv ESG
E&S Score Q1	Dummy variable that equals one for firms in the top quartile according to the E&S score in a given fiscal year, and zero otherwise.	Refinitiv ESG
Scope 1 Carbon Emissions	Direct emissions of CO_2 and CO_2 equivalents from sources that are owned or controlled by the company. The data item in Refinitiv ESG is *TR.CO2DirectScope1*.	Refinitiv ESG
Resource Use Score	A score that reflects a company's performance and capacity to reduce the use of materials, energy or water, and to find more eco-efficient solutions by improving supply chain management. The score corresponds to the data item *TR.TRESGResourceUseScore* in Refinitiv ESG.	Refinitiv ESG
Emissions Score	A score that measures a company's commitment and effectiveness towards reducing environmental emissions in its production and operational processes. The score corresponds to the data item *TR.TRESGEmissionsScore* in Refinitiv ESG.	Refinitiv ESG
Innovation Score	A score that reflects a company's capacity to reduce the environmental costs and burdens for its customers, thereby creating new market opportunities through new environmental technologies and processes, or eco-designed products. The score corresponds to the data item *TR.TRESGInnovationScore* in Refinitiv ESG.	Refinitiv ESG
Workforce Score	A score that measures a company's effectiveness in terms of providing job satisfaction, a healthy and safe workplace, maintaining diversity and equal opportunities and development opportunities for its workforce. The score corresponds to the data item *TR.TRESGWorkforceScore* in Refinitiv ESG.	Refinitiv ESG

Variable	Description	Source
Human Rights Score	A score that measures a company's effectiveness in terms of respecting fundamental human rights conventions. The score corresponds to the data item *TR.TRESGHumanRightsScore* in Refinitiv ESG.	Refinitiv ESG
Community Score	A score that measures the company's commitment to being a good citizen, protecting public health and respecting business ethics. The score corresponds to the data item *TR.TRESGCommunityScore* in Refinitiv ESG.	Refinitiv ESG
Management Score	A score that measures a company's commitment and effectiveness towards following best practice corporate governance principles. The score corresponds to the data item *TR.TRESGManagementScore* in Refinitiv ESG.	Refinitiv ESG
Shareholders Score	A score that measures a company's effectiveness towards equal treatment of shareholders and the use of anti-takeover devices. The score corresponds to the data item *TR.TRESGShareholdersScore* in Refinitiv ESG.	Refinitiv ESG
CSR Strategy Score	A score that reflects a company's practices to communicate that it integrates economic (financial), social and environmental dimensions into its day-to-day decision-making processes. The score corresponds to the data item *TR.TRESGCSRStrategyScore* in Refinitiv ESG.	Refinitiv ESG
Stock Return Variables		
Stock Return	Stock return calculated over the period of one year (from December 31 to December 31). Winsorized at the 1% and 99% levels.	CS-CIQ, NA and Global
Annualized Return (2014–2019)	Annualized stock return calculated over the years 2014–2019. Winsorized at the 1% and 99% levels.	CS-CIQ, NA and Global
Future Return	The cumulative stock performance from July of year t to June year $t+1$. Does not include penny stocks and firms with more than three missing monthly return observations. Winsorized at the 1% and 99% levels.	CS-CIQ, NA and Global
Firm Characteristics		
Capex/Assets	Ratio of capital expenditures to total assets. The variable is constructed using Compustat data items $capx/at$. Winsorized at the 1% and 99% levels.	CS-CIQ, NA and Global
Cash/Assets	Ratio of cash plus short-term investments divided by total assets. The variable is constructed using Compustat data items csh/at. Winsorized at the 1% and 99% levels.	CS-CIQ, NA and Global

Variable	Description	Source
Debt/Assets	Ratio of total debt in current liabilities plus total long-term debt to total assets. The variable is constructed using Compustat data items $(dlc + dltt)/at$. Winsorized at the 1% and 99% levels.	CS-CIQ, NA and Global,
EBIT/Assets	Ratio of earnings before interest and taxes to total assets. The variable is constructed using Compustat data items $ebit/at$. Winsorized at the 1% and 99% levels.	CS-CIQ, NA and Global
Log(Assets)	Logarithm of total assets. The variable is constructed using Compustat data item at. We use the U.S. Federal Reserve Board's H.10 Release to convert foreign currencies to USD. Winsorized at the 1% and 99% levels.	CS-CIQ, NA and Global, U.S. Fed
PP&E/Assets	Ratio of property, plant and equipment to total assets. The variable is constructed using Compustat data items $ppent/at$. Winsorized at the 1% and 99% levels.	CS-CIQ, NA and Global
R&D/Assets	Ratio of research and development expenses to total assets (missing values are set to zero). The variable is constructed using Compustat data items xrd/at. Winsorized at the 1% and 99% levels.	CS-CIQ, NA and Global
Sales Growth	Total sales at the end of the year divided by total sales at the end of the previous year, minus one. The variable is constructed using Compustat data item *sale*. Winsorized at the 1% and 99% levels.	CS-CIQ, NA and Global

Figure 1: Academic Articles Mentioning ASSET4 Data over Time

This figure shows the cumulative number of academic articles (published papers and working papers) with ASSET4 data mentions between the year 2003 (founding year of ASSET4) and the first half of the year 2021. It also reports the cumulative number of articles that mention ASSET4 in combination with ESG. The data were retrieved from https://app.dimensions.ai/discover/publication on June 24, 2021. Our search terms are "ASSET4" and "ASSET4 and ESG." The search is not case-sensitive.

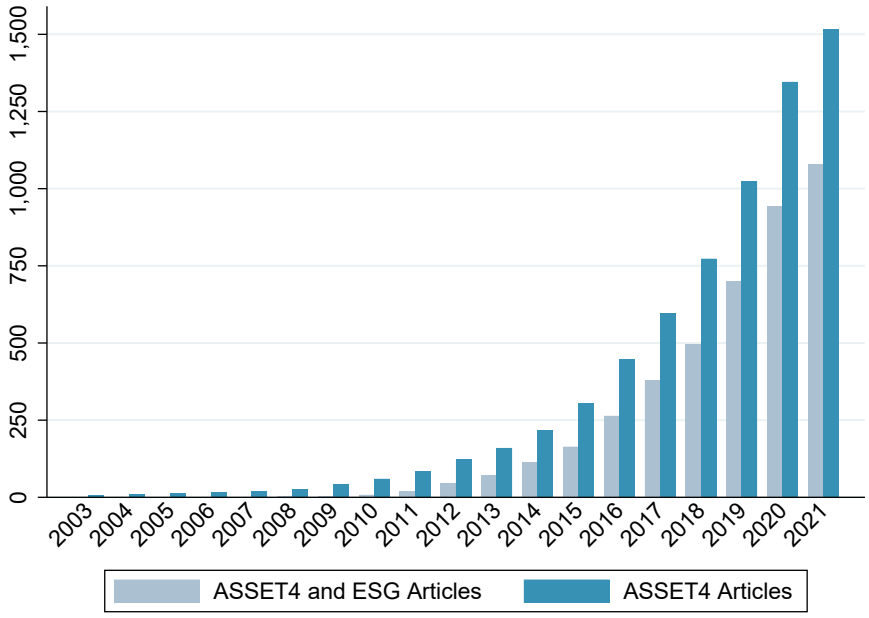

Figure 2: One-off ESG Score Rewriting: Decile Rank Changes

This figure shows the fractions of the sample that are subject to a decile rank change based on an ESG score in the 09/2018 (initial) and in the 09/2020 (rewritten) version of the Refinitiv ESG data. The sample consists of 29,828 firm-year observations between 2011 and 2017, with decile ranks being calculated in each sample year. A value of 0 indicates no change in a firm's decile rank.

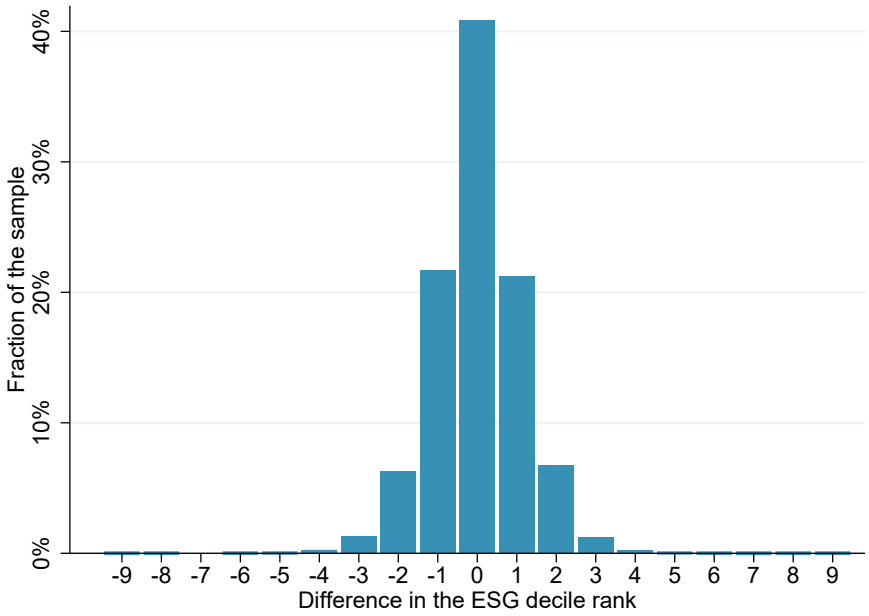

Table 1: Data Downloads and Sample Composition

This table reports information on the data downloads and sample composition. Panel A reports data fields downloaded in each data download. We indicate with "M" the data downloads used to examine the one-off methodology-related data rewriting, and with "O" the downloads used to examine the ongoing data rewriting. Column 1 reports whether the download contains the total ESG score, Column 2 reports whether the download contains the pillar subscores (i.e., the environmental (E), social (S), and governance (G) subscores), and Column 3 reports whether the download contains granular data items (among them CO_2 Data) that constitute the total ESG score. Panel B reports the sample composition for the analysis comparing the 09/2018 (initial) and 02/2020 (rewritten) data downloads (one-off methodology-related data rewriting). The sample consists of 29,828 firm-year observations between 2011 and 2017 for which we have an ESG score in both the 09/2018 (initial) and the 09/2020 (rewritten) data versions. Column 1 reports the number of firm-year observations by year, and Columns 2 and 3 report the number of firm-year observations for which an ESG score was added or deleted in the 09/2020 data version.

Panel A: Content of Data Downloads

	ESG Score	Pillar Scores	Granular/CO_2 Data
Month/Year	(1)	(2)	(3)
09/2018 (M)	✓	✓	✗
11/2019 (O)	✗	✗	✓
02/2020 (O)	✓	✗	✗
09/2020 (M)	✓	✓	✗
02/2021 (O)	✓	✓	✓
03/2021 (O)	✓	✓	✓

Panel B: Sample Composition for 09/2018 and 09/2020 Data Downloads

	ESG Score in both 09/2018 and 09/2020 Versions	ESG Score Additions in 09/2020 Version	ESG Score Deletions in 09/2020 Version
Year	(1)	(2)	(3)
2011	3,244	66	11
2012	3,386	69	11
2013	3,544	58	17
2014	3,737	49	14
2015	4,537	107	15
2016	5,418	154	16
2017	5,962	288	14
Full sample	29,828	791	98

Table 2: Deviations between the Initial and Rewritten Refinitiv ESG Data

This table documents relative deviations of the ESG scores (in %) between the initial and rewritten data from 2011 to 2017. Panel A looks at the one-off methodology-related data rewriting and compares 09/2018 (initial) and 09/2020 (rewritten) downloaded versions of the Refinitiv ESG data. Panel B looks at the ongoing data rewriting and compares the 02/2021 (initial) and 03/2021 (rewritten) versions of the Refinitiv ESG data. The sample in Panel A consists of 29,828 firm-year observations between 2011 and 2017. The sample in Panel B consists of 30,385 firm-year observations between 2011 and 2017. In both panels, Columns 1 and 2 report mean and median values of the relative score deviation (in %) between the different data versions, computed as $ESG\ Score^{Rewritten\ Data}$ divided by $ESG\ Score^{Initial\ Data}$ minus one, times 100. Columns 3 to 10 provide the same deviations (in %) for the E, S, and G subscores, as well as for the average of the E and S subscores. Variable definitions are reported in Table A1.

Panel A: One-off Methodology-related ESG Score Rewriting (09/2018 vs. 09/2020 Data)

	$\Delta\ ESG\ Score$		$\Delta\ E\ Score$		$\Delta\ S\ Score$		$\Delta\ G\ Score$		$\Delta\ E\&S\ Score$	
Year	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2011	-21.44	-19.04	-44.09	-39.75	-2.65	-19.02	113.61	-3.07	-24.94	-27.95
2012	-19.95	-17.51	-41.07	-36.23	0.17	-18.53	137.65	-4.68	-22.30	-24.92
2013	-20.09	-17.67	-42.13	-38.00	0.10	-18.96	131.28	-4.62	-22.74	-25.92
2014	-18.91	-16.67	-41.72	-38.21	4.59	-17.08	119.74	-4.85	-20.92	-25.18
2015	-20.67	-18.37	-48.32	-45.12	15.40	-16.99	110.44	-6.95	-19.46	-26.36
2016	-21.50	-19.60	-53.60	-52.07	14.73	-14.69	112.34	-9.41	-21.30	-26.45
2017	-20.87	-19.21	-52.96	-51.86	16.44	-11.97	102.36	-9.60	-19.97	-24.58
Full sample	-20.57	-18.43	-47.36	-44.03	8.62	-16.38	116.24	-6.95	-21.39	-25.87

Panel B: Ongoing ESG Score Rewriting (02/2021 vs. 03/2021 Data)

	$\Delta\ ESG\ Score$		$\Delta\ E\ Score$		$\Delta\ S\ Score$		$\Delta\ G\ Score$		$\Delta\ E\&S\ Score$	
Year	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2011	-0.00	0.00	-0.05	0.00	0.05	0.00	0.01	0.00	-0.02	0.00
2012	-0.00	0.00	0.03	0.00	0.07	0.00	0.02	0.00	0.00	0.00
2013	0.03	0.00	0.05	0.00	0.11	0.00	0.04	0.00	0.08	0.00
2014	0.05	0.00	0.00	0.00	0.14	0.00	0.11	0.00	0.04	0.00
2015	0.07	0.00	0.09	0.00	0.12	0.00	0.09	0.00	0.17	0.00
2016	0.07	0.00	0.34	0.00	0.08	0.00	0.16	0.00	0.29	0.00
2017	0.12	0.00	0.57	0.00	0.14	0.00	0.10	0.00	0.45	0.00
Full sample	0.06	0.00	0.19	0.00	0.10	0.00	0.08	0.00	0.18	0.00

Table 3: One-off ESG Score Rewriting: Summary Statistics

This table reports summary statistics for the sample that examines the one-off methodology-related ESG score rewriting. The sample consists of 29,828 firm-year observations between 2011 and 2017 common to both the 09/2018 (initial) and the 09/2020 (rewritten) data downloads. Variable definitions are reported in Table A1.

Variable	Mean	SD	25%	Median	75%
09/2018 Data (Initial)					
ESG Score	50.41	18.04	36.13	49.90	64.51
E Score	50.35	31.94	16.04	48.24	84.45
S Score	50.52	31.43	18.73	50.02	82.51
G Score	50.09	30.24	21.21	53.26	77.50
E&S Score	50.44	30.43	19.40	49.05	81.30
09/2020 Data (Rewritten)					
ESG Score	41.82	20.64	25.23	39.94	57.54
E Score	32.78	28.86	4.10	27.66	56.78
S Score	42.12	23.57	23.44	39.57	59.72
G Score	48.46	22.75	30.08	48.76	66.82
E&S Score	37.45	24.34	16.41	33.03	57.03
Score Deviations					
Δ *ESG Score* (in %)	-20.57	21.26	-32.86	-18.43	-6.77
Δ *E Score* (in %)	-47.36	38.77	-80.97	-44.03	-19.69
Δ *S Score* (in %)	8.62	84.90	-37.29	-16.38	17.69
Δ *G Score* (in %)	116.24	353.88	-34.27	-6.95	84.36
Δ *E&S Score* (in %)	-21.39	37.20	-43.01	-25.87	-8.33
Firm Characteristics					
Stock Return (in %)	14.76	37.55	-7.43	10.83	31.58
Future Return (in %)	13.94	36.97	-8.23	10.26	30.82
Log(Assets)	8.54	1.77	7.42	8.47	9.61
Capex/Assets	0.05	0.05	0.02	0.03	0.06
Cash/Assets	0.15	0.15	0.04	0.10	0.19
Debt/Assets	0.24	0.18	0.10	0.23	0.36
EBIT/Assets	0.07	0.10	0.03	0.06	0.11
PP&E/Assets	0.27	0.25	0.05	0.20	0.43
R&D/Assets	0.02	0.04	0.00	0.00	0.01
Sales Growth	0.09	0.29	-0.02	0.05	0.14

Table 4: One-off and Ongoing ESG Score Rewriting: Quantile Overlaps

This table reports the fraction of firm-year observations (in %) assigned to different top and bottom quantiles (deciles, quartiles, and terciles) across different versions of the Refinitiv ESG data. Panel A compares firm-year observations that are present in both the 09/2018 (initial) and the 09/2020 (rewritten) data versions. Panel B compares firm-year observations that are present in both the 02/2021 (initial) and the 03/2021 (rewritten) data versions. In Panel A, the quantile overlaps are calculated based on 29,828 firm-year observations for which an ESG score (or its respective component part) is non-zero and is available in both versions of the data between 2011 and 2017. In Panel B, the quantile overlaps are calculated based on 30,385 firm-year observations for which an ESG score (or its respective component part) is non-zero and is available in both versions of the data between 2011 and 2017. Each panel shows first the quantile overlaps for the total ESG score, followed by overlaps for the E, S, and G subscores, and the average of the E and S (E&S) subscores. Variable definitions are reported in Table A1.

Panel A: One-off Rewriting (09/2018 vs. 09/2020 Data)				Panel B: Ongoing Rewriting (02/2021 vs. 03/2021 Data)			
	Decile	Quartile	Tercile		Decile	Quartile	Tercile
		ESG Score				*ESG Score*	
Top	70.4	82.8	86.2	Top	98.7	99.5	99.5
Bottom	68.5	80.2	83.9	Bottom	98.8	99.3	99.5
		E Score				*E Score*	
Top	45.7	68.7	76.4	Top	98.1	99.0	99.2
Bottom	58.1	75.9	79.9	Bottom	99.2	99.2	99.3
		S Score				*S Score*	
Top	52.8	73.1	75.8	Top	98.8	99.2	99.5
Bottom	47.3	62.7	70.9	Bottom	99.0	99.3	99.3
		G Score				*G Score*	
Top	37.5	49.4	55.1	Top	98.9	99.3	99.4
Bottom	33.7	44.2	51.7	Bottom	98.9	99.3	99.5
		E&S Score				*E&S Score*	
Top	57.3	78.4	83.0	Top	99.0	99.4	99.6
Bottom	50.5	72.9	80.7	Bottom	98.9	99.2	99.4

Table 5: One-off ESG Score Rewriting: Stock Returns and Firm Characteristics

This table reports the results of regressions of deviations (in %) in ESG scores between the 09/2018 (initial) and the 09/2020 (rewritten) versions of the Refinitiv ESG data on stock returns and firm characteristics. The relative score deviation is computed for each firm-year combination as $ESG\ Score^{09/2020\ Data}$ divided by $ESG\ Score^{09/2018\ Data}$ minus one, times 100. We report results for $\Delta\, ESG\ Score$, $\Delta\, E\ Score$, $\Delta\, S\ Score$, $\Delta\, G\ Score$, and $\Delta\, E\&S\ Score$ (average of the E and S subscore). The sample consists of 20,884 firm-year observations between 2011 and 2017 for which we have all data available. Regressions are estimated at the firm-year level. t-statistics, based on standard errors clustered at the firm level, are reported in parentheses. Variable definitions are reported in Table A1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable	Δ *ESG Score*	Δ *E Score*	Δ *S Score*	Δ *G Score*	Δ *E&S Score*
	(1)	(2)	(3)	(4)	(5)
Stock Return	-0.46	1.31**	6.39***	5.28	3.38***
	(-1.37)	(2.09)	(4.86)	(1.20)	(5.48)
Log(Assets)	4.71***	9.21***	-8.47***	-19.44***	0.84***
	(25.00)	(27.88)	(-13.69)	(-8.19)	(2.79)
Sales Growth	-5.34***	-7.63***	21.84***	23.05***	4.75***
	(-9.27)	(-7.37)	(7.92)	(4.11)	(3.88)
Capex/Assets	-10.87	-10.37	23.25	-419.59***	4.31
	(-1.60)	(-0.88)	(1.23)	(-5.05)	(0.42)
Cash/Assets	-0.29	-11.54***	34.43***	147.45***	8.20**
	(-0.14)	(-2.88)	(4.32)	(4.14)	(2.12)
Debt/Assets	-2.96*	-5.21*	19.51***	-4.23	5.04**
	(-1.95)	(-1.86)	(3.43)	(-0.24)	(1.98)
EBIT/Assets	17.27***	28.50***	-101.57***	59.71	-25.16***
	(6.39)	(5.76)	(-9.65)	(1.57)	(-4.99)
PP&E/Assets	2.51	6.16*	-11.06*	64.86***	-2.82
	(1.28)	(1.86)	(-1.86)	(2.84)	(-0.94)
R&D/Assets	40.63***	62.40***	121.91***	-632.88***	78.91***
	(5.44)	(4.94)	(3.95)	(-5.60)	(5.51)
Observations	20,884	20,884	20,884	20,884	20,884
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Industry x Year fixed effects	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.21	0.27	0.38	0.49	0.26

Table 6: One-off and Ongoing ESG Score Rewriting: Future Returns and E&S/ESG Scores

The table reports the results of regressions of yearly stock returns (*Future Return*) on E&S/ESG scores measured using the 09/2018, 09/2020, 02/2021, and 03/2021 versions of the Refinitiv ESG data. In Panel A, we relate returns to the *E&S Score* and in Panel B we relate returns to the *ESG Score*. In each panel, Columns 1 to 4 use the continuous scores, and Columns 5 to 8 the top-quartile dummy. The returns (in %) capture firms' cumulative stock performance from July *t* to June *t+1*. The *E&S Score*, the *ESG Score*, the top-quartile dummies, and firm fundamentals are measured as of the most recent fiscal year (*t-1*) preceding the return calculation. *E&S Score* is calculated by averaging the E and S subscore. We drop penny stocks and firms with more than three missing monthly observations. The sample in both panels consists of 20,874 firm-year observations between 2011 and 2017. *t*-statistics, based on standard errors clustered at the firm level, are reported in parentheses. Variable definitions are reported in Table A1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: E&S Scores								
	09/2018 Data	09/2020 Data	02/2021 Data	03/2021 Data	09/2018 Data	09/2020 Data	02/2021 Data	03/2021 Data
Dependent variable	*Future Return*	*Future Return*	*Future Return*	*Future Return*	*Future Return*	*Future Return*	*Future Return*	*Future Return*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
E&S Score	0.001	0.031**	0.029**	0.030**				
	(0.06)	(2.43)	(2.26)	(2.31)				
E&S Score Q1					0.892	1.170**	1.272**	1.332**
					(1.56)	(2.09)	(2.23)	(2.33)
Log(Assets)	-1.174***	-1.477***	-1.457***	-1.464***	-1.293***	-1.344***	-1.361***	-1.370***
	(-5.03)	(-6.13)	(-6.03)	(-6.06)	(-5.96)	(-6.16)	(-6.20)	(-6.24)
Sales Growth	7.575***	7.765***	7.754***	7.759***	7.647***	7.661***	7.669***	7.675***
	(5.03)	(5.17)	(5.16)	(5.16)	(5.10)	(5.11)	(5.12)	(5.12)
Capex/Assets	-49.050***	-49.163***	-49.133***	-49.126***	-49.377***	-49.233***	-49.276***	-49.286***
	(-6.36)	(-6.38)	(-6.38)	(-6.38)	(-6.40)	(-6.39)	(-6.40)	(-6.40)
Cash/Assets	6.934***	6.968***	6.963***	6.959***	6.923***	6.895***	6.867***	6.867***
	(2.60)	(2.62)	(2.61)	(2.61)	(2.60)	(2.59)	(2.58)	(2.58)
Debt/Assets	-3.806**	-3.612**	-3.621**	-3.616**	-3.702**	-3.689**	-3.686**	-3.679**
	(-2.35)	(-2.23)	(-2.24)	(-2.23)	(-2.29)	(-2.28)	(-2.28)	(-2.28)
EBIT/Assets	14.596***	13.848***	13.906***	13.883***	14.343***	14.190***	14.181***	14.151***
	(3.70)	(3.51)	(3.52)	(3.52)	(3.67)	(3.62)	(3.62)	(3.61)
PP&E/Assets	7.042***	7.005***	6.999***	6.991***	7.050***	7.036***	7.034***	7.031***
	(4.30)	(4.27)	(4.27)	(4.26)	(4.30)	(4.29)	(4.29)	(4.29)
R&D/Assets	37.843***	35.253***	35.446***	35.366***	36.904***	36.442***	36.368***	36.290***
	(3.18)	(2.95)	(2.97)	(2.96)	(3.11)	(3.07)	(3.06)	(3.06)
Observations	20,874	20,874	20,874	20,874	20,874	20,874	20,874	20,874
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12

Table 6: Continued

Panel B: ESG Scores								
	09/2018 Data	09/2020 Data	02/2021 Data	03/2021 Data	09/2018 Data	09/2020 Data	02/2021 Data	03/2021 Data
Dependent variable	*Future Return*	*Future Return*	*Future Return*	*Future Return*	*Future Return*	*Future Return*	*Future Return*	*Future Return*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ESG Score	0.022	0.024*	0.024*	0.024*				
	(1.34)	(1.69)	(1.68)	(1.65)				
ESG Score Q1					0.806	0.969*	1.029*	1.005*
					(1.47)	(1.73)	(1.84)	(1.81)
Log(Assets)	-1.326***	-1.371***	-1.371***	-1.368***	-1.291***	-1.316***	-1.326***	-1.323***
	(-5.68)	(-5.78)	(-5.76)	(-5.74)	(-5.90)	(-5.97)	(-6.01)	(-6.00)
Sales Growth	7.676***	7.720***	7.721***	7.719***	7.639***	7.646***	7.651***	7.649***
	(5.11)	(5.13)	(5.13)	(5.13)	(5.09)	(5.10)	(5.11)	(5.11)
Capex/Assets	-49.189***	-49.087***	-49.081***	-49.075***	-49.159***	-49.202***	-49.182***	-49.191***
	(-6.38)	(-6.37)	(-6.37)	(-6.37)	(-6.38)	(-6.39)	(-6.38)	(-6.38)
Cash/Assets	6.950***	6.955***	6.955***	6.951***	6.912***	6.902***	6.898***	6.896***
	(2.61)	(2.61)	(2.61)	(2.61)	(2.60)	(2.59)	(2.59)	(2.59)
Debt/Assets	-3.707**	-3.663**	-3.664**	-3.666**	-3.712**	-3.718**	-3.705**	-3.709**
	(-2.29)	(-2.26)	(-2.26)	(-2.27)	(-2.30)	(-2.30)	(-2.29)	(-2.30)
EBIT/Assets	14.150***	14.015***	14.017***	14.026***	14.275***	14.247***	14.233***	14.243***
	(3.59)	(3.55)	(3.55)	(3.55)	(3.64)	(3.64)	(3.63)	(3.64)
PP&E/Assets	7.068***	7.049***	7.046***	7.042***	7.073***	7.069***	7.058***	7.058***
	(4.31)	(4.30)	(4.30)	(4.30)	(4.32)	(4.31)	(4.31)	(4.31)
R&D/Assets	36.530***	36.235***	36.262***	36.270***	36.958***	36.777***	36.695***	36.714***
	(3.07)	(3.04)	(3.04)	(3.04)	(3.12)	(3.10)	(3.09)	(3.09)
Observations	20,874	20,874	20,874	20,874	20,874	20,874	20,874	20,874
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12

Table 7: Ongoing ESG Score Rewriting: Changes in Raw Data Items

This table reports the percentage of firms experiencing a change in the raw ESG data between the 02/2021 (initial) and 03/2021 (rewritten) data downloads. The table is based on 30,385 firm-year observations that are present in both versions of the data. Panel A shows the fraction of firms that experience a rewriting of the total ESG score. Panel B shows the fraction of firms that experience a rewriting of the E, S, and G subscores that shape the total ESG score. Panel C shows the fraction of firms that experience a rewriting of the category subscores that shape the E, S, and G subscores. Panel D shows the fraction of firms that experience a rewriting of raw data items that flow into the category scores, pillar scores and ultimately to the total ESG score. Years with a low fraction of firms that experienced data rewriting are shown in green. Years with a moderate fraction of firms that experienced data rewriting are shown in yellow. Years with a high fraction of firms that experienced data rewriting are shown in red. Variable definitions are reported in Table A1.

	2011	2012	2013	2014	2015	2016	2017	Full Sample
	Panel A: Firm-Years with Changes in Total ESG Score							
ESG Score	80%	80%	80%	80%	88%	92%	94%	86%
	Panel B: Firm-Years with Changes in Pillar Scores							
E Score	51%	54%	50%	48%	53%	46%	50%	50%
S Score	58%	59%	59%	55%	68%	74%	73%	65%
G Score	43%	44%	45%	49%	54%	62%	66%	54%
	Panel C: Firm-Years with Changes in Category Scores							
Resource Use Score	34%	45%	39%	39%	36%	35%	28%	36%
Emissions Score	37%	37%	39%	40%	40%	30%	40%	37%
Innovation Score	19%	21%	19%	11%	23%	15%	11%	17%
Workforce Score	53%	55%	52%	47%	55%	61%	50%	54%
Human Rights Score	12%	16%	17%	16%	15%	15%	16%	15%
Community Score	53%	57%	52%	46%	56%	59%	51%	53%
Management Score	32%	34%	34%	33%	40%	46%	50%	40%
Shareholders Score	29%	32%	33%	28%	33%	38%	47%	35%
CSR Strategy Score	6%	7%	7%	17%	17%	16%	18%	14%
	Panel D: Firm-Years with Changes in Raw Data Items							
Raw Data Items	4%	4%	4%	4%	6%	7%	8%	6%

Table 8: One-off and Ongoing Data Rewriting: Scope 1 Carbon Emissions

This table reports deviations of the Scope 1 carbon emission data across various versions of the Refinitiv ESG data (variable *CO2DirectScope1*). Panel A compares firm-year observations that are present in both the 11/2019 (initial) and the 02/2021 (rewritten) versions of the Refinitiv ESG data. Panel B compares firm-year observations that are present in both the 11/2019 (initial) and 02/2021 (rewritten) versions of the Refinitiv ESG data. The sample in Panel A consists of 8,356 firm-year observations and the sample in Panel B consists of 11,956 firm-year observations between 2011 and 2017. In Panel A, we report the fraction of the firm-year observations that were either added, deleted, or rewritten. Columns 1 and 4 report the fraction of firm-year observations that were added in the rewritten version. Columns 2 and 5 report the fraction of firm-year observations that were deleted in the rewritten version. Columns 3 and 6 report the fraction of firm-year observations that were modified. In Panel B, we calculate a yearly sum of Scope 1 emissions in metric tons of CO_2 in the initial version of the data as the standardizing variable. For each year, we compute the sum of all metric tons of Scope 1 CO_2 emissions that were added, deleted, or rewritten and standardize them by the computed yearly sum. We report these values in Columns 1 and 4, Columns 2 and 5, and Columns 3 and 6 of Panel B, respectively. Variable definitions are reported in Table A1.

	Panel A: One-off Rewriting (11/2019 vs. 02/2021 Data)			Panel B: Ongoing Rewriting (02/2021 vs. 03/2021 Data)		
	Added	Deleted	Rewritten	Added	Deleted	Rewritten
Year	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A.1: Firm-Years (in %)			Panel B.1: Firm-Years (in %)		
2011	20.9	1.3	14.2	0.0	0.1	0.1
2012	19.8	1.4	15.9	0.1	0.0	0.1
2013	18.8	2.4	16.4	0.2	0.1	0.1
2014	23.4	1.9	14.6	0.1	0.1	0.1
2015	23.7	2.1	17.8	0.3	0.1	0.2
2016	24.0	0.9	21.9	0.6	0.0	0.7
2017	29.7	1.3	23.6	0.9	0.0	1.2
Full sample	23.6	1.6	18.4	0.4	0.1	0.4
	Panel A.2: Emissions (in %)			Panel B.2: Emissions (in %)		
2011	23.2	1.7	2.4	0.0	0.0	0.0
2012	24.2	1.0	2.5	0.0	0.0	0.1
2013	15.1	6.0	3.0	0.0	0.0	0.0
2014	34.0	0.8	2.6	0.0	0.0	0.1
2015	30.7	0.7	2.5	1.1	0.0	0.1
2016	34.1	0.8	3.2	0.3	0.0	0.1
2017	42.1	0.8	3.9	0.3	0.0	0.0
Full sample	29.1	1.7	2.9	0.3	0.0	0.1

Internet Appendix
for
"Is History Repeating Itself?
The (Un)predictable Past of ESG Ratings"

Table IA1: Studies using Refinitiv ESG (or ASSET4) Data

The table lists selected studies in leading finance journals as well as several recent working papers that use Refinitiv ESG (or ASSET4) data in their analyses.

Paper Authors	Paper Name	Paper Stage/Journal
Published Papers		
Albuquerque et al. (2020)	Resiliency of environmental and social stocks: An analysis of the exogenous COVID-19 market crash	*Review of Corporate Finance Studies*
Bae et al. (2021)	Board reforms and dividend policy: International evidence	*Journal of Financial and Quantitative Analysis*
Cao et al. (2019)	Peer effects of corporate social responsibility	*Management Science*
Cousins et al. (2020)	Shareholder wealth effects of modern slavery regulation	*Management Science*
Dai et al. (2020)	Socially responsible corporate customers	*Journal of Financial Economics*
Ding et al. (2021)	Corporate immunity to the COVID-19 pandemic	*Journal of Financial Economics*
Dyck et al. (2019)	Do institutional investors drive corporate social responsibility? International evidence	*Journal of Financial Economics*
Eccles et al. (2014)	The impact of corporate sustainability on organizational processes and performance	*Management Science*
Fauver et al. (2017)	Board reforms and firm value: Worldwide evidence	*Journal of Financial Economics*
Ferrell et al. (2016)	Socially responsible firms	*Journal of Financial Economics*
Flammer (2020)	Corporate green bonds	*Journal of Financial Economics*
Liang and Renneboog (2017)	On the foundations of corporate social responsibility	*Journal of Finance*
O'Donovan et al. (2019)	The value of offshore secrets: Evidence from the Panama Papers	*Review of Financial Studies*
Working Papers		
Berg et al. (2021)	Aggregate confusion: The divergence of ESG ratings	Working Paper
Dimson et al. (2021)	Coordinated engagements	Working Paper
Gibson et al. (2021)	The sustainability footprint of institutional investors: ESG driven price pressure and performance	Working Paper
Krueger et al. (2021)	The sustainability wage gap	Working Paper

Table IA2: One-off and Ongoing Data Rewriting: Changes in Year-on-Year Trends

The table reports the fraction of firms (in %) for which the year-on-year (YoY) changes in the ESG scores were modified at least once because of the data rewriting. The sample consists of firms for which the total ESG score, the E, S, and G subscores, or the average of the E and S (E&S) subscores are available over at least two years in the respective data versions between 2011 and 2017. The comparisons are based on the 09/2018, 09/2020, 02/2021, or 03/2021 versions of the Refinitiv ESG data. We compute for each firm in each data version its ESG score YoY trend. If a consecutive firm-year has a higher (lower) score than the previous one, we flag it as an improvement (worsening). We then identify firms where the YoY trend changed across data versions in at least one instance (e.g., from improvement to worsening or from constant to improvement, etc.). We subsequently divide the number of affected firms by the total number of firms in the sample. Since the table is symmetric, duplicate entries are omitted and replaced with a hyphen. Variable definitions are reported in Table A1.

	ESG Score		
	09/2020 Data	02/2021 Data	03/2021 Data
09/2018 Data	61.8	61.8	62.0
09/2020 Data	-	13.5	15.4
02/2021 Data	-	-	5.8
	E Score		
	09/2020 Data	02/2021 Data	03/2021 Data
09/2018 Data	85.7	85.8	85.5
09/2020 Data	-	17.6	19.9
02/2021 Data	-	-	7.8
	S Score		
	09/2020 Data	02/2021 Data	03/2021 Data
09/2018 Data	77.1	77.4	77.6
09/2020 Data	-	12.6	15.1
02/2021 Data	-	-	6.4
	G Score		
	09/2020 Data	02/2021 Data	03/2021 Data
09/2018 Data	74.2	74.3	74.3
09/2020 Data	-	11.4	13.1
02/2021 Data	-	-	3.7
	E&S Score		
	09/2020 Data	02/2021 Data	03/2021 Data
09/2018 Data	74.9	75.1	74.8
09/2020 Data	-	15.2	17.7
02/2021 Data	-	-	7.9

Table IA3: Description of Changes to the ESG Scoring Methodology

The table cites the description of the changes to Refinitiv ESG's scoring methodology (Refinitiv, 2020c).

Change name	Description provided by Refinitiv
(1) Change to Materiality Matrix	"Refinitiv enhanced ESG scores further takes into account that not all metrics have the same importance to every industry. The Refinitiv ESG magnitude matrix is developed as a proprietary model and is applied at the category level. Importantly, the magnitude values are automatically and dynamically adjusted as ESG corporate disclosure evolves and matures. For Boolean metrics, levels of data disclosure can act as a proxy for investor driven pressure on company reporting. Levels of disclosure inform the relative 'weight' of data points for each industry. For measurable numeric metrics, we use our data to determine which sectors contribute most and the proportion of the contribution to the total is used as a proxy for the level of materiality for that sector. For example, the more a given sector contributes to carbon emissions, the more material are carbon emissions data points to companies in that sector. Refinitiv proprietary "magnitude matrix" assesses materiality, showing the weight, from 1 to 10, of data points for each industry."
(2) Change to Transparency/ Investment Grade Scores	"The previous ESG scoring methodology allocated a score of 0.5 to companies which didn't report on metrics, essentially giving them the 'benefit of the doubt'. However, as this may disincentivize companies to report on their ESG performance, the enhanced methodology assigns a score of zero to companies who don't report on metrics relevant to the industry. This new approach encourages company disclosure and transparency."

Table IA4: Ongoing ESG Score Rewriting: Quantile Overlaps

This table reports the fraction of firm-year observations (in %) assigned to different top and bottom quantiles (deciles, quartiles, and terciles) across various versions of the Refinitiv ESG data. Panel A compares firm-year observations that are present in both the 09/2018 (initial) and the 02/2020 (rewritten) versions of the Refinitiv ESG data. Panel B compares firm-year observations that are present in both the 09/2020 (initial) and the 03/2021 (rewritten) versions of the Refinitiv ESG data. In Panel A, the quantile overlaps calculated based on 29,658 firm-year observations for which an ESG score is non-zero and is available in both versions of the data between 2011 and 2017. In Panel B, the quantile overlaps calculated based on 30,370 firm-year observations for which an ESG score (or its respective component part) is non-zero and is available in both versions of the data between 2011 and 2017. The panels show the quantile overlaps for the total ESG score, followed by overlaps for the E, S, and G subscores, and the average of the E and S (E&S) subscores (depending on availability). Variable definitions are reported in Table A1.

Panel A: Ongoing Rewriting (09/2018 vs. 02/2020 Data)

	ESG Score		
	Decile	Quartile	Tercile
Top	87.8	92.9	94.0
Bottom	86.7	92.5	94.0

Panel B: Ongoing Rewriting (09/2020 vs. 03/2021 Data)

	Decile	Quartile	Tercile
	ESG Score		
Top	94.7	97.1	97.8
Bottom	95.5	96.9	97.7
	E Score		
Top	89.5	95.0	96.2
Bottom	94.7	96.4	96.9
	S Score		
Top	96.7	98.0	98.3
Bottom	96.6	97.9	98.1
	G Score		
Top	95.9	96.9	97.5
Bottom	95.8	97.1	97.5
	E&S Score		
Top	94.9	97.0	97.7
Bottom	96.6	97.6	97.8

Table IA5: One-off ESG Score Rewriting: Past Returns and Firm Characteristics

This table reports the results of regressions of deviations (in %) in ESG scores between the 09/2018 (initial) and the 09/2020 (rewritten) versions of the Refinitiv ESG data on stock returns (annualized return over the years 2014 to 2019) and firm characteristics. The relative score deviation is computed for each firm-year combination as *ESG Score*$^{09/2020\ Data}$ divided by *ESG Score*$^{09/2018\ Data}$ minus one, times 100. We report results for Δ *ESG Score*, Δ *E Score*, Δ *S Score*, Δ *G Score*, and Δ *E&S Score* (average of the E and S subscore). The sample consists of 19,554 firm-year observations between 2011 and 2017 for which we have all data available. Regressions are estimated at the firm-year level. *t*-statistics, based on standard errors clustered at the firm level, are reported in parentheses. Variable definitions are reported in Table A1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable	Δ *ESG Score*	Δ *E Score*	Δ *S Score*	Δ *G Score*	Δ *E&S Score*
	(1)	(2)	(3)	(4)	(5)
Annualized Return (2014–2019)	0.19	1.06	4.92	23.41	1.96
	(0.16)	(0.49)	(1.27)	(1.63)	(1.00)
Log(Assets)	4.67***	9.12***	-8.48***	-21.15***	0.79**
	(23.94)	(26.26)	(-13.15)	(-8.31)	(2.51)
Sales Growth	-6.32***	-8.58***	27.43***	26.25***	6.22***
	(-9.76)	(-7.55)	(8.99)	(3.84)	(4.67)
Capex/Assets	-5.45	-1.45	35.00*	-481.17***	14.57
	(-0.75)	(-0.11)	(1.75)	(-5.04)	(1.35)
Cash/Assets	-0.45	-13.24***	35.29***	159.02***	7.74*
	(-0.20)	(-3.08)	(4.14)	(4.14)	(1.87)
Debt/Assets	-2.65*	-4.44	21.94***	-4.74	6.33**
	(-1.67)	(-1.49)	(3.64)	(-0.25)	(2.35)
EBIT/Assets	16.03***	27.32***	-112.55***	32.98	-29.10***
	(5.58)	(5.10)	(-9.90)	(0.77)	(-5.32)
PP&E/Assets	1.73	3.61	-11.95*	75.58***	-4.33
	(0.83)	(1.02)	(-1.90)	(2.95)	(-1.37)
R&D/Assets	40.60***	60.52***	101.11***	-720.20***	69.06***
	(5.06)	(4.45)	(3.11)	(-5.78)	(4.58)
Observations	19,554	19,554	19,554	19,554	19,554
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry x Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.20	0.27	0.38	0.49	0.26

Table IA6: Ongoing ESG Score Rewriting: Relationship between Ongoing ESG Score Changes and ESG Events

This table reports in Panel A Pearson correlation coefficients between the change in the RepRisk ESG score and change in the Refinitiv ESG score between the 02/2021 (initial) and 03/2021 (rewritten) data downloads. Panel B reports the same correlations for changes for RepRisks and Refinitiv ESG's E, S, and G subscores. The RepRisk score measures a firm's reputational risk exposure to ESG issues by analyzing controversies in the media. The score ranges between 0 (low risk) and 100 (high risk). The matched sample between RepRisk and Refinitiv data consists of 22,133 firm-year observations between 2011 and 2017. Variable definitions are reported in Table A1.

	2011	2012	2013	2014	2015	2016	2017	Full Sample
Panel A: Correlation of Changes in Refinitiv's and RepRisk's ESG Scores								
ESG Score	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00
Panel B: Correlation of Changes in Refinitiv's and RepRisk's E, S, and G Scores								
E Score	0.02	0.01	0.01	0.00	0.00	0.01	0.00	0.00
S Score	0.00	0.00	0.03	0.00	0.00	0.01	0.00	0.00
G Score	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00

Table IA7: One-off and Ongoing Data Rewriting: Correlations between the Refinitiv ESG Scores and MSCI/Sustainalytics Scores

This table reports Pearson correlation coefficients between ESG scores in four Refinitiv data downloads (09/2018, 09/2020, 02/2021, and 03/2021) and MSCI (Panel A) as well as Sustainalytics (Panel B) ESG Scores. We calculate the correlations between pairs from the same level of aggregation, i.e., ESG scores with ESG scores, E scores with E scores, S scores with S scores, and G scores with G scores. The first column indicates the version of the Refinitiv ESG data. The matched sample between MSCI and Refinitiv data consists of 21,556 firm-year observations (between 2011 and 2017), and the corresponding figure for the Sustainalytics and Refinitiv ESG data amounts to 23,386 firm-year observations for the same period. Variable definitions are reported in Table A1.

	ESG Score	*E Score*	*S Score*	*G Score*
Panel A: Correlations with MSCI Scores				
09/2018 Data	45%	31%	26%	18%
09/2020 Data	44%	34%	23%	10%
02/2021 Data	43%	34%	22%	10%
03/2021 Data	43%	34%	22%	10%
Panel B: Correlations with Sustainalytics Scores				
09/2018 Data	65%	67%	53%	43%
09/2020 Data	69%	70%	56%	31%
02/2021 Data	69%	70%	56%	31%
03/2021 Data	69%	70%	56%	31%

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