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The Power of ESG Ratings on Stock Markets

SAFE Working Paper No. 310

The power of ESG ratings on stock markets [*]

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March 2, 2021

Abstract

This paper studies the impact of environmental, social, and governance (ESG) ratings on investors' preferences and stock prices. We exploit a change in ESG rating methodology that non-linearly shifted ESG ratings for firms as a natural experiment. We show that the 'pseudo'-changes in the ESG ratings induced by the change in methodology are unrelated to potential fundamental changes in firm's sustainability. Yet, we find that an exogenous change in a stock's ESG rating exerts a transitory price pressure and alters the composition of stock ownership. Individual investors are especially sensitive to the 'pseudo'-changes in the ESG ratings. They (dis)invest in stocks that they misconceive as ESG (down-) upgraded. Short sellers act as arbitrageurs and take the other side of retail investors' trades. Overall, we find that a one standard deviation quasi-increase in the ESG ratings translates into 1pp drop in stock monthly abnormal return.

Keywords: Corporate Social Responsibility, ESG Rating Agencies, Sustainable Investments, Socially responsible investing, ESG, Portfolio choice

JEL Classification: G11, G12, G23, G59, M14, Q5

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1 Introduction

Rating agencies play a role of middlemen. They collect information on firms, process it, and transfer them to investors in a concise form. A failure to provide accurate ratings can have far-reaching consequences – for example, the East Asian Financial Crisis (1997), the collapse of Enron (2001) and Worldcom (2002), or the Great Recession (2007–2009), just to name a few. Rating agencies are among the most powerful voices in today's capital market and investors closely follow firms' ratings and invest accordingly.

Rating revisions are expected to disclose new information. Thus, investors react to changes in a firm's (risk) ranking by revising their investment portfolio choices. But what if ratings revisions were unrelated to either firm-specific or market-wide information and reflected no new knowledge on a firm's risk? Would investors still invest in line with ratings recommendations? We address these questions by looking at environmental social, and governance (ESG) ratings of U.S. companies and exploring a quasi-natural experiment.

Socially responsible investing (SRI) has become mainstream in the past decade and is continuing to grow.[1] The increased demand for sustainable investing has been accompanied by the rise of environmental, social, and governance rating agencies (ESGRAs) and their sustainability ratings. The sustainability ratings provided by different ESGRAs are often times incompatible (e.g., Chatterji, Durand, Levine, and Touboul, 2016; Berg, Koelbel, and Rigobon, 2019; Billio, Costola, Hristova, Latino, and Pelizzon, 2020), which may leave investors confused. Investors need to be able to trust the accuracy of sustainability ratings and understand them well in order to make informed investment decisions, which, in aggregate, may affect firms' performance, capital structure and capital allocation in

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[1]In 2018, over \$30 trillion world-wide were invested in sustainable investments and the value of socially responsible investing grew by 33% over two-year period (GSIA, 2019). In the U.S., the value of SRI assets has reached \$17.1 trillion at the start of 2020, which translates into a 42% increase since 2018 (US-SIF, 2020). This implies that currently every third professionally managed U.S. dollar is invested in sustainable activities.

the markets (see e.g., Kisgen, 2006, 2007; Manso, 2013).

In this paper, we assess the power of ESG ratings on stock markets by investigating the impact of changes in ESG ratings on investors portfolio choice and the consequent transitory price pressure on stocks. Addressing this question directly is not straightforward since it can be difficult to empirically disentangle a shift in the ESG ratings *per se* from the new information that it provides about fundamentals. We overcome this difficulty by investigating an unexplored natural experiment that inverted the scale and the interpretation of ESG ratings. Specifically, we use an adaptation of a new ESG rating methodology by Morningstar and Yahoo Finance that non-linearly shifted ESG ratings for firms. The new rating methodology resulted in changes to firm's ESG ratings that were unrelated to the sustainability practices of companies in question.

At the beginning of October 2019, Morningstar enhanced the new Morningstar Sustainability Rating methodology, which it adopted from Sustainalytics. Yahoo Finance also switched to the new ESG *Risk* Ratings mechanically, given that Yahoo Finance is a free provider of the Morningstar Sustainability Rating on its platform since February 2018. Both the old ESG Ratings and the new ESG *Risk* Ratings share the same scale between 0 and 100. However, they capture firm's sustainability from two different angles: the previous ESG Ratings increase while the new ESG *Risk* Ratings decrease with the degree of firm's sustainability.

Figure 1 illustrates the main finding of the paper: investors are sensitive to changes in the ESG ratings by (dis)investing in more (less) sustainable assets, which, in turn, exerts a significant price pressure and is reflected in risk-adjusted abnormal returns. Figure 1 visually investigates the relationship between stock's single-factor abnormal return and a relative change in a firm's ESG ranking due to the implementation of the new ESG rating methodology. The majority of the stocks in our sample experience a 'pseudo'-ESG downgrade – i.e., their new ESG *Risk* Rating is lower then their old ESG Rating.

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Roughly 6% percent of companies are 'pseudo'-ESG upgraded – i.e., their new ESG *Risk* Rating is higher than their old ESG Rating. The dashed vertical line corresponds to the average change in the ESG ratings (-28.76). Stocks, which are perceived as quasi-downgraded in terms of sustainability, face a decrease in the risk-adjusted abnormal returns. On the other hand, abnormal returns significantly increase for firms, which experience a quasi-upgrade. Given the higher proportion of pseudo-ESG downgrades, we find a stronger response to pseudo-ESG upgrades than downgrades. It is also worth noting that for stocks with only minor changes in their ESG ratings – that is those not affected by the introduction of the new rating methodology – we do not observe any significant change in their abnormal returns. We estimate that over three months after the implementation of the new sustainability rating methodology, the pseudo-ESG downgraded (upgraded) firms, experienced on average 1.85pp lower (3.94pp higher) risk-adjusted monthly abnormal return.

In order to understand the effect of the change in the ESG rating methodology on stock returns, we investigate responses of different types of investors to the exogenous shock in sustainability ratings. Specifically, we focus on individual investors, 13F institutions, and short-sellers. We believe that the three groups of investors are fairly different from each other in terms of financial literacy, their access to information, ability to process information, and attention. Thus, we expect them to respond differently to the exogenous change in the ESG ratings. Retail investors are generally perceived as less sophisticated, uninformed investors or as noise traders (e.g., Calvet, Campbell, and Sodini, 2007; Barber, Odean, and Zhu, 2006). 13F institutions are long-term investors, less sensitive to short-term information-driven price swings. Last but not least, short-sellers are traditionally considered well-informed – or at least able to process information (e.g., Boehmer, Jones, and Zhang, 2008; Engelberg, Reed, and Ringgenberg, 2012; Cohen, Diether, and Malloy, 2007; Diether, Lee, and Werner, 2009; Boehmer, Huszar, and Jordan, 2010).

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Using a novel database on assets' popularity from Robinhood in order to proxy for an aggregate retail investors portfolio, we find that individual investors significantly increase their investment in pseudo-ESG upgraded firms and reduce their positions in quasi-downgraded stocks. These results suggests that retail investors are confused or lack the understanding of the new ESG *Risk* Ratings and adjusted their portfolios in line with the misconceived sustainability ratings. The aggregate 13F ownership of a given stock remains unaffected by the change in the ESG rating methodology. However, when we look at short-sellers, we find that they increase their short positions in stocks experiencing a pseudo-ESG upgrade, and buy back shares of quasi-downgraded firms. This implies, that short-sellers are actually benefiting from retail investors' confusion and take the other side of their trades. They are therefore playing an important role in the financial markets by arbitraging away shifts in stock prices that are not related to changes in firm's fundamentals. However, as our analysis shows, they are not able to prevent the temporary effect on stock returns.

In line with Pedersen, Fitzgibbons, and Pomorski's (2020), Merton's (1987), and Fama and French's (2007) theoretical models, we document that shifts in ESG rankings induce investors flows, which in turn can exert a short-term price pressure on the affected securities even in the presence of informed investors. While Hartzmark and Sussman (2019) find no empirical support that sustainable funds generate superior performance, we document at a stock-level that changes in (perceived) sustainability ratings affect investors preferences and reallocate capital in the markets. The redistribution of investors' capital can, in fact, have (at least in a short run) an impact on prices of assets.

Our experiment provides a unique setting to evaluate the importance of sustainability ratings. The change in rating methodology affected a sizeable portion of the U.S. stock market (70% of the total number of common stocks and 95% of U.S. market capitalization) and was not correlated with any potentially confounding shifts in firms' fundamentals.

Thus, it allows us to identify a causal impact of sustainability ratings on stock returns and investors behaviour. Our work also sheds light on the importance of transparency of ratings methodologies and investors' understanding of them. Investors care about sustainability of their investments (Hartzmark and Sussman, 2019) and changes in sustainability ratings can direct capital allocation in the market. This calls for an unified framework that does not leave retail investors disadvantaged.

The paper is organized as follows. Below, we discuss our paper's contribution to the existing literature. In Section 2, we provide an in-depth description of the change in the ESG rating methodology. In Section 3, we describe the data sources and the variable construction in detail. Section 4 reports the empirical empirical results. Section 5 concludes.

1.1 Literature

Our paper relates to three strains of literature. We contribute to the literature examining how investors value SRI aspects in their investment decision process. Hong and Kacperczyk (2009) document that social norms are an important driver of lower investors demand for 'sin' stocks, which results in higher expected returns on firms involved in the production of alcohol, tobacco, and gaming. The authors look at the heterogeneity in investors exposure to social norms and their ownership level of sin stocks. In contrast, we investigate how a change in the perceived degree of vice affects investors portfolios. We document that although individual investors are less confined by social norms, they rebalance away from stocks that they mistakenly perceive as becoming more sinful – i.e., less sustainable. Hartzmark and Sussman (2019) also finds that investors (both institutional and individual) indeed value sustainability by examining investors flows to and from mutual funds with different sustainability globes. Similarly to our empirical approach, Hartzmark and Sussman (2019) use a quasi-natural experiment – an imple-

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mentation of Morningstar sustainability globes in March 2016. While, high sustainable funds experienced significant inflows after the introduction of mutual fund sustainability rankings, low ESG ranked funds suffered investors' withdrawals. Our paper builds on Hartzmark and Sussman's (2019) findings but rather than focusing on mutual funds flows we investigate institutional investors as well as individual investors and short-sellers investment behaviour. We show that individual investors monitor stocks' sustainability rankings very closely and instantly respond to sizeable changes in firm's sustainability. Consequently, the ESG ranking-induced shift in (individual) investors' demand exerts a significant pressure on asset prices. Building on the literature investigating potential drivers of investors preferences for sustainable investments (Białkowski and Starks, 2016; Barber, Morse, and Yasuda, 2021; Riedl and Smeets, 2017; Alok, Kumar, and Wermers, 2020; Krueger, Sautner, and Starks, 2020), we focus on active sustainability management of investors' portfolios. We show that investors keep close track of changes in firms' sustainability but respond mechanically to changes in ESG ratings.

Our empirical work is also related to recent theoretical and empirical studies investigating the impact of ESG-related risk on asset prices. Pástor, Stambaugh, and Taylor (2020) develop an equilibrium model to assess the impact of sustainable investing on asset prices. 'Green' stocks generate negative alphas due to investors' taste for SRI and green stocks' climate change hedging ability. Pedersen et al. (2020) proposes an ESG-adjusted capital asset pricing model (CAPM). The model reconciles two opposing views whether high ESG rating stocks generate higher or lower expected returns. The under- or out-performance of sustainable firms depends on wealth of investors that are unaware of firms' ESG ratings. Our paper provides empirical support to Pedersen et al.'s (2020) theoretical model by showing that changes to firm's ESG performance may cause investors flows and exert short-term price pressure on affected stocks. The differences in expected returns for high and low ESG rating firms may be due to investors taste for holding sustainable

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assets. Fama and French (2007) show that investors' taste can have long-run implications for asset prices, even in the presence of informed investors. Prices may eventually converge to rational values, when misinformed investors correct their erroneous beliefs so that they coincide with beliefs of informed investors. Our empirical findings support the price convergence hypothesis. Even though, short-sellers take the other side of a trade, individual investors misinterpretation of the new rating methodology temporarily affect stock prices. Recent empirical papers documents that ESG-related risk factors like drought risk (Hong, Li, and Xu, 2019), carbon risk (Bolton and Kacperczyk, 2020), or pollution risk (Hsu, Li, and Tsou, 2020) significantly affect asset prices. We contribute to this empirical literature by documenting that asset prices are also affected by changes in ESG ratings, at least temporarily.

Finally, we contribute to the literature on information intermediaries – in particular, rating agencies. Recent studies highlight the importance of conflict of interest between investors and information intermediaries on the quality of disclosed information (Biglaiser, 1993; Lizzeri, 1999). A failure to disclose an unbiased recommendation or rating may have considerable consequences. Griffin and Tang (2011) document that rating teams relied on aggressive assumptions and inflated collateralized debt obligations (CDOs) ratings, which contributed to financial crises in 2008. Overall market conditions may affect rating agencies' willingness to inflate their ratings (Bolton, Freixas, and Shapiro, 2012). The accuracy of credit ratings seems to deteriorate during boom times. Ashcraft, Goldsmith-Pinkham, and Vickery (2010) shows that credit ratings standards of morgage-backed-securities (MBS) were particularly low during the peak of real estate boom. Credit ratings for the same financial product may vary across rating agencies (Cantor and Packer, 1997; Shin and Moore, 2003; Becker and Milbourn, 2011). The problem of split ratings is even more pronounce in case of firm's sustainability evaluations (Chatterji et al., 2016; Chatterji, Levine, and Toffel, 2009; Semenova and Hassel, 2015; Dorfleitner, Halbritter,

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and Nguyen, 2015; Delmas and Blass, 2010; Berg et al., 2019; Billio et al., 2020). Because investors value sustainability (Hartzmark and Sussman, 2019), the accuracy of ESG ratings plays a very important role. We show that investors who misinterpreted firms' sustainability rankings rebalance their portfolio by buying stocks that they perceive as more ESG-oriented and sell firms that they regard as less sustainable.

2   ESG Rating Methodology Change

Morningstar currently provides sustainability rating for over 75,000 companies and 40,000 mutual funds worldwide. At the beginning of October 2019, Morningstar launched new Morningstar Sustainability Rating methodology. It replaced firm-specific ESG Ratings with modified ESG *Risk* Ratings provided by Sustainalytics. This change in the ESG rating methodology applied both to firms and investment companies. The change in Morningstar Sustainability Rating methodology coincided with Yahoo Finance's decision to also change their sustainability rating (provided by Sustainalytics) from ESG Rating to ESG Risk Rating.[2]

According to Morningstar and Sustainalytics, the new sustainability rating methodology has at least two main advantages: i) it incorporates material ESG risk and ii) allows for cross-industries comparisons. Both the new and old ESG (*Risk*) Ratings share the same scale between 0 and 100. While sustainability ranking was increasing with the (old) ESG Rating, it is now decreasing with the (new) ESG *Risk* Rating. Thus, companies with high ESG Rating before October 2019, were rated with low ESG *Risk* Ratings after the new methodology adaptation. Table 1 provides selected examples of how sustainability ratings changed between the beginning of September and October 2019. Microsoft's ESG rating dropped from 75 pre-change to 14.28 (in terms of ESG *Risk* Rating) post-

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[2]Yahoo Finance has been providing sustainability ratings from Sustainalytics for more than 2,000 companies since February 1, 2018. For more details, see: https://www.sustainalytics.com/esg-investing-news/yahoo-finance-adds-sustainability-scores/.

change. On the other hand, Earthstone Enegry's rating 'increased' by 22.07 from 46.00 to 68.07. There were some companies for which the ESG rating level stayed almost the same – e.g., Jounce Therapeutics and SkyWest. Given that the new ESG *Risk* Rating incorporates controversies and allows across industries comparisons, the shift from ESG Rating to ESG *Risk* Rating has not been linear. For example, Marrone Bio Innovation and Outfront Media had the same ESG Ratings before the methodology change, but their ESG *Risk* Ratings diverged after the new methodology adoption. While Marrone Bio Innovation experienced 'pseudo'-upgrade (from 45.00 to 62.40), Outfront Madia was faced with 'pseudo'-downgrade (from 45.00 to 21.75). Similarly, Merck and VF were rated with the same ESG Rating (68.00) before the methodology change, but their post new methodology adoption ESG *Risk* Ratings were almost 20 points apart (30.37 vs 11.94).

While Morningstar was communicating the ESG ranking methodology to the media and clients since June 2019, there is almost no record of information about the new ESG rating methodology disclosed directly to the users of Yahoo Finance. We have evidence, however, that the ratings reported by Yahoo Finance did change at the same time, because they were provided by Morningstar to Yahoo Finance. The overlap in the introduction of the new methodology but the discrepancy in the communication allows us to investigate different types of investors responses to this change and their consequences. It is likely that less informed investors, which rely on information from Yahoo Finance, responded with their pre-defined interpretation of the sustainability ratings without understanding the specific details of the new rating methodology. We use the end of September 2019 as a cut-off between pre- and post-implementation of new ESG methodology and investigate both asset pricing implications and investors' responses.

3 Data and Variable Construction

In this section, we introduce the main data sources and processing procedures. We also explain the construction of the variables used for our analysis and we discuss descriptive statistics.

3.1 Data

The ESG (*Risk*) Ratings come from Morningstar database. We collected the sustainability ratings from Morningstar Direct for all companies trading at NYSE, Nasdaq, and Amex exchanges for the period of June 2019 to January 2020. The stock data (daily returns, prices, and shares outstanding) for common shares (share code 10 and 11) are obtained from the Center for Research in Security Prices (CRSP). To avoid the issue of small 'penny' stocks, we impose the constraint that a stock price, at the end of the beginning of the control period, must be greater than 1 USD. In order to merge the ESG ratings data to CRSP stock database, we convert ISINs of U.S. companies (starting with 'US') from Morningstar to 8-digit CUSIPs.

The investor level data come from three different sources. We use Robinhood's stock popularity measure as a proxy for retail investors ownership. We obtain the number of retail investors holding a given stock from Robinhood available on `Robintrack.net` website. Robintrack provides intra-day information on the number of investors holding a given stock.[3] First, we compute the mean daily number of investors holding a given stock, then we aggregate the daily means into monthly averages. When we choose to use a median number of investors instead our results remain essentially unchanged. We merge Robinhood data to CRSP dataset by means of stock ticker symbol.

Next, we use Thomson Reuters 13F institutional ownership aggregated across all 13F

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[3]In August 2020, Robinhood closed down the API that Robintrack was using, so the dataset is only available until August 2020.

institutional investors at a stock level. The 13F institutional ownership data are available at a quarterly frequency. For the purpose of our analysis, we use 13F holdings at the end of September 2019 (the last quarter-end before ESG rating methodology change) and December 2019 (the first quarter-end after the new ESG rating methodology introduction). Finally, we collect the information on short interest available through Compustat – Capital IQ. Both for 13F ownership and short interest data, we use CUSIP identifier to match 'more-informed' investors positions with CRSP stock database.

3.2 Variable construction

We start with computing abnormal returns. We use daily stock excess returns in order to estimate loadings on risk factors from 12-month rolling-window regressions. Then, we obtain abnormal returns in the following month by applying the estimated beta coefficients from the first step. We download the information on daily and monthly risk factors for Fama and French (1993) three- and Carhart (1997) four-factor model from Kenneth French's website. For the robustness purposes, we also use two sub-periods to estimate loadings on risk factors: from July 2018 to June 2019 (for the pre-period) and from October 2018 to September 2019 (for the post-period). Our results remain quantitatively and qualitatively unchanged.

Next, we define two measures that capture the change in firm's ESG rating. ΔESG_i is a change in stock i's ESG rating between October 2019 (the first month after the new ESG rating methodology implementation) and September 2019 (the last month before the change in the ESG rating methodology). $\Delta\overline{\text{ESG}}_i$ is defined in a very similar manner and captures a change in an average ESG rating between the treatment period (October 2019 – December 2020) and the control period (July 2019 – September 2019). It is important to mention that Morningstar reports the ESG ratings at the end of a month. This implies that ESG ratings issued in September 2019 were firstly available to the public from the

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beginning of October 2019. Thus, we use the ESG ratings at the end of September 2019 as a measure of sustainability rating known in October 2019. We also construct an indicator variable PSEUDO-ESG DOWNGRADE$_i$ that equals to one if stock i's change in an average ESG rating belongs to the lower quartile of $\Delta\overline{\text{ESG}}_i$ distribution. This dummy variable is supposed to capture the incorrect perception of investors that a stock has been significantly downgraded in terms of their sustainability rating. Stocks with high ESG Ratings before the methodology change and very low ESG *Risk* Ratings after the new methodology introduction belong to the group of 'pseudo'-ESG downgraded stocks. In order to capture heterogeneous effects of pseudo-ESG upgrades and downgrades, we also define PSEUDO-ESG UPGRADE$_i$ as an indicator variable that takes value of one if stock i's post new methodology implementation ESG *Risk* Rating is higher than the pre methodology change ESG Rating. Roughly 6% of the firms experienced a quasi-upgrade in their sustainability rankings in our sample.

We continue with the construction of variables that reflect investors' ownership. We first focus on individual investors' stock ownership that we proxy by the number of investors holding a given stock. However, the number of Robinhood investors is strongly correlated with firm's market capitalization ($\rho = 0.50$). This implies that larger stocks are held by a greater number of individual investors. Following Coval and Stafford (2007), we adjust retail investors' ownership for the company's size, by dividing the mean number of Robinhood investors holding a stock i in month t, # RETAIL$_{i,t}$, by the average dollar trading volume from April to June 2019 (one quarter before the control period).[4] We compute 13F OWNERSHIP$_{i,t}$ by dividing aggregated positions of 13F institutions at the end of a quarter by the number of shares outstanding. Analogously, we construct SHORT INTEREST$_{i,t}$ by dividing an average number of shares sold short in the pre/post period by the number of shares outstanding.

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[4]Dividing the number of retail investors by the market capitalization in a previous quarter yields very similar results.

3.3 Summary statistics

Table 2 reports summary statistics for the stocks before and after Morningstar ESG Rating methodology change. The mean (median) firm experienced a pseudo-ESG downgrade – both mean and median ESG values are higher before the change. An average (median) a stock is held by roughly 3000 (300) Robinhood investors. 13F institutions hold 16 – 18% of shares outstanding of stocks in our sample. On the other hand, 5.5% of shares outstanding is sold short for an average stock.

Figure 2 provides some initial insights into the change in the ESG rating methodology. It depicts the distribution of a change in ESG ratings $\Delta\overline{\text{ESG}}_i$ due to the introduction of the new ESG rating methodology. The vast majority of firms faced a negative change in their ESG ratings. Only 148 stocks out of 2,451, which comprise our sample, experienced a quasi-upgrade of their sustainability rating. We use an orange solid vertical line to highlight the 25th percentile of $\Delta\overline{\text{ESG}}_i$ distribution. All stocks below the lower quartile constitute the pseudo-ESG downgraded group that we use to define PSEUDO-ESG DOWNGRADE$_i$ indicator variable.

4 Empirical Results

This section presents our main empirical findings. Throughout the analysis, we employ a generalized difference-in-difference specification to investigate the outcomes of firms with greater exposure to the change in the ESG rating methodology – our treatment.

4.1 Stock's response to the ESG rating methodology change

We start our analysis with examining the effect of the ESG rating methodology change on stock abnormal returns. We estimate the following Dif-in-dif specification:

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$$\text{ARET}_{i,t} \;\;=\;\; \gamma_0 + \gamma_1 \Delta\text{ESG}_i \times \text{Post}_t + \text{D}_i + \text{D}_t + \varepsilon_{i,t}, \tag{1}$$

where $\text{ARET}_{i,t}$ is stock i's abnormal return in month t computed with single-, three-, or four-factor model. ΔESG_i captures stock i's exposure to the treatment – i.e., the change in its ESG rating due to Morningstar methodology change. We expect stocks with either very positive (negative) change in their ESG ratings to experience higher (lower) abnormal returns after the adoption of the new ESG rating methodology. We use four measures to capture a stock's exposure to the change in ESG rating methodology: ΔESG_i, $\Delta\overline{\text{ESG}}_i$, Pseudo-ESG Downgrade$_i$, and Pseudo-ESG Upgrade$_i$, which we define in more details in the previous section. D_i and D_t stand for stock and month fixed effects. Standard errors are clustered at a stock level.

We report the regression estimates equation (1) in Table 3. In columns (1) to (4), we relate single-factor abnormal returns to the change in the ESG rating methodology. In columns (5) to (8), we replicate this exercise with the Fama and French (1993) three-factor abnormal returns as the dependent variable. Finally, in the last four columns, we use Carhart (1997) four-factor model abnormal return. The coefficient estimates on the interaction terms between ΔESG_i (or $\Delta\overline{\text{ESG}}_i$) and Post_t are positive and highly statistically significant. The positive interaction coefficient implies that stocks experience negative (positive) abnormal returns after a quasi-downgrade (upgrade) of their sustainability rating has taken place. A one standard deviation decrease in firm's ESG rating translates into 1pp drop in stock monthly abnormal return (for a single-, three, or four-factor model).

We continue our analysis by investigating whether the abnormal returns are differentially impacted by pseudo-ESG upgrades vs downgrades. In columns (3), (7), and (11), we compare the average abnormal returns of stocks with extreme (below the lower quar-

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tile) negative change in ESG ratings to other stocks with less negative changes in their sustainability ratings. The coefficient on the interaction term between PSEUDO-ESG DOWNGRADE$_i$ and POST$_t$ is negative and again highly statistically significant. In columns (4), (8), and (12), we include an additional interaction term between PSEUDO-ESG UPGRADE$_i$ and POST$_t$. PSEUDO-ESG UPGRADE$_i$ is a dummy variable that equals one if a stock experience a positive change in its sustainability rating, and is otherwise zero. This implies that we are comparing average abnormal returns after the introduction of the new methodology of utmost downgraded or upgraded firms to a group of stocks, which ESG ratings have not substantially changed. We find that the coefficient estimate on PSEUDO-ESG UPGRADE$_i$ × POST$_t$ is positive and statistically significant, while the PSEUDO-ESG DOWNGRADE$_i$ and POST$_t$ remains negative and significant at 5%-level.

Figure 3 visually investigates the effect of the change in the ESG rating methodology on stock abnormal returns. We estimate a dynamic version of the regression equation (1) in the following way:

$$\text{ARET}_{i,t} \;\; = \;\; \gamma_0 + \sum_{e=-4,\, e\neq-1}^{4} \gamma_e \Delta\text{PSEUDO-ESG DOWNGRADE}_i \times \text{D}(e)_t + \text{D}_i + \text{D}_t + \varepsilon_{i,t}, \;\; (2)$$

where D$(e)_t$ is equal to one exactly e periods after (or before if e is negative) the implementation of the new ESG rating methodology. The main coefficients of interests are γ_e coefficients – the treatment dummies, which capture highly negative changes in firms' ESG ratings. Figure 3 plots the γ_e coefficients together with 95% confidence intervals using standard errors clustered at a stock level. We observe that the trend in the abnormal returns of quasi-ESG downgraded firms is not significantly different from the trend in the abnormal returns of our control group of stocks (that experience less negative changes in their ESG ratings) before the introduction of the new ESG rating methodology. However, the pseudo-ESG downgraded firms experience a significant decrease in their abnormal returns once the new ESG rating methodology has been implemented. The magnitude of

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the effect is quite large as the abnormal returns of the pseudo-ESG downgraded firms drop by 1.47pp one month (1.14pp two months) after the methodology change.

4.2 Investors' responses to the change in the ESG rating methodology

We now focus on different types of investors, from less- to more-informed, and investigate how they react to the change in the ESG rating methodology. In our analysis, we consider retail investors, 13F institutions, and short-sellers. We examine how the number of retail shareholders, institutional ownership, and short interest changed around the ESG rating methodology event. We follow Mian and Sufi (2011) and estimate the generalized Dif-in-Dif specification of the form:[5]

$$\Delta \text{Ownership}_i \;\; = \;\; \delta_0 + \delta_1 \Delta \text{ESG}_i + \eta_{i,t}, \tag{3}$$

where $\Delta \text{Ownership}_i$ is a difference in investors' ownership measure for stock i between post- and pre-methodology change period. ΔESG_i is defined as previously and captures stock i's exposure to the treatment – i.e., the change in its ESG rating due to Morningstar methodology change. We adjust standard errors for heteroscedasticity.

We report the regression coefficients in Table 4. In columns (1) – (4), we focus on retail investors response to the methodology change. We define retail investors ownership as an average number of investors holding stock i scaled by the average dollar trading volume from April to June 2019 (one quarter before the control period). We find a positive and highly statistically significant coefficient on the change in the ESG rating. The scaled number of retail investors drops by 8% relative to the mean for stocks experiencing a one standard deviation decrease in the sustainability rating. In columns (3) and (4), we

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[5]This specification is equivalent to Mian and Sufi's (2011) first-stage regression from equation (2). We replace $HousePriceGrowth0206_{zm}$ with $\Delta \text{Ownership}_i$ on the LHS and $Elasticity_{m,1997}$ with ΔESG_i on the RHS.

investigate whether retail investors are more likely to respond to pseudo-ESG downgrades or upgrades. The coefficient estimate on PSEUDO-ESG DOWNGRADE$_i$ is negative and significant, while the coefficient on PSEUDO-ESG UPGRADE$_i$ is positive and also significant. This result shows that the scaled number of retail investors increases (decreases) by 15% (10%) relative to the mean as a result of an ESG upgrade (extreme downgrade) of a stock compared to firms which experienced mild changes in their sustainability ratings.

Next, we shift our focus toward investors that are traditionally perceived as more informed (short-sellers) or having longer investment horizons and thus, less sensitive to short-term information-driven swings (13F institutions). In columns (5) – (8), we regress the change in an aggregate percentage of institutional ownership of a given stock between December 2019 (the first quarter-end after new methodology implementation) and September 2019 (the last quarter-end before the methodology change) on the firm's change in the ESG (*Risk*) rating. Not surprisingly, we find that institutional investors do not rebalance their portfolios in response to the methodology change. The coefficients are indeed not significant for all different ways we measure the changes in the ESG ratings (ΔESG$_i$, PSEUDO-ESG UPGRADE$_i$, PSEUDO-ESG DOWNGRADE$_i$). The lack of 13F response to the new ESG ratings may be due to at least two reasons. First, 13F institutions may have better knowledge about the companies they invest in. Thus, they perceive the change in the ESG ratings rather as a fluke than a real piece of information. Second, 13F institutions may have better ability to process information and understand the implications of the methodology change.

Finally, we investigate short-sellers response. In columns (9) – (12), we regress the change in an average percentage of shares sold short for a given stock between two periods: post (October 2019 – December 2019) and pre (July 2019 and September 2019). We find that short-sellers behave in an exact opposite way to retail investors. They increase their short positions for stocks that experienced a pseudo-ESG upgrade, which are bought by

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retail investors. On the other hand, short sellers reduce their short positions for stocks that experienced a pseudo-downgrade and are sold by retail investors. The coefficient estimate on the change in the ESG rating is positive and significant, as well as economically relevant. A one standard deviation increase in pseudo-ESG upgrade translates into 2.8% increase in percentage of shares sold short relative to the mean. The last two columns in Table 4 show that short-sellers respond both to positive and negative changes in the ESG ratings, by increasing and decreasing their short positions, respectively. The short interest increases (decreases) by 7.4% (3.3%) relative to the mean as a result of ESG upgrade (extreme downgrade) of a stock compared to firms which experienced mild changes in their sustainability ratings.

4.3 Robustness

So far our analysis relies on the assumption that changes in the ESG ratings between September and October 2019 were not correlated to any fundamental changes in firm's sustainability. A potential concern is that the pseudo-ESG downgraded firms indeed deteriorated in their sustainability and therefore, they experienced negative abnormal returns. The same argument applies to pseudo-upgraded firms. In order to ensure that our analysis is robust to potential fundamental changes in firm's sustainability, we focus on Sustainalytics ESG *Risk* Ratings available for both sub-periods.[6] A year earlier, in February 2018, Sustainalytics launched its new ESG risk rating methodology. Consequently, we observe Sustainalytics ESG *Risk* Ratings before and after the adoption of the new ESG rating methodology by Morningstar and Yahoo Finance.

First, we relate changes in the ESG ratings due to the introduction of the new rating methodology to the changes in Sustainalytics *Risk* Rating. Figure 4 illustrates the cor-

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[6]We are able to obtain Sustainalytics ESG *Risk* for 2,315. Thus, there are 136 stocks for which we are not able to collect information on Sustainalytics ratings. Nevertheless, our sub-sample is representative of the firms we consider in our main analysis.

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relation between changes in Sustainalytics and Morningstar ESG ratings. We construct the change in the average Sustainalytics Risk Rating by computing a difference between a firm's average Sustainalytics Risk Rating between post (October – December 2019) and pre (July – September 2019) period. The change in the ESG (*Risk*) Rating due to the implementation of the new rating methodology is constructed as described in the previous section. The figure suggests that the two changes are completely unrelated to each other, the correlation is zero. Regression estimates from a linear regression of changes in Sustainalytics ratings on the changes in the ESG (*Risk*) Ratings reported in the bottom left corner of the figure further indicate that there is no link between these two changes in ESG ratings. This Figure also shows that ΔSUSTAINALYTICS RATING is almost zero (between -5 and +5) for a 98.6% of stocks.

Despite these comforting results, we repeat our analysis from Table 3 and add a contemporaneous Sustainalytics ESG *Risk* Rating as a control variable. We report the regression estimates of Equation (1) with a change in Sustainalytics ESG *Risk* Rating interacted with the POST$_t$ dummy variable in Table 5. All the coefficients of interest on the interaction terms remain almost unchanged and become even more significant. On the contrary, the coefficient estimate on the the interaction term between the change in Sustainalytics ratings and time indicator variable ΔSUSTAINALYTICS RATING$_i$ × POST turns out to be insignificant. This implies that two stocks with exactly the same changes in their Sustainalytics ratings experience different abnormal returns due to stocks' heterogeneous exposure to Morningstar's rating methodology change. This result provides a strong support to our findings, that a variation in the ESG ratings that is unrelated to the fundamental changes in firm's sustainability, can exert a significant price pressure.

Armed with these results, we focus again on different types of investors and their responses to the change in the ESG rating methodology while controlling for the shift in Sustainalytics ESG *Risk* Rating. We rerun our estimation from Table 4, but include the

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change in Sustainalytics ESG *Risk* Rating as a control variable. We report our results in Table 6. Our results again remain quantitatively and qualitatively unchanged, when we control for firm's ESG up- and downgrades due to fundamental changes in firm's sustainability.

5   Conclusion

We provide a causal evidence that changes in ESG ratings unrelated to any sustainability news shape investors portfolio allocation decision and result in temporary price pressure on the affected stocks. We find that stocks that face a pseudo-ESG downgrade, experience a decrease in the risk-adjusted monthly abnormal returns by 1.85pp, while quasi-upgraded stocks' abnormal returns increase by 3.94pp. This suggests that sustainability ratings are important to investors and the shifts in ESG ratings can alter capital allocation in the markets.

In order to understand the mechanism through which the implementation of the new ESG rating methodology affects prices of stocks, we investigate responses of three types of investors: individual investors, 13F institutions, and short-sellers. Using novel data on security popularity from Robinhood, we find that shifts in individual investors' ownership of stocks in our sample are consistent with the observed abnormal return response to the exogenous change in the ESG rating methodology. This result suggests that retail investors are either unaware of the methodology change or misunderstand the new ESG *Risk* Rating. Consequently, they increase their investment in stocks that they perceive as more sustainable (with a higher ESG *Risk* Rating) and reduce their positions in pseudo-ESG downgraded firms (with a lower ESG *Risk* Rating).

When we examine behaviour of more informed investors, we find very distinct responses. 13F institutions, in aggregate, do not rebalance their portfolios in response to

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the implementation of the new ESG rating methodology. The lack of 13F institutions' response is consistent with our hypothesis that 13F investors are aware and understand the changes in the rating methodology. On the other hand, short-sellers react as informed investors are expected to behave – they take the other side of retail investors' trades. They increase their short positions for quasi-upgraded stocks and decrease their short positions for stocks with negative changes in their sustainability ratings.

Overall, these results suggest that investors relay on sustainability ratings and draw on them when choosing securities to (in)exclude (into) from their portfolios. However, investors' shortcomings in processing and understanding information may lead to sub-optimal allocation of capital in the markets even in the presence of arbitrageurs. Our work has important policy implications, as it stresses the importance of transparency of sustainability ratings and the need to provide access to information on firms' sustainability in a more unified manner.

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Table 1: Example of the change in the ESG rating methodology.

This table provides an example how the sustainability ratings change due to the implementation of the new rating methodology by Morningstar and Yahoo Finance. We list company's name, ticker symbol, ESG Rating, ESG *Risk* Rating, and Sustainalytics subindustries information for 8 firms. ESG Rating is a firm's sustainability rating at the beginning of September 2019 (the last month before the change in the ESG rating methodology). ESG *Risk* Rating is firm's sustainability rating at the beginning of October 2019 (the month when the new ESG rating methodology was adopted by Morningstar). Both Ratings share the same scale: 0 – 100. While ESG Rating increases with firm's degree of sustainability, ESG *Risk* Rating decrease. ESG *Risk* Rating allows for across industries comparisons and incorporate controversies into the risk rating. Sustainalytics estimates firm's material risk at a subindustry level.

COMPANY NAME	Ticker	ESG Rating (Pre)	ESG *Risk* Rating (Post)	Sustainalytics subindustry
Microsoft Corp	MSFT	75.00	14.28	Enterprise and Infrastructure Software
Earthstone Energy Inc	ESTE	46.00	68.07	Oil & Gas Exploration and Production
Marrone Bio Innovation Inc	MBII	45.00	62.40	Agricultural Chemicals
Outfront Media Inc	OUT	45.00	21.75	REITs
VF Corp	VFC	68.00	11.94	Luxury Apparel
Merck & Co Inc	MRK	68.00	30.37	Pharmaceuticals
Jounce Therapeutics Inc	JNCE	44.00	44.00	Biotechnology
SkyWest Inc	SKYW	43.00	43.05	Airlines

Table 2: Summary statistics.

This table reports summary statistics of the main variables used in this paper. Our sample focuses on U.S. common stocks with share code 10 and 11 with share price above 1 USD at the end of June 2019 and covers two sub-periods: from July 2019 to September 2019 (the last three months before Morningstar ESG rating change) and October 2019 to December 2019 (the first three months after the introduction of new Morningstar ESG methodology). For each variable, we calculate mean, median, standard deviation, 5th, 25th, 75th, and 95th percentile for each sub-period. 1-F ARET, 3-F ARET, 4-F ARET are stock i's abnormal return in month t using single-, three-factor, and Cahart four-factor model, respectively. We use 12-month moving-window in order to estimate risk factor loadings for each stock. ESG is Morningstar ESG rating. For the pre period, ESG denotes ESG Rating with values between 0 and 100. The higher ESG Rating is, the more sustainable is the firm. For the post period, ESG denotes ESG *Risk* Rating that decreases with firm's degree of sustainability. # RETAIL is a number of retail investors holding a given stock through Robinhood trading platform and expressed in hundreds. % 13F OWN is a percentage of shares outstanding held by 13F institutions expressed in percentage points. SHORT INT (%) denotes short interest and is defined as a percentage of shares outstanding sold short (expressed in percentage points). LOG(MCAP) is a natural logarithm of a stock's market capitalization.

	Pre (Jul 2019 – Sep 2019)							Post (Oct 2019 – Dec 2020)						
	Mean	SD	P5	P25	P50	P75	P95	Mean	SD	P5	P25	P50	P75	P95
1-F ARet	-0.73	6.50	-11.96	-3.53	-0.21	2.48	8.33	0.08	6.58	-8.95	-2.88	-0.24	2.55	10.75
3-F ARet	0.61	6.57	-9.83	-2.40	0.78	3.59	10.37	-0.04	6.56	-9.29	-3.03	-0.36	2.41	10.63
4-F ARet	0.65	6.62	-9.87	-2.40	0.73	3.58	10.91	-0.11	6.55	-9.43	-3.07	-0.30	2.41	10.39
ESG	43.71	5.35	36.35	40.16	42.55	47.00	53.72	30.38	10.43	14.63	22.83	30.02	36.53	48.99
# Retail	27.31	153.32	0.01	0.70	2.67	9.38	74.75	29.53	165.05	0.12	0.83	2.97	10.58	78.99
% 13F Own	17.06	11.13	0.00	6.81	18.10	27.53	31.85	16.86	10.99	0.00	8.20	16.22	27.36	31.82
Short Int (%)	5.60	6.36	0.49	1.54	3.26	7.22	18.84	5.47	6.54	0.34	1.46	3.14	6.91	18.12
Log(Mcap)	12.11	1.78	9.56	10.74	11.99	13.21	15.33	12.16	1.79	9.57	10.82	12.07	13.28	15.35

Table 3: The effect of new ESG rating methodology on stock abnormal returns – a difference-in-difference analysis.

This table reports coefficients from a difference-in-difference regressions of the form:

$$\text{ARET}_{i,t} = \gamma_0 + \gamma_1 \Delta\text{ESG}_i \times \text{POST}_t + \text{D}_i + \text{D}_t + \varepsilon_{i,t}.$$

Our sample focuses on U.S. common stocks with share code 10 and 11 and covers two sub-periods: from July 2019 to September 2019 (the last three months before Morningstar ESG rating change) and October 2019 to December 2019 (the first three months after the introduction of new Morningstar ESG methodology). ΔESG_i is a change in stock's i Morningstar ESG rating between September 2019 (the last month before Morningstar ESG methodology change) and October 2019 (the first month when ESG Risk Rating was introduced). $\Delta\overline{\text{ESG}}_i$ denotes a change in an average Morningstar ESG rating for stock i. In order to calculate an average ESG rating for pre (post) period, we use ESG Rating (ESG *Risk* Rating) for from July 2019 to September 2019 (October 2019 to December 2019). PSEUDO-ESG DOWNGRADE is a dummy variable that equals one if the change in an average ESG rating for stock i, $\Delta\overline{\text{ESG}}_i$, belongs to the lower quartile of $\Delta\overline{\text{ESG}}_i$ distribution and zero otherwise. PSEUDO-ESG DOWNGRADE$_i$ captures a quasi-downgrade of firm's sustainability – when stock i has a high ESG Rating before the methodology change and a very low ESG *Risk* Rating after the new methodology introduction. PSEUDO-ESG UPGRADE$_i$ is an indicator variable that takes value of one if a stock experiences a quasi-upgrade, otherwise zero. POST$_t$ is an indicator variable that equals one when the new ESG rating methodology is introduced, otherwise zero. In columns (1) – (4), we report regression coefficients with a single-factor abnormal return as an independent variable. We estimate it by using market beta from 12-month rolling-window regression. In columns (5) – (8) ((9) – (12)), we use three-factor (Carhart four-factor) abnormal return as a LHS variable. D$_i$ and D$_t$ denote stock and year×month fixed effects. Standard errors are corrected for heteroscedasticity and clustered at a stock level.

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	SINGLE FACTOR ABNRET				THREE FACTOR ABNRET				CARHART ABNRET			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\Delta\text{ESG}_i \times \text{POST}_t$	0.10 (7.17)				0.070 (4.83)				0.069 (4.80)			
$\Delta\overline{\text{ESG}}_i \times \text{POST}_t$		0.10 (7.10)				0.070 (4.78)				0.069 (4.76)		
PSEUDO ESG DOWNGRADE$_i \times \text{POST}_t$			-2.05 (-5.64)	-1.76 (-4.89)			-1.12 (-3.07)	-0.87 (-2.39)			-1.30 (-3.53)	-1.10 (-3.02)
PSEUDO ESG UPGRADE$_i \times \text{POST}_t$				3.57 (2.83)				3.21 (2.53)				2.47 (1.96)
Stock FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year×Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14471	14471	14471	14471	14471	14471	14471	14471	14471	14471	14471	14471
R^2	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

Standard errors clustered at a stock level – t statistics in parentheses.

Table 4: Investors response to the change in Morningstar ESG rating methodology – a difference-in-difference analysis.

This table reports coefficients from a difference-in-difference regressions of the form:

$$\Delta\text{OWNERSHIP}_i = \delta_0 + \delta_1 \Delta\text{ESG}_i + \eta_i.$$

Our sample focuses on U.S. common stocks with share code 10 and 11 and covers two sub-periods: from July 2019 to September 2019 (the last three months before Morningstar ESG rating change) and October 2019 to December 2019 (the first three months after the introduction of new Morningstar ESG methodology). ΔESG_i is a change in stock's i Morningstar ESG rating between September 2019 (the last month before Morningstar ESG methodology change) and October 2019 (the first month when ESG Risk Rating was introduced). $\Delta\overline{\text{ESG}}_i$ denotes a change in an average Morningstar ESG rating for stock i. In order to calculate an average ESG Morningstar rating for pre (post) period, we use ESG Rating (ESG *Risk* Rating) for from July 2019 to September 2019 (October 2019 to December 2019). PSEUDO-ESG DOWNGRADE$_i$ is a dummy variable that equals one if the change in an average ESG rating for stock i, $\Delta\overline{\text{ESG}}_i$, belongs to lower quartile and zero otherwise. PSEUDO-ESG DOWNGRADE$_i$ captures a quasi-downgrade of firm's sustainability – when stock i has a high ESG Rating before the methodology change and a very low ESG *Risk* Rating after the new methodology introduction. PSEUDO-ESG UPGRADE$_i$ is an indicator variable that takes value of one if a stock experiences a quasi-upgrade, otherwise zero. PSEUDO-ESG UPGRADE$_i$ is an indicator variable that takes value of one if a stock experiences a quasi-upgrade, otherwise zero. In columns (1) – (4), we report regression coefficients from $\Delta\#\text{RETAIL}_i$ on the change in firm's ESG rating. $\#\text{RETAIL}_{i,p}$ is defined as a mean number of Robinhood investors holding a stock i in period p divided by an average dollar trading volume between April and June 2016. In columns (5) – (8), we report estimates from $\Delta\%13\text{F}_i$ regressions. The $\%13\text{F}_{i,p}$ is defined as a percentage of shares outstanding held by 13F institutions at the end of September 2019 (the last quarter end before the change in ESG rating methodology) and December 2019 (the first quarter after the new ESG methodology introduction). In columns (9) – (12), we report regression estimates with $\Delta\%\text{SHORT INTEREST}_i$ as the LHS variable. $\%\text{SHORT INTEREST}_{i,p}$ is defined as an average percentage of shares outstanding that are sold short before and after the ESG rating methodology introduction. Standard errors are corrected for heteroscedasticity.

	$\Delta\#\text{Retail}_i$				$\Delta\%13\text{F}_i$				$\Delta\%\text{Short Interest}_i$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ΔESG_i	0.0037 (5.59)				-0.00080 (-0.09)				0.010 (3.78)			
$\Delta\overline{\text{ESG}}_i$		0.0037 (5.58)				-0.0011 (-0.12)				0.011 (3.82)		
Pseudo ESG Downgrade$_i$			-0.071 (-4.73)	-0.063 (-4.07)			0.053 (0.15)	0.055 (0.15)			-0.21 (-2.09)	-0.18 (-1.76)
Pseudo ESG Upgrade$_i$				0.10 (2.60)				0.019 (0.03)				0.41 (2.09)
Observations	2451	2451	2451	2451	2451	2451	2451	2451	2451	2451	2451	2451
R^2	0.014	0.014	0.005	0.008	0.000	0.000	0.000	0.000	0.005	0.005	0.002	0.004

Heteroscedasticity adjusted standard errors – t statistics in parentheses.

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Table 5: The effect of new ESG rating methodology on stock abnormal returns – a robustness analysis.

This table reports coefficients from a difference-in-difference regressions of the form:

$$\text{ARet}_{i,t} = \gamma_0 + \gamma_1 \Delta\text{ESG}_i \times \text{Post}_t + \gamma_2 \Delta\overline{\text{Sustainalytics Rating}}_i \times \text{Post}_t + \text{D}_i + \text{D}_t + \varepsilon_{i,t}.$$

Our sample focuses on U.S. common stocks with share code 10 and 11 and covers two sub-periods: from July 2019 to September 2019 (the last three months before Morningstar ESG rating change) and October 2019 to December 2019 (the first three months after the introduction of new Morningstar ESG methodology). ΔESG_i is a change in stock's i Morningstar ESG rating between September 2019 (the last month before Morningstar ESG methodology change) and October 2019 (the first month when ESG Risk Rating was introduced). $\Delta\overline{\text{ESG}}_i$ denotes a change in an average Morningstar ESG rating for stock i. In order to calculate an average ESG rating for pre (post) period, we use ESG Rating (ESG *Risk* Rating) for from July 2019 to September 2019 (October 2019 to December 2019). Pseudo-ESG Downgrade is a dummy variable that equals one if the change in an average ESG rating for stock i, $\Delta\overline{\text{ESG}}_i$, belongs to the lower quartile of $\Delta\overline{\text{ESG}}_i$ distribution and zero otherwise. Pseudo-ESG Downgrade$_i$ captures a quasi-downgrade of firm's sustainability – when stock i has a high ESG Rating before the methodology change and a very low ESG *Risk* Rating after the new methodology introduction. Pseudo-ESG Upgrade$_i$ is an indicator variable that takes value of one if a stock experiences a quasi-upgrade, otherwise zero. Post$_t$ is an indicator variable that equals one when the new ESG rating methodology is introduced, otherwise zero. $\Delta\overline{\text{Sustainalytics Rating}}_i$ is a change in stock i's sustainability *risk* rating available through Sustainalytics before and after the implementation of the new rating methodology by Morningstar. In columns (1) – (4), we report regression coefficients with a single-factor abnormal return as an independent variable. We estimate it by using market beta from 12-month rolling-window regression. In columns (5) – (8) ((9) – (12)), we use three-factor (Carhart four-factor) abnormal return as a LHS variable. D_i and D_t denote stock and year×month fixed effects. Standard errors are corrected for heteroscedasticity and clustered at a stock level.

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	SINGLE FACTOR ABNRET				THREE FACTOR ABNRET				CARHART ABNRET			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\Delta \text{ESG}_i \times \text{POST}_t$	0.11 (7.72)				0.078 (5.37)				0.078 (5.40)			
$\Delta \overline{\text{ESG}}_i \times \text{POST}_t$		0.11 (7.66)				0.079 (5.36)				0.079 (5.38)		
PSEUDO ESG DOWNGRADE$_i \times$ POST$_t$			-2.23 (-6.06)	-1.92 (-5.25)			-1.32 (-3.55)	-1.03 (-2.81)			-1.50 (-4.03)	-1.28 (-3.44)
PSEUDO ESG UPGRADE$_i \times$ POST$_t$				4.00 (3.06)				3.66 (2.78)				2.92 (2.23)
ΔSUSTAINALYTICS RATING$_i \times$ POST$_t$	-0.010 (-0.07)	-0.086 (-0.55)	-0.089 (-0.57)	-0.073 (-0.46)	-0.051 (-0.38)	-0.10 (-0.78)	-0.10 (-0.76)	-0.089 (-0.65)	-0.031 (-0.23)	-0.085 (-0.62)	-0.086 (-0.63)	-0.074 (-0.54)
Stock FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year×Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13669	13669	13669	13669	13669	13669	13669	13669	13669	13669	13669	13669
R^2	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14

Standard errors are clustered at a stock level − t statistics in parentheses.

Table 6: Investors response to the change in Morningstar ESG rating methodology – a robustness analysis.

This table reports coefficients from a difference-in-difference regressions of the form:

$$\Delta\text{OWNERSHIP}_i = \delta_0 + \delta_1 \Delta\text{ESG}_i + \delta_2 \Delta\overline{\text{SUSTAINALYTICS RATING}}_i + \eta_i.$$

ΔESG_i is a change in stock's i Morningstar ESG rating between September 2019 (the last month before Morningstar ESG methodology change) and October 2019 (the first month when ESG risk Rating was introduced). $\Delta\overline{\text{ESG}}_i$ denotes a change in an average Morningstar ESG rating for stock i. In order to calculate an average ESG Morningstar rating for pre (post) period, we use ESG Rating (ESG *Risk* Rating) for from July 2019 to September 2019 (October 2019 to December 2019). PSEUDO-ESG DOWNGRADE$_i$ is a dummy variable that equals one if the change in an average ESG rating for stock i, $\Delta\overline{\text{ESG}}_i$, belongs to lower quartile and zero otherwise. PSEUDO-ESG DOWNGRADE$_i$ captures a quasi-downgrade of firm's sustainability – when stock i has a high ESG Rating before the methodology change and a very low ESG *Risk* Rating after the new methodology introduction. PSEUDO-ESG UPGRADE$_i$ is an indicator variable that takes value of one if a stock experiences a quasi-upgrade, otherwise zero. PSEUDO-ESG UPGRADE$_i$ is an indicator variable that takes value of one if a stock experiences a quasi-upgrade, otherwise zero. In columns (1) – (4), we report regression coefficients from $\Delta\#\text{RETAIL}_i$ on the change in firm's ESG rating. $\Delta\overline{\text{SUSTAINALYTICS RISK RATING}}_i$ is a change in an average sustainability *risk* rating provided by Sustainalytics before and after the implementation of the new rating methodology by Morningstar. $\#\text{RETAIL}_{i,p}$ is defined as a mean number of Robinhood investors holding a stock i in period p divided by an average dollar trading volume between April and June 2016. In columns (5) – (8), we report estimates from $\Delta\%13\text{F}_i$ regressions. The $\%13\text{F}_{i,p}$ is defined as a percentage of shares outstanding held by 13F institutions at the end of September 2019 (the last quarter end before the change in ESG rating methodology) and December 2019 (the first quarter after the new ESG methodology introduction). In columns (9) – (12), we report regression estimates with $\Delta\%\text{SHORT INTEREST}_i$ as the LHS variable. $\%\text{SHORT INTEREST}_{i,p}$ is defined as an average percentage of shares outstanding that are sold short before and after the ESG rating methodology introduction. Standard errors are corrected for heteroscedasticity.

	$\Delta\#\text{Retail}_i$				$\Delta\%13\text{F}_i$				$\Delta\%\text{Short Interest}_i$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ΔESG_i	0.0026 (4.48)				0.0031 (0.33)				0.012 (4.48)			
$\Delta\overline{\text{ESG}}_i$		0.0026 (4.44)				0.0034 (0.36)				0.013 (4.53)		
Pseudo ESG Downgrade$_i$			-0.032 (-2.30)	-0.026 (-1.82)			-0.049 (-0.14)	-0.050 (-0.14)			-0.22 (-2.23)	-0.18 (-1.77)
Pseudo ESG Upgrade$_i$				0.080 (2.80)				-0.019 (-0.03)				0.55 (2.88)
$\Delta\overline{\text{Sustainalytics Rating}}_i$	-0.00021 (-0.08)	-0.0020 (-0.76)	-0.0018 (-0.68)	-0.0015 (-0.57)	-0.050 (-0.66)	-0.052 (-0.69)	-0.052 (-0.68)	-0.052 (-0.68)	0.0047 (0.20)	-0.0037 (-0.16)	-0.0035 (-0.15)	-0.0015 (-0.06)
Observations	2315	2315	2315	2315	2315	2315	2315	2315	2315	2315	2315	2315
R^2	0.012	0.012	0.002	0.005	0.000	0.000	0.000	0.000	0.007	0.007	0.002	0.006

Standard errors are adjusted for heteroscedasticity – t statistics in parentheses.

Figure 1: Abnormal return response to the change in ESG rating methodology.

This figure depicts the relation between a change in ESG ratings due to the new rating methodology and stocks' abnormal returns. We use a semi-parametric regression of a change in firm's single-factor abnormal return on the relative change in the ESG rating. We define the change in firm's single-factor abnormal return as a difference between stock's average abnormal return during period when the new ESG rating methodology has been implemented (October – December 2019) and before the methodology change was introduced (July – September 2019). The relative change in ESG rating captures the change in Morningstar ESG (*Risk*) Rating between post and pre the ESG rating methodology implementation relative to the mean change. The shaded areas represent 95% confidence intervals. The horizontal dashed orange line represents a zero change in firm's abnormal returns. The vertical dashed orange line depicts a mean change in the ESG ratings.
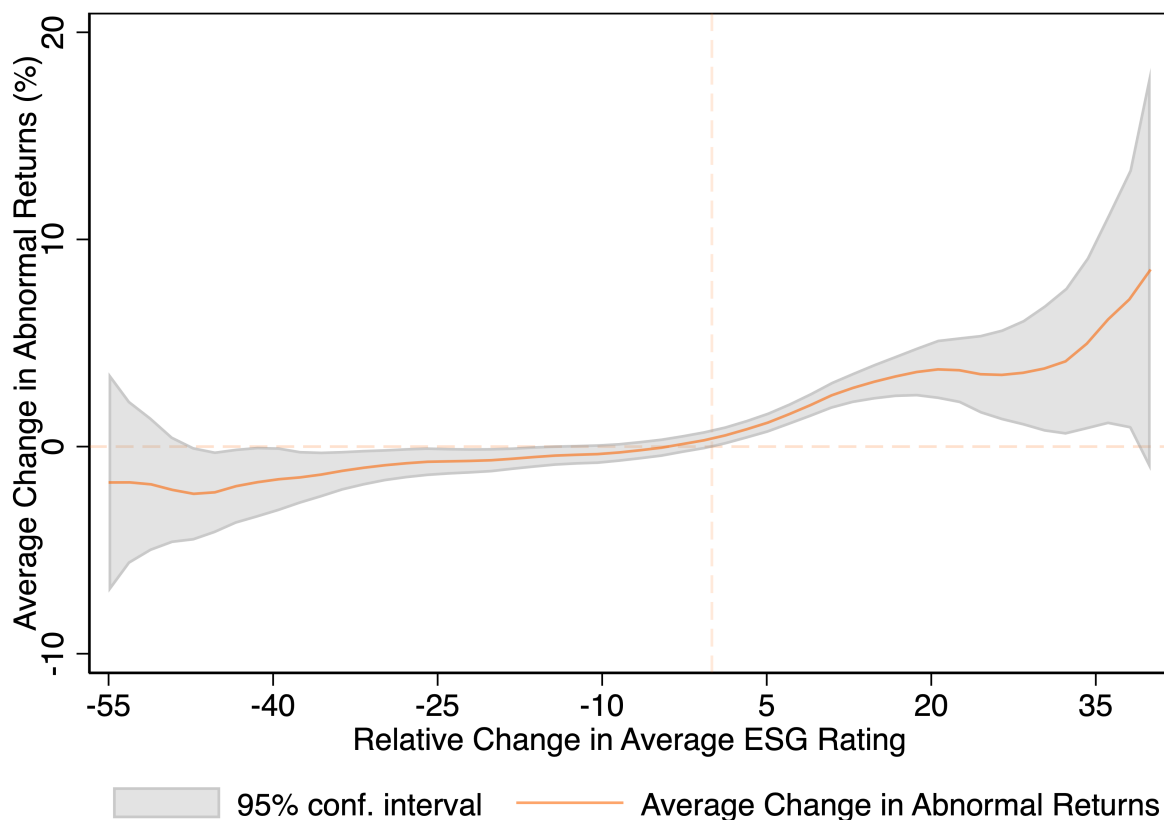
Figure 2: The histogram of a change in ESG ratings due to the adoption of the new ESG rating methodology.

This figure shows the distribution of a change in ESG ratings due to the introduction of the new ESG rating methodology by Morningstar. In order to calculate the change in an average ESG rating $\Delta\overline{\text{ESG}}$, we first compute an average ESG ($Risk$) Rating for pre (post) period and then, we take the difference between the two periods for each stock. We use ESG Rating (ESG $Risk$ Rating) for from July 2019 to September 2019 (October 2019 to December 2019). The orange vertical solid line represents the 25th percentile of $\Delta\overline{\text{ESG}}$ distribution. In our analysis, we use an additional measure of ESG rating change – a pseudo-ESG downgrade. PSEUDO-ESG DOWNGRADE is a dummy variable that equals one if the change in an average Morningstar ESG rating for stock i, $\Delta\overline{\text{ESG}}$, belongs to the lower quartile of $\Delta\overline{\text{ESG}}$ distribution and zero otherwise. PSEUDO-ESG DOWNGRADE captures a quasi-downgrade of sustainability rating – when stock i has a high ESG Rating before the methodology change and a very low ESG Risk Rating after the new methodology introduction.

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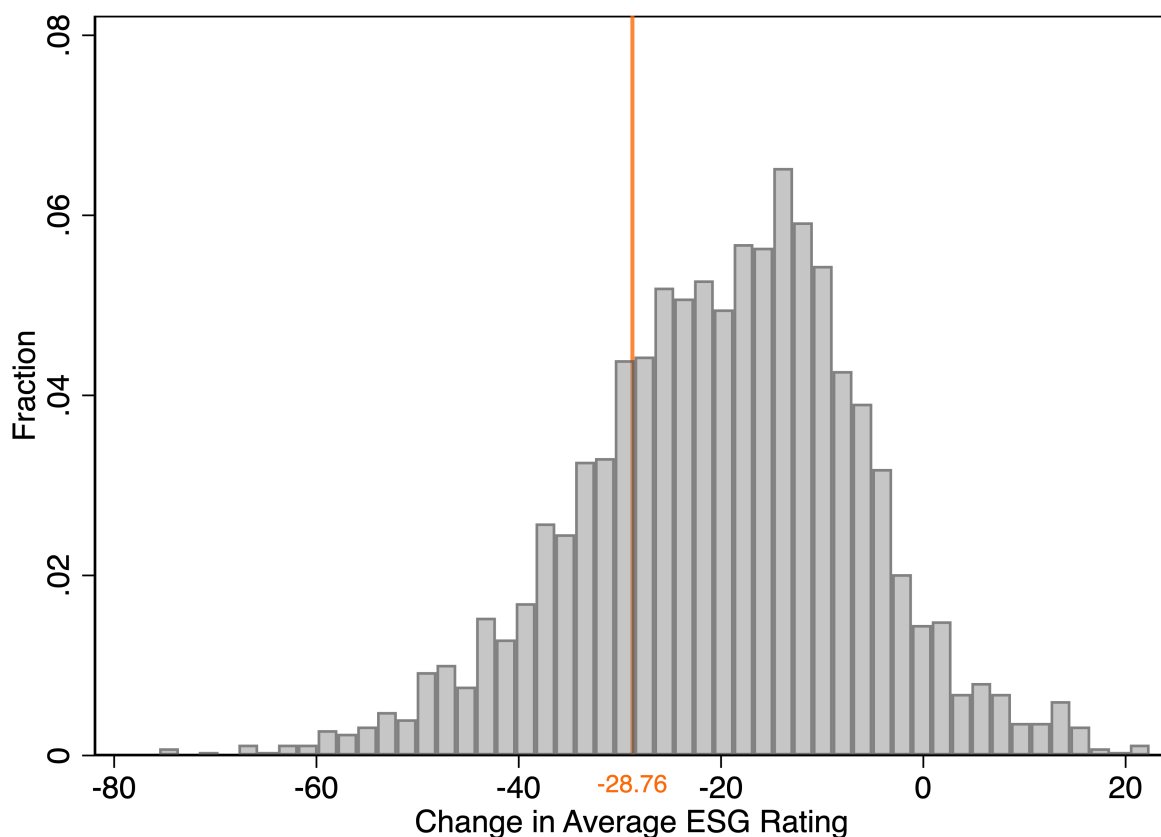
Figure 3: The effect of the new ESG rating methodology on stock abnormal returns – a dynamic difference-in-difference analysis.

This figure shows the relative effect of the new ESG rating methodology on abnormal returns of firms that experienced a quasi-downgrade of their sustainability ratings. We plot γ_e regression coefficients on the interaction terms from the following specification:

$$\text{ARET}_{i,t} = \gamma_0 + \sum_{e=-4,\, e\neq-1}^{6} \gamma_e \Delta \text{ESG}_i \times \text{D}(e)_t + \text{D}_i + \text{D}_t + \varepsilon_{i,t}.$$

$\text{ARET}_{i,t}$ is a single-factor abnormal return estimated by using market beta from 12-month rolling-window regression. ΔESG_i is a change in stock's i Morningstar ESG rating between September 2019 (the last month before Morningstar ESG methodology change) and October 2019 (the first month when the new ESG *Risk* Rating was introduced). We use September 2019 as a reference month. D_i and D_t denote stock and year×month fixed effects. In our analysis, we use U.S. common stocks with share codes 10 and 11 from June 2019 (4 months before Morningster ESG rating methodology change) until May 2020 (8 months after the new ESG rating methodology introduction). We plot with a grey dot point estimates together with 95% confidence intervals (dash line) using standard errors clustered at a stock level.
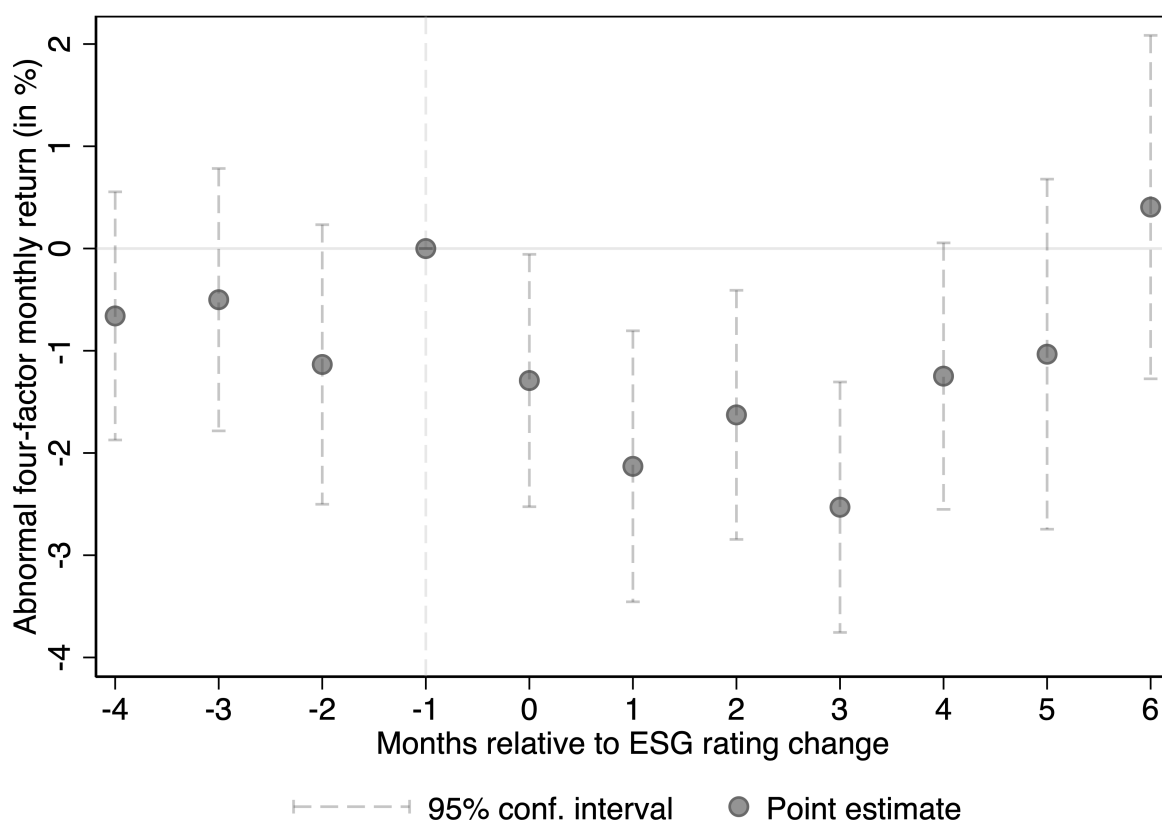
Figure 4: The relationship between the change in Sustainalytics rating and the change in ESG ratings due to the introduction of the new ESG rating methodology.

This figure shows the correlation between the change in an average Sustainalytics rating between post (October – December 2019) and pre (July – September 2019) period and the average change in ESG rating due to the introduction of the new ESG rating methodology by Morningstar and Yahoo Finance. For each firm we plot with grey circles the change in its Sustainalytics rating on the y-asxis and the change in ESG rating due to the adoptation of the new rating methodology on the x-axis. The orange line represents the linear regression model that is tabulated in the bottom left corner of the figure.

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