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ESG ratings rewriting or recalibration?

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Citation

ESG RATINGS REWRITING OR RECALIBRATION?

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SINGAPORE MANAGEMENT UNIVERSITY
2023

ESG Ratings Rewriting or Recalibration?

Zhang Chengshuang

Submitted to Lee Kong Chian School of Business
in partial fulfillment of the requirements for the
Doctor of Business Administration

Dissertation Committee

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I hereby declare that this DBA dissertation is my original work

and it has been written by me in its entirety.

I have duly acknowledged all the sources of information which have been used in this

dissertation.

The DBA dissertation has also not been submitted for any degree

in any university previously.

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13 June 2023

ESG Ratings Rewriting or Recalibration?

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Abstract

ESG ratings are the nexus of sustainable development. Are ongoing retroactive adjustments of ESG scores rewriting or recalibration? Using datasets from 20 random weeks of downloads of Refinitiv ESG universe between 7 October 2021 to 14 December 2022, we find that the positive link between ESG scores or E&S scores to firms' stock returns existed between 2011 to 2017, disappeared between 2002 to 2011 and attenuated between 2017 to 2021. Using the formation of the International Sustainability Standard Board on 3rd November 2021 as the external shock event, we further find that the retroactive ESG score adjustments are not driven by stock returns and therefore are likely recalibrations. We extend (Berg et al., 2020a)'s findings that ongoing retroactive ESG score adjustments are rewritings driven by firms' stock returns, a classic agency problem, we could not validate such findings with scientific evidence on our randomly downloaded datasets closer to the date. The positive link is time frame dependent; while ongoing retroactive ESG score adjustments are prevalent, it postulates recalibrations.

Contents

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Lastly, I would like to dedicate the paper to my parents. They are my role models, for their moral values, achievements and contributions to their academic fields, well-respected and meaningful lives.

Section 1: Introduction

As the world sails towards sustainable development, demand for green assets has surged tremendously. For instance, between 2010 to 2020, assets under management by US-domiciled institutions jumped more than five folds to over US$17 trillion in 2020, with every one in three US dollars invested in 2020 onwards being managed according to ESG investing principles as per US SIF. Furthermore, according to United Nations Principles for Responsible Investment, more than US$120 trillion in assets under management globally pledged according to ESG investing principles as of December 2021. ESG investing principles have a strong reliance on ESG ratings; therefore, the reliability and credibility of ESG ratings are paramount. However, ESG rating divergence of the same rated firms by different rating providers casts doubt about rating reliability. To make it worse, according to (Berg et al., 2020a, BFS hereafter), ongoing retroactive adjustments of ESG and E&S scores of the same firm years happen at Refinitiv, one of the top rating providers; one standard deviation increase in the rewritten E&S scores is associated with stock returns that are 94 basis points higher per year; it is a rating provider's incentive to retroactively strengthen the link between ESG scores and stock returns, as the latter is a key consideration for data users, i.e., institutional investors to choose ESG rating providers. ESG score rewritings are thus motivated by conflicts of interest, a classic agency problem. The rating credibility of Refinitiv, along with other influential ESG rating providers such as MSCI, Sustainalytics and S&P Global, etc., would inevitably be at stake. If the allegation on ESG ratings is on the wrong footing, trillions of dollars investments would be left in shambles without ESG performance assessment.

We believe otherwise. As more industry peers are being rated and more data points are being disclosed by rated firms, historical ESG scores on the same firm years recalibrate automatically to better reflect the relative material ESG performance of the rated firm among industry peers.

Whether ongoing adjustments of historical Refinitiv ESG scores for the same firm years are due to rewriting or recalibration is worth investigating and therefore it is our research question.

Our paper shed light on the obscurity of the current ESG rating practice for policymakers, institutional investors, listed companies, and stakeholders by in large, as we investigate the ongoing retroactive ESG score adjustments on the same firm years by Refinitiv, a top ESG rating provider covering over 88% of global market capitalization. As the ESG data from Refinitiv in BFS's paper and ours were downloaded at different points in time, the purpose of our investigation is not about rebuttal of their paper, rather it is about providing up-to-date validations.

We use ESG rating data collected consecutively for 18 weeks between 7 October 2021 and 10 February 2022, as well as E, S, G, E&S, and ESG rating data collected on 16 & 17 November and 14 December 2022 from Refinitiv, to validate BFS's findings and to further investigate whether ongoing ESG score adjustments on same firm years retroactively by Refinitiv are due to rewritings driven by stock returns. Our paper is structured as followings: the introduction is Section 1, followed by Section 2 the theoretical & institutional background, data & empirical design are in Section 3; empirical analyses are in Section 4; followed by Section 5 the conclusion & contribution.

Section 2: Theoretical & Institutional Background

2.1 ESG ratings versus ESG performance

ESG ratings are designed to capture the ESG performance of the rated firms. It is widely documented that rating providers have divergences in scope, measurement, and weight for ESG rating methodologies. The correlation coefficients between any two of the top rating providers are between -0.57 to 0.71 (Berg et al., 2019). Moreover, sustainability reporting from rated firms as the primary source for ESG ratings is self-disclosure and qualitative in nature. More ESG self-disclosure from the rated firms leads to greater ESG rating divergence (Christensen et al., 2022). Nevertheless, ESG ratings are important yardsticks for firm's ESG performance. Three theories are ongoing among academics and practitioners. First, ESG ratings are arbitrary; without the standard and necessary checks & balances, they are driven by firm level characteristics such as past stock returns (Berg et al., 2019), therefore ESG ratings are dominated by noise (Berg et al., 2022). Second, ESG ratings drive stock performance as they provide material information (Gibson Brandon et al., 2021). Firms with high ESG ratings tend to enjoy lower cost of capital compared with firms with low ESG ratings. Lastly, ESG ratings are driven by firms' ESG practices, which in turn drive stock returns (Kotsantonis et al., 2016). Good ESG practices attract consumers' preference which in turn generate higher revenue and better firm performance, ceteris paribus.

2.2 ESG ratings versus asset pricing

ESG ratings as an asset pricing (asset return) predictor are inconclusive, partially due to the arbitrary nature of ESG ratings, as there is a lack of an internationally recognized ESG disclosure and reporting standard. The phenomenon of stock market outperformance by ESG leaders according to ESG ratings over the past decade was largely driven by the massive shift in investors' preference for green stocks over brown stocks (Pástor et al., 2021). Among value-

weighted portfolios formed between 2012 to 2020 on NYSE, AMEX and Nasdaq listed companies, the top tercile of greenness portfolios outperformed the bottom tercile of brownness portfolios cumulatively by 174%, or a monthly Sharpe ratio of 0.33, larger than the Sharpe ratio of the stock market during the same period (Pástor et al., 2022). However, using data between 2002 to 2019 on NYSE, AMEX, and Nasdaq-listed companies and the ESG ratings of six influential raters, brown stocks outperformed green stocks by 7.08% per year on raw returns or 4.8% per year on CAPM-adjusted returns (Avramov et al., 2022). Therefore, we conjecture that investors' preference for green assets was the primary driver behind the corroborated green stock outperformance. Finally, ESG investing can be conceptualized by the ESG efficient frontier. On one hand, the benefit of ESG information can be quantified as the resulting increase in the maximum Sharpe ratio; on the other hand, the cost of ESG preference can be quantified as the drop in Sharpe ratio, when choosing portfolios with better ESG attributes. The outcome is often a trade-off (Pedersen et al., 2021).

2.3 ESG rater's business model – user-paid or issuer-paid

The academic debate over which business model, user-paid or issuer-paid is superior to deter agency problem is ongoing. While the ESG rating providers adopt the user-paid business model, agency problem borne out of pecuniary desire is behind the retroactive rewritings of historical ESG scores, according to BFS. Taking refuge from the credit rating industry, Cornaggia (Bruno et al., 2016) has done extensive empirical research on investor (user) - paid model versus issuer-paid model over credit rating stability and timeliness of rating changes. Their results affirmed the superiority of the user-paid credit rating model. The user-paid model received further verdict in "Reliable sustainability ratings: the influence of business models on information intermediaries"(Eccles et al., 2012) . The information intermediaries with the most transparent business models, especially those users pay directly, tend to generate the most reliable & valuable information. The current ESG rating practice is precisely investor (user) - paid model.

We do not argue that investor-paid model is immune from agency problem; given any prolonged anomalies of asset pricing will be caught up by market players, the retroactive rewritings according to historical stock performance will not get the ESG rating agency very far down the road, before losing its magic to "attract" subscribers, i.e. institutional investors. This was precisely the case in 2022, it was the first year since 2011 that ESG funds had experienced an outflow of assets under management when their returns pared that of non-ESG funds (Wilkes & Murugaboopathy, 2022).

2.4 Institutional background - ESG rater idiosyncrasy

Like every ESG rating provider, Refinitiv's ESG rating methodology has its idiosyncrasy. According to the methodology published online by Refinitiv (*Refinitiv-Esg-Scores-Methodology.Pdf*, n.d.), the ESG score of a firm is calculated based on the formula below:

$$Score = \frac{\left[Number\ of\ companies\ with\ a\ worse\ value + \frac{Number\ of\ companies\ with\ the\ same\ value\ included\ in\ the\ current\ one}{2}\right]}{Number\ of\ Companies\ with\ a\ value}$$

When a new firm is added to or subtracted from Refinitiv ratings regardless of which year, ESG scores of its rated peers will automatically be adjusted retroactively based on the above formula.

Figure 1: Refinitiv ESG Coverage Timeline (*Refinitiv ESG Methodology.*)
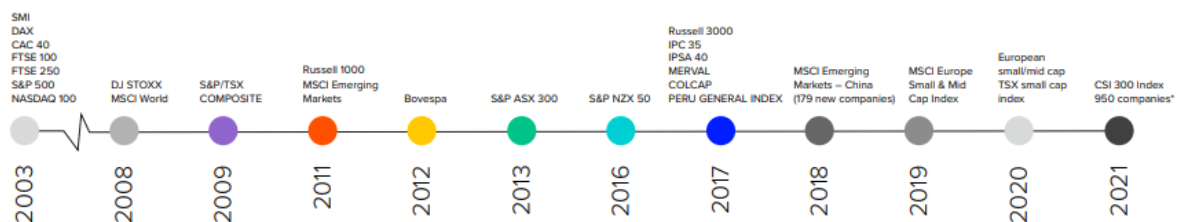
Furthermore, Figure 1 reports the roadmap of the ESG coverage timeline by Refinitiv. As the coverage increased from 3244 firms in 2011 to 5962 firms in 2017, further increased to 9499 firms, 9897 firms & 11350 firms on 7 October 2021, 10 February 2022 & 14 December 2022

downloads respectively, scores of the same firm-year would inevitably experience changes as more firms had been added to the coverage.

Today, Refinitiv covers 13000+ companies, i.e., over 88% of the global market capitalization, with time series data going back to 2002. The universe of Refinitiv coverage tracks 23 benchmark indices and all the constituents in these indices are covered. Refinitiv does index rebalancing every quarter and any constituents that are newly added to or subtracted from these 23 indices will also form part of retroactive ESG score adjustments[1] . Indeed, firms under coverage by Refinitiv ESG are not static which is reflected by the weekly adjustments of the historical ESG scores of the same firm-year.

We identified eight attributes of Refinitiv's ongoing historical ESG score adjustments, after correspondence with Refinitiv's product and customer service teams and conducting our own empirical investigations.

Figure 2 below depicts the eight attributes. Six of the eight attributes point to recalibrations: controversial ESG events, ESG scores formula, the timing for adding coverage, index rebalancing, restatement from issuers and industry recategorization due to mergers and acquisitions. The attribute of ongoing data fine-tuning is a question mark and so does the attribute of weekly data refreshing, although both acts could be due to other attributes such as issuers' restatement or controversial ESG events. Nevertheless, our request for Refinitiv to replicate our findings using our datasets ceased by Refinitiv, after two months of extensive correspondence, citing that Refinitiv could not verify reasons for score changes as the data are overwritten weekly with new values.

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[1] Endnote: Correspondence with the Content and Customer teams at Refinitiv

Figure 2: Attributes for Refinitiv ongoing retroactive ESG score adjustments
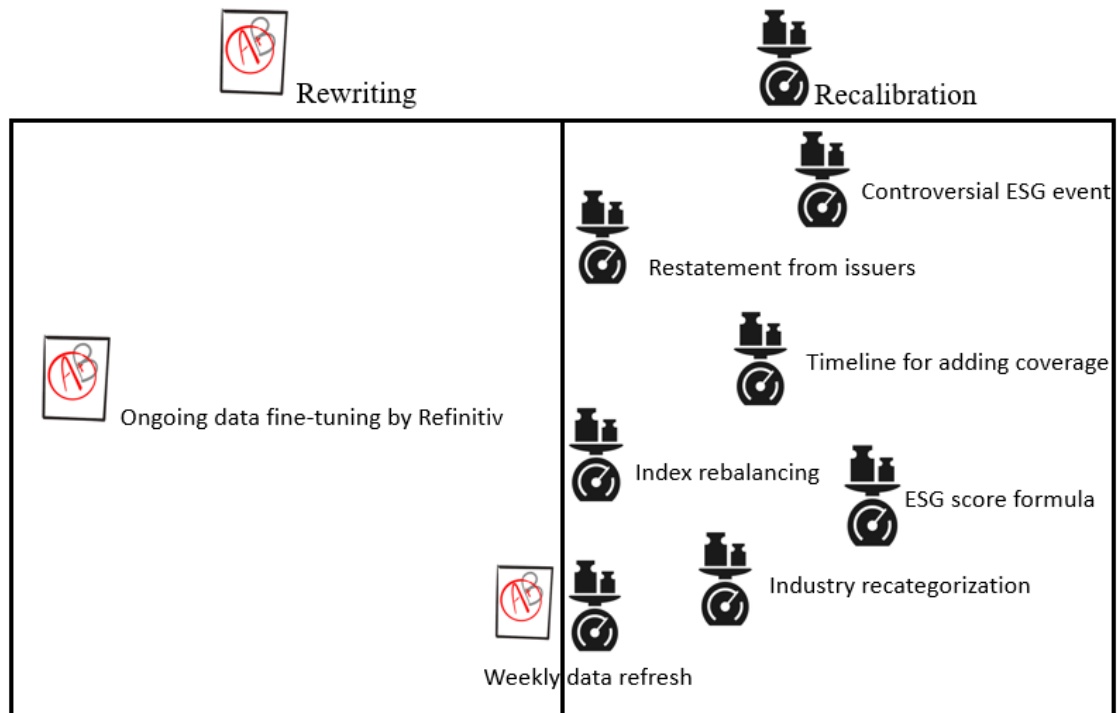
It is unlikely that Refinitiv's ESG score rewritings are commercially driven and motivated by conflicts of interest. We believe that ongoing ESG score adjustments are plausibly driven by the above depicted dynamic attributes. Therefore, we conjecture that recalibration is a more plausible explanation.

Section 3: Data & Empirical Design

3.1 Data

Our datasets contain 20 weeks of downloads from Refinitiv ASSET4 Eikon Datastream, collected between 7 October 2021 and 10 February 2022, 17 November, and 14 December 2022 for firm-year 2002 to 2021. On average, each dataset contains over 70,000 firm-year observations per download or over 1.4 million firm-year observations in total (Figure 3). Separately, we obtained firm-level data such as annual total stock returns, annual sales growth, total asset, EBIT, Capex, PPE, cash, debt to asset, and R&D, as well as country and industry fixed effect data from Refinitiv Datastream. **Appendix Table A1 & Table A2** exhibit the variable definitions and summary statistics respectively.

Figure 3: Numbers of Observations in Refinitiv Universe Downloads
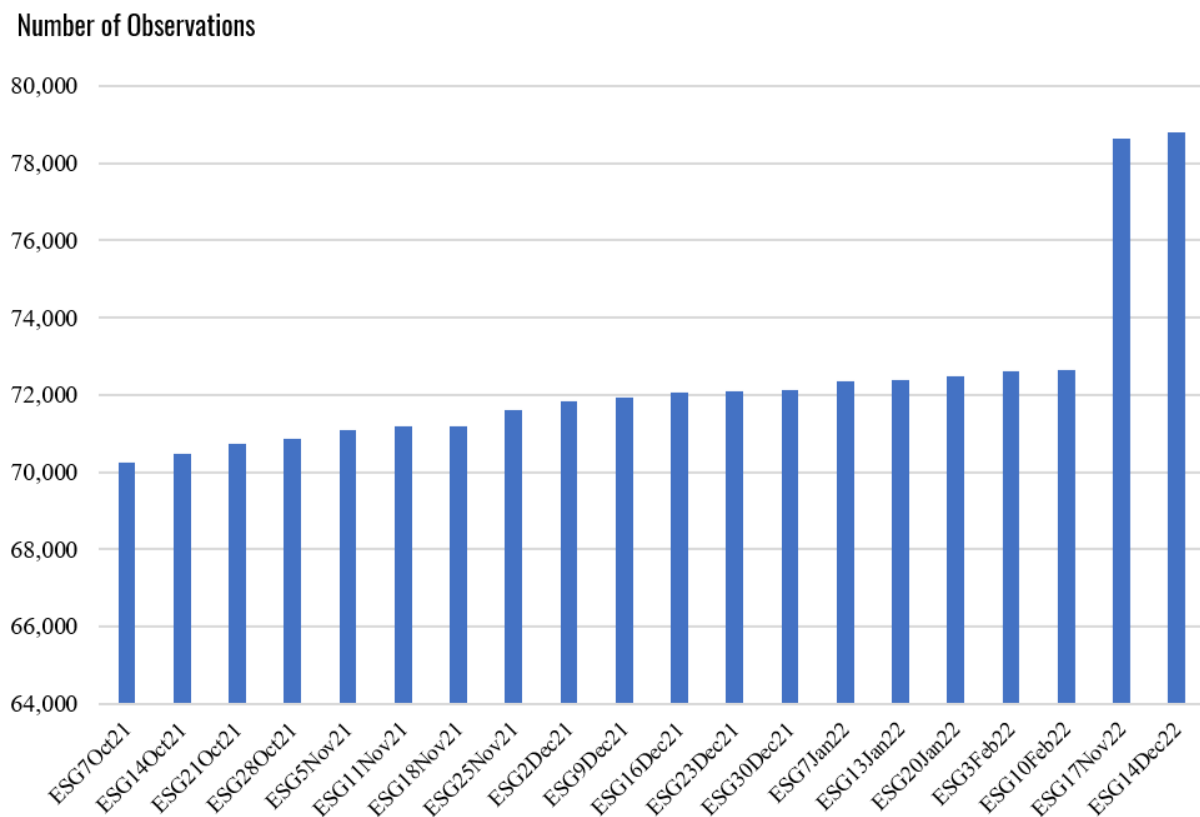
3.2 Key Constructs

We use panel data regressions as our primary tool for analyses with the following key constructs. ΔScore is defined as the relative score difference between two downloads of the same firm year, it could be the difference of ESG score, E&S score, E, S or G scores. It is calculated as:

$$\Delta Score_{i,t} = \left(\frac{S_{i,t}^A}{S_{i,t}^B} - 1\right) x100 \tag{1}$$

where $S_{i,t}^A$ is the ESG score of firm i in year t from download A.

$$AR_{i,t}^D = \left(\frac{P_{i,t}^D}{P_{i,t-1}^D} - 1\right) - \beta_i^{CAPM}\left(\frac{P_{S\&P500,t}^D}{P_{S\&P500,t-1}^D} - 1\right) \tag{2}$$

$$AR_{i,t}^W = \left(\frac{P_{i,t}^W}{P_{i,t-1}^W} - 1\right) - \beta_i^{CAPM}\left(\frac{P_{S\&P500,t}^W}{P_{S\&P500,t-1}^W} - 1\right) \tag{3}$$

AR denotes the abnormal stock return in percentage. We use *D, W* to indicate the daily and weekly frequency. P is the closing price of an individual stock (or market index, S&P 500). *t* is either daily or weekly. β_i^{CAPM} is the estimated CAPM beta of firm *i*.

Daily or weekly market returns are derived from S&P 500 index; daily and weekly stock prices are from Refinitiv US universal coverage (LA4CTYUS). Following the approach in BFS & (Albuquerque et al., 2020), we used return data from 1st July 2019 to 30th June 2021, or 505 trading days to derive CAPM beta for each stock under Refinitiv US coverage. CAPM beta was then used to estimate expected daily or weekly stock returns, which were subtracted from the actual daily or weekly stock returns to derive the abnormal stock returns in (2) and (3).

3.3 Empirical Model

We use formulas (5) & (6) to corroborate key findings in BFS.

$$\Delta Score_{it} = \alpha + \beta Annual\ Stock\ Return_{it} + \gamma'X_{it} + \delta_c + \delta_j + \delta_t + \varepsilon_{it} \qquad (4)$$

$$Future\ Stock\ Return_{it} = \beta Score_{i,t-1} + \gamma'X_{i,t-1} + \delta_c + \delta_j + \delta_t + \epsilon_{it} \qquad (5)$$

Annual Stock Return is a firm *i*'s calendar year stock return in year *t* , times 100;

Future Stock Return is a firm *i*'s stock return from July in year *t* to June in year *t+1* ,*times 100.*

t is between 2011 to 2017, or otherwise specified. The vector of control variables X_{it} includes ln(Total Asset), Sales Growth, Capex/Assets, Cash/Assets, Debt/Assets, EBIT/Assets, PP&E/Assets, and R&D/Assets, δc, δj, and δt represent the country, industry, and year-fixed effects respectively. All variables are winsorized at 1% and 99% levels and missing R&D data were treated as zero, according to BFS' paper, so do formula (4) and formula (5).

Furthermore, we designed a Difference-in-Differences study by using the formation of the International Sustainability Standard Board ("ISSB") on 3rd November 2021 as the exogenous shock to test the plausible causal effect on firm-level stock performance driven by ESG score retroactive adjustments (BFS).

On the 3rd of November 2021, the IFRS Foundation announced the formation of ISSB to develop an international baseline sustainability standard for financial disclosure. We believe ISSB formation is a good exogenous shock, as it sent a strong signal that a global baseline of sustainability standard would be developed and implemented for greater transparency & standardization of ESG reporting and measurement. This will deter any retroactive ESG score adjustments or manipulation that are driven other than the ESG performance of the rated firms.

We classified firms into quartiles according to their ESG scores in firm-year 2017-2020, for downloads on 7 October 2021 and 10 February 2022, or 3591 companies under Refinitiv US coverage. Top ESG quartile (Treatment group) equals to one for firms ranked in the top 25% in either download, otherwise zero. Given the two downloads are of the same nature, we can conjecture a parallel effect for the treatment and control groups before & after the exogenous shock (Figure 4); we do not believe the formation of ISSB would have any direct effect on firms' stock returns either, neither would the effect between the treatment group and the control group be unstable cross-sectional in our panel data.

Our period of Difference-in-Differences study started on 4th October and ended on 3rd December 2021, one month before and one month after the exogenous shock, which was on 3rd November 2021, 44 trading days or 9 weeks in total.

If the after treatment effect (ATE) or β_1 is less pronounced on post-shock download, it postulates that the retroactive ESG score adjustments are commercially driven rewritings; as its effect on stock returns become subdued in anticipation of ESG reporting and measurement standardization; otherwise, if the ATE or β_1 is more pronounced on post-shock download, it conjectures that the retroactive ESG score adjustments are not commercially driven rewritings; it is therefore plausible to be recalibrations.

Figure 4: Difference-in-differences Study

ATE: after treatment effect

Control Group (Rest ESG Quartiles)
Downloaded on 7 October 2021
& 10 February 2022

Treatment Group (Top ESG Quartile)
Downloaded on 7 October 2021
& 10 February 2022
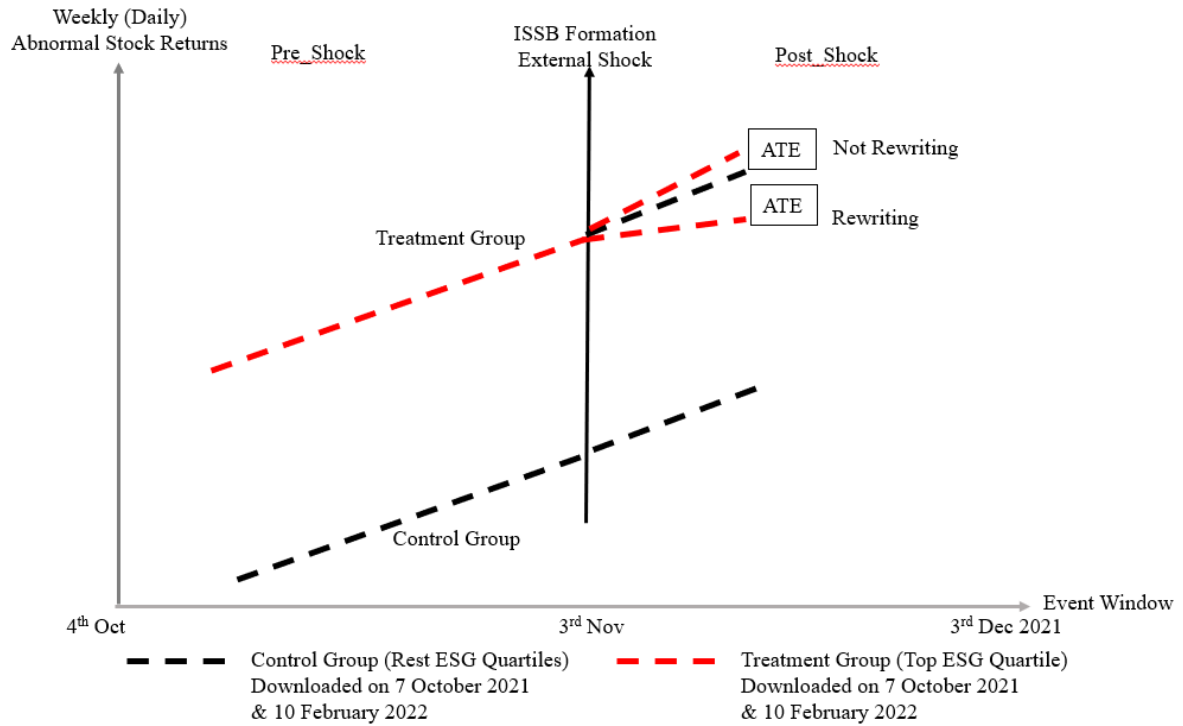
$AR_{i,t} = \alpha + \boldsymbol{\beta_1}$ *Top ESG Quartile $_i$ × Post_ISSB $_t$ + β_2 Top ESG Quartile $_i$ + β_3 Post_ISSB $_t$* +

$\delta_i + \delta_t + \epsilon_{it}$ (6)

Stock Returns $_{it}$ = $\alpha + \boldsymbol{\beta_1}$, Top ESG Quartile $_i$ × Post_ISSB $_t$ + β_2, Top ESG Quartile $_i$ + β_3,

Post_ISSB $_t$ + $\delta_i + \delta_t + \epsilon_{it}$ (7)

$AR_{i,t} = \alpha + \boldsymbol{\beta_1}$ *Bottom ESG Quartile $_i$ × Post_ISSB $_t$ + β_2 Bottom ESG Quartile $_i$ + β_3*

Post_ISSB $_t$ + $\delta_i + \delta_t + \epsilon_{it}$ (8)

i denotes firm, t denotes time; the Top ESG quartile equals to one if a firm's ESG score ranks in the top 25%, otherwise it is zero. Post_ISSB equals to one, if time t was between 4th November 2021 to 3rd December 2021; otherwise, it is zero. δ_i and δ_t are firm and time fixed effect respectively. We further expanded the experiments in the robustness tests including a)

daily or weekly stock returns as the dependent variable (formula 7), b) bottom quartile ESG firms as the treatment group (formula 8).

Section 4: Empirical Analyses

There are three parts in our empirical analyses: first, we conducted validations on BFS's findings in 4.1; then we moved on to test our explanations in 4.2, finally we concluded the empirical analyses by robustness tests in 4.3. We present the map to navigate in the empirical analyses in Figure 5.

Figure 5: Map of Empirical Analyses
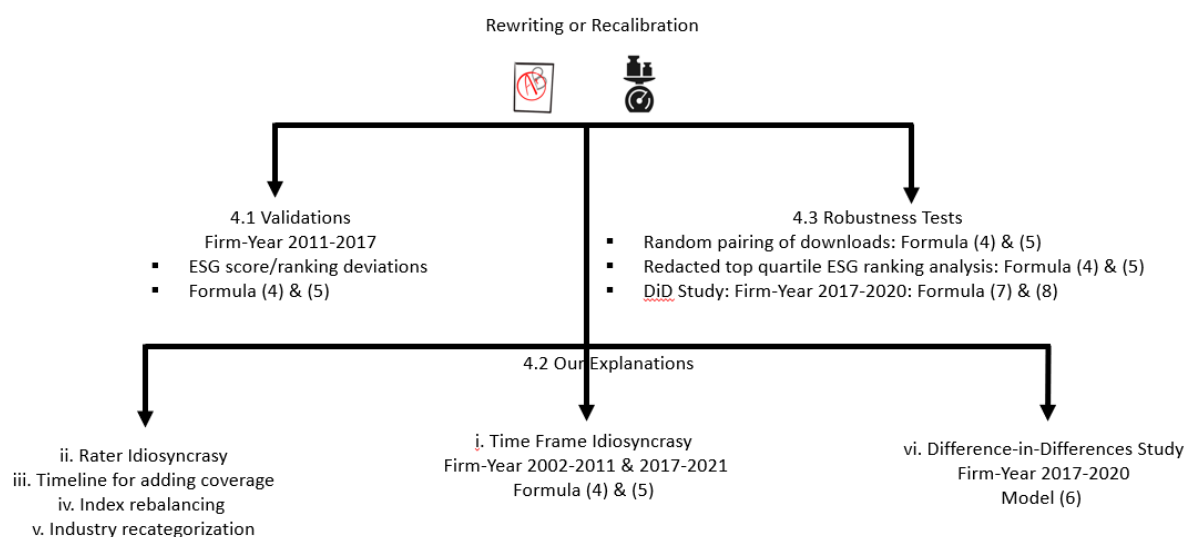
4.1 Validations of (Berg et al., 2020a) Findings

We first conducted the duplication tests on key findings in "Is History Repeating Itself: The (Un)predictable Past of ESG Ratings" (Berg et al., 2020a) in 5 parts.

Validation 1: Ongoing changes in the numbers of firms under the same firm-year

We validated the changes in the number of firms under the same firm-year in Refinitiv universal ESG coverage between firm-year 2002 to 2021. **Appendix Table A3** reports the results. Figure 6 reports the data in graphics. Our results show similar patterns to those of BFS, i.e, numbers of firms under coverage in the same firm year experienced constant changes since the inception in 2002. For instance, there are 5381 firms in firm-year 2016 from the download on 7 October 2021 and the number decreases to 3570 firms in firm-year 2016 from the

download on 5 November 2021; and recovers to 5353 firms in firm-year 2016 from the download on 9 December 2021.

Figure 6: Number of Firms under Refinitiv ESG Coverage: Firm-Year 2011-2017
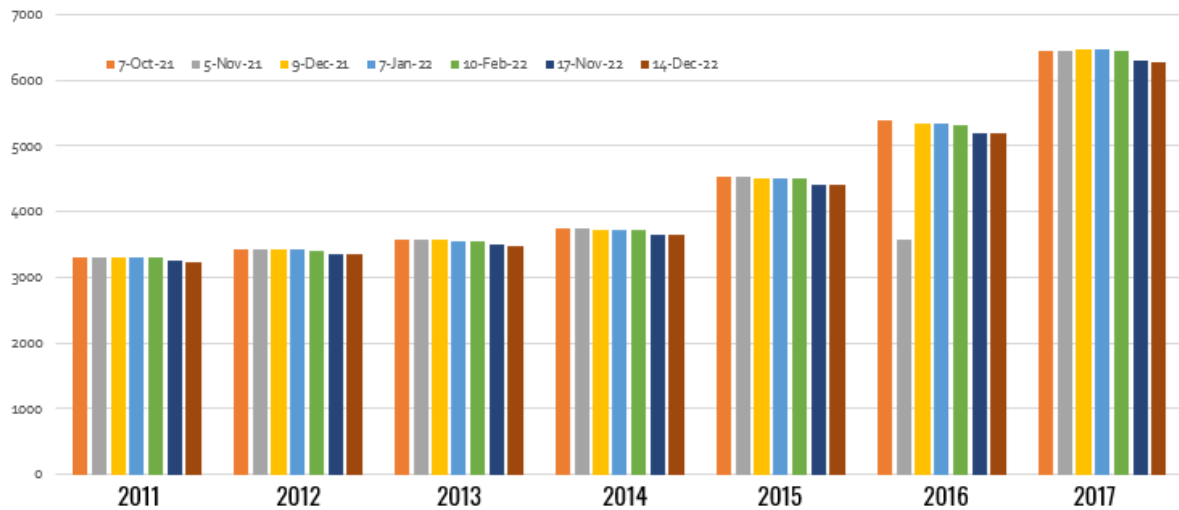
Validation 2: Ongoing deviations of historical ESG scores

We then proceed to validate the ongoing deviations of historical ESG scores. Overall, 29.4% of ESG scores of the same firm-year experienced changes between 10 February 2022 and 7 October 2021 downloads for firm-year 2011 to 2017 in Panel A of **Appendix Table A4**, which is higher than the 6% ESG score deviations reported in BFS' paper between February 2021 and March 2021 downloads. Our test is based on the exact ESG score overlapping for the same firm-year between two downloads, whereas BFS' deviations of ESG scores are based on the mean ESG scores. When we compare two downloads closer apart, Panel B in **Appendix Table A4** presents the results of ESG score deviations between 14 Dec 2022 and 17 Nov 2022 downloads, the deviations reduced to 9.52%.

Validation 3: ESG quantile ranking changes of the same firm from different downloads

Only 70% of ESG quartile rankings of the same firm overlapped in two different downloads in September 2018 and September 2020, according to BFS' findings. We confirmed BFS' findings, ESG quartile rankings of the same firm overlapped between 98% to 70% for firm-year 2002 to 2021 between 10 February 2022 and 7 Oct 2021 downloads (Figure 7).

Figure 7: ESG Quartile Ranking Changes of the Same Firm Between Downloads

The table reports ESG quartile ranking changes of the same firm between firm-year 2002 to 2021. X-axis is the firm-year and Y-axis is the number of rated firms experienced ESG quartile ranking changes between 7 October 2021 and 10 February 2022 downloads.
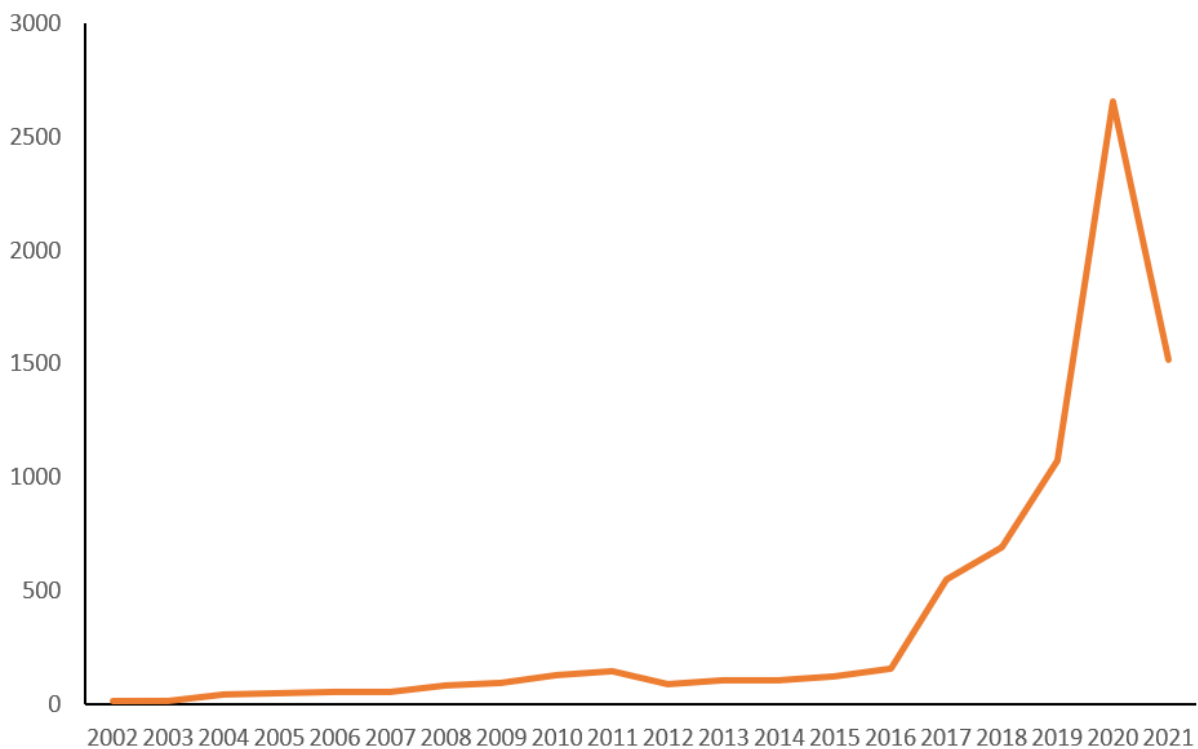
Validation 4: Correlations of ESG score or E&S score deviations and firm historical stock performance

ESG score rewritings driven by firms' stock returns is the key finding in BFS' paper. Nevertheless, BFS' paper does not provide any empirical tests on ongoing downloads, except for the one-off comparison between September 2020 (after the major overhaul of Refinitiv ESG methodology) download and September 2018 (before the major overhaul of Refinitiv ESG methodology) download for firm-year 2011-2017.

Refinitiv had a major methodology overhaul in March 2020, regarding the treatment of missing data & dynamic weightage allocations on E and S pillar metrics. (*Refinitiv-Esg-Scores-Methodology.*)

We conducted validations on these findings by using the deviations of ESG scores from 7 October 2021 and 10 February 2022 downloads, as well as deviations of E&S, E, S and G scores from downloads on 16 November 2022 and 14 December 2022. **Table 1** reports our results, we do not find statistically significant correlations between deviations of ESG, E&S, E, S or G scores and firms' annual stock returns.

Validation 5: Predictive power of ESG scores or E&S scores to future stock returns

We cross-examine whether the ongoing ESG score adjustments have statistically significant predictive power to future stock returns for firm-year 2011 to 2017. Unlike BFS' results, which showed statistically significant predictive power on rewritten ESG scores and E&S scores to future stock returns, but not the initial ESG and E&S scores downloaded in September 2018. Our results showed that regardless of timing for downloads, ESG scores or E&S scores individually have a statistically significant predictive power of 99% confidence level to future stock returns (**Table 2**). Moreover, unlike BFS' results pointed to ascending statistically significant predictive power of top quartile ESG scores in later download in February 2021 (t=1.84) to early download in September 2020 (t=1.73), our results showed no such a pattern.

In conclusion, we validated BFS's documentation on retroactive adjustments of historical ESG scores for the same firm-year between 2011 to 2017, we recorded ESG score deviations between 9.52% to 29.40% depending on the interval of downloads. We could not validate

statistically significant correlations between deviations of ESG, E&S, E, S or G scores and the firm's past stock performance on the rewritten data; regardless of timing for downloads, our results showed significant predictive power of ESG score and E&S scores to future stock performance between firm-year 2011 to 2017.

Table 1: Correlations between ESG Score Deviations and Annual Stock Returns

This table reports the regression results on deviations of ESG scores between downloads. The ESG score deviations are calculated below:

(1) ΔESG Score $_{it}$ = (ESG score $_{it}$ $^{10/02/22}$ / ESG score $_{it}$ $^{07/10/21}$ − 1)*100

(2) ΔE&S $_{it}$ = (E&Sscore $_{it}$ $^{14/12/22}$ / E&Sscore $_{it}$ $^{16/11/22}$ − 1)*100

(3) ΔE $_{it}$ = (Escore $_{it}$ $^{14/12/22}$ / Escore $_{it}$ $^{16/11/22}$ − 1)*100

(4) ΔS $_{it}$ = (Sscore $_{it}$ $^{14/12/22}$ / Sscore $_{it}$ $^{16/11/22}$ − 1)*100

(5) ΔG $_{it}$ = (Gscore $_{it}$ $^{14/12/22}$ / Gscore $_{it}$ $^{16/11/22}$ − 1)*100

We report results for the ΔESG score, ΔE&S score (average of the E & S subscore), ΔE score, ΔS score and ΔG score. The sample consists of 12,786 to 15,011 firm-year observations **between 2011 and 2017**. Regressions are estimated at the firm-level, with country, industry and year fixed effects. Standard errors are reported in the parentheses. Variable definitions are reported in Appendix Table A1. *** $p<0.01$, ** $p<0.05$, * $p<0.1$, indicate statistical significance at 1%, 5% and 10% levels, respectively.

Regressions Dependent Variables	(1) ΔESG	(2) ΔE&S	(3) ΔE	(4) ΔS	(5) ΔG
Annualstockreturn	-0.00155	0.000121	-1.83e-05	4.34e-06	2.45e-05
	(0.00568)	(0.000206)	(0.000134)	(0.000163)	(8.57e-05)
ln(total assets)	-0.0352	0.0164	0.0279	-0.00110	0.0286**
	(0.843)	(0.0306)	(0.0199)	(0.0242)	(0.0127)
Annualsalesgrowth	0.00368	-7.46e-05	-0.000179	-0.000206	9.60e-05
	(0.00768)	(0.000279)	(0.000220)	(0.000221)	(0.000116)
PPE/Assets	-0.0665	-0.200	-0.0860	-0.174	-0.00140
	(4.651)	(0.168)	(0.110)	(0.133)	(0.0699)
Cash/Assets	-1.080	-0.0553	-0.0569	-0.123	0.140**
	(4.176)	(0.152)	(0.102)	(0.120)	(0.0629)
EBIT/Assets	1.048	-0.0438	-0.128*	-0.0560	-0.179***
	(3.185)	(0.116)	(0.0752)	(0.0921)	(0.0480)
R&D/Assets	-6.484	-0.0365	-0.0207	-0.0960	-0.0634
	(13.55)	(0.492)	(0.447)	(0.390)	(0.204)
Debt/Assets	-0.0211	-0.00202*	-0.00140*	-0.00159*	-8.03e-05
	(0.0331)	(0.00120)	(0.000798)	(0.000952)	(0.000500)
Capex/Assets	-0.0236	0.00225	-0.00171	0.00311	0.00132
	(0.0698)	(0.00254)	(0.00163)	(0.00201)	(0.00105)
Constant	1.802	-0.138	-0.331	0.115	-0.451**
	(13.10)	(0.475)	(0.313)	(0.376)	(0.197)
Observations	15,000	15,007	12,786	15,007	15,011
R-squared	0.145	0.336	0.244	0.148	0.206

Table 2 Predictive Power of ESG/E&S Scores to Future Stock Returns

This table reports the regression results of future stock return on ESG/E&S scores measured using different downloads as indicated below. ESG/E&S scores are in year t, while future stock returns are in year t+1 (July in year t to June in year t+1) to prevent look ahead bias from back testing. Models (1) and (2) are using ESG scores downloaded on 7 Oct 2021 and 10 Feb 2022 as regressors; Models (3) and (4) are using E&S scores downloaded on 16 Nov 2022 and 14 Dec 2022 as regressors; Models (5) and (6) are using top quartile ESG scores downloaded on 7 Oct 21 and 10 Feb 22 as regressors; Models (7) and (8) are using top quartile E&S scores downloaded on 16 Nov 2022 and 14 Dec 2022 as regressors. The sample consists of 4090 to 13740 firm-year observations **between 2011 and 2017**. Regressions are estimated at the firm-level, with country, industry and year fixed effects. Standard errors are reported in the parentheses. Control variables follow that of Table 2. Variable definitions are reported in Appendix Table A1. *** p<0.01, ** p<0.05, * p<0.1, indicate statistical significance at 1%, 5% and 10% levels, respectively.

2011-2017	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Future stock return	Future stock return	Future stock return	Future stock return	Future stock return	Future stock return	Future stock return	Future stock return
L.ESG7Oct21	0.218*** (0.0494)							
L.ESG10Feb22		0.225*** (0.0493)						
L.ESscore16Nov22			0.130*** (0.0226)					
L.ESscore14Dec22				0.130*** (0.0226)				
L.ESG7Oct21_TopQ					0.310** (0.124)			
L.ESG10Feb22_TopQ						0.307** (0.125)		
L.ESscore16Nov22_TopQ							0.196*** (0.0624)	
L.ESscore14Dec22_TopQ								0.194*** (0.0626)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	282.9*** (21.22)	283.5*** (21.19)	287.4*** (21.21)	287.4*** (21.21)	454.4*** (49.10)	461.7*** (49.57)	509.2*** (52.08)	507.6*** (52.15)
Observations	13,727	13,740	13,739	13,738	4,180	4,134	4,102	4,090
R-squared	0.213	0.213	0.214	0.214	0.234	0.235	0.227	0.227

4.2 Our explanations

We then proceed to test our explanations. Our explanations play out in three parts: i) time frame idiosyncrasy for green stock (ESG leaders) outperformance, which could be reflected by the positive link between ESG score or E&S score deviations and firms' stock returns; ii) ESG rater idiosyncrasy in methodology and practice causing retroactive adjustments of ESG scores. To cross examine the plausible causal effect of retroactive ESG score adjustments due to firms' stock returns, we use the formation of ISSB on 3rd November 2021 as the exogenous shock to conduct difference-in-differences study.

i.   The Time frame idiosyncrasy

It is well documented that investors' preference for green assets started a decade ago, ESG investing was not a mainstream practice before 2011 (Pástor et al., 2021). To prove our explanation of time frame idiosyncrasy, we replicated the same tests using formulas (4) and (5) on firm-year 2002-2011 and firm-year 2017-2021, using the same downloads on 7 October 2021 and 10 February 2022 for ESG scores, and downloads on 16 November and 14 December 2022 for E&S scores.

Table 3 reports the results. Once again, we do not find statistically significant correlations between deviations of ESG or E&S scores on firms' annual stock returns between 2017-2021. When we turned to firm-year between 2002 to 2011, we could not establish correlations between ESG score deviations and firms' annual stock returns.

BFS did not run the same regression using formula (4) on the ongoing downloads on 02/2021 and 03/2021. Neither BFS nor we could replicate the significant relations on ongoing downloads for firm-year 2011 to 2017.

Next, we went on to cross examine the predictive power of ESG scores to future stock returns by switching to the time frame between 2002 to 2011, while using the same downloads on 7 October 2021 and 10 February 2022. The statistically significant predictive power of ESG or E&S scores to future stock returns disappeared (**Table 4**).

We could not validate the findings in BFS' paper in different time periods. It is highly possible that our datasets and BFS' datasets were downloaded at different points in time; however, it is still meaningful to compare the empirical findings in **Table 5**, as our datasets were downloaded randomly closer to the date, and our empirical test periods expanded beyond that of BFS.

Table 3 Correlations between ESG Score/E&S Score Deviations and Annual Stock Return

We report results for the ΔESG scores, ΔE&S scores (average of the E & S subscores) on firm's annual stock return. The sample consists of 10,365 to 19,677 firm-year observations **between 2002 to 2011, and 2017 to 2021.** The samples are downloads on 7 Oct 21 and 10 Feb 22 for ΔESG and downloads on 17 Nov 22 and 14 Dec 22 for ΔE&S. Regressions are estimated at the firm-level, with country, industry and year fixed effects. Standard errors are reported in the parentheses. Control variables are the same as in Table 2. Variable definitions are reported in Table A1. *** $p<0.01$, ** $p<0.05$, * $p<0.1$, indicate statistical significance at 1%, 5% and 10% levels, respectively.

Dependent Variables	(1) ΔESG	(2) ΔESG	(3) ΔE&S
Time Frame	**2017-2021**	**2002-2011**	**2017-2021**
Annualstockreturn	-0.000915	-0.00336	0.00771
	(0.00115)	(0.00657)	(0.00800)
Control Variables	Yes	Yes	Yes
Constant	-1.704	-21.90	-9.333
	(3.601)	(16.53)	(23.31)
Observations	14,693	10,365	19,677
R-squared	0.511	0.211	0.201

Table 4 Predictive power of ESG/E&S Scores to Future Stock Return

This table reports the regression results of future stock return on ESG/E&S scores from different downloads. ESG/E&S scores are in year t, while future stock returns are in year t+1 (July in year t to June in year t+1) to prevent look ahead bias from back testing. Models (1) and (2) are using ESG scores downloaded on 7 Oct 2021 and 10 Feb 2022 as regressors; Models (3) and (4) are using E&S scores downloaded on 16 Nov 2022 and 14 Dec 2022 as regressors. The sample consists of 8490 to 8503 firm-year observations **between 2002 and 2011**. Regressions are estimated at the firm-level, with country, industry and year fixed effects. Standard errors are reported in the parentheses. Control variables are the same as in Table 2. Variable definitions are reported in Table A1. *** p<0.01, ** p<0.05, * p<0.1, indicate statistical significance at 1%, 5% and 10% levels, respectively.

2002-2011	(1)	(2)	(3)	(4)
Dependent Variable	Future stock return	Future stock return	Future stock return	Future stock return
L.ESG7Oct21	-0.0411			
	(0.0512)			
L.ESG10Feb22		-0.0411		
		(0.0512)		
L.ESscore16Nov22			-0.0263	
			(0.0217)	
L.ESscore14Dec22				-0.0263
				(0.0217)
Control Variables	Yes	Yes	Yes	Yes
Constant	583.9***	583.4***	578.6***	578.6***
	(29.02)	(28.99)	(29.37)	(29.37)
Observations	8,490	8,503	8,503	8,503
R-squared	0.242	0.242	0.242	0.242

Table 5: Our Validations & Extension on BFS's Findings:

Firm Year	2011-2017	2002-2011	2017-2021
	Correlations of ΔESG or ΔE&S on Annual Stock Returns: Formula (4)		
Downloads	BFS Findings		
09/2020 vs 09/2018	Yes	NA	NA
	Our Validation & Extension		
02/2022 vs 10/2021	**No**	**No**	**No**
	Predictive Power of ESG or E&S Scores to Future Stock Returns: Formula (5)		
	BFS Findings		
09/2018	No	NA	NA
09/2020	Yes	NA	NA
02/2021	Yes	NA	NA
03/2021	Yes	NA	NA
	Our Validation & Extension		
10/2021	**Yes**	**Disappeared**	**Reduced**
02/2022	**Yes**	**Disappeared**	**Reduced**

We therefore postulate that the reported retroactive ESG score rewritings due to past stock returns have time frame idiosyncrasy, i.e. period dependency. The one-off statistically significant relationship reported by BFS using September 2018 as the initial download could not be replicated in other time periods. As the period moves backward to 2002-2011 or forward to 2017-2021, the predictive power of ESG or ESG scores on firms' future stock returns disappeared or attenuated.

ii.   Idiosyncrasy of Refinitiv methodology

Every ESG rater has its proprietary methodology, and so does Refinitiv. The crux of Refinitiv ESG rating methodology lies in its formula of the relative ESG performance score:

a. ESG score formula:

$$Score = \frac{\left[Number\ of\ companies\ with\ a\ worse\ value + \frac{Number\ of\ companies\ with\ the\ same\ value\ included\ in\ the\ current\ one}{2}\right]}{Number\ of\ companies\ with\ a\ value}$$

Although the score formula fences out the outliers; it makes a firm's ESG score very sensitive to the denominator of the total number of peer companies with a value, i.e., being rated by Refinitiv. The timeline for adding coverage and ongoing index re-balancing will have a major impact on the number of companies with a value; industry recategorization and index rebalancing would also affect the numerator and the denominator in the ESG score formula.

iii.   Timeline for adding coverage by Refinitiv

Refinitiv has been gradually expanding ESG coverage according to the timeline below.

Figure 8: Timeline of newly rated firms added by Refinitiv.

(*Refinitiv-Esg-Scores-Methodology*):

2003	2008	2009	2011	2012	2013	2016	2017	2018	2019	2020	2021
SMI:20	STOXX 50	S&P/TSX 250	Russell 1000	Bovespa 92	S&P/ASX 300	S&P NZ 50	Russell 3000	MSCI CN 179	MSCI EU 1259	European Small/mid 239	CSI 300 950
DAX:40	MSCI World 1511		MCI E.M 1386				IPC 35			TSX small cap 227	
FTSE 100 FTSE 250 S&P 500 Nasdaq 100							IPSA 40 Merval 10 Colca 45 Peru 36				
950	1561	250	**2386**	92	300	50	**3166**	179	1259	466	**1250**
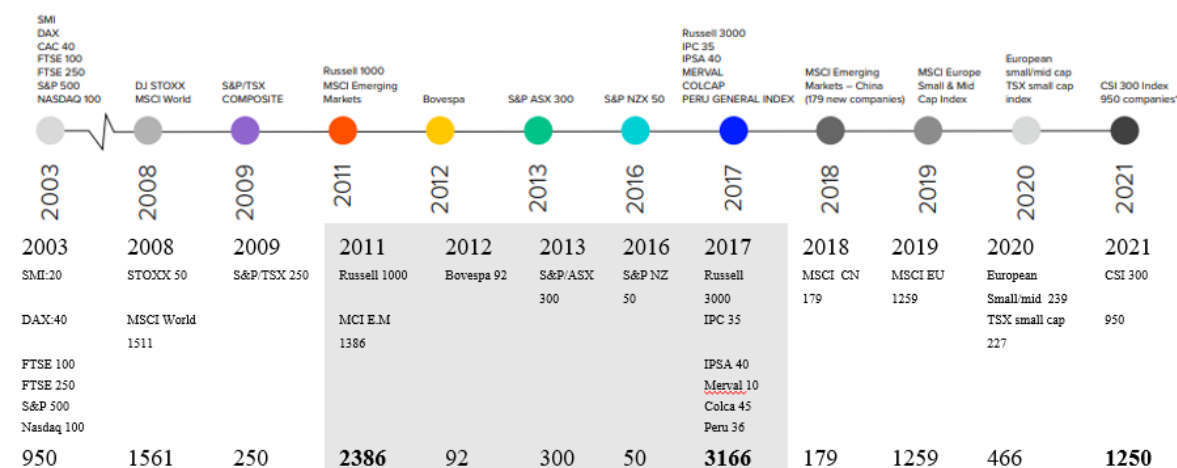
Based on the above timeline, Refinitiv added 2386 and 3166 newly rated firms to its coverage in 2011 and 2017 respectively, it had ongoing addition of new coverage since 2016, with the latest reported addition of 1250 firms in 2021.

Frequencies of retroactive ESG score adjustments are correlated with the addition of newly rated firms. **Appendix Table A5**. reports this phenomenon. For instance, the relatively high percentage of retroactive adjustments of ESG scores for the same firm year in 2011, 2017 and thereafter coincided with the rapid expansion of Refinitiv's ESG coverage: 2386 firms were added to the coverage in 2011; 3166 firms were added in 2017, followed by 179 firms in 2018, 1259 firms in 2019, 466 firms in 2020, and 1250 firms in 2021.

The most recent coverage expansion was in 2021 with 1250 firms added. According to our correspondence with Refinitiv representatives[2], the ESG data collection process for new firms began in Q4 2021 and ended in Q2 2022. It takes on average 4-6 weeks to process ESG information and publishes ESG data once all ESG documents are publicly disclosed by a rated

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[2] Endnote: correspondence with Refinitiv representatives

firm. The updating process is completed for most of the companies within 8 weeks. It explains the pattern of sudden jump of numbers for ESG coverage in Q4 2022 to reflect these new firms been added in 2021 (Appendix Table A5)

As new firms are added to the coverage, historical ESG scores of their peers will inevitably be adjusted according to the formula of Refinitiv ESG score. It supports our explanation that ongoing ESG score adjustments are driven by the dynamic changes in the number of firms under coverage i.e. recalibration, as part of the idiosyncrasy of Refinitiv ESG methodology.

iv.   Index rebalancing attribute

Refinitiv tracks 23 benchmark indices, and all constituents under these indices are covered by Refinitiv. Refinitiv does index balancing every quarter and any constituents that are newly added to or subtracted from these 23 indices will be reflected in the subsequent ESG Coverage.

Below are the re-balancing schedules for major indices every year:

Russell indices: fourth Friday of June

S&P indices: first Friday of March, June, September, and December

MSCI indices: May and November

May and June, followed by November and December every year are the peak periods for index rebalancing. Given the time frame of 6-8 weeks on average for Refinitiv to update its ESG coverage due to index rebalancing, the surge in ESG score adjustments would start in late July to August (for May, and June index rebalancing) and in late January to February (for November, December index rebalancing) each year, which coincides with the recorded surge of ESG score adjustments in the February and March 2021 downloads in BFS' paper, as well as our downloads in end January to February 2022.(Appendix Table A5).

v.   Industry recategorization

Industry recategorization happens when a rated firm experiences mergers and acquisitions. It could also stem from the rater's idiosyncrasy. As a result of Refinitiv's acquisition by the London Stock Exchange Group in February 2021, Refinitiv Business Classification (TRBC) of certain industries such as Telecommunications had to be recategorized, which triggered ESG score adjustments. This explained the retroactive ESG score adjustments beyond the recent 5 years, i.e., beyond 2017 (Appendix Table A5). It is highlighted in the latest methodology of Refinitiv published in May 2022, ESG scores of more than 5 years would be definite without further adjustments.

We, therefore, conclude that attributes of Refinitiv's idiosyncratic ESG score formula, the timeline for adding coverage, index rebalancing and industry recategorization are the main reasons for the ongoing historical ESG score adjustments, in addition to ESG controversial event and restatement from rated firms. It supports our explanation that ongoing ESG score adjustments are driven by ESG rater's idiosyncratic methodology and practice for recalibration.

vi.   Difference-in-differences study: Daily Analysis

To cross examine the plausible causal relationship between retroactive ESG score adjustments and past stock performance of the rated firms, we conducted a Difference-in-Differences study using ISSB formation as the exogenous shock. Upon formation, ISSB called for standardization of ESG measurement via an international baseline sustainability disclosure standard. (*IFRS - IFRS Foundation Announces International Sustainability Standards Board, Consolidation with CDSB and VRF, and Publication of Prototype Disclosure Requirements*, n.d.)

If the retroactive ESG score adjustments are driven by immediate past stock performance to pander to institutional users, the formation of ISSB would send a strong signal and deter such behaviour from reputation backlash. Thus the average treatment effect ("ATE") on abnormal stock returns for post_ISSB (post-shock) would have been weaker or less pronounced. On the other hand, if the retroactive ESG score adjustments are due to recalibration, the ATE on abnormal stock returns would have not been much different before or after the ISSB formation.

Using one month before and one month after the formation of ISSB on 3rd November 2021 as the window, we examined the interactive effect of top quartile ESG ranking stocks (treatment group) x Post_ISSB (exogenous shock) on abnormal stock returns of 3591 Refinitiv USA universal coverage during these 44 trading days. We conducted the DiD study on the 7 October 2021 download, prior to the ISSB formation as the pre-shock and the on 10 February 2022 download, post the ISSB formation as the post shock for firm year 2017-2020. **Table 6** and **Table 7** report results on daily and weekly abnormal stock returns respectively.

With time and firm fixed effects, ATE has significant effects on daily abnormal stock returns for both downloads (t-value ranges between 7.79 to 11.61) in Table 6. ATE (β_1 coefficient) is slightly stronger in the post-shock download compared to the pre-shock download between firm years 2017-2019. For instance, for firm-year 2019, post-shock download ATE contributed 7.12 bps (33.9 bps x 21 days in %) to the daily abnormal stock returns between 4th November to 3rd December 2021, compared to the pre-shock download of 6.64 bps (31.6 bps x 21 days in %).

Table 6: Difference-in-Differences Study – Daily Abnormal Stock Return Analysis

This table reports the results of DiD study using the ISSB formation on 3rd November 2021 as the external shock event, regressing daily abnormal stock returns from 4th October to 3rd December 2021 on the interactive variable of top quartile ESG firms x post_ISSB. Top quartile ESG firms are the treatment group which equals to 1 if the firm belongs to the top quartile ranking; otherwise 0. Post_ISSB dummy equals to 1 if the time period is between 4th November to 3rd December 2021, otherwise 0. Regressions are performed on ESG data from the pre-shock download on 7 Oct 2021 and the post-shock download on 10 Feb 2022. The sample consists of 108,446 to 135,278 firm-year observations for firm-year between 2017 and 2020. Regressions are estimated at the firm-level, with control variables, firm and time-fixed effects. Standard errors are reported in the parentheses. Variable definitions are reported in Appendix Table A1. *** p<0.01, ** p<0.05, * p<0.1, indicate statistical significance at 1%, 5% and 10% levels, respectively.

ATE: Average Treatment Effect on Treated

Downloads	7-Oct-21		10-Feb-22		7-Oct-21		10-Feb-22	
	2020	2020	2020	2020	2019	2019	2019	2019
Dependent Variable				Daily Abnormal Stock Returns				
	ATE	Controls	ATE	Controls	ATE	Controls	ATE	Controls
Top ESG quartile x **post_ISSB, bps**	**38.3***		**37.4***		**31.6***		**33.9***	
	(3.75)		(3.22)		(3.14)		(3.17)	
post_ISSB, bps		-39.3***		-37.3***		-33.4***		-35.6***
		(2.18)		(2.06)		(2.25)		(2.33)
Observations	121,303	121,303	135,278	135,278	127,882	127,882	130,935	130,935
	2018	2018	2018	2018	2017	2017	2017	2017
VARIABLES	ATE	Controls	ATE	Controls	ATE	Controls	ATE	Controls
Top ESG quartile x **post_ISSB, bps**	**28.6***		**29.0***		**25.4***		**27.7***	
	(3.21)		(3.45)		(3.26)		(3.27)	
post_ISSB, bps		-28.8***		-29.7***		-24.6***		-26.9***
		(2.27)		(2.60)		(2.43)		(2.48)
Observations	115,584	115,584	118,551	118,551	108,446	108,446	111,155	111,155

We repeated the same DiD study using weekly abnormal stock returns as the dependent variable using formula (6). The results in Table 7 show the same pattern as that of Table 6. With time and firm fixed effects, ATE has significant effects on weekly abnormal stock returns between the firm year 2017 to 2020 for both downloads (t-value ranges between 3.79 to 6.01). ATE (β_1 coefficient) is slightly stronger in the post-shock download compared to the pre-shock download the for firm year 2017 to 2019. For firm year 2019, ATE contributed 3.08 bps (77.0 bps x 4 weeks in %) to weekly abnormal stock returns between 4th November to 3rd December 2021 in the post-shock download, compared to the pre-shock download of 2.29 bps (57.1 bps x 4 weeks in %).

Table 7: Difference in Differences Study – Weekly Abnormal Stock Return Analysis

This table reports the results of DiD study according to the same specifications as Table 6, except weekly abnormal stock returns are the dependent variable. The sample consists of 22,689 to 28,314 firm-year observations for firm-year between 2017 and 2020. Regressions are estimated at the firm-level, with control variables, firm and time-fixed effects. Standard errors are reported in the parentheses. Variable definitions are reported in Appendix Table A1. *** $p<0.01$, ** $p<0.05$, * $p<0.1$, indicate statistical significance at 1%, 5% and 10% levels, respectively.

Downloads	7-Oct-21		10-Feb-22		7-Oct-21		10-Feb-22	
	2020	2020	2020	2020	2019	2019	2019	2019
			Weekly Abnormal Stock Returns					
	ATE	Controls	ATE	Controls	ATE	Controls	ATE	Controls
Top ESG quartile x post_ISSB, bps	**91.5***		**82.4***		**57.1***		**77.0***	
	(15.4)		(13.7)		(12.7)		(15.8)	
post_ISSB, bps		-68.2***		-63.1***		-47.5***		-66.8***
		(8.39)		(7.94)		(8.34)		(1.27)
Observations	25,389	25,389	28,314	28,314	26,766	26,766	27,405	27,405
	2018	2018	2018	2018	2017	2017	2017	2017
VARIABLES	ATE	Controls	ATE	Controls	ATE	Controls	ATE	Controls
Top ESG quartile x post_ISSB, bps	**59.9***		**74.7***		**53.8***		**67.4***	
	(15.8)		(17.3)		(16.0)		(17.6)	
post_ISSB, bps		-48.0***		-60.2***		-39.2***		-52.5***
		(12.2)		(14.1)		(12.7)		(14.8)
Observations	24,192	24,192	24,813	24,813	22,698	22,698	23,265	23,265

If the retroactive ESG scores adjustments are rewritings driven by stock returns, ATE would have been less pronounced in the post-shock download, compared to the pre-shock download. Thus, it further supports our explanation that retroactive ESG score adjustments are not rewritings driven by stock performance.

4.3 Robustness Tests

To be rigorous, we proceed to conduct three types of robustness tests to confirm our empirical results.

  i. Random Pairing of Downloads

First, we randomly pair datasets among 20 downloads. Instead of comparing the 10 February 2022 download with the 7 October 2021 download, we randomly compared 17 November 2022 download with 7 October 2021 download for ESG scores deviations, and 14 December 2022 download with 10 February 2022 download for E&S score deviations. We repeat the empirical test on the explanatory power of historical firm stock returns by ESG score or E&S score deviations, using the same firm-year between 2011 to 2017 as per BFS. **Appendix Table A6** reports the results. It again shows no statistically significant correlation between deviations of ESG scores and firms' stock returns.

We then test the predictive power of future stock performance by ESG scores by random pairs of downloads on 11 November 2021 and 20 January 2022; and 16 November 2022 and 14 December 2022 downloads for E&S scores, under two time periods: 2002-2011 and 2017-2021. **Appendix Table A7** reports the results. The statistically significant predictive power of ESG scores or E&S scores to future stock returns disappeared for the time period between 2002 to 2011; but resumed for the time period between 2017 to 2021. This phenomenon confirms our explanation of time frame idiosyncrasy.

  ii. Redacted ESG Top Quartile Ranking Analysis

Next, we designed a redacted ESG top quartile ranking analysis, by anchoring 9421 rated firms from the first Refinitiv Eikon universal download on 7 October 2021 as the baseline dataset, and tacking the subsequent monthly downloads on 11 November 2021, 9 December 2021, 13

January 2022 and 10 February 2022, subtracting rated firms that are not part of the initial 9421 rated firms, as well as rated firms in the initial dataset but subsequently being removed due to index rebalancing for instance. We then rank these 5 ESG datasets into quartiles; and examine the score deviations as well as rating changes triggered among the top quartile ranking firms, using the baseline dataset as the benchmark.

The redacted ESG top quartile ranking analysis takes away possible noise due to constant changes in the number of rated firms in the denominator of the Refinitiv ESG score equation, disentangling index rebalancing, timeline of new coverage. Instead, the analysis focuses on the same set of rated firms throughout, to investigate further the relationship between the ongoing retroactive ESG scores adjustments and firms' characteristics such as stock returns. Figure 9 highlights the empirical design of the redacted ESG top quartile ranking analysis.

Figure 9: Redacted ESG Top Quartile Ranking Analysis
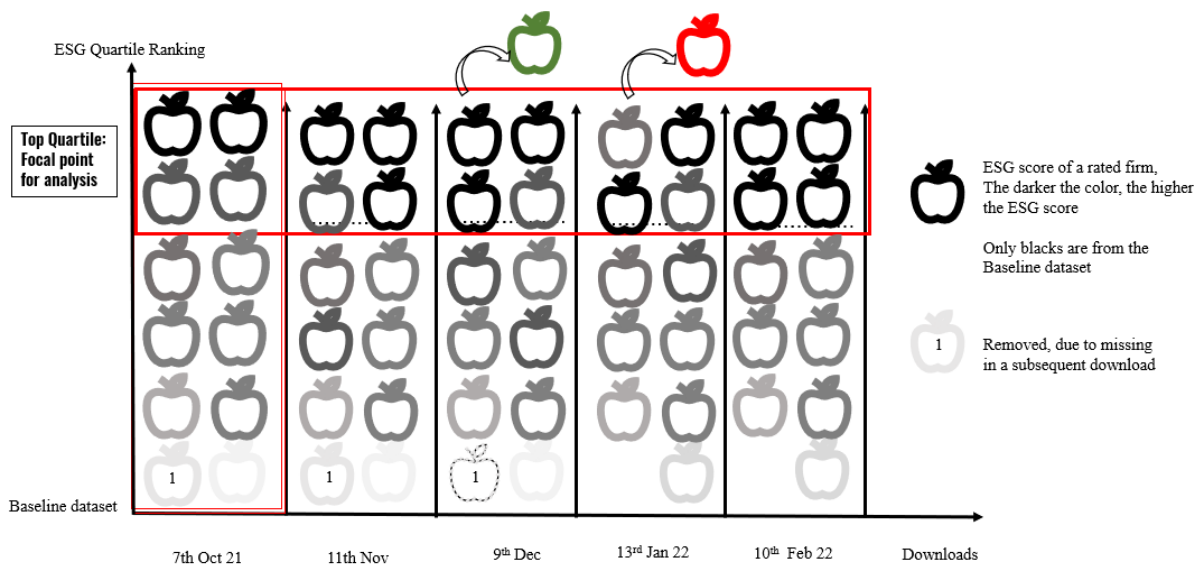
Appendix Table A8 reports the results on ESG score deviations from the baseline dataset. ESG score deviations range from 16.8% to 29.4% between later downloads on 11 November 2021, 9 December 2021, 13 January 2022 and 10 February 2022 to the baseline download on 7 October 2021 between firm years 2011 to 2017; and 0.45% to 57.71% between firm years

2002 to 2011; and 91.86% to 98.39% between firm years 2017 to 2021. The rampant ESG score adjustments on the same firms for the same firm year retroactively provided a fertile ground for the investigation on what drives these adjustments: commercially driven rewriting or accuracy drive recalibration?

Appendix Table A9 reports the results of ESG ranking changes due to ongoing retroactive ESG score adjustments. The results show similar patterns as that of Appendix Table A4. Firm years between 2017 to 2021 experienced more of such ranking changes which triggered rating changes as compared to firm years before 2017.

We then proceed to test the correlations between top quartile ESG score deviations and firms' stock returns. Panel A in **Table 8** highlights the results for firm-year between 2011 to 2017. Except for ESG score deviations between the download on 9 December 2021 and the download on 7 October 2021, with a t-value of 1.84, we could not establish statistically significant correlations between ESG score deviations and firms' stock returns. Panel B & Panel C report the results of the same regression for firm year between 2002 to 2011 and 2017 to 2021 respectively. No correlations are found in Panel B. Negatively significant correlations are found in three out of the four data pairs in Panel C.

Lastly, we test the predictive power of top-quartile ESG rankings to future stock returns. **Table 9** reports the results. Once again, we find statistically significant predictive power of top quartile ESG rankings in these redacted datasets to future stock returns between firm years 2011 to 2017 as highlighted in Panel A of Table 9; such statistically significant predictive power attenuated between firm year 2017 to 2021 in Panel C; largely disappeared between firm year 2002 to 2011 in Panel B, except the 90% confidence level on 9 December 2021 and 13 January 2022 downloads with t-value of 1.67 and 1.66 respectively.

The results from the redacted ESG ranking analyses exhibit similar patterns with the main analyses, thus it corroborates our explanation of time frame idiosyncrasy. The predictive power is time period dependent, and it is attenuated since 2017; while ongoing retroactive ESG score adjustments are prevalent, it postulates recalibrations.

Table 8: Correlations between Top Quartile ESG Score Deviations and Annual Stock Return

We report regression results of the ΔESG score of top quartile ESG ranking firms on annual stock returns using the **redacted datasets**. Model (1) represents ΔESG between 11 Nov 21 to 7 Oct 21 downloads; Model (2) represents ΔESG between 9 Dec 21 to 7 Oct 21 downloads; Model (3) represents ΔESG between 13 Jan 22 to 7 Oct 21 downloads; Model (4) represents ΔESG between 10 Feb 22 to 7 Oct 21 downloads. Panel A contains the sample of 4542 to 4592 firm-year observations **between 2011 and 2017**. Panel B contains the sample of 2252 to 2278 firm-year observations **between 2002 and 2011**. Panel C contains the sample of 4131 to 4191 firm-year observations **between 2017 and 2021**. Regressions are estimated at the firm-level, with country, industry and year fixed effects. Standard errors are reported in the parentheses. Control variables are the same as in Table 2. Variable definitions are reported in Table A1. *** $p<0.01$, ** $p<0.05$, * $p<0.1$, indicate statistical significance at 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)
	11Nov21vs7Oct21	9Dec21vs7Oct21	13Jan22vs7Oct21	10Feb22vs7Oct21
Dependent Variable	ΔESG	ΔESG	ΔESG	ΔESG
Panel A		**2011-2017**		
Annualstockreturn	0.000144	0.000249*	0.000117	0.000242
	(0.000111)	(0.000135)	(0.000296)	(0.000347)
Control Variables	Yes	Yes	Yes	Yes
Constant	-0.396	-0.756**	-1.199	0.183
	(0.310)	(0.378)	(0.824)	(0.965)
Observations	4,592	4,591	4,553	4,542
R-squared	0.552	0.478	0.262	0.222
Panel B		**2002-2011**		
Annualstockreturn	-4.53e-05	-4.53e-05	-4.55e-05	1.92e-05
	(5.94e-05)	(5.94e-05)	(5.98e-05)	(0.000288)
Control Variables	Yes	Yes	Yes	Yes
Observations	2,278	2,278	2,263	2,252
R-squared	0.873	0.873	0.873	0.513
Panel C		**2017-2021**		
Annualstockreturn	-0.00177***	-0.00241***	-0.00142*	-0.000314
	(0.000520)	(0.000626)	(0.000830)	(0.000888)
Control Variables	Yes	Yes	Yes	Yes
Observations	4,190	4,191	4,145	4,131
R-squared	0.455	0.480	0.594	0.583

iii.   Difference-in-Differences Study

Lastly, we repeat the DiD study using formulas (7) and (8). Formula (7) uses daily or weekly stock returns as the dependent variable. Formula (8) is an inversion of formula (6), instead of top quartile ESG stocks being the treatment group, we use the bottom quartile ESG stocks as the treatment group. We conducted DiD studies on daily and weekly stock returns.

The results of formula (7) are reported in **Appendix A10** (daily stock returns) and **Appendix A11** (weekly stock returns). Both exhibit similar patterns as Table 6 and Table 7, ATEs are positively significant across the board for firm-year between 2017 to 2020. Except for 2020, post-shock download exhibit slightly stronger effects compared to pre-shock downloads on daily (6.95 bps versus 6.28 pbs) stock returns and weekly (2.78 bps versus 2.05 bps) stock returns respectively.

Similar results are found in formula (8) as shown in **Appendix A12** and **Appendix A13**. ATEs of bottom quartile ESG stocks are negatively significant to daily and weekly abnormal stock returns across the board, post-shock download exhibited slightly stronger effects than that of the pre-shock download.

These results from further DiD studies corroborate that ongoing retroactive ESG score adjustments on the same firm years are not driven by firms' stock returns, therefore are not rewritings.

Table 9 Predictive Power of ESG Scores to Future Stock Returns

The table reports regression results of yearly stock returns (future stock return) on ESG scores **using the redacted datasets**. Model (1) is top quartile ESG firms downloaded on 7 Oct 2021; Model (2) is top quartile ESG firms on 11 Nov 2021; Model (3) is top quartile ESG firms on 9 Dec 2021; Model (4) is top quartile ESG firms on 13 Jan 2022; Model (5) is top quartile ESG firms on 10 Feb 2022. Panel A reports firm-year observations **between 2011 and 2017**. Panel B reports firm-year observations **between 2002 and 2011**. Panel C reports firm-year observations **between 2017 and 2021**. The rest specifications are the same as in Table 8.

	(1)	(2)	(3)	(4)	(5)
Dependent variable			Future Stock Returns		
Panel A			**2011-2017**		
L.ESG7Oct21_TopQ	0.297**				
	(0.125)				
L.ESG11Nov21_TopQ		0.310**			
		(0.125)			
L.ESG9Dec21_TopQ			0.313**		
			(0.125)		
L.ESG13Jan22_TopQ				0.313**	
				(0.125)	
L.ESG10Feb22_TopQ					0.310**
					(0.125)
Control Variables	Yes	Yes	Yes	Yes	Yes
Constant	452.1***	453.3***	452.3***	453.7***	460.0***
	(49.39)	(49.30)	(49.35)	(49.34)	(49.46)
Observations	4,156	4,160	4,149	4,145	4,143
R-squared	0.234	0.234	0.236	0.236	0.235
Panel B			**2002-2011**		
L.ESG7Oct21_TopQ	0.227				
	(0.176)				
L.ESG11Nov21_TopQ		0.223			
		(0.175)			
L.ESG9Dec21_TopQ			0.291*		
			(0.174)		
L.ESG13Jan22_TopQ				0.289*	
				(0.174)	
L.ESG10Feb22_TopQ					0.276
					(0.175)
Control Variables	Yes	Yes	Yes	Yes	Yes
Observations	1,726	1,731	1,722	1,721	1,719
R-squared	0.349	0.350	0.348	0.348	0.348
Panel C			**2017-2021**		
L.ESG7Oct21_TopQ	0.273*				
	(0.152)				
L.ESG11Nov21_TopQ		0.269*			
		(0.151)			
L.ESG9Dec21_TopQ			0.285*		
			(0.152)		
L.ESG13Jan22_TopQ				0.288*	
				(0.152)	
L.ESG10Feb22_TopQ					0.267*
					(0.153)
Control Variables	Yes	Yes	Yes	Yes	Yes
Observations	4,957	4,981	4,987	4,996	4,999
R-squared	0.308	0.308	0.312	0.310	0.309

Section 5: Conclusion & Contribution

Our empirical study shed light on the plausible commercially driven retroactive ESG score adjustments. On one hand, we confirm BFS's findings on the ongoing retroactive adjustments of ESG scores by Refinitiv; on the other hand, our empirical results show no ongoing statistical evidence for retroactive ESG score adjustments driven by stock performance. Instead, our results conjecture recalibration. Our results show that regardless of timing for downloads, ESG scores and E&S scores had a significant effect, or positive link on firms' stock performance between firm year 2011 to 2017, but such effect (or link) disappeared between firm year 2002 to 2011; and attenuated between firm year 2017-2021. This is further supported by a redacted ESG top quartile ranking analysis, where we anchored around the retroactive ESG score adjustments on top quartile ranking firms using the initial download as the baseline, taking away added or subtracted firms in the subsequent downloads. These empirical tests showed consistent results pointing to our explanations of time frame idiosyncrasy. The predictive power or positive link is time period dependent, and it did not quite exist prior to 2011 and it attenuates since 2017; while ongoing retroactive ESG score adjustments are prevalent, it postulates recalibrations.

It is highly plausible that the surge of investors' green appetite drove the outperformance of green stocks with higher ESG scores between the firm year 2011 to 2017. Investors' green preference has far more impact on firms' stock performance than firms' arbitrary ESG scores. As a matter of fact, ESG funds experienced their first outflow of assets under management in 2022, after underperformance of non-ESG funds. In addition to time frame idiosyncrasy, methodology and practice idiosyncrasies of the rating provider such as ESG score formula, ESG coverage roadmap, index rebalancing and industry recategorization, as well as ESG controversial events and restatement by rated firms are the main reasons behind the ongoing

retroactive ESG score adjustments of Refinitiv. Furthermore, using ISSB formation on 3rd November 2021 as the exogenous shock, top quartile ESG ranking stocks x post ISSB formation post shock exhibited slightly stronger after treatment effect on the treatment group compared to that of the pre-shock between 2017 to 2019. It should have been weaker if the retroactive ESG adjustments were driven by firms' stock performance. Thus, ongoing ESG score adjustments by Refinitiv are unlikely driven by firms' stock performance, and are likely recalibration.

Our findings expand BFS' findings. Our datasets and their datasets were downloaded at different points in time, and our datasets were random and closer to the date, and our empirical tests expand the time period beyond 2011 to 2017, to include 2002 to 2011 and 2017 to 2021. Our empirical findings for retroactive ESG score adjustments corroborate recalibrations. While retroactive ESG score adjustments are problematic, just like the uneven but progressive development and adoption of GAAP reporting standards over the past eighty-five years, it is a natural evolution towards greater reporting transparency and standardization. However, ESG data users need to be mindful about this phenomenon while employing data from ESG rating providers.

Endnote

Correspondence with the Content & Customer Service Teams at Refinitiv

Date	Correspondence

05/01
2023

R: Resolution has been provided last December 16, unfortunately, as these are historical data we were not able to trace the reason for score changes as the data are overwritten weekly with new values. Please see attached email for your reference.

16/12
2022

Q: Is it possible for you to send me the CURRENT Refinitiv checklist for ongoing historical ESG score adjustments?

A: Here is the resolution provided by our specialist:

Sadly, we were not able to trace reason for score changes as the data are overwrite weekly with new values (if there is a change).

Below are the reasons if scores were changes (as the underlying values were also changes)

- default values for some boolean data measures, in some industries default values were not updated hence score got recalculated based on underlying data.

- There was change in TRBC code for telecommunication industry, due to which score got recalculate historically.

Hope this helps.

22/11
2022

Summary of key takeaways from the Zoom call with the content team

- 80% of the content team is based in Bangalore, and the rest of the content team is spread around The Philippines and Indonesia. London is the head office while the senior managers are based.

- Four factors that cause the ESG score changes:

1. Restatement from issuers

2. Refinitiv's own data fine-tuning if they realize that the data entered is incorrect.

3. Timing of sustainability reports published by issuers

4. Industry categories change due to change in the maximum revenue contribution of the issuer

- These 4 factors drive the ESG score changes on a weekly basis via Refinitiv algorithm; if the score changes trigger the rating changes, the latter will automatically be reflected in the dataset too.

- Once a year, between 4-6 weeks after an issuer publishes its annual sustainability report, an analyst of Refinitiv will complete an update of the issuer's ESG score in the dataset

18/11
2022

Q: Refinitiv had controversial score as a separate pillar since 2002?

A: Yes. Controversial score as a separate pillar since 2002

Q: What are the reasons causing the score differences of the same firm in the same year from different downloads, based on Refinitiv ESG methodology?

A: -The main reason for change in scores is industry and country benchmarks, as the scores are relative scores. Environment & Social scores are industry benchmarked and Governance scores are country benchmarked. Thus, any changes in the score of other companies in the same industry will affect score of a company. The change in ESG score for same year might be because of the changes in the data collected in our database. We follow weekly refresh of data and if any data is amended then this may lead to the change in ESG score of the company.

Q: Why there was a much smaller number of firms experienced different scores between 2012 to 2016?

A: We amend values when there is a restatement made by the companies in their reports. Most of the cases companies amend values for past 3-5 years. The scores prior to 2016 are made 'definitive' because there will not be changes as you have said.

Scores will be marked as 'definitive' for all historical years excluding the five most recent. For instance, if the most recent fiscal year is FY2020, then all historical scores prior to

FY2016 will be considered definitive – but not those between FY2016 and FY2020. Definitive scores remain unchanged, even if there are changes to the underlying data due to company restatements or data corrections.

17/11 **Q:** When did Refinitiv add the controversial score in the ratings

2022 **A:** Starting from 2002 we have controversies scores

Q: How does Refinitiv retroactively assign these controversial scores?

A: The ESG Controversy Category Score is calculated based on 23 ESG controversy topics. These topics are considered for deriving ESG Controversies Score based on materiality and data availability. This score measures a company's exposure to environmental, social and governance controversies and negative events reflected in global media. Kindly check 23 ESG controversy topics considered for Controversy Score calculation in page#13&23.

https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/refinitiv-esg-scores-methodology.pdf

Q: What is the ongoing update procedure for controversial scores?

A: Any relevant news which qualifies as ESG Controversy News for the companies which are part of our coverage is collected on day-to-day basis. Collected news is categorized into 33 different data points or topics. The collected news goes to the products after the weekly upload cycle.

ESG Controversy News can be subjective due to the nature of its reporting and can make categorization into data points quite challenging. However, our robust methodology, experience and subject matter expertise ensures controversies are not only collected in a timely manner but also categorized into respective data points for ease of use. Once the controversy news is captured for a company, we may come across many following news as updates on the same news, which will not be collected, except for the major updates which will increase the negative impact for example: increase in fine amount, new cases being filed against the company, huge increase in impacts of pollution etc.

Sources: ESG Controversies News is sourced from publicly available top English editorial sources like Reuters, Associated Press, Financial Times etc through Refinitiv Eikon and from some publicly available regulatory-body websites like: http://www.fda.gov, https://www.eeoc.gov, https://www.osha.gov, https://www.ftc.gov and https://www.cpsc.gov ESG Controversy News for the companies which are part of our coverage is collected on day-to-day basis, as and when the controversies are reported by the publicly available news sources. The collected news goes to the products after the weekly upload cycle and will have an impact on the 'ESG Controversies Scores' and 'ESG Combined Scores'.

14/11 2022

Q: I'd like to know which month of 2021 did Refinitiv ESG start give ratings for CSI300 index companies (.CSI300)?

A: CSI 300 index companies has been added into ESG coverage in 2021. Generally, our collection process for 2021 ESG data began in Q4 2021 and ends in Q2 2023. We take on an average 4-6 weeks to process ESG information and publish the data on our products once all ESG documents are publicly disclosed by a company. Our update process is completed for most of the companies within 8 weeks.

The ESG data for a company Is updated annually once, based on the fiscal year, and Is aligned with corporate reporting patterns. Unlike Financial/Annual Filings, there is no mandatory timeline within which companies are required to file their ESG Reports. ESG/CSR/Non-financial reports are filed annually once, and this covers the entire fiscal year. Based on a general observation, companies do not maintain any standard timeline to report these CSR/Non-financial reports and publish this as per their convenience On average, there is a 6-10 months delay in reporting the CSR reports when compared to Financial reports and this could extend up to 1 year or more depending on the company.

Q: When downloading Eikon ESG data using DataStream <LA4GLACT> on 7th October 2021, I got 9499 companies; but on 10th February 2022, I got 9897 companies. Can you advise the difference on the number? Why?

A: LA4GLACT on DataStream retrieves only the active companies in our ESG Coverage.
The increase in number from 7th October 2021 to 10th February 2022 can be due to the
increase in our coverage.

Currently, Refinitiv covers 13000+ companies – both active + inactive, covering over 88% of
the global market capitalization with time series data going back to 2002. We track 23
benchmark indices and all the constituents forming part of these indices are covered by us.
We also do index re-index balancing every quarter and if any constituents that are newly
added to these 23 indices will also form part of our ESG Coverage.

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Table A1 Variable Definitions and Data Sources

This tables defines the variables used in the analysis.

Variable	Description	Source
ESG score	Overall score of a firm's ESG performance. The score covers a firm's environment (E), social (S) and corporate governance (G) performance. The score ranges between 0 (minimum) -100 (maximum). The score is downloaded from Refinitiv Eikon Datastream with TRESGS code and LA4GLACT for universal coverage	Refinitiv ESG
E&G 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 downloads. For example, the score deviation is computed for each firm-year combination as Score $_{10/02/2022\ data}$ – Score $_{7/10/2021\ data}$ divided by Score $_{7/10/2021\ data}$ minus 1, time 100	Refinitiv ESG
Δ E&S score	Percentage deviation defined as Δ ESG score but for the E&S score	Refinitiv ESG
ΔE score	Percentage deviation defined as Δ ESG score but for the E score	Refinitiv ESG
ΔS score	Percentage deviation defined as Δ ESG score but for the S score	Refinitiv ESG
ΔG score	Percentage deviation defined as Δ ESG score but for the G score	Refinitiv ESG
Stock Return Variables		
Annual Stock Return	Calendar year stock return (1st January to 31st December). Winsorized at the 1% and 99% levels	Refinitiv Datastream
Future Stock Return	The cumulative stock performance from July of year t to June of year t+1. Winsorized at the 1% and 99% levels	Refinitiv Datastream
Abnormal Stock Return	The daily or weekly abnormal stock return is the difference between the daily or weekly actual return of the	Refinitiv Datastream, Getsymbols

stock and the CAPM beta times the daily or weekly return of the market, expressed as a percentage.

The CAPM beta is estimated by using daily return of Refinitiv US coverage (LA4CTYUS) from July 2019 to June 2021, where the market proxy is S&P 500.

Control Variables		
Capex/Assets	Ratio of capital expenditures to total assets. The variable is downloaded directly from Eikon. Winsorized at the 1% and 99% levels	Refinitiv Datastream
Cash/Assets	Ratio of cash plus short-term investment divided by total assets. The variable is constructed using Eikon download. Winsorized at the 1% and 99% levels	Refinitiv Datastream
Debt/Assets	Ratio of total debt in current liabilities plus total long-term debt to total assets. The variable is downloaded directly from Eikon. Winsorized at the 1% and 99% levels	Refinitiv Datastream
EBIT/Assets	Ratio of earnings before interest and taxes to total assets. The variable is constructed using Eikon download. Winsorized at the 1% and 99% levels	Refinitiv Datastream
Ln (Assets)	Natural logarithm of total assets. The variable is constructed using Eikon download in USD. Winsorized at the 1% and 99% levels	Refinitiv Datastream
PPE/Assets	Ratio of property, plant and equipment to total assets. Missing values are set to zero. The variable is constructed using Eikon download. Winsorized at the 1% and 99% levels	Refinitiv Datastream
R&D/Assets	Ratio of research and development expenses to total assets. The variable is constructed using Eikon download. Winsorized at the 1% and 99% levels	Refinitiv Datastream
Annual Sales Growth	Total sales at the end of the year divided by the total sales at the end of the previous year, minus one. The variable is downloaded directly from Eikon. Winsorized at the 1% and 99% levels	Refinitiv Datastream

Table A2 Summary Statistics: 20 Weeks Refinitiv ESG Universe Download & Control Variables: Firm-year 2002-2021

Variables	N	mean	median	S.D	min	25%	75%	max
ESG7Oct21	70,245	41.67	39.58	20.58	0.140	25.09	57.15	95.19
ESG14Oct21	70,485	41.68	39.60	20.59	0.140	25.09	57.20	95.19
ESG21Oct21	70,721	41.60	39.53	20.60	0.140	25.01	57.11	95.19
ESG28Oct21	70,868	41.61	39.54	20.60	0.140	25.02	57.125	95.19
ESG5Nov21	71,093	41.62	39.55	20.61	0.140	25.00	57.13	95.19
ESG11Nov21	71,197	41.64	39.58	20.61	0.140	25.02	57.16	95.19
ESG18Nov21	71,197	41.64	39.58	20.61	0.140	25.02	57.16	95.19
ESG25Nov21	71,606	41.56	39.52	20.67	0.0400	24.93	57.14	95.19
ESG2Dec21	71,841	41.57	39.52	20.66	0	24.92	57.16	95.19
ESG9Dec21	71,945	41.58	39.52	20.66	0	24.92	57.18	95.19
ESG16Dec21	72,049	41.66	39.60	20.65	0.130	25.00	57.25	95.19
ESG23Dec21	72,088	41.66	39.60	20.66	0.130	25.01	57.26	95.19
ESG30Dec21	72,131	41.68	39.62	20.66	0.130	25.02	57.27	95.19
ESG7Jan22	72,355	41.70	39.63	20.65	0.170	25.04	57.30	95.19
ESG13Jan22	72,396	41.71	39.66	20.66	0.170	25.05	57.32	95.19
ESG20Jan22	72,486	41.71	39.66	20.66	0.170	25.04	57.33	95.19
ESG3Feb22	72,595	41.70	39.65	20.65	0.190	25.02	57.32	95.15
ESG10Feb22	72,630	41.71	39.66	20.66	0.190	25.03	57.36	95.15
ESG17Nov22	78,623	42.34	40.32	20.69	0.310	25.65	58.05	95.75
ESG14Dec22	78,799	42.43	40.46	20.71	0.310	25.72	58.17	95.79
Escore16Nov22	78,614	34.01	29.11	28.85	0	5.43	58.14	99.22
Sscore16Nov22	78,572	42.75	40.34	23.68	0.0500	23.80	60.74	99.56
Gscore16Nov22	78,623	48.84	49.12	22.56	0.0600	30.63	67.02	99.45
ESscore16Nov22	78,572	76.75	68.79	48.72	0.0500	34.75	116	196.3
Escore14Dec22	78,790	34.08	29.24	28.86	0	5.53	58.24	99.21
Sscore14Dec22	78,748	42.83	40.44	23.70	0.0500	23.86	60.84	99.56
Gscore14Dec22	78,799	48.94	49.27	22.55	0.0600	30.77	67.13	99.47
ESscore14Dec22	78,748	76.91	69.03	48.76	0.0500	34.87	116.22	196.3
Ln(totalasset)	174,420	14.06	14.11	2.287	0	12.62	15.52	22.43
Cash/Asset	156,909	0.181	0.110	0.203	-0.387	0.044	0.234	2.462
EBIT/Asset	169,027	-0.0172	0.060	7.760	-2,130	0.018	0.111	1,059
R&D/Asset	98,073	0.0944	0.004	6.744	-0.213	0	0.034	2,042
PPE/Asset	170,718	0.279	0.202	0.263	-0.0463	0.048	0.441	1.395
Debt/Asset	172,775	32.81	20.46	1,555	0	5.76	35.94	460,192
Capex/Asset	161,607	192,286	3.24	7.61e+07	-677.8	1.04	6.97	47.11
AnnualSales Growth (%)	167,629	34,569	8.05	1.33e+07	-100	-0.43	21.7	372.98
Annual StockReturn(%)	144,654	64.96	10.13	11,263	-100	-13.37	37.76	287.38
country_id	202,340	40.95	36	24.85	1	16	68	71
industry_id	202,340	92.65	68	55.10	1	52	150	184
firm_id	226,580	5,665	-	3,270	1	-	-	11,329

Table A3: Number of Firms under Refinitiv Universe Coverage: Firm-year 2002-2021

The table below reports monthly downloads between October 2021 to February 2022, November & December 2022; Highlighted period between 2011 to 2017 is used in (Berg et al., 2020a). Historical Refinitiv Universe Coverage on number of companies downloaded retroactively is not static, even tracing from the inception of the coverage in 2002.

Year	7Oct21	5Nov21	9Dec21	7Jan22	10Feb22	17Nov22	14Dec22
2002	648	648	647	646	645	637	636
2003	656	656	655	654	653	645	644
2004	1269	1269	1267	1264	1261	1240	1238
2005	1600	1600	1598	1595	1592	1569	1567
2006	1630	1630	1628	1625	1622	1599	1597
2007	1831	1830	1828	1825	1822	1797	1794
2008	2249	2248	2244	2238	2234	2198	2194
2009	2582	2581	2577	2571	2566	2525	2521
2010	3135	3133	3129	3122	3116	3068	3062
2011	3313	3311	3307	3299	3293	3244	3238
2012	3429	3427	3423	3415	3409	3358	3352
2013	3571	3569	3564	3556	3549	3495	3488
2014	3741	3739	3732	3724	3717	3659	3652
2015	4535	4528	4519	4509	4499	4415	4402
2016	5381	3570	5353	5343	5328	5201	5188
2017	6457	6458	6479	6467	6447	6297	6284
2018	7330	7329	7351	7334	7315	7145	7131
2019	8460	8508	8542	8532	8518	8337	8326
2020	8007	8553	8988	9223	9356	9700	9727
2021	421	706	1114	1413	1688	8494	8835

Table A4: Deviations Between Downloads for Firm-year 2011-2017

The table reports ESG score deviations for the same firm-year but from different downloads.

$$\Delta Score_{i,t} = \left(\frac{S^A_{i,t}}{S^B_{i,t}} - 1\right) x100$$

where $S^A_{i,t}$ is the ESG score of firm i in year t from download A. Panel A is between 10 Feb 2022 and 7 Oct 2021 download; Panel B is between 14 Dec 2022 and 17 Nov 2022 downloads.

Year	ΔScore
Panel A	
2011-2017	29.40
2011	76.30
2012	1.63
2013	1.71
2014	1.74
2015	1.87
2016	2.04
2017	97.43
Panel B	
2011-2017	9.52

Table A5: Numbers of firms with ESG Score Deviations from the Baseline Download

The table reports the number of firms with different ESG scores from the baseline download on 7 October 2021 (the first download). There are 20 downloads including the baseline download for firm-year 2002 to 202. Full explanations are recorded in the Endnote section.

Year/Download	7Oct21	14Oct	21Oct	28Oct	5Nov	11Nov	18Nov21	25Nov	2Dec	9Dec
2002	648	0	0	0	2	2	2	2	5	5
2003	656	0	0	0	2	2	2	2	5	5
2004	1269	0	0	1	6	6	6	6	10	10
2005	1600	0	1	2	8	7	7	8	13	13
2006	1630	0	1	2	9	8	8	9	14	14
2007	1831	0	1	2	10	9	9	9	15	15
2008	2249	0	1	2	13	10	10	10	19	19
2009	2582	0	1	2	17	12	12	12	24	24
2010	3135	0	1	2	21	14	14	14	29	29
2011	3313	0	1	2	23	15	15	15	32	32
2012	3429	0	1	2	24	16	16	16	32	32
2013	3571	0	1	3	25	17	17	17	34	34
2014	3741	0	1	3	27	18	18	18	36	36
2015	4535	0	1	4	32	23	23	23	45	45
2016	5381	0	1	5	37	29	29	28	52	52
2017	6457	3339	3972	4184	4760	4981	4981	5539	5645	5630
2018	7330	4806	5696	5977	6459	6592	6592	6863	6897	6879
2019	8460	7154	7986	8028	8139	8159	8159	8220	8248	8259
2020	8007	7710	7926	7924	7917	7927	7927	7913	7917	7904
2021	421	404	420	420	418	418	418	417	417	417

Year/Download	16Dec	23Dec	30Dec21	7Jan22	13Jan	20Jan	3Feb	10Feb	17Nov22	14Dec
2002	4	4	4	4	4	4	4	4	15	18
2003	4	4	4	4	4	4	4	4	15	18
2004	9	9	9	8	8	8	176	176	194	199
2005	11	11	11	10	10	10	639	639	1512	1517
2006	12	12	12	11	11	11	779	779	1561	1566
2007	13	13	13	12	12	12	1085	1085	1091	1097
2008	17	17	17	16	16	16	1316	1316	2031	2036
2009	22	22	21	20	20	20	1912	1912	2377	2382
2010	27	27	26	25	25	25	2379	2379	2969	2974
2011	30	30	29	29	30	2505	2501	2501	3099	3103
2012	30	30	29	29	29	29	29	29	3215	3219
2013	32	32	31	31	31	31	31	31	3354	3359
2014	34	34	33	33	33	33	33	33	3558	3563
2015	43	43	42	42	42	42	42	42	4340	4339
2016	50	50	49	49	49	49	49	49	5123	5123
2017	5688	5684	5732	6138	6133	6164	6184	6173	6175	6240
2018	6907	6900	6914	7102	7100	7109	7100	7100	7022	7089
2019	8256	8251	8270	8292	8267	8256	8242	8249	8130	8288
2020	7913	7903	7903	7904	7892	7894	7888	7870	7710	9702
2021	416	414	416	415	416	415	413	415	405	8785

Robustness Test – Random Pairing Downloads

Table A6: Regressions of ESG Score Deviations on Firm Characteristics including

Annual Stock Return for Firm year 2011-2017

We report results for ΔESG scores on firm's annual stock returns. The sample consists of 15,000 to 15,011 firm-year observations **between 2011 to 2017**. Formula (1) is between downloads on 17 Nov 21 and 7Oct 21; formula (2) is between downloads on 14 Dec 21 and 7 Oct 21; formula (3) is between downloads 17 Nov 22 and 10 Feb 22; and formula (4) is between downloads on 14 Dec 22 and 10 Feb 22. Regressions are estimated at the firm-level, with country, industry and year fixed effects. Standard errors are reported in the parentheses. Variable definitions are reported in Table A1. *** $p<0.01$, ** $p<0.05$, * $p<0.1$, indicate statistical significance at 1%, 5% and 10% levels, respectively.

Dependent Variables - ΔESG	(1) 17Nov22vs7Oct21	(2) 14Dec22vs7Oct21	(3) 17Nov22vs10Feb22	(4) 14Dec22vs10Feb22
Annualtotalstockreturn	-0.00412	-0.00402	-0.00126	-0.00117
	(0.00935)	(0.00935)	(0.00797)	(0.00797)
lntotalasset	-1.106	-1.095	-1.023	-1.011
	(1.386)	(1.387)	(1.181)	(1.181)
Annualsalesgrowth	-0.00135	-0.00135	-0.00440	-0.00440
	(0.0126)	(0.0126)	(0.0108)	(0.0108)
PPEtoAsset	3.982	3.867	3.820	3.702
	(7.647)	(7.648)	(6.496)	(6.497)
CashtoAsset	-1.197	-1.152	-0.760	-0.717
	(6.866)	(6.867)	(5.849)	(5.850)
EBITtoAsset	4.262	4.084	3.149	2.973
	(5.238)	(5.238)	(4.465)	(4.465)
R&DtoAsset	-4.133	-4.256	2.583	2.465
	(22.28)	(22.29)	(19.00)	(19.00)
DebttoAsset	-0.000636	-0.00232	0.0189	0.0172
	(0.0545)	(0.0545)	(0.0464)	(0.0464)
CapextoAsset	0.0625	0.0657	0.0846	0.0877
	(0.115)	(0.115)	(0.0979)	(0.0979)
Constant	16.89	16.79	14.55	14.44
	(21.54)	(21.54)	(18.34)	(18.34)
Observations	15,000	15,000	15,011	15,011
R-squared	0.368	0.368	0.353	0.353

Table A7: Predictive Power of ESG Scores to Future Stock Returns, Firm-year 2002-2011 and Firm-year 2017-2021

This table reports the results of regressions of yearly stock returns (future stock return) on ESG scores or E&S scores (the average of E and S scores) measured using different downloads as indicated in the table. ESG scores are in year t, while future stock returns are in year t+1 (defined as July in year t to June in year t+1) to prevent look ahead bias from back testing. Formula (1) is using ESG scores downloaded on 11 Nov 2021 as the regressor for firm-year 2002 -2011; Formula (2) is using ESG scores downloaded on 20 Jan 2022 as the regressor for firm-year 2002-2011; Formula (3) is using ESG scores downloaded on 11 Nov 2021 as the regressor for firm-year 2017-2021; Formula (4) is using ESG scores downloaded on 20 Jan 2022 as the regressor for firm-year 2017-2021; Formula (5) is using E&S scores downloaded on 16 Nov 2022 as the regressor for firm-year 2017-2021; Formula (6) is using E&S scores downloaded on 14 Dec 2022 as the regressor for firm-year 2017-2021. The sample contains 8497 to 18,177 observations. Regressions are estimated at the firm-level, with country, industry and year fixed effects. Standard errors are reported in the parentheses. Variable definitions are reported in Table A1. *** $p<0.01$, ** $p<0.05$, * $p<0.1$, indicate statistical significance at 1%, 5% and 10% levels, respectively.

VARIABLES	(1) Future stock return	(2) Future stock return	(3) Future stock return	(4) Future stock return	(5) Future stock return	(6) Future stock return
Time Period	2002-2011	2002-2011	2017-2021	2017-2021	2017-2021	2017-2021
L.ESG11Nov21	-0.0428		0.171***			
	(0.0512)		(0.0657)			
L.ESG20Jan22		-0.0432		0.195***		
		(0.0512)		(0.0645)		
L.ESscore16Nov22					0.129***	
					(0.0282)	
L.ESscore14Dec22						0.128***
						(0.0282)
L.lntotalasset	-37.25***	-37.23***	-34.16***	-34.86***	-35.51***	-35.57***
	(1.783)	(1.783)	(1.767)	(1.754)	(1.746)	(1.746)
L.Annualsalesgrowth	-0.0612***	-0.0610***	-0.0681***	-0.0690***	-0.0689***	-0.0692***
	(0.0202)	(0.0202)	(0.0115)	(0.0114)	(0.0114)	(0.0113)
L.PPEtoAsset	47.21***	47.29***	68.25***	69.22***	66.56***	66.34***
	(12.69)	(12.68)	(9.880)	(9.842)	(9.780)	(9.782)
L.CashtoAsset	-6.560	-6.568	-26.79***	-26.15***	-28.42***	-28.68***
	(9.313)	(9.312)	(7.140)	(7.067)	(7.023)	(7.029)
L.EBITtoAsset	-124.3***	-124.3***	-64.21***	-64.48***	-64.01***	-63.99***
	(8.108)	(8.107)	(5.772)	(5.646)	(5.626)	(5.627)
L.RDtoAsset	-42.07	-42.04	-53.89***	-47.45***	-46.72***	-46.87***
	(37.83)	(37.83)	(15.05)	(14.53)	(14.44)	(14.45)
L.Debttoasset	0.780***	0.779***	0.583***	0.579***	0.580***	0.579***
	(0.0804)	(0.0803)	(0.0605)	(0.0601)	(0.0596)	(0.0596)
L.Capextoasset	-0.280*	-0.286*	-0.899***	-0.988***	-0.997***	-0.995***
	(0.160)	(0.160)	(0.151)	(0.150)	(0.149)	(0.149)
Constant	583.3***	583.0***	497.1***	505.6***	514.2***	515.4***
	(29.01)	(29.00)	(25.49)	(25.28)	(25.31)	(25.31)
Observations	8,497	8,503	17,598	17,941	18,157	18,177
R-squared	0.242	0.242	0.305	0.302	0.303	0.303

Robustness Tests – Redacted ESG Ranking Analyses

Table A8: Number of Firms with ESG Score Deviations from the Baseline Download on 7Oct21

The table reports the number of firms with different ESG scores from the baseline download on 7 October 2021 (the first download). There are 5 downloads one month apart including the baseline download for firm-year 2002 to 2021. The sample is redacted that subsequent downloads track the baseline download by subtracting rated firms do not belong to the baseline download; so do rated firms in the baseline download but removed in the subsequent downloads. The final datasets only contain rated firms throughout the five monthly downloads.

Year	7Oct21	11Nov21	9Dec21	13Jan22	10Feb22
2002	648	2	6	8	9
2003	656	2	6	8	9
2004	1269	8	14	18	188
2005	1600	9	17	22	653
2006	1630	10	18	23	793
2007	1831	12	20	25	1100
2008	2249	16	28	36	1339
2009	2582	18	33	42	1938
2010	3135	21	39	48	2410
2011	3313	22	42	54	2533
2012	3429	23	42	53	61
2013	3571	25	45	58	67
2014	3741	26	49	62	71
2015	4535	36	65	81	92
2016	5381	49	86	104	118
2017	6457	5032	5739	6274	6330
2018	7330	6649	7003	7259	7276
2019	8460	8268	8451	8508	8515
2020	8007	8574	8957	9254	9387

Table A9: Top Quartile Deviations & Rating Changes

The table reports the ESG score deviations of the top quartile in subsequent downloads as well as number of firms with ESG scores deviations that triggered ESG rating changes in the redacted datasets.

Year	7Oct21	11Nov21	9Dec21	13Jan22	10Feb22
Panel A	**Total # Top Quartile**		**# of score deviations in the top quartile**		
2002	50	1	1	1	1
2003	61	0	0	0	0
2004	108	1	1	1	15
2005	192	1	1	1	78
2006	219	1	2	1	98
2007	367	0	0	0	205
2008	520	1	1	1	302
2009	650	2	3	2	471
2010	795	3	4	3	591
2011	852	3	5	4	660
2012	955	4	6	5	5
2013	958	4	6	5	5
2014	1012	5	7	6	6
2015	1191	6	8	7	7
2016	1384	6	8	7	7
2017	1592	1161	1391	1526	1543
2018	1910	1723	1797	1855	1849
2019	2260	2184	2199	2204	2202
2020	2168	2101	2110	2096	2094
2021	123	95	95	97	95
Panel B		**Top quartile ESG score deviations triggered rating changes**			
2002	50	0	0	0	0
2003	61	1	0	0	0
2004	108	1	0	0	0
2005	192	0	0	0	1
2006	219	1	0	0	0
2007	367	0	0	0	2
2008	520	2	1	0	1
2009	650	2	0	0	5
2010	795	2	0	0	1
2011	852	1	0	2	4
2012	955	2	1	2	2
2013	958	0	0	1	1
2014	1012	3	1	1	1
2015	1191	3	0	1	1
2016	1384	0	0	1	1
2017	1592	3	6	18	25
2018	1910	15	19	36	37
2019	2260	30	38	51	53
2020	2168	47	82	121	130
2021	123	7	8	10	10

Robustness Tests – Difference-in-Differences Study – Daily Abnormal Stock Returns

Table A10: Difference-in-Differences Study – Daily Stock Returns

This table reports the results of DiD study using the ISSB formation on 3rd November 2021 as the external shock event, regressing daily stock returns from 4th October to 3rd December 2021 on interactive variable of top quartile ESG firms x post_ISSB. Top quartile ESG firms are the treatment group which equals to 1 if the firm belongs to the top quartile ranking; otherwise 0. Post_ISSB dummy equals to 1 if the time period is between 4th November to 3rd December 2021, otherwise 0. Regressions are performed on ESG data from pre-shock download on 7 Oct 21 and post shock download on 10 Feb 22

The sample consists of 108.489 to 135,278 firm-year observations for firm-year between 2017 and 2020. Regressions are estimated at the firm-level, with control variables, firm and time fixed effects. Standard errors are reported in the parentheses. Control variables are the same as in Table 2. Variable definitions are reported in Table A1. *** p<0.01, ** p<0.05, * p<0.1, indicate statistical significance at 1%, 5% and 10% levels, respectively.

ATE: Average Treatment Effect on Treated

Downloads	7-Oct-21		10-Feb-22		7-Oct-21		10-Feb-22	
	2020	2020	2020	2020	2019	2019	2019	2019
Dependent Variable	Daily Stock Returns							
	ATE	Controls	ATE	Controls	ATE	Controls	ATE	Controls
Top ESG quartile x post_ISSB, bps	**36.2***		**35.7***		**29.9***		**33.1***	
	(3.72)		(3.22)		(3.07)		(3.39)	
Post_ISSB, bps		-90.5***		-89.0***		-85.9***		-89.2***
		(2.07)		(1.97)		(2.08)		(2.57)
Observations	121,303	121,303	135,278	135,278	127,925	127,925	131,000	131,000
	2018	2018	2018	2018	2017	2017	2017	2017
VARIABLES	ATE	Controls	ATE	Controls	ATE	Controls	ATE	Controls
Top ESG quartile x post_ISSB, bps	**29.4***		**30.9***		**28.2***		**30.7***	
	(3.46)		(3.67)		(3.51)		(3.70)	
Post_ISSB,bps		-83.8***		-85.8***		-80.6***		-83.4***
		(2.59)		(2.87)		(2.70)		(2.97)
Observations	115,627	115,627	118,616	118,616	108,489	108,489	111,220	111,220

Table A11 Difference-in-Differences Study – Weekly Stock Returns

This table reports the results of DiD study using the ISSB formation on 3rd November 2021 as the external shock event, regressing weekly stock returns from 4th October to 3rd December 2021 on interactive variable of top quartile ESG firms x post_ISSB. Top quartile ESG firms are the treatment group, which equals to 1 if the firm belongs to the top quartile ranking; otherwise 0. Post_ISSB dummy equals to 1 if the time period is between 4th November to 3rd December 2021, otherwise 0. Regressions are performed on ESG data from pre-shock download on 7 Oct 21 and post shock download on 10 Feb 22

The sample consists of 22,707 to 28,314 firm-year observations for firm-year between 2017 and 2020. Regressions are estimated at the firm-level, with control variables, firm and time fixed effects. Standard errors are reported in the parentheses. Control variables are the same as in Table 2. Variable definitions are reported in Table A1. *** $p<0.01$, ** $p<0.05$, * $p<0.1$, indicate statistical significance at 1%, 5% and 10% levels, respectively.

ATE: Average Treatment Effect on Treated

Downloads	7-Oct-21		10-Feb-22		7-Oct-21		10-Feb-22	
	2020	2020	2020	2020	2019	2019	2019	2019
Dependent Variable				Weekly Stock Returns				
	ATE	Controls	ATE	Controls	ATE	Controls	ATE	Controls
Top ESG quartile x post_ISSB, bps	**84.8*****		**77.0*****		**51.2*****		**69.6*****	
	(15.8)		(14.2)		(13.1)		(16.1)	
post_ISSB		-0.0373***		-0.0370***		-0.0358***		-0.0377***
		(0.000831)		(0.000787)		(0.000830)		(0.00127)
Observations	25,389	25,389	28,314	28,314	26,775	26,775	27,418	27,418
	2018	2018	2018	2018	2017	2017	2017	2017
VARIABLES	ATE	Controls	ATE	Controls	ATE	Controls	ATE	Controls
Top ESG quartile x post_ISSB, pbs	**59.7*****		**72.4*****		**61.0*****		**72.5*****	
	(16.1)		(17.5)		(16.3)		(17.9)	
post_ISSB		-0.0364***		-0.0375***		-0.0358***		-0.0370***
		(0.00121)		(0.00141)		(0.00126)		(0.00147)
Observations	24,201	24,201	24,826	24,826	22,707	22,707	23,278	23,278

Table A12 Difference-in-Differences Study – Daily Abnormal Stock Returns

This table reports the results of DiD study using the ISSB formation on 3rd November 2021 as the external shock event, regressing daily abnormal stock returns from 4th October to 3rd December 2021 on interactive variable of bottom quartile ESG firms x post_ISSB. **Bottom quartile ESG firms are the treatment group** which equals to 1 if the firm belongs to the bottom quartile ranking; otherwise 0. Post_ISSB dummy equals to 1 if the time period is between 4th November to 3rd December 2021, otherwise 0. Regressions are performed on ESG data from pre-shock download on 7 Oct 21 and post shock download on 10 Feb 22

The sample consists of 20,680 to 25,168 firm-year observations for firm-year between 2017 and 2020. Regressions are estimated at the firm-level, with control variables, firm and time fixed effects. Standard errors are reported in the parentheses. Control variables are the same as in Table 2. Variable definitions are reported in Table A1. *** p<0.01, ** p<0.05, * p<0.1, indicate statistical significance at 1%, 5% and 10% levels, respectively.

ATE: Average Treatment Effect on Treated

Downloads	7-Oct-21		10-Feb-22		7-Oct-21		10-Feb-22	
	2020	2020	2020	2020	2019	2019	2019	2019
Dependent Variable	Daily Abnormal Stock Returns							
	ATE	Controls	ATE	Controls	ATE	Controls	ATE	Controls
Bottom ESG Quartile x post_ISSB, bps	**-58.4***		**-63.3***		**-64.9***		**-58.2***	
	(11.0)		(10.4)		(9.71)		(9.77)	
post_ISSB		-0.0100***		-0.00954***		-0.00869***		-0.00892***
		(0.000406)		(0.000383)		(0.000390)		(0.000395)
Observations	22,568	22,568	25,168	25,168	23,792	23,792	24,360	24,360
	2018	2018	2018	2018	2017	2017	2017	2017
VARIABLES	ATE	Controls	ATE	Controls	ATE	Controls	ATE	Controls
Bottom ESG Quartile x post_ISSB, bps	**-64.0***		**-64.8***		**-51.2***		**-47.6***	
	(9.71)		(10.3)		(14.0)		(13.9)	
post_ISSB		-0.00771***		-0.00775***		-0.00743***		-0.00764***
		(0.000402)		(0.000397)		(0.000401)		(0.000403)
Observations	21,504	21,504	22,056	22,056	20,176	20,176	20,680	20,680

Table A13: Difference-in-Differences Study – Weekly Abnormal Stock Returns

This table reports the results of DiD study using the ISSB formation on 3rd November 2021 as the external shock event, regressing weekly abnormal stock returns from 4th October to 3rd December 2021 on interactive variable of bottom quartile ESG firms x post_ISSB. **Bottom quartile ESG firms are the treatment group** which equals to 1 if the firm belongs to the bottom quartile ranking; otherwise 0. Post_ISSB dummy equals to 1 if the time period is between 4th November to 3rd December 2021, otherwise 0. Regressions are performed on ESG data from pre-shock download on 7 Oct 21 and post shock download on 10 Feb 22

The sample consists of 22,689 to 28,314 firm-year observations for firm-year between 2017 and 2020. Regressions are estimated at the firm-level, with control variables, firm and time fixed effects. Standard errors are reported in the parentheses. Control variables are the same as in Table 2. Variable definitions are reported in Table A1. *** p<0.01, ** p<0.05, * p<0.1, indicate statistical significance at 1%, 5% and 10% levels, respectively.

ATE: Average Treatment Effect on Treated

Downloads	7-Oct-21		10-Feb-22		7-Oct-21		10-Feb-22	
	2020	2020	2020	2020	2019	2019	2019	2019
Dependent Variable				Weekly Abnormal Stock Returns				
	ATE	Controls	ATE	Controls	ATE	Controls	ATE	Controls
Bottom ESG quartile x post_ISSB, bps	**-86.0***		**-68.0***		**-69.0***		**-120.0***	
	(0.00189)		(0.00178)		(0.00177)		(0.00336)	
post_ISSB		0.00328***		0.00325***		-0.00160**		-0.00176**
		(0.000800)		(0.000745)		(0.000710)		(0.000713)
Observations	25,389	25,389	28,314	28,314	26,766	26,766	27,405	27,405
	2018	2018	2018	2018	2017	2017	2017	2017
VARIABLES	ATE	Controls	ATE	Controls	ATE	Controls	ATE	Controls
Bottom ESG quartile x post_ISSB, bps	**-43.6**		**-103.0***		**-55.8**		**-108.0***	
	(0.00198)		(0.00367)		(0.00226)		(0.00399)	
post_ISSB		-0.00221*		-0.00158*		-0.00118		-0.000864
		(0.00114)		(0.000809)		(0.00114)		(0.000749)
Observations	24,192	24,192	24,813	24,813	22,698	22,698	23,265	23,265