

# Short Sellers and Social Responsibility Ratings\*

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## Abstract

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# Short Sellers and Social Responsibility Ratings

## Abstract

We study how socially responsible investing has impacted short selling. Among firms with high levels of expected short interest, those with higher social responsibility ratings have less shorting. This persists despite these firms having more lendable shares and lower lending fees. We show that social responsibility ratings create costs for short sellers through two channels: 1) some long-side investors are reluctant to sell socially responsible stocks, even if valuations warrant it, and 2) short squeeze risk—socially responsible stocks may experience price jumps when attention to ESG issues spikes. Our findings show socially responsible investing can deter short selling.

*Keywords:* Corporate social responsibility ratings; environmental ratings; short-selling targets; short-selling risks; market efficiency

*JEL Classification:* G12; G14; G23; G41

# 1 Introduction

The Forum for Sustainable and Responsible Investment estimated in 2020 that 33% of professionally managed assets in the U.S.—\$17.1 trillion or more in aggregate—take socially responsible investment factors into account when making investment decisions. This means that many investors make decisions not just based on expected financial returns but also on how firms are rated according to various social and environmental criteria. In this paper, we study whether that impacts short selling. Specifically, we ask whether short sellers avoid firms that may be attractive to investors who consider social and environmental ratings in their investment decisions. This question is important because a good deal of academic research shows that short sellers are sophisticated investors who make markets more efficient (e.g., [Dechow, Hutton, Meulbroek, and Sloan \(2001\)](#), [Duan, Hu, and McLean \(2010\)](#), [Boehmer, Jones, and Zhang \(2008\)](#), [Christophe, Ferri, and Hsieh \(2010\)](#), [Engelberg, Reed, and Ringgenberg \(2012\)](#), and [Boehmer and Wu \(2013\)](#)). If socially responsible investing limits short selling, then it may also limit the roles that short sellers play in price formation and market efficiency.

[Diamond and Verrecchia \(1987\)](#) point out that short sellers face additional costs and risks relative to long investors. Arbitrage positions and especially short positions have holding costs ([Pontiff \(1996 and 2006\)](#), and [Ofek, Richardson, and Whitelaw \(2004\)](#)). Short sellers must keep their short sale proceeds in a margin account that pays minimal or no interest. They must pay lending fees on borrowed shares. They are exposed to both fundamental risk and noise trader risk ([Barberis, and Thaler \(2003\)](#)). Thus, the longer a short position remains open, the costlier it is for the short seller. We hypothesize that higher corporate social responsibility ratings can increase these costs and risks. If this is the case, then, all else equal, there should be less shorting in stocks with higher corporate social responsibility ratings.

Typically, long-side investors sell stocks they believe to be overvalued. However, investors

with preferences for social and environmental ratings may continue to hold highly rated stocks even if market values or earnings news suggest a sale is warranted (Cao, Titman, Zhan, and Zhang (2023) and Starks, Venkat, and Zhu (2024)). If a significant number of investors behave this way, then mispricing will take longer to resolve.<sup>1</sup> For this reason, short sellers may avoid shorting stocks with higher social and environmental ratings, as the aforementioned holding costs may be greater.

The risk of a short squeeze may also be higher for stocks with higher social and environmental ratings. Although investors may buy such stocks for rational reasons, some investors could develop sentiment toward socially responsible investing. For example, investors could become overly optimistic about firms with high ESG ratings. If short sellers take positions in firms with high ESG ratings and positive sentiment toward ESG investing spikes, short sellers may face a margin call or even be forced to exit the position at a loss.

Our empirical analyses use two social responsibility ratings: ESG ratings from the Refinitiv ESG database and the “Green score” from Pástor, Stambaugh, and Taylor (2022). We also use two measures of expected short interest. The first is the model of Drake, Rees, and Swanson (2011). It is based on 11 firm-level variables that significantly predict short interest ratios. The expected value from this model is a strong predictor of short selling in our sample. We also use the mispricing score from Stambaugh, Yu, and Yuan (2015), a widely-used metric based on 11 prominent stock return anomalies. The mispricing score is also a strong predictor of short selling in our sample.

We find that overall and especially among firms with high levels of expected short interest, those with higher ESG scores and higher Green scores have less shorting. These effects are not driven by commonly used measures of short sale constraints, such as the supply of lendable shares and lending fees. In contrast, among firms with high levels of expected short interest, those with high ESG scores and high Green scores have more lendable shares, lower lending

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<sup>1</sup>Some short sellers may also agree with the firm’s social agendas and not want to short it for the same reason that socially responsible investors take long positions.

fees, and less volatile lending fees. Thus, even though short sellers are not facing higher constraints, they are still less willing to short stocks with higher social and environmental ratings.

To better establish a causal link between corporate social responsibility ratings and short selling, we utilize the biannual FTSE4Good index reconstitution as an exogenous shock to corporate social responsibility ratings. The FTSE4Good index specializes in corporate ESG issues, and inclusion in the index enhances a firm’s ESG reputation. We match the included event firms with similar control firms according to several important firm characteristics and conduct a difference-in-differences regression analysis using the matched sample. After inclusion in the FTSE4Good index, treated firms have significantly less short selling than matched control firms. These findings further support the idea that short sellers avoid stocks attractive to investors who prefer higher social and environmental scores.

We then study the mechanisms through which corporate social responsibility ratings impact short selling. Institutions that favor socially responsible stocks may underreact to overvaluation in highly rated stocks, making the mispricing more persistent and short selling more costly. Consequently, short sellers may be less willing to short high ESG stocks that are held by socially responsible institutions, even when these stocks have strong short-selling signals. Consistent with this idea, we find that the negative relation between social responsibility ratings and short selling is stronger in stocks with more ownership by institutions focused on socially responsible investing.

We find that institutional investors typically sell firms with high levels of expected short interest. That makes sense, as institutions will want to reduce ownership in stocks that may be overvalued. However, we find that high ESG scores eliminate this effect; institutions do not sell stocks with high levels of expected short interest that also have high ESG scores.

We next examine short squeeze risk. If sentiment towards ESG varies over time, then it can create the risk of a short squeeze in high ESG stocks. Consistent with this idea, we find that when the Google Search Volume Index for the topic “Environmental, social and

corporate governance” increases, the shorting of high ESG stocks decreases.

Our paper is the first to investigate the effect of corporate social responsibility ratings on short selling. We build on a literature showing that some long-side institutions prefer firms with higher ESG or other social responsibility ratings. [Starks, Venkat, and Zhu \(2024\)](#) document that long-term institutional investors are more patient with high ESG firms, as they are less inclined to sell high ESG stocks with disappointing earnings. [Cao, Titman, Zhan, and Zhang \(2023\)](#) show that socially responsible institutions react less strongly to quantitative signals. We complement these studies by showing that short sellers avoid stocks with higher social responsibility ratings. As we mention above, this investigation is important because a large number of papers show that short sellers contribute to market efficiency.

Our paper suggests that ESG ratings can create additional risks and costs for short sellers. Much of the short-selling literature focuses on short sellers’ information sources (see, for example, [Karpoff and Lou \(2010\)](#), [Christophe, Ferri, and Hsieh \(2010\)](#), [Dechow, Hutton, Meulbroek, and Sloan \(2001\)](#), [Hirshleifer, Teoh, and Yu \(2011\)](#), [Drake, Rees, and Swanson \(2011\)](#), and [McLean, Pontiff, and Reilly \(2022\)](#)) and constraints ([Reed \(2002\)](#), and [Saffi, and Sigurdsson \(2011\)](#)). Papers showing that costs and risks impact short selling include [Asquith, Pathak, and Ritter \(2005\)](#), [Duan, Hu, and McLean \(2010\)](#), and [Engelberg, Reed, and Ringgenberg \(2012\)](#). Our paper builds on these studies and shows that socially responsible investing can create additional costs and risks for short sellers.

Our paper is also related to an emerging literature concerned with how social responsibility ratings affect asset prices. Empirical studies document mixed evidence of the relation between corporate social responsibility ratings and future stock returns. For example, [Hong and Kacperczyk \(2009\)](#) find that “sin” stocks outperform other stocks. Using “100 Best Companies to Work for in America” as a measure of employee satisfaction, [Edmans \(2011\)](#) documents a positive relationship between employee satisfaction and long-run stock performance. [Bolton and Kacperczyk \(2021\)](#) find that the firms with higher total CO2 emissions have higher returns and conclude that this effect reflects compensation for risk. In contrast,

Atilgan, Demirtas, Edmans, and Gunaydin (2024) show that unexpected returns around earnings announcements drive this effect, which is consistent with mispricing. We build on these studies by showing that social responsibility ratings can limit short sellers' role in price formation.

## 2 Data and Key Measures

### 2.1 Data

The data that we use in this paper are taken from several sources. ESG ratings are from Refinitiv ESG score, which covered firms in the S&P 500 index at the beginning of our sample period and later expanded to the Russell 1000 index.<sup>2</sup>

We obtain daily firm-level data on equity lending characteristics, including the short interest ratio, lendable shares, the utilization ratio, and lending fees from Markit Securities Finance. We acquire analyst coverage and forecast data from I/B/E/S. Stock returns, prices, and trading volumes are obtained from the Center for Research on Security Prices (CRSP). Accounting data are from COMPUSTAT.

We use institutional holdings (13F) data from Thomson Reuters, and data on U.S. individual stock options from OptionMetrics. We obtain monthly Fama-French factors and risk-free rates from Kenneth French's data library. Our sample period is from January 2006 to December 2022. We begin in 2006 because this is the first year that Markit provides daily short selling data.

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<sup>2</sup>The scores were initially constructed by ASSET4, a company acquired in 2009 by Thomson Reuters. In 2017, Thomson Reuters enriched the database with thirteen new data items, with one of them being a new, modified overall ESG score. We use this ESG score for our analysis. In 2018, Thomson Reuters spun off the ESG rating business into a separate subsidiary, Thomson Reuters Refinitiv, and renamed the ratings Refinitiv ESG.

## 2.2 Key measures

### 2.2.1 Short Targets: Expected Values of Shorting

Our study asks whether short sellers avoid stocks with high social responsibility ratings that they would otherwise target. Most stocks have little short interest. To address this issue, we estimate an expected value of short selling and focus on stocks with high expected values. We follow [Drake, Rees, and Swanson \(2011\)](#) and use the parameters from their regression model to estimate an expected short interest ratio.<sup>3</sup>

[Drake, Rees, and Swanson \(2011\)](#) run an ordered logistical multivariate regression using 11 variables, which have been shown in prior research to predict stock returns. [Drake et al. \(2011\)](#) show that these variables also predict short selling in the expected direction. These 11 predictors are classified into four groups. The first group labeled Accounting, consists of earnings surprise (SUE), total accruals (TACCR), and capital expenditures (CAPEX). The Valuation group consists of market-value-of-equity (MVE), earnings-to-price ratio (EP), book-to-market ratio (BTM), and average daily stock turnover (TURN). The Growth group consists of realized sales growth (SG) and forecasted long-term earnings growth (LTG). The Momentum group consists of earnings forecast revisions (FREV) and price momentum (MOM).

We use the coefficients from the [Drake et al. \(2011\)](#) estimation to calculate a predicted short interest value for each firm-quarter. We then sort each monthly cross-section of stocks into five groups based on the predicted short-interest values as of the most recent quarter-end. The stocks in the highest quintile with the highest expected short interest are defined as *Short Target*. *Short Target* does a good job at predicting actual short selling. Stocks defined as *Short Target* have an average short interest ratio of 7.07%, while those that are not *Short Target* have an average value of 3.05%.

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<sup>3</sup>The parameter values that we obtain from [Drake, Rees, and Swanson \(2011\)](#) are reported in Table 3, Panel B, of their paper.

We also use the [Stambaugh, Yu, and Yuan \(2015\)](#) composite quantitative signal (SYY score) to define the short-selling targets. The SYY score is updated monthly based on an average of each stock’s rankings on 11 anomaly variables. The SYY score is constructed each month by averaging the cross-sectional rankings of 11 anomaly variables. The variables include *Net Stock Issues*, *Composite Equity Issues*, *Accruals*, *Net Operating Assets*, *Asset Growth*, *Investment to Assets*, *Distress*, *O-score*, *Momentum*, *Gross Profitability Premium*, and *Return on Assets*.

For each anomaly variable, stocks are sorted into 100 groups and assigned a rank of 1 to 100. The highest rank is given to stocks with the lowest predicted returns or stocks that are the most overvalued according to the anomaly variables. We sort the stocks into five groups based on the monthly mispricing score. Those that fall into the fifth quintile, which are expected to have the lowest returns, are identified as short targets. We obtain similar results using SYY and the [Drake et al. \(2011\)](#) measure and thus only report results using the SYY measure for robustness in the last two tables of this paper.

### 2.2.2 Social Responsibility Measures

We use two different measures of corporate social responsibility. The first is the annually updated ESG score from the Refinitiv database. According to Refinitiv, the scores are based on the relative ratings of ESG factors with the company’s sector (for environmental and social) and country of incorporation (for governance). Refinitiv ESG score covers more than 15,500 firms globally that are represented in major indices. Raw Refinitiv ESG scores range from 0 to 100. We divide the raw Refinitiv ESG scores by 100 to interpret regression coefficients more conveniently.

Our second measure is the Green score from [Pástor, Stambaugh, and Taylor \(2022\)](#). We follow [Pástor et al. \(2022\)](#) and compute the unadjusted greenness score of firm  $i$  at the end of quarter  $t$  as:

$$G_{i,t} = -(10 - Escore_{i,t}) \times \frac{Eweight_{i,t}}{100}, \quad (1)$$

where  $Escore_{i,t}$  and  $Eweight_{i,t}$  are from company  $i$ 's most updated MSCI rating data at the end of quarter  $t$ .<sup>4</sup> The quantity  $10 - Escore_{i,t}$  measures how far the company is from a perfect environmental score of 10. The product  $(10 - Escore_{i,t}) \times Eweight_{i,t}$  measures how brown the firm is, which reflects both how poorly the firm scores on environmental issues and how large the environmental impacts are for the industry's typical firm (i.e.,  $Eweight_{i,t}$ ). The initial minus sign converts the measure from brownness to greenness. Finally, the Green score we use in our analysis is

$$g_{i,t} = G_{i,t} - \overline{G_t} \quad (2)$$

where  $\overline{G_t}$  is the value-weighted average of  $G_{i,t}$  across all the firms  $i$ . Our final Green score measures the company's greenness relative to the market portfolio, as in [Pástor, Stambaugh, and Taylor \(2022\)](#).

### 2.2.3 Short Selling Variables

We use two variables to measure short selling and four variables that reflect short-sale constraints. To measure short selling at the stock-month level, we take the daily average of each short selling variable every month.

Short selling variables:

*Short Interest Ratio* is shares shorted scaled by total shares outstanding.

*Utilization Ratio* is shares shorted divided by the number of lendable shares.

Short sale constraint variables:

*Lendable Shares Ratio* is the number of daily shares available for lending relative to a firm's total shares outstanding.

*Lending Fee* is the average transaction-weighted rate reported by Markit and expressed

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<sup>4</sup>*Escore* is a number between 0 and 10 measuring the firm's weighted-average score across 13 environmental issues related to climate change, natural resources, pollution and waste, and environmental opportunities. These scores are designed to measure a company's resilience to long-term environmental risks. *Eweight* which is typically constant across firms in the same industry, is a number between 0 and 100 measuring the importance of environmental issues relative to social and governance issues.

in percentage per annum.

*Lending Fee Volatility* is the standard deviation of the daily lending fee within each month. This measure comes from Engelberg, Reed, and Ringgenberg (2018). Engelberg et al. (2018) and D’Avolio (2002) document that short sellers are concerned not only with the level of fees but also with volatility of fees.

*Put-Call Volatility Ratio* is the ratio of the implied volatility of put options to the implied volatility of call options. Short sellers facing short sale constraints may buy put options in the option market instead, thus making the put-call ratio deviate from one. To measure the demand for put options relative to call options, we focus on the middle-term ATM options with maturity between 30 days to 60 days and the absolute delta between 0.4 and 0.6.

#### 2.2.4 Other Firm-Level Variables

We use several common firm-level variables as controls in our regression.

$\ln(ME)$  is the logarithm of market capitalization.

$\ln(BM)$  is the logarithm of the book equity-to-market equity ratio.

*Institutional Ownership* is the total number of shares held by 13F institutions at the end of the most recent quarter scaled by total shares outstanding.

*Analyst* is the number of analysts following the firm, measured at the end of the last month.

*Leverage* is total liabilities scaled by total assets at the most recent fiscal year-end.

*Loss* is a dummy variable indicating a negative net income.

### 2.3 Sample summary

We report the time-series average of cross-sectional summary statistics in Table 1. Panel A reports descriptive statistics for the short selling variables. The average *Short Interest*

*Ratio* is 3.93%, so the average firm has 3.93% of its outstanding shares shorted. The *Short Interest Ratio* variable is right-skewed; the median is only 1.94%. So, although some firms have high amounts of shorting, most have very little. The 10<sup>th</sup> percentile and 90<sup>th</sup> percentile values of *Short Interest Ratio* are 0.34% and 10.25%.

Not all of a firm’s shares can be borrowed. The *Lendable Shares Ratio* averages 28.44% in our sample, so for the typical firm, slightly more than a quarter of its shares can be borrowed. The *Utilization Ratio*, which scales shares shorted by the number of lendable shares, averages at 11.58%. Like the *Short Interest Ratio*, the *Utilization Ratio* is right-skewed, as its median is 5.72%. Both the *Short Interest Ratio* and the *Utilization Ratio* have sizeable cross-sectional variation, with standard deviations of 5.15% and 14.72%, respectively.

The average *Lending Fee* is 0.56% per year, so it is typically inexpensive to borrow shares in our sample. The 10<sup>th</sup> percentile and 90<sup>th</sup> percentile values of *Lending Fee* are 0.34% and 0.42%, so the vast majority of stocks do not have high lending fees, whereas a few in the right tail have very high lending fees, as the mean value exceeds the 90<sup>th</sup> percentile value.

[Insert Table 1 about here]

Panel B of Table 1 reports summary statistics for the *ESG Score*, *Green Score*, and other firm-level variables that we use in our analyses. *ESG Score* ranges from 0 to 1. It has a mean of 0.42, a median of 0.40, and a standard deviation of 0.19. *Green Score* has an average of 0.06, a median of 0.25, and a standard deviation of 1.25. Such large variations in ESG scores and Green scores are useful for estimating the effect of corporate social responsibility ratings on short selling.

The variable *Short Target* is equal to 1 if the firm is in the highest quintile of expected short interest values from the Drake, Rees, and Swanson (2011) estimation and zero otherwise. In our sample, 24% of the stocks have *Short Target* values of 1.

Our sample is limited to firms with ESG ratings from Refinitiv, which rates firms in the S&P 500 and the Russell 1000. These are all large firms. The average firm in our sample has

80% of shares held by institutions and is followed by 14.71 analysts. Short sale constraints and other types of arbitrage costs tend to be smaller for large firms ([Pontiff \(2006\)](#)).

Panel C reports the time-series averages of cross-sectional Pearson and Spearman correlations among our main variables. The Pearson correlations are shown below the diagonal and Spearman correlations are above the diagonal. There are several interesting correlations worth noting, taking Spearman correlations as an example. The *ESG Score* and *Green Score* are only weakly correlated (0.09). So, each variable reflects a fairly independent measure of corporate social responsibility. What constitutes good social and environmental policy is subjective, so it is unsurprising that different variables may disagree. Disagreement among the metrics is beneficial for our purposes, as each variable can then give us a fairly independent test. What matters for our framework is that a sufficient number of Investors consider the firm attributes that the metric is capturing.

The Spearman correlation between *ESG Score* (*Green Score*) and the *Short Interest Ratio* is -0.25 (-0.07). Similarly, the Spearman correlation between *ESG Score* (*Green Score*) and *Short Target* is -0.13 (-0.12), so stocks that are expected to be targeted by short sellers do not have high ESG scores or high Green scores. We have no controls here, but the correlations do suggest that stocks with high ESG scores and high Green scores are on average not highly shorted.

## 3 Main Results

### 3.1 Short selling and corporate social responsibility ratings

We begin our analyses by examining the effect of ESG ratings and the *Green Score* on short selling.<sup>5</sup> We estimate the following firm-month panel regression:

$$\begin{aligned} Short\ Selling_{i,t} = & \alpha + \beta_1 ESG_{i,t-1} \times Short\ Target_{i,t-1} + \beta_2 ESG_{i,t-1} + \beta_3 Short\ Target_{i,t-1} \\ & + \beta' X_{i,t-1} + \gamma_i + \theta_i + \epsilon_{i,t} \end{aligned} \quad (3)$$

where *Short Selling*<sub>*i,t*</sub> is either the short interest ratio or the utilization ratio, *Short Target*<sub>*i,t-1*</sub> is a dummy that equals one for stocks in the top quintile based on expected short interest values from the model of [Drake, Rees, and Swanson \(2011\)](#) as of the most recent quarter-end. *Short Selling*<sub>*i,t*</sub> is the average daily short-selling activities in each month, measured either by the short interest ratio or the utilization ratio. *ESG*<sub>*i,t-1*</sub> is the most recent *ESG Score* (or *Green Score*) at the end of the last month. *X*<sub>*i,t-1*</sub> are control variables, which include market capitalization, book-to-market ratio, institutional ownership, analyst coverage, firm leverage, and a loss dummy.  $\gamma_i$  is the time-fixed effect, and  $\theta_i$  is the firm-fixed effect.

The coefficient for ESG ( $\beta_2$ ) captures the incremental effect of ESG Ratings on short selling after controlling for other factors known to impact short selling. The coefficient on the interaction term ( $\beta_1$ ) shows whether the effects of ESG on shorting are different for firms with high expected short interest ratios, or those with values of *Short Target* equal to 1. The sum of the  $\beta_1$  and  $\beta_2$  coefficients estimates the total effect of ESG on short selling. The results are reported in Table 2. We use the *ESG Score* in Panel A and replace it with the *Green Score* in Panel B.

In all of the specifications, the coefficient on *Short Target*<sub>*i,t-1*</sub> is positive and statistically

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<sup>5</sup>We focus on the short targets because these stocks would typically be targeted by short sellers.

significant, showing that the expected short interest ratio from [Drake, Rees, and Swanson \(2011\)](#)’s estimation strongly predicts the actual short interest ratio. In regression 2, which has the full set of controls, the *Short Target* coefficient is 2.640 (t-statistic = 9.42). This means that, on average, firms with Short Target values of one have short interest that is higher by 2.64%. The sample mean (median) for short interest is 3.93% (1.94%), so 2.64% is a meaningful effect.

Across all four of the specifications in Panel A, both the ESG coefficient and the interaction coefficient are negative and significant. Thus, higher ESG ratings reduce short selling, and do so more among stocks that short sellers would typically target.

In regressions 1 and 2, the dependent variable is the *Short Interest Ratio*. The sum of the ESG coefficient and interaction coefficients in regression 2, which has the full set of controls, is  $-0.672 + -2.301 = -2.973$ . Based on this, a one-standard-deviation increase in *ESG Score* (0.19) is associated with a 0.56% decrease in short interest ratios among firms that short sellers typically target. As we mention above, the mean (median) level of short interest in our sample is 3.93% (1.94%), so 0.56% is a sizeable effect.

Regressions 3 and 4 replace the *Short Interest Ratio* with the *Utilization Ratio* (shares shorted / lendable shares) as the dependent variable. In regression 4, the ESG coefficient is -1.742, and the *ESG-Short Target* interaction coefficient is -10.961 (t-statistic = -5.86). With these coefficients, we can estimate that a one-standard deviation increase in *ESG Score* leads to a 2.41% decrease in the *Utilization Ratio* among firms likely to be targeted by short sellers. The *Utilization Ratio* has a mean (median) value of 11.58% (5.72%), so this also is an economically meaningful effect.

[Insert Table 2 about here]

Panel B of Table 2 uses the *Green Score* of [Pástor, Stambaugh, and Taylor \(2022\)](#) in place of the ESG score. Consistent with the results with ESG scores in Panel A, we find that higher Green scores are associated with lower levels of short selling. In all four

specifications, the coefficients for the *Green Score* and the coefficients for the interaction between *Green Score* and *Short Target* are negative and 7 out of the 8 are significant.

In regression 2, the dependent variable is the *Short Interest Ratio*, and the full set of controls are included. The coefficient for *Green Score* is -0.163 (t-statistic = -2.39), while the coefficient for *Short Target*  $\times$  *Green Score* is -0.196 (t-statistic = -2.16). A one-standard-deviation increase in the *Green Score* is therefore associated with a 0.45% decrease in short interest, which is about the same effect as that with the *ESG Score* in Panel A. In regression 4, the overall effect of a one-standard-deviation increase in *Green Score* is a 0.85% reduction in the utilization ratio for a firm that is a short target. This effect is smaller than that of ESG, which is reported in Panel A, but the effect here is still economically significant.

### 3.2 The role of short sale constraints

The results in Table 2 suggest that higher ESG ratings and green scores deter short sellers. Perhaps this is because firms with higher ESG scores and higher green scores have higher lending fees and other common short sale constraints. We explore this possibility in Table 3.

In these analyses, we estimate the regressions reported in Table 2, but replace the measures of short selling with measures of short sale constraints as the dependent variables. We use four different measures of short sale constraints described in Section 2.2.3: lendable shares, lending fees, volatility in lending fees, and the put-call implied volatility ratio. We report the results in Table 3. Panel A reports results for the *ESG Score* and Panel B reports results for the *Green Score*.

[Insert Table 3 about here]

In Panel A, regressions 1 and 2 report the results for *Lendable Shares* (shares available for loan / total shares outstanding), which measures the willingness of long investors to

lend out shares. The coefficient for *ESG* is positive and significant, showing that overall, high ESG stocks have a greater supply of lendable shares. The coefficient on the interaction of *Short Target* and *ESG* is not significant, so high ESG stocks that short sellers would typically target do not have a lower supply of lendable shares.

Regressions 3 and 4 study lending fees. Lending fees are not higher for high ESG stocks. Lending fees are unsurprisingly higher for stocks that are *Short Targets*, but less so if a *Short Target* also has a high *ESG Score*. In regression 3, the coefficient for the *Short Target* is 0.243 (t-statistic = 2.85), while the coefficient for the *Short Target* and *ESG Score* interaction is -0.405 (t-statistic = -2.53). *ESG Scores* range from 0 to 1, so *Short Targets* with *ESG Scores* above 0.6 have lower lending fees than firms that are not *Short Targets*. It could be that lending fees are lower for *Short Targets* with high *ESG Scores* because short sellers avoid stocks with high *ESG Scores*. In any case, higher lending fees are not deterring short sellers from shorting high ESG stocks.

Engelberg, Reed, and Ringgenberg (2018) explain that lending fee volatility is a risk to short sellers and show that it deters short selling. But this does not explain why short sellers avoid stocks with high ESG scores. Regressions 5 and 6 show that high ESG stocks do not have higher lending fee volatility. It is higher for short targets, but ESG scores reduce this effect. In regression 6, the coefficient for *Short Target* is 0.052 (t-statistic = 3.91) and the coefficient for *Short Target*  $\times$  *ESG Score* interaction is -0.096 (t-statistic = -3.31). Thus, for short targets with ESG scores above 0.54, lending fee volatility is lower as compared to stocks that are not short targets. Put differently, short targets with high ESG scores are less risky to short in terms of lending fee volatility, so it cannot explain the low short interest in high ESG stocks.

Regressions 7 and 8 show that the put-call implied volatility ratio is lower for short targets with high ESG scores, indicating that investors are not buying more options on these stocks due to higher short sale constraints. As with lending fees and lending fee volatility, the coefficient for *Short Target* is positive and significant, so firms that are short targets

have higher put-call implied volatility ratios, but for short targets that also have high ESG scores, the put-call implied volatility ratios are lower.

Panel B of Table 3 reports the results using *Green Score* instead of the *ESG Score*. Regressions 1 and 2 show that firms with higher *Green* scores have more lendable shares than other firms. The interaction between *Green Score* and *Short Target* is insignificant, so short sellers are not avoiding firms with high *Green* scores due to a lack of shares being available to short.

Regressions 3 and 4 report the results for lending fees. Lending fees are not higher for firms with higher *Green Score* values. The interaction coefficients for *Short Target* and *Green Score* are positive and insignificant, so short sellers are not avoiding firms with higher *Green* scores because of high lending fees. Regressions 5 and 6 show that lending fee volatility is not higher for firms with higher *Green* scores, nor is it higher for short targets with higher values of *Green Score*. Regressions 7 and 8 report similar findings using the put-call implied volatility ratio.

Taken in their entirety, the findings in Table 3 show that the lower levels of short selling for firms with high ESG scores and high *Green* scores, documented in Table 2, are not due to common short sale constraints such as fewer lendable shares, higher lending fees, and more volatile lending fees. If anything, these common constraints are lower for short targets with high ESG scores and high *Green* scores.

### 3.3 A natural experiment with the FTSE4Good index

To establish a causal link between corporate social responsibility ratings and short selling, we study the effects of the biannual reconstitution of the FTSE4Good index on short selling. Inclusion in the index may be considered a shock to the firm’s corporate social responsibility reputation.

Launched in 2001, the FTSE4Good Index Series serve as benchmarks and tradable indices

for ESG investors. Criteria for index inclusion are developed via an extensive market consultation process and approved by an independent committee of experts. There are two different indices. The FTSE4Good Developed Index (23 countries) and FTSE4Good Emerging Index (20 countries). We focus on U.S. stocks, which are included in the FTSE4Good Developed Index. As of May 31, 2024, there were 267 U.S. stocks in the FTSE4Good Developed Index, constituting 62.12% of the index's total market capitalization (FTSE (2024))<sup>6</sup>.

Because FTSE4Good is an established index specializing in corporate ESG issues, inclusion events should positively shock the included firms' ESG reputations. Moreover, funds that have an ESG focus benchmark themselves against ESG indices. Inclusion in an ESG index may mean that ESG-focused funds will want to hold the stock to reduce tracking error. For these reasons, we test whether short sellers treat stocks differently after inclusion in the FTSE4Good Index.

To test for the effects of FTSE4Good Index inclusion, we conduct a different-in-differences type experiment. For each treated firm we find one control firm matched on ESG score, size, book-to-market value, the number of analysts following, and institutional ownership, all measured in the year before inclusion. We then estimate the following regression equation using an event window of (-6, +6) months, excluding the event month:

$$\begin{aligned}
Short\ Selling_{i,t} = & \alpha + \beta_1 Treat_{i,t} \times Post_{i,t} \times Short\ Target_{i,t-1} + \beta_2 Treat_{i,t} \times Post_{i,t} \\
& + \beta_3 Post_{i,t} \times Short\ Target_{i,t-1} + \beta_4 Treat_{i,t} \times Short\ Target_{i,t-1} \\
& + \beta_5 Post_{i,t} + \beta_6 Short\ Target_{i,t-1} + \beta_7 Treat_{i,t} + \beta' X_{i,t-1} + \gamma_i + \theta_i + \epsilon_{i,t}
\end{aligned} \tag{4}$$

In equation (4),  $Treat_{i,t}$  is a dummy equal to one for stocks included in the FTSE4Good index and zero otherwise.  $Post_{i,t}$  is a dummy equal to one for the six months after the event and zero otherwise.  $Short\ Target_{i,t-1}$  is the same as in the earlier regressions and is equal to

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<sup>6</sup>More information about the index can be found on the FTSE4Good Index Factsheet: <https://www.lseg.com/en/ftse-russell/indices/ftse4good>

1 if the firm is expected to have high levels of short interest according to the model of [Drake, Rees, and Swanson \(2011\)](#) and zero otherwise. The hypothesis that FTSE4Good index inclusion reduces short selling is tested with the coefficient  $\beta_1$ , which captures how short selling changes after a stock is included in the FTSE4Good index relative to its matched control firm.

[Insert Table 4 about here]

The regression results are reported in Table 4. Regressions 1 and 2 report results using the *Short Interest Ratio* as the dependent variable. In regression 2, which has the most exhaustive set of controls, the coefficients estimate that the *Short Interest Ratio* decreases by 1.77% among short targets after index inclusion.

Regressions 3 and 4 study the *Utilization Ratio*. The coefficients in regression 4 show that it decreases by 4.94% among short targets after index inclusion. Although the number of events is limited, the difference-in-differences analysis suggests a negative causal impact of corporate social responsibility ratings on short selling among firms that short sellers would typically target.

One concern with this analysis is that our findings are due to increased passive ownership or ETF ownership as the result of index inclusion. It could be that short sellers are less willing to short stocks after inclusion in any index, and our results in Table 4 reflect a general index inclusion effect as opposed to a corporate social responsibility ratings effect. To investigate this possibility, we perform a placebo test using a reconstruction of the Russell 1000/2000 index.

We follow [Appel, Gormley, and Keim \(2016\)](#) and use inclusion in the Russell 2000 as an exogenous shock to ETF ownership and institutional ownership. The Russell indices are value-weighted, so the larger firms in an index receive the greatest weights. The 1,000<sup>th</sup> largest stock in the market that is included in the Russell 1000 has a trivial portfolio weight, whereas the 1,001<sup>st</sup> largest stock included in the Russell 2000 will be given considerable index

weight. Therefore, the largest firms in the Russell 2000 index are likely to be widely held by funds and ETFs tracking the Russell 2000, whereas ETFs and funds tracking the Russell 1000 will hold much less of the smallest firms in the Russell 1000.

If short selling of short targets among the 50 largest stocks in the Russell 2000 index is lower than that for short targets among the 50 smallest stocks in the Russell 1000 index, then this would be evidence of an index effect deterring short selling. Such results would suggest that our results with the FTSE4Good Index Series inclusion might reflect a more general index effect, rather than an effect caused by corporate social responsibility ratings.

We run the same difference-in-differences regression as in equation (4), but define treated firms as the largest 50 stocks in the Russell 2000 index, while the control firms are the smallest 50 stocks included in the Russell 1000 index. The results are tabulated in Appendix Table A1. We find that there is more short selling in short targets among the 50 largest stocks in the Russell 2000 index compared to short targets among the 50 smallest stocks in the Russell 1000 index.<sup>7</sup> This is the opposite result that we would expect to find if index inclusion deterred short selling. Instead, it suggests that index inclusion encourages short selling, perhaps because inclusion leads to more institutions owning the stock, making it easier to borrow. In any case, our placebo test helps to rule out the possibility that a general index effect drives our FTSE4Good inclusion results.

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<sup>7</sup>Using the same empirical setting, [Glosten, Nallareddy, and Zou \(2021\)](#) show that after stocks switch from Russell 1000 to Russell 2000, they are held by more ETFs, the information efficiency increases and returns react more to earnings.

## 4 Channels: Long Investors’ Reluctance to Sell and ESG Sentiment

### 4.1 Do Socially responsible investors deter short sellers?

Several studies suggest that some institutional investors are willing to hold firms with strong social responsibility ratings regardless of expected investment returns. [Hartzmark and Sussman \(2019\)](#) document that mutual fund managers can attract more fund inflows by holding high ESG stocks. [Cao, Titman, Zhan, and Zhang \(2023\)](#) find that socially responsible institutions continue to hold stocks with strong quantitative selling signals. [Starks, Venkat, and Zhu \(2024\)](#) document that investors are more patient with high ESG firms and sell less after negative earnings surprises. Such preferences could delay the selling of stocks with high corporate social responsibility ratings that become overvalued. This, in turn, delays the price correction process, thereby making the short selling of such stocks costlier.

To investigate this possibility, we examine whether the negative relation between ESG and short selling is stronger when there are more socially responsible investors holding the stock. We follow [Hwang, Titman, and Wang \(2021\)](#) and [Cao, Titman, Zhan, and Zhang \(2023\)](#) and, using 13F data, sort financial institutions into three groups, based on the average ESG score of the firms in their portfolios. Institutions in the top tercile with the highest average ESG scores are labeled socially responsible institutions.

For each firm in each quarter, we measure the number of shares held by socially responsible institutions divided by the total number of shares held by all of the institutions (SRIO). We sort stocks into two groups based on SRIO at the end of the last quarter and test whether the negative relationship between ESG and short selling is stronger for stocks with higher SRIO.

We estimate the regression (Equation (3)) that is reported in Table 2 for SRIO stocks and for low SRIO stocks. We then compare the effects between the two groups.

[Insert Table 5 about here]

The results are reported in Table 5 and show that the negative relation between short selling and ESG is greater in stocks with higher SRIO. Regressions 1 and 2 use the *Short Interest Ratio* as the dependent variable, while regressions 3 and 4 use the *Utilization Ratio* as the dependent variable. In both cases, the coefficient for  $ESG \times Short\ Target$  is significant only in the high SRIO ownership group (regressions 2 and 4). The differences in the coefficients between the high and low SRIO groups are negative and significant at the 1% level. We find similar effects using the *Green Score* in place of *ESG*, but do not report them for the sake of brevity.

## 4.2 Long-side investors and selling short targets

The regressions reported in Table 6 provide more evidence that long-side investors delay selling high ESG stocks, even when there are negative signals. In these tests, we examine all institutions together and ask whether institutional investors are less likely to sell high ESG stocks that short sellers would typically target.

Specifically, we regress the change in the quarterly holdings of mutual funds and all 13F institutions on *Short Target*, *ESG Score*, and their interaction. We estimate the following firm-quarter panel regression:

$$\begin{aligned} Holding\ Changes_{i,t} = & \alpha + \beta_1 ESG_{i,t-1} \times Short\ Target_{i,t-1} + \beta_2 ESG_{i,t-1} \\ & + \beta_3 Short\ Target_{i,t-1} + \beta' X_{i,t-1} + \gamma_i + \theta_i + \epsilon_{i,t} \end{aligned} \quad (5)$$

where *Holding Changes*<sub>*i,t*</sub> is measured by one of the four variables: log change in the number of mutual funds owning the stock, change in mutual fund ownership as a percentage of shares outstanding, log change in the number of 13F institutions owning the stock, and change in institutional ownership as a percentage of shares outstanding. Previous research suggests that these measures are informative with respect to valuation and future returns

(Sias, Starks, and Titman (2006), Khan, Kogan, and Serafeim (2012), and Edelen, Ince, and Kadlec (2016)).  $X_{i,t-1}$  are the control variables, which are measured at the end of the previous quarter. The control variables include market capitalization, book-to-market ratio, analyst coverage, firm leverage, and loss dummy. We also include quarter and firm fixed effects.

[Insert Table 6 about here]

All of the eight specifications reported in Table 6 show that institutions decrease their ownership if a stock is a short target and that this negative relation is mitigated if the stock has a higher *ESG Score*. The results for the log change in the number of mutual funds (regressions 7 and 8) have the expected sign, but the coefficients are statistically insignificant. The coefficients in the other six regressions are statistically significant.

In regression 2, which has institutional ownership change as the dependent variable and the complete set of control variables, the coefficient for *Short Target* is -0.655 (t-statistic = -2.19), and the coefficient for *Short Target*  $\times$  *ESG Score* is 1.403 (t-statistic = 2.36). Taken together, the coefficients show that if a stock has an *ESG Score* of 0.47 or higher (ESG scores range from 0 to 1), the effect of being a short target is completely eliminated, i.e., institutions are not more likely to sell the stock.

Similarly, in regression 6, which studies mutual fund ownership, the coefficient for *Short Target* is -0.259 (t-statistic = -1.73), and the coefficient for *Short Target*  $\times$  *ESG Score* is 0.638 (t-statistic = 2.09). Thus, for ESG scores greater than 0.41, the effect of being a short target is neutralized. These findings support the idea that short sellers are more likely to avoid stocks with high ESG ratings despite the short-selling signal because institutional investors will continue to hold these stocks, which supports their prices.

### 4.3 ESG sentiment and short squeeze risk

Although some investors may invest in stocks with high ESG scores for rational reasons, other investors may develop sentiment towards ESG. Given the popularity of ESG investing, firms with high ESG scores might experience sudden and large buying pressures when the public collectively pays attention to ESG issues, leading to stock price increases. During such times, short sellers would be wise to avoid high ESG stocks. In this section of the paper, we test whether this is the case.

We follow [Da, Engelberg, and Gao \(2011\)](#) and use Google Search volume as a proxy for retail investor attention. [Da, Engelberg, and Gao \(2011\)](#) show that when the search volume for a stock increases, its price is inflated and its subsequent returns are lower.

We also follow [Choi, Gao, and Jiang \(2020\)](#) and calculate the logarithm of monthly change in the Google Search Volume Index (DGSVI) on the topic “Environmental, social and corporate governance”<sup>8</sup> and divide the sample into two sub-periods based on low ESG attention and high ESG attention. We then test whether our results are stronger during high-attention months.

We report our results in Table 7. The dependent variable in regressions 1 and 2 is the *Short Interest Ratio*. In both regressions, the *ESG Score* coefficient and the *Short Target*  $\times$  *ESG Score* interaction coefficient are both negative and significant. This means that during periods of both high and low ESG attention, there is less shorting of high ESG stocks.

However, the *Short Target*  $\times$  *ESG Score* interaction coefficient is -1.973 (t-statistic = -3.12) in regression 1, which is estimated in the low-attention sample, and -2.590 (t-statistic = -3.81) in regression 2, estimated in the high-attention sample. The difference in the coefficient is economically meaningful and statistically significant at the 5% level.

Regressions 3 and 4 use the Utilization Ratio as the dependent variable, and we get similar

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<sup>8</sup>We find consistent results when using other topics, such as “Global Warming” and “Socially Responsible Investing”.

findings. The *Short Target*  $\times$  *ESG Score* interaction coefficient is -9.885 (t-statistic= -5.07) in the low attention sample and -11.803 (t-statistic = -6.00) in the high attention sample. The coefficient difference is significant at the 1% level, showing that short sellers are more deterred when attention to ESG is higher.

Overall, the findings in Table 7 show that when there is an increase in Google search volume for ESG-related topics, short sellers are even less willing to short high ESG stocks that are also short targets. This is consistent with the idea that when attention to ESG is higher, the upside jump probability of high ESG stocks is higher, creating greater risks for short sellers.

[Insert Table 7 about here]

## 5 An Alternative Measure of Expected Short Selling

In this section of the paper, we use [Stambaugh, Yu, and Yuan's \(2015\)](#) mispricing signal (*SY Y score*) as an alternative to the expected short interest ratio from [Drake, Rees, and Swanson \(2011\)](#). We explain this method in more detail in Section 2.2.1 of this paper.

We estimate the same regressions reported in Tables 2 and 3, but use SY Y to make the short target variable. The results are reported in Tables 8 and 9. Consistent with the results in Tables 2 and 3, Tables 8 and 9 show that short targets with higher ESG scores have less shorting and that common short sale costs do not explain this effect.

In Table 8, the dependent variable is short interest in regressions 1 and 2, and the utilization ratio in regressions 3 and 4. In all four regressions, the results show less shorting among high ESG firms and that this effect is greater among stocks that the SY Y metric identifies as overvalued.

In regression 2, which has the full set of controls, the *Short Target* coefficient is 1.472 (t-statistic = 7.81). This means that, on average, firms with *Short Target* values equal to

one have short interest higher by 1.5% (the sample median is 1.94%). This result is expected; it shows short sellers target stocks that the *SYT* metric identifies as overvalued.

The sum of the ESG coefficient and interaction coefficients in regression 2 is  $-1.710 + -0.989 = -2.699$ . Based on this, a one-standard-deviation increase in the *ESG Score* (0.19) is associated with a 0.51% decrease in short interest among overvalued firms, similar to the effect we report in Table 2 (a 0.56% decrease).

Repeating this exercise for regression 4, we find that a one-standard-deviation increase in ESG score leads to a 2.13% decrease in the *Utilization Ratio* among overvalued firms. Again, this is similar to the effect (2.41%) reported in Table 2.

Table 9 confirms that the reluctance of short sellers to target overvalued stocks is not explained by conventional shorting costs. In regression 1, which studies the supply of lendable shares, the ESG coefficient is positive and significant, showing a greater supply for high ESG firms. The ESG coefficient is positive but insignificant in regression 2, where more controls are included.

In regressions 3 and 4, which study lending fees, the ESG coefficients are negative but insignificant. The ESG-short target interaction coefficients are negative, and the coefficient in regression 4 is significant. These results show lending fees are either the same or lower for high ESG stocks. Regressions 5 and 6 tell the same story for lending fee volatility; it is either the same or lower for high ESG stocks.

Regressions 7 and 8 study the put-call implied volatility ratio. All of the coefficients are insignificant. The findings do not suggest that short sellers use options to bet against high ESG stocks.

## 6 Conclusion

Previous studies show that short sellers are sophisticated investors that make markets more efficient. We find that socially responsible investing can deter short selling. Our findings

show that short sellers avoid stocks with higher ESG ratings and Green scores. This is not explained by short selling being costlier for highly rated stocks via traditional channels, such as fewer lendable shares or higher lending fees.

We find evidence of two channels through which corporate social responsibility ratings deter short selling. First, short sellers face higher uncertainty about whether and when long-side investors will sell high ESG stocks when valuations warrant it. Thus, mispricing can persist for longer periods, which increases holding costs.

Second, high ESG stocks may respond to positive sentiment about ESG. When attention to ESG spikes, it can create losses for short sellers. Consistent with this idea, we show that short sellers avoid high ESG stocks more when there is more attention, as measured by Google search, to ESG and related issues.

Taken in their entirety, our findings show that long-investors' preferences for socially responsible investing can impact short sellers' role in the price formation process. Stocks with high social responsibly ratings that would typically be targeted by short sellers are avoided, which means that short sellers' views are less reflected in prices and markets may be less efficient.

## References

- Appel, Ian R., Todd A. Gormley, and Donald B. Keim, 2016, Passive investors, not passive owners, *Journal of Financial Economics* 121, 111–141.
- Asquith, Paul, Parag A. Pathak, and Jay R. Ritter, 2005, Short interest, institutional ownership, and stock returns, *Journal of Financial Economics* 78, 243–276.
- Atilgan, Yigit, K. Ozgur Demirtas, Alex Edmans, and A. Doruk Gunaydin, 2024, Does the carbon premium reflect risk or mispricing?, Working Paper.
- Barberis, Nicholas, and Richard Thaler, 2003, A survey of behavioral finance, *Handbook of the Economics of Finance* 1, 1053–1128.
- Boehmer, Ekkehart, and Juan (Julie) Wu, 2013, Short selling and the price discovery process, *Review of Financial Studies* 26, 287–322.
- Boehmer Ekkehart, Charles M. Jones, and Xiaoyan Zhang, 2008, Which shorts are informed?, *Journal of Finance* 63, 491–527.
- Bolton, Patrick, and Marcin Kacperczyk, 2021, Do investors care about carbon risk?, *Journal of Financial Economics* 142, 517–549.
- Cao, Jie, Sheridan Titman, Xintong Zhan, and Weiming Zhang, 2023, ESG preference, institutional trading, and stock return patterns, *Journal of Financial and Quantitative Analysis* 58, 1843–1877.
- Choi, Darwin, Zhenyu Gao, and Wenxi Jiang, 2020, Attention to global warming, *Review of Financial Studies* 33, 1112–1145.
- Christophe, Stephen E., Michael G. Ferri, and Jim Hsieh, 2010, Informed trading before analyst downgrades: Evidence from short sellers, *Journal of Financial Economics* 95, 85–106.
- D’Avolio, Gene, 2002, The market for borrowing stock, *Journal of Financial Economics* 66, 271–306.
- Da, Zhi, Joseph Engelberg, and Pengjie Gao, 2011, In search of attention, *Journal of Finance* 66, 1461–1499.
- Dechow, Patricia M., Aour P. Hutton, Lisa Meulbroek, and Richard G. Sloan, 2001, Short-sellers, fundamental analysis, and stock returns, *Journal of Financial Economics* 61, 77–106.

- Diamond, Douglas W., and Robert E. Verrecchia, 1987, Constraints on short-selling and asset price adjustment to private information, *Journal of Financial Economics* 18, 277–311.
- Drake, Michael S., Lynn Rees, and Edward P. Swanson, 2011, Should investors follow the prophets or the bears? Evidence on the use of public information by analysts and short sellers, *The Accounting Review* 86, 101–130.
- Duan, Ying, Gang Hu, and R. David McLean, 2010, Costly arbitrage and idiosyncratic risk: Evidence from short sellers, *Journal of Financial Intermediation* 19, 564–579.
- Edelen, Roger M., Ozgur S. Ince, and Gregory B. Kadlec, 2016, Institutional investors and stock return anomalies, *Journal of Financial Economics* 119, 472–488.
- Edmans, Alex, 2011, Does the stock market fully value intangibles? Employee satisfaction and equity prices, *Journal of Financial Economics* 101, 621–640.
- Engelberg, Joseph E., Adam V. Reed, and Matthew C. Ringgenberg, 2012, How are shorts informed?: Short sellers, news, and information processing, *Journal of Financial Economics* 105, 260–278.
- Engelberg, Joseph E., Adam V. Reed, and Matthew C. Ringgenberg, 2018, Short-selling risk, *Journal of Finance* 73, 755–786.
- Fama, Eugene F., and Kenneth R. French, 1992, The cross-section of expected stock returns, *Journal of Finance* 47, 427–265.
- Fama, Eugene F., and Kenneth R. French, 1993, Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* 33, 3–56.
- Glosten, Lawrence, Suresh Nallareddy, and Yuan Zou, 2021, ETF activity and informational efficiency of underlying securities, *Management Science* 67, 22–47.
- Hartzmark, Samuel M., and Abigail Sussman, 2019, Do investors value sustainability? A natural experiment examining ranking and fund flows, *Journal of Finance* 74, 2789–2837.
- Hirshleifer, David, Siew Hong Teoh, and Jeff Jiwei Yu, 2011, Short arbitrage, Return asymmetry, and the accrual anomaly, *Review of Financial Studies* 24, 2429–2461.
- Hong, Harrison, and Marcin Kacperczyk, 2009, The price of sin: The effects of social norms on markets, *Journal of Financial Economics* 93, 15–36.

- Hwang, Chuan Yang, Sheridan Titman, and Ying Wang, 2021, Investor tastes, corporate behavior, and stock returns: An analysis of corporate social responsibility, *Management Science* 68, 7065–7791.
- Karpoff, Jonathan M., and Xiaoxia Lou, 2010, Short sellers and financial misconduct, *Journal of Finance* 65, 1879–1913.
- Khan, Mozaffar, Leonid Kogan, and George Serafeim, 2012, Mutual fund trading pressure: Firm-level stock price impact and timing of SEOs, *Journal of Finance* 67, 1371–1395.
- McLean, R. David, Jeffrey Pontiff, and Christopher Reilly, 2022, Taking sides on return predictability, *Journal of Financial Economics*, forthcoming.
- Ofek, Eli, Matthew Richardson, and Robert F. Whitelaw, 2004, Limited arbitrage and short sales restrictions: Evidence from the options markets, *Journal of Financial Economics* 74, 305–342.
- Pástor, Ľuboš, Robert F. Stambaugh, and Lucian A. Taylor, 2022, Dissecting green returns, *Journal of Financial Economics* 146, 403–424.
- Pontiff, Jeffrey, 1996, Costly arbitrage: Evidence from closed-end funds, *The Quarterly Journal of Economics* 111, 1135–1151.
- Pontiff, Jeffrey, 2006, Costly arbitrage and the myth of idiosyncratic risk, *Journal of Accounting and Economics* 42, 35–52.
- Reed, Adam V., 2002, Costly short-selling and stock price adjustment to earnings announcements, *Working Paper*.
- Refinitiv, 2023, Environmental, social and governance (ESG) scores from Refinitiv, [https://www.lseg.com/content/dam/data-analytics/en\\_us/documents/methodology/lseg-esg-scores-methodology.pdf?esg=Super+Retail+Group+Ltd](https://www.lseg.com/content/dam/data-analytics/en_us/documents/methodology/lseg-esg-scores-methodology.pdf?esg=Super+Retail+Group+Ltd), Accessed on 2024-03-30.
- Saffi, Pedro A. C., and Kari Sigurdsson, 2011, Price efficiency and short selling, *Review of Financial Studies* 24, 821–852.
- Sias, Richard W., Laura T. Starks, and Sheridan Titman, 2006, Changes in institutional ownership and stock returns: Assessment and methodology, *Journal of Business* 79, 2869–2910.

Stambaugh, Robert, Jianfeng Yu, and Yu Yuan, 2015, Arbitrage asymmetry and the idiosyncratic volatility puzzle, *Journal of Finance* 70, 1903–1948.

Starks, Laura, Parth Venkat, and Qifei Zhu, 2024, Corporate ESG profiles and investor horizons, *Journal of Finance*, forthcoming.

**Table 1: Summary statistics**

This table presents descriptive statistics of short-selling activities, stock characteristics, and the correlation matrix. Panel A reports the stock-month summary statistics of short-selling activities variables. Panel B reports the summary statistics of ESG score, the Green score used in [Pástor, Stambaugh, and Taylor \(2022\)](#), the logarithm of market capitalization, the logarithm of the book to market value, institutional ownership, analyst coverage, firm leverage, and loss dummy indicating negative earnings last year. We present the time-series average of cross-sectional distributions. *Short Interest Ratio* is the daily average of shares shorted relative to the total shares outstanding within a month. *Lendable Shares* is the daily average of shares available for lending on a given day relative to a firm’s total shares outstanding within a month. *Utilization Ratio* is *Short Interest Ratio* divided by *Lendable Shares*. *Lending Fee* is the daily average of the transaction-weighted rate reported by Markit and expressed in percentage per annum within a month. *ESG Score* is the annually updated raw score from the Refinitiv database. *Green Score* is stocks’ greenness measure used in [Pástor, Stambaugh, and Taylor \(2022\)](#). Each quarter, we calculate out-of-sample predicted short interest using the estimates from [Drake, Rees, and Swanson \(2011\)](#). Each month, stocks are sorted into quintiles based on their predicted short interest as of the most recent quarter-end. *Short Target* is a dummy equal to one for stocks in quintile 5, representing those with the highest predicted short interest.  $\ln(ME)$  is the logarithm of market capitalization.  $\ln(BM)$  is the logarithm of book to market ratio. *Institutional Ownership* is the percentage of common stocks owned by institutions in the previous quarter. *Analyst* is the number of analysts following the firm in the previous quarter. *Leverage* is the total liabilities scaled by the total asset at the most recent fiscal year end. *Loss* is a dummy variable indicating a negative income. Panel C reports the time-series average of cross-sectional correlations among different short selling variables, *ESG Score*, *Green Score*, and other firm characteristics. The Pearson correlations are shown below the diagonal together with Spearman correlations above the diagonal. The sample period is from January 2006 to December 2022.

Panel A: Short-selling activities

| Jan 2006-Dec 2022        | Mean  | Std   | 10-Pctl | Q1    | Med   | Q3    | 90-Pctl |
|--------------------------|-------|-------|---------|-------|-------|-------|---------|
| Short Interest Ratio (%) | 3.93  | 5.15  | 0.34    | 0.74  | 1.94  | 5.03  | 10.25   |
| Lendable Shares (%)      | 28.44 | 7.91  | 18.56   | 23.98 | 29.03 | 33.47 | 37.64   |
| Utilization Ratio (%)    | 11.58 | 14.72 | 0.79    | 1.95  | 5.72  | 15.42 | 30.57   |
| Lending Fee (%)          | 0.56  | 1.85  | 0.34    | 0.35  | 0.35  | 0.37  | 0.42    |

Panel B: Stock characteristics

| Jan 2006-Dec 2022       | Mean  | Std  | 10-Pctl | Q1    | Med   | Q3    | 90-Pctl |
|-------------------------|-------|------|---------|-------|-------|-------|---------|
| ESG Score               | 0.42  | 0.19 | 0.19    | 0.28  | 0.40  | 0.55  | 0.69    |
| Green Score             | 0.06  | 1.25 | -1.78   | -0.67 | 0.25  | 1.10  | 1.48    |
| Short Target            | 0.24  | 0.43 | 0.00    | 0.00  | 0.00  | 0.38  | 1.00    |
| $\ln(ME)$               | 8.80  | 1.20 | 7.28    | 7.94  | 8.73  | 9.71  | 10.61   |
| $\ln(BM)$               | -1.09 | 0.85 | -2.13   | -1.55 | -1.01 | -0.51 | -0.14   |
| Institutional Ownership | 0.80  | 0.20 | 0.54    | 0.72  | 0.84  | 0.93  | 1.00    |
| Analyst                 | 14.71 | 7.75 | 5.48    | 8.78  | 13.77 | 19.61 | 25.22   |
| Leverage                | 0.28  | 0.21 | 0.03    | 0.13  | 0.26  | 0.39  | 0.54    |
| Loss                    | 0.14  | 0.34 | 0.00    | 0.00  | 0.00  | 0.06  | 0.69    |

Panel C: Correlations among short-selling activities and stock characteristics

| <div> <div>Pearson</div> <div>Spearman</div> </div> | Var1  | Var2  | Var3  | Var4  | Var5  | Var6  | Var7  | Var8  | Var9  | Var10 | Var11 | Var12 | Var13 |
|-----------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Short Interest Ratio                                | 1.00  | 0.21  | 0.88  | 0.27  | -0.20 | -0.04 | 0.33  | -0.34 | 0.02  | 0.28  | -0.11 | 0.11  | 0.18  |
| Lendable Shares                                     | 0.18  | 1.00  | -0.09 | -0.14 | 0.01  | -0.05 | 0.07  | -0.11 | 0.06  | 0.59  | -0.03 | -0.08 | -0.07 |
| Utilization Ratio                                   | 0.94  | -0.01 | 1.00  | 0.40  | -0.24 | -0.03 | 0.30  | -0.34 | 0.00  | 0.07  | -0.13 | 0.14  | 0.21  |
| Lending Fee                                         | 0.15  | -0.13 | 0.18  | 1.00  | -0.07 | -0.01 | 0.08  | -0.12 | 0.03  | -0.08 | -0.08 | 0.06  | 0.12  |
| ESG Score                                           | -0.25 | -0.01 | -0.29 | -0.06 | 1.00  | 0.09  | -0.13 | 0.54  | -0.03 | -0.12 | 0.33  | -0.04 | -0.13 |
| Green Score                                         | -0.07 | -0.06 | -0.06 | -0.02 | 0.09  | 1.00  | -0.11 | 0.14  | -0.12 | -0.01 | 0.15  | -0.09 | -0.06 |
| Short Target                                        | 0.32  | 0.06  | 0.29  | 0.11  | -0.13 | -0.12 | 1.00  | -0.11 | -0.12 | 0.18  | 0.21  | 0.03  | 0.17  |
| Ln(ME)                                              | -0.40 | -0.16 | -0.41 | -0.08 | 0.52  | 0.15  | -0.10 | 1.00  | -0.26 | -0.16 | 0.61  | -0.04 | -0.22 |
| Ln(BM)                                              | 0.03  | 0.08  | 0.02  | 0.01  | -0.04 | -0.12 | -0.11 | -0.27 | 1.00  | -0.05 | -0.21 | -0.12 | 0.07  |
| Institutional Ownership                             | 0.33  | 0.60  | 0.20  | -0.03 | -0.17 | -0.01 | 0.21  | -0.24 | -0.05 | 1.00  | -0.02 | 0.00  | 0.02  |
| Analyst                                             | -0.13 | -0.05 | -0.15 | -0.02 | 0.34  | 0.14  | 0.20  | 0.62  | -0.23 | -0.04 | 1.00  | -0.12 | -0.06 |
| Leverage                                            | 0.09  | -0.08 | 0.10  | 0.06  | 0.01  | -0.12 | 0.00  | -0.01 | -0.05 | 0.01  | -0.10 | 1.00  | 0.09  |
| Loss                                                | 0.18  | -0.06 | 0.19  | 0.10  | -0.13 | -0.06 | 0.17  | -0.21 | 0.09  | 0.05  | -0.07 | 0.09  | 1.00  |

**Table 2: Short selling and ESG ratings**

This table presents the results from panel regressions of short-selling demand as a function of a short target dummy, and ESG Ratings in Panel A (firm greenness in Panel B). Short-selling is proxied by the short interest ratio and utilization ratio. Each quarter, we calculate out-of-sample predicted short interest using the estimates from [Drake, Rees, and Swanson \(2011\)](#). Each month, stocks are sorted into quintiles based on their predicted short interest as of the most recent quarter-end. *Short Target* is a dummy equal to one for stocks in quintile 5, representing those with the highest predicted short interest. In Panel A, *ESG Score* is the annually updated raw score from the Refinitiv database. In Panel B, *Green Score* is the stocks' greenness measure used in [Pástor, Stambaugh, and Taylor \(2022\)](#). Control variables include the logarithm of market capitalization, the logarithm of book-to-market value, institutional ownership, analyst coverage, firm leverage, and a loss dummy indicating negative earnings. All regressions include firm-fixed effects and time-fixed effects. The t-statistics in the brackets are calculated from robust clustered standard errors by the firm. \*\*\*, \*\*, and \* denote significance at the 0.01, 0.05, and 0.10 levels, based on a two-sided test. The sample period is from January 2006 to December 2022.

Panel A. Short-selling demand and ESG performance

|                                 | Short Interest Ratio |                       | Utilization Ratio    |                       |
|---------------------------------|----------------------|-----------------------|----------------------|-----------------------|
|                                 | (1)                  | (2)                   | (3)                  | (4)                   |
| Short Target $\times$ ESG Score | -1.550**<br>(-2.04)  | -2.301***<br>(-3.66)  | -8.355***<br>(-4.03) | -10.961***<br>(-5.86) |
| Short Target                    | 2.643***<br>(7.91)   | 2.640***<br>(9.42)    | 8.473***<br>(8.90)   | 8.850***<br>(10.30)   |
| ESG Score                       | -1.151**<br>(-2.17)  | -0.672<br>(-1.34)     | -3.074**<br>(-2.09)  | -1.742<br>(-1.21)     |
| Ln(ME)                          |                      | -1.854***<br>(-11.08) |                      | -5.218***<br>(-11.12) |
| Ln(BM)                          |                      | 0.430***<br>(3.22)    |                      | 0.647*<br>(1.73)      |
| Institutional Ownership         |                      | 6.518***<br>(8.56)    |                      | 11.947***<br>(6.55)   |
| Analyst                         |                      | 0.028**<br>(2.36)     |                      | 0.101**<br>(2.57)     |
| Leverage                        |                      | 5.458***<br>(8.97)    |                      | 13.756***<br>(7.39)   |
| Loss                            |                      | 0.619***<br>(6.77)    |                      | 2.068***<br>(7.63)    |
| Firm Fixed Effects              | Yes                  | Yes                   | Yes                  | Yes                   |
| Time Fixed Effects              | Yes                  | Yes                   | Yes                  | Yes                   |
| Adj R-squared                   | 0.569                | 0.624                 | 0.590                | 0.625                 |
| Observations                    | 148,448              | 133,268               | 148,448              | 133,268               |

Panel B. Short-selling demand and firm greenness

|                                   | Short Interest Ratio |                      | Utilization Ratio    |                      |
|-----------------------------------|----------------------|----------------------|----------------------|----------------------|
|                                   | (1)                  | (2)                  | (3)                  | (4)                  |
| Short Target $\times$ Green Score | -0.198**<br>(-2.05)  | -0.196**<br>(-2.16)  | -0.528**<br>(-2.01)  | -0.490**<br>(-1.98)  |
| Short Target                      | 2.105***<br>(15.53)  | 1.909***<br>(14.83)  | 5.485***<br>(14.44)  | 4.989***<br>(13.55)  |
| Green Score                       | -0.310***<br>(-4.34) | -0.163**<br>(-2.39)  | -0.570***<br>(-2.77) | -0.190<br>(-0.92)    |
| Ln(ME)                            |                      | -1.404***<br>(-8.44) |                      | -4.099***<br>(-8.91) |
| Ln(BM)                            |                      | 0.740***<br>(5.75)   |                      | 1.453***<br>(3.84)   |
| Institutional Ownership           |                      | 6.705***<br>(10.90)  |                      | 12.466***<br>(8.23)  |
| Analyst                           |                      | 0.033***<br>(3.03)   |                      | 0.110***<br>(3.23)   |
| Leverage                          |                      | 5.498***<br>(9.14)   |                      | 14.183***<br>(7.93)  |
| Loss                              |                      | 0.613***<br>(7.42)   |                      | 2.064***<br>(8.35)   |
| Firm Fixed Effects                | Yes                  | Yes                  | Yes                  | Yes                  |
| Time Fixed Effects                | Yes                  | Yes                  | Yes                  | Yes                  |
| Adj R-squared                     | 0.613                | 0.657                | 0.644                | 0.673                |
| Observations                      | 148,737              | 133,229              | 148,737              | 133,229              |

**Table 3: Short-selling constraints and ESG ratings**

This table presents the results from panel regressions of short-selling constraints as a function of a short target dummy, and ESG Ratings in Panel A (firm greenness in Panel B). Short-selling constraints are measured by lendable shares, lending fee, ERR short selling risks (Engelberg, Reed, and Ringgenberg (2018)), and put-call volatility ratio. Each quarter, we calculate out-of-sample predicted short interest using the estimates from Drake, Rees, and Swanson (2011). Each month, stocks are sorted into quintiles based on their predicted short interest as of the most recent quarter-end. *Short Target* is a dummy equal to one for stocks in quintile 5, representing those with the highest predicted short interest. In Panel A, the *ESG Score* is the annually updated raw score from the Refinitiv database. In Panel B, *Green Score* is the stocks' greenness measure used in Pástor, Stambaugh, and Taylor (2022). Control variables include the logarithm of market capitalization, the logarithm of book-to-market value, institutional ownership, analyst coverage, firm leverage, and a loss dummy indicating negative earnings. All regressions include firm-fixed effects and time-fixed effects. The t-statistics in the brackets are calculated from robust clustered standard errors by the firm. \*\*\*, \*\*, and \* denote significance at the 0.01, 0.05, and 0.10 levels, based on a two-sided test. The sample period is from January 2006 to December 2022.

Panel A. Short-selling constraints and ESG performance

|                                 | Lendable Shares   |                      | Lending Fee       |                      | ERR Short Selling Risk | Put-call Volatility Ratio |                      |                      |
|---------------------------------|-------------------|----------------------|-------------------|----------------------|------------------------|---------------------------|----------------------|----------------------|
|                                 | (1)               | (2)                  | (3)               | (4)                  | (5)                    | (6)                       | (7)                  | (8)                  |
| Short Target $\times$ ESG Score | -0.602<br>(-0.71) | -0.067<br>(-0.08)    | -0.260<br>(-1.64) | -0.405**<br>(-2.53)  | -0.078***<br>(-2.69)   | -0.096***<br>(-3.31)      | -0.660***<br>(-3.23) | -0.829***<br>(-4.05) |
| Short Target                    | 0.314<br>(0.86)   | -0.166<br>(-0.49)    | 0.189**<br>(2.33) | 0.243***<br>(2.85)   | 0.048***<br>(3.59)     | 0.052***<br>(3.91)        | 0.443***<br>(4.50)   | 0.500***<br>(4.95)   |
| ESG Score                       | 1.497**<br>(2.21) | 1.370**<br>(2.06)    | -0.124<br>(-1.10) | -0.047<br>(-0.43)    | -0.023<br>(-1.21)      | -0.009<br>(-0.49)         | 0.012<br>(0.08)      | 0.159<br>(1.11)      |
| Ln(ME)                          |                   | -0.551***<br>(-2.82) |                   | -0.292***<br>(-4.09) |                        | -0.048***<br>(-4.32)      |                      | -0.388***<br>(-5.40) |
| Ln(BM)                          |                   | 0.046<br>(0.31)      |                   | -0.005<br>(-0.14)    |                        | -0.004<br>(-0.67)         |                      | -0.028<br>(-0.69)    |
| Institutional Ownership         |                   | 8.798***<br>(11.64)  |                   | -0.135<br>(-0.92)    |                        | -0.010<br>(-0.42)         |                      | 0.022<br>(0.13)      |
| Analyst                         |                   | 0.028*<br>(1.85)     |                   | 0.002<br>(0.69)      |                        | 0.001<br>(0.96)           |                      | 0.001<br>(0.39)      |
| Leverage                        |                   | -1.760**<br>(-2.54)  |                   | 0.627***<br>(2.82)   |                        | 0.069*<br>(1.88)          |                      | 0.480*<br>(1.86)     |
| Loss                            |                   | -0.436***<br>(-4.63) |                   | 0.078**<br>(2.40)    |                        | 0.019***<br>(3.41)        |                      | 0.100**<br>(2.13)    |
| Firm Fixed Effects              | Yes               | Yes                  | Yes               | Yes                  | Yes                    | Yes                       | Yes                  | Yes                  |
| Time Fixed Effects              | Yes               | Yes                  | Yes               | Yes                  | Yes                    | Yes                       | Yes                  | Yes                  |
| Adj R-squared                   | 0.829             | 0.842                | 0.426             | 0.432                | 0.262                  | 0.252                     | 0.181                | 0.187                |
| Observations                    | 148,448           | 133,268              | 148,448           | 133,268              | 148,404                | 133,228                   | 129,030              | 116,340              |

Panel B. Short-selling constraints and firm greenness

|                                   | Lendable Shares   |                      | Lending Fee         |                      | ERR Short            | Selling Risk         | Put-call Volatility Ratio |                      |
|-----------------------------------|-------------------|----------------------|---------------------|----------------------|----------------------|----------------------|---------------------------|----------------------|
|                                   | (1)               | (2)                  | (3)                 | (4)                  | (5)                  | (6)                  | (7)                       | (8)                  |
| Short Target $\times$ Green Score | -0.016<br>(-0.19) | -0.043<br>(-0.51)    | 0.015<br>(0.46)     | 0.019<br>(0.54)      | 0.001<br>(0.30)      | 0.003<br>(0.56)      | -0.023<br>(-0.68)         | -0.009<br>(-0.27)    |
| Short Target                      | -0.001<br>(-0.01) | -0.140<br>(-1.11)    | 0.199***<br>(4.34)  | 0.199***<br>(4.01)   | 0.037***<br>(4.50)   | 0.038***<br>(4.23)   | 0.237***<br>(4.68)        | 0.237***<br>(4.45)   |
| Green Score                       | 0.134*<br>(1.69)  | 0.180**<br>(2.20)    | -0.034**<br>(-2.31) | -0.014<br>(-0.97)    | -0.007***<br>(-2.88) | -0.004*<br>(-1.74)   | -0.041*<br>(-1.94)        | -0.013<br>(-0.64)    |
| Ln(ME)                            |                   | -0.023<br>(-0.12)    |                     | -0.369***<br>(-4.14) |                      | -0.061***<br>(-4.57) |                           | -0.392***<br>(-4.20) |
| Ln(BM)                            |                   | 0.097<br>(0.67)      |                     | 0.096**<br>(2.28)    |                      | 0.007<br>(1.01)      |                           | 0.023<br>(0.49)      |
| Institutional Ownership           |                   | 7.696***<br>(12.21)  |                     | 0.015<br>(0.09)      |                      | 0.000<br>(0.01)      |                           | 0.261<br>(1.38)      |
| Analyst                           |                   | 0.033**<br>(2.21)    |                     | -0.002<br>(-0.48)    |                      | -0.001<br>(-1.02)    |                           | -0.002<br>(-0.40)    |
| Leverage                          |                   | -1.125*<br>(-1.67)   |                     | 1.289***<br>(4.20)   |                      | 0.165***<br>(3.62)   |                           | 0.746**<br>(2.23)    |
| Loss                              |                   | -0.389***<br>(-4.65) |                     | 0.109***<br>(3.04)   |                      | 0.018***<br>(3.11)   |                           | 0.095*<br>(1.91)     |
| Firm Fixed Effects                | Yes               | Yes                  | Yes                 | Yes                  | Yes                  | Yes                  | Yes                       | Yes                  |
| Time Fixed Effects                | Yes               | Yes                  | Yes                 | Yes                  | Yes                  | Yes                  | Yes                       | Yes                  |
| Adj R-squared                     | 0.843             | 0.853                | 0.504               | 0.513                | 0.308                | 0.303                | 0.180                     | 0.183                |
| Observations                      | 148,737           | 133,229              | 148,737             | 133,229              | 148,691              | 133,189              | 121,857                   | 109,475              |

**Table 4: Short-selling around FTSE4Good US Index inclusion events**

This table reports panel regression results of short-selling around FTSE4Good US Index inclusion events. The dependent variables include the Short Interest Ratio and the Utilization Ratio. The event window spans (-6, +6) months, excluding the event month. We match firms that are included in the index with firms that are not included using a propensity score matching approach. Our matching variables include ESG score, market capitalization, the logarithm of book-to-market value, institutional ownership, analyst coverage, firm leverage, and a loss dummy indicating negative earnings before the event. *Treat* is a dummy equal to one for stocks included in the FTSE4Good US Index in that month, and zero otherwise. *Post* is a dummy equal to one for the period after index inclusion, and zero otherwise. Each quarter, we calculate out-of-sample predicted short interest using the estimates from [Drake, Rees, and Swanson \(2011\)](#). Each month, stocks are sorted into quintiles based on their predicted short interest as of the most recent quarter-end. *Short Target* is a dummy equal to one for stocks in quintile 5, representing those with the highest predicted short interest. All regressions include firm-fixed effects and time-fixed effects. The t-statistics in the brackets are calculated from robust clustered standard errors by the firm. \*\*\*, \*\*, and \* denote significance at the 0.01, 0.05, and 0.10 levels, based on a two-sided test. The sample period is from January 2006 to December 2022.

|                                           | Short Interest Ratio |                     | Utilization Ratio  |                     |
|-------------------------------------------|----------------------|---------------------|--------------------|---------------------|
|                                           | (1)                  | (2)                 | (3)                | (4)                 |
| Post $\times$ Treat $\times$ Short Target | -1.673**<br>(-2.13)  | -1.770**<br>(-2.26) | -4.794*<br>(-1.95) | -4.941**<br>(-1.99) |
| Post $\times$ Treat                       | 0.084<br>(0.44)      | 0.189<br>(1.08)     | 0.427<br>(0.75)    | 0.656<br>(1.12)     |
| Post $\times$ Short Target                | 0.454<br>(0.81)      | 0.510<br>(0.91)     | -0.039<br>(-0.02)  | 0.085<br>(0.05)     |
| Treat $\times$ Short Target               | -0.399<br>(-0.71)    | -0.662<br>(-1.26)   | -2.177<br>(-0.77)  | -3.006<br>(-1.10)   |
| Short Target                              | 1.521***<br>(2.94)   | 1.409***<br>(2.71)  | 4.412**<br>(2.07)  | 3.958*<br>(1.93)    |
| Post                                      | 0.014<br>(0.12)      | 0.018<br>(0.15)     | -0.208<br>(-0.53)  | -0.156<br>(-0.36)   |
| Treat                                     | 0.639**<br>(2.24)    | 0.573**<br>(2.04)   | 0.924<br>(1.09)    | 0.870<br>(1.12)     |
| Controls                                  | No                   | Yes                 | No                 | Yes                 |
| Firm Fixed Effects                        | Yes                  | Yes                 | Yes                | Yes                 |
| Time Fixed Effects                        | Yes                  | Yes                 | Yes                | Yes                 |
| Adj R-squared                             | 0.751                | 0.753               | 0.728              | 0.736               |
| Observations                              | 4,608                | 4,368               | 4,608              | 4,368               |

**Table 5: The impacts of socially responsible investors**

This table investigates the relationship between ESG Ratings and short-selling in two subsamples with high and low socially responsible institutional ownership (*SRIO*). Each quarter, we calculate out-of-sample predicted short interest using the estimates from [Drake, Rees, and Swanson \(2011\)](#). Each month, stocks are sorted into quintiles based on their predicted short interest as of the most recent quarter-end. *Short Target* is a dummy equal to one for stocks in quintile 5, representing those with the highest predicted short interest. *ESG Score* is the annually updated raw score from the Refinitiv database. To calculate *SRIO*, we follow [Cao, Titman, Zhan, and Zhang \(2023\)](#), and first calculate a value-weighted size-adjusted ESG score as the socially responsible score for all the institutions. Then we define socially responsible (*SR*) institutions (one-third of all) based on their scores. *SRIO* is the number of shares held by *SR* institutions divided by the total number of shares held by all the institutions. Each month, we divide all the stocks into two groups based on socially responsible institutional ownership (*SRIO*) as of the most recent quarter-end. We report the results for the high *SRIO* group, and the low *SRIO* group, and their coefficient difference. Control variables include the logarithm of market capitalization, the logarithm of book-to-market value, institutional ownership, analyst coverage, firm leverage, and loss dummy indicating negative earnings. All regressions include firm-fixed effects and time-fixed effects. The t-statistics in the brackets are calculated from robust clustered standard errors by the firm. \*\*\*, \*\*, and \* denote significance at the 0.01, 0.05, and 0.10 levels, based on a two-sided test.

|                                 | Short Interest Ratio |                       | Utilization Ratio    |                       |
|---------------------------------|----------------------|-----------------------|----------------------|-----------------------|
|                                 | Low SRIO             | High SRIO             | Low SRIO             | High SRIO             |
|                                 | (1)                  | (2)                   | (3)                  | (4)                   |
| Short Target $\times$ ESG Score | -0.197<br>(-0.21)    | -1.860**<br>(-2.52)   | -7.062***<br>(-2.70) | -10.553***<br>(-4.03) |
| Short Target                    | 1.741***<br>(4.80)   | 2.206***<br>(5.95)    | 6.730***<br>(6.86)   | 8.607***<br>(6.25)    |
| ESG Score                       | -0.526<br>(-0.59)    | -0.304<br>(-0.56)     | 0.582<br>(0.22)      | -1.796<br>(-1.09)     |
| Ln(ME)                          | -2.184***<br>(-8.68) | -2.631***<br>(-10.18) | -6.446***<br>(-9.06) | -7.252***<br>(-10.17) |
| Ln(BM)                          | 0.477**<br>(2.48)    | 0.318*<br>(1.90)      | 0.659<br>(1.21)      | 0.339<br>(0.65)       |
| Institutional Ownership         | 8.396***<br>(7.60)   | 3.738***<br>(5.14)    | 17.631***<br>(6.55)  | 6.070***<br>(3.37)    |
| Analyst                         | 0.009<br>(0.50)      | 0.030**<br>(2.42)     | 0.019<br>(0.35)      | 0.105**<br>(2.39)     |
| Leverage                        | 6.570***<br>(7.10)   | 4.852***<br>(6.44)    | 18.377***<br>(7.02)  | 12.205***<br>(4.62)   |
| Loss                            | 0.485***<br>(3.81)   | 0.537***<br>(4.69)    | 1.772***<br>(4.52)   | 2.007***<br>(5.33)    |
| Diff (High–Low)                 | -1.662***            |                       | -3.491***            |                       |
| p-value                         | 0.000                |                       | 0.010                |                       |
| Firm Fixed Effects              | Yes                  | Yes                   | Yes                  | Yes                   |
| Time Fixed Effects              | Yes                  | Yes                   | Yes                  | Yes                   |
| Adj R-squared                   | 0.672                | 0.672                 | 0.670                | 0.666                 |
| Observations                    | 55,739               | 58,857                | 55,739               | 58,857                |

**Table 6: Short target, ESG Ratings, and long-side institutions' trading behavior**

This table reports the panel regression results of quarterly trading behavior of mutual funds and institutions towards short target stocks with different ESG scores. In Columns (1) and (2), institutional ownership change is defined as the difference between total institutional ownership next quarter and this quarter. In Columns (3) and (4), institution number change is defined as the difference between the logarithm of institution numbers holding the stock next quarter and this quarter. In Columns (5) and (6), mutual fund ownership change is defined as the difference between total mutual fund ownership next quarter and this quarter. In Columns (7) and (8), mutual fund number change is defined as the difference between the logarithm of mutual funds holding the stock next quarter and this quarter. Each quarter, we calculate out-of-sample predicted short interest using the estimates from [Drake, Rees, and Swanson \(2011\)](#). Each month, stocks are sorted into quintiles based on their predicted short interest as of the most recent quarter-end. *Short Target* is a dummy equal to one for stocks in quintile 5, with the highest predicted short interest. *ESG Score* is the annually updated raw score from the Refinitiv database. Control variables include the logarithm of market capitalization, the logarithm of book-to-market value, analyst coverage, firm leverage, and loss dummy indicating negative earnings. All regressions include firm-fixed effects and time-fixed effects. The t-statistics in the brackets are calculated from robust clustered standard errors by the firm. \*\*\*, \*\*, and \* denote significance at the 0.01, 0.05, and 0.10 levels, based on a two-sided test. The sample period is from January 2006 to December 2022.

|                           | Institution<br>Ownership Change |                     | Institution<br>Number Change |                      | Mutual Fund<br>Ownership Change |                     | Mutual Fund<br>Number Change |                      |
|---------------------------|---------------------------------|---------------------|------------------------------|----------------------|---------------------------------|---------------------|------------------------------|----------------------|
|                           | (1)                             | (2)                 | (3)                          | (4)                  | (5)                             | (6)                 | (7)                          | (8)                  |
| Short Target $\times$ ESG | 1.607***<br>(2.97)              | 1.403**<br>(2.36)   | 4.579**<br>(2.30)            | 3.723*<br>(1.74)     | 0.839***<br>(3.00)              | 0.638**<br>(2.09)   | 0.608<br>(0.26)              | 0.379<br>(0.15)      |
| Short Target              | -0.780***<br>(-2.94)            | -0.655**<br>(-2.19) | -2.587***<br>(-2.87)         | -2.324**<br>(-2.32)  | -0.355***<br>(-2.66)            | -0.259*<br>(-1.73)  | -1.253<br>(-1.06)            | -1.193<br>(-0.90)    |
| ESG                       | -0.373<br>(-1.19)               | -0.392<br>(-1.19)   | 0.217<br>(0.18)              | 1.107<br>(0.89)      | -0.353**<br>(-2.06)             | -0.323*<br>(-1.76)  | -0.249<br>(-0.21)            | 0.558<br>(0.44)      |
| Ln(ME)                    |                                 | 0.012<br>(0.12)     |                              | -1.862***<br>(-4.63) |                                 | -0.132**<br>(-2.39) |                              | -1.713***<br>(-3.76) |
| Ln(BM)                    |                                 | -0.120<br>(-1.22)   |                              | -0.928**<br>(-2.54)  |                                 | -0.006<br>(-0.12)   |                              | -1.080**<br>(-2.34)  |
| Analyst                   |                                 | -0.001<br>(-0.10)   |                              | -0.023<br>(-0.51)    |                                 | 0.005<br>(0.95)     |                              | -0.013<br>(-0.31)    |
| Leverage                  |                                 | -0.261<br>(-0.64)   |                              | -0.056<br>(-0.04)    |                                 | 0.007<br>(0.03)     |                              | -4.250***<br>(-3.07) |
| Loss                      |                                 | -0.090<br>(-0.76)   |                              | -1.603***<br>(-3.68) |                                 | -0.038<br>(-0.59)   |                              | -1.821***<br>(-2.96) |
| Firm Fixed Effects        | Yes                             | Yes                 | Yes                          | Yes                  | Yes                             | Yes                 | Yes                          | Yes                  |
| Time Fixed Effects        | Yes                             | Yes                 | Yes                          | Yes                  | Yes                             | Yes                 | Yes                          | Yes                  |
| Adj R-squared             | 0.0264                          | 0.0241              | 0.0121                       | 0.0121               | 0.106                           | 0.103               | 0.0785                       | 0.0779               |
| Observations              | 49,550                          | 44,762              | 49,550                       | 44,762               | 49,359                          | 44,600              | 49,359                       | 44,600               |

**Table 7: Attention to ESG and short selling**

This table investigates the relationship between ESG Ratings and short-selling in two subperiods with high and low ESG attention. Each quarter, we calculate out-of-sample predicted short interest using the estimates from [Drake, Rees, and Swanson \(2011\)](#). Each month, stocks are sorted into quintiles based on their predicted short interest as of the most recent quarter-end. *Short Target* is a dummy equal to one for stocks in quintile 5, representing those with the highest predicted short interest. *ESG Score* is the annually updated raw score from the Refinitiv database. To measure ESG attention, we calculate monthly innovation on the Google Search Volume of the topic “Environmental, social and corporate governance”. Then we divide the whole sample periods into two subperiods and report the results for low ESG attention period, high ESG attention period, and their coefficient difference. Control variables include the logarithm of market capitalization, the logarithm of book-to-market value, institutional ownership, analyst coverage, firm leverage, and loss dummy indicating negative earnings. All regressions include firm-fixed effects and time-fixed effects. The t-statistics in the brackets are calculated from robust clustered standard errors by the firm. \*\*\*, \*\*, and \* denote significance at the 0.01, 0.05, and 0.10 levels, based on a two-sided test. The sample period is from January 2006 to December 2022.

|                                 | Short Interest Ratio  |                       | Utilization Ratio     |                       |
|---------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|                                 | Low ESG<br>Attention  | High ESG<br>Attention | Low ESG<br>Attention  | High ESG<br>Attention |
|                                 | (1)                   | (2)                   | (3)                   | (4)                   |
| Short Target $\times$ ESG Score | -1.973***<br>(-3.12)  | -2.590***<br>(-3.81)  | -9.885***<br>(-5.07)  | -11.803***<br>(-6.00) |
| Short Target                    | 2.336***<br>(8.14)    | 2.919***<br>(9.53)    | 7.963***<br>(8.90)    | 9.632***<br>(10.45)   |
| ESG Score                       | -0.587<br>(-1.16)     | -0.760<br>(-1.44)     | -1.712<br>(-1.15)     | -1.796<br>(-1.19)     |
| Ln(ME)                          | -1.929***<br>(-11.24) | -1.801***<br>(-10.31) | -5.541***<br>(-10.90) | -4.993***<br>(-10.61) |
| Ln(BM)                          | 0.406***<br>(2.90)    | 0.441***<br>(3.24)    | 0.652<br>(1.59)       | 0.608<br>(1.64)       |
| Institutional Ownership         | 5.535***<br>(7.70)    | 7.619***<br>(9.13)    | 10.464***<br>(5.89)   | 13.686***<br>(6.92)   |
| Analyst                         | 0.029**<br>(2.32)     | 0.025**<br>(1.98)     | 0.109***<br>(2.59)    | 0.086**<br>(2.20)     |
| Leverage                        | 5.100***<br>(8.19)    | 5.695***<br>(8.90)    | 13.278***<br>(6.87)   | 13.984***<br>(7.28)   |
| Loss                            | 0.619***<br>(5.87)    | 0.640***<br>(6.56)    | 2.208***<br>(6.72)    | 1.985***<br>(7.28)    |
| Diff (High–Low)                 |                       | -0.616**              |                       | -1.915***             |
| p-value                         |                       | 0.04                  |                       | 0.000                 |
| Firm Fixed Effects              | Yes                   | Yes                   | Yes                   | Yes                   |
| Time Fixed Effects              | Yes                   | Yes                   | Yes                   | Yes                   |
| Adj R-squared                   | 0.614                 | 0.636                 | 0.621                 | 0.631                 |
| Observations                    | 64,460                | 68,678                | 64,460                | 68,678                |

**Table 8: Short selling, the Mispricing Score, and ESG Ratings**

This table presents the results from panel regressions of short-selling as a function of a short target dummy and ESG Ratings. Short-selling demand is proxied by the short interest ratio and utilization ratio. Each month, we sort stocks based on monthly [Stambaugh, Yu, and Yuan \(2015\)](#) mispricing score. *Short Target* is a dummy equal to one for stocks in quintile 5, those that the SYY metric identifies as overvalued. *ESG Score* is the annually updated raw score from the Refinitiv database. Control variables include the logarithm of market capitalization, the logarithm of book-to-market value, institutional ownership, analyst coverage, firm leverage, and a loss dummy indicating negative earnings. All regressions include firm-fixed effects and time-fixed effects. The t-statistics in the brackets are calculated from robust clustered standard errors by the firm. \*\*\*, \*\*, and \* denote significance at the 0.01, 0.05, and 0.10 levels, based on a two-sided test. The sample period is from January 2006 to December 2022.

|                                 | Short Interest Ratio |                      | Utilization Ratio    |                       |
|---------------------------------|----------------------|----------------------|----------------------|-----------------------|
|                                 | (1)                  | (2)                  | (3)                  | (4)                   |
| Short Target $\times$ ESG Score | -1.115**<br>(-2.25)  | -1.710***<br>(-3.53) | -7.038***<br>(-4.37) | -8.484***<br>(-5.21)  |
| Short Target                    | 1.491***<br>(7.92)   | 1.472***<br>(7.81)   | 5.818***<br>(8.96)   | 5.981***<br>(8.99)    |
| ESG Score                       | -1.309**<br>(-2.40)  | -0.989**<br>(-1.98)  | -3.938**<br>(-2.56)  | -2.710*<br>(-1.86)    |
| Ln(ME)                          |                      | -1.390***<br>(-8.60) |                      | -4.502***<br>(-10.34) |
| Ln(BM)                          |                      | 0.349***<br>(2.79)   |                      | 0.008<br>(0.02)       |
| Institutional Ownership         |                      | 7.713***<br>(9.74)   |                      | 14.077***<br>(7.58)   |
| Analyst                         |                      | 0.035***<br>(2.94)   |                      | 0.099**<br>(2.51)     |
| Leverage                        |                      | 5.166***<br>(9.31)   |                      | 11.801***<br>(7.31)   |
| Loss                            |                      | 0.622***<br>(7.91)   |                      | 2.002***<br>(8.76)    |
| Firm Fixed Effects              | Yes                  | Yes                  | Yes                  | Yes                   |
| Time Fixed Effects              | Yes                  | Yes                  | Yes                  | Yes                   |
| Adj R-squared                   | 0.580                | 0.633                | 0.625                | 0.653                 |
| Observations                    | 203,608              | 162,198              | 203,608              | 162,198               |

**Table 9: Short selling constraints, The Mispricing Score, and ESG Ratings**

This table presents the results from panel regressions of short-selling constraints as a function of a short target dummy and ESG Ratings. Short-selling constraints are measured by lendable shares, lending fee, ERR short selling risks (Engelberg, Reed, and Ringgenberg (2018)), and put-call volatility ratio. Each month, we sort stocks based on the monthly Stambaugh, Yu, and Yuan (2015) mispricing score. *Short Target* is a dummy equal to one for stocks in quintile 5, which are overvalued according to the SYR measure. *ESG Score* is the annually updated raw score from the Refinitiv database. Control variables include the logarithm of market capitalization, the logarithm of book-to-market value, institutional ownership, analyst coverage, firm leverage, and a loss dummy indicating negative earnings. All regressions include firm-fixed effects and time-fixed effects. The t-statistics in the brackets are calculated from robust clustered standard errors by the firm. \*\*\*, \*\*, and \* denote significance at the 0.01, 0.05, and 0.10 levels, based on a two-sided test. The sample period is from January 2006 to December 2022.

|                                 | Lendable Shares   |                      | Lending Fee       |                      | ERR Short Selling Risk |                      | Put-call Volatility Ratio |                      |
|---------------------------------|-------------------|----------------------|-------------------|----------------------|------------------------|----------------------|---------------------------|----------------------|
|                                 | (1)               | (2)                  | (3)               | (4)                  | (5)                    | (6)                  | (7)                       | (8)                  |
| Short Target $\times$ ESG Score | -0.220<br>(-0.36) | -0.427<br>(-0.71)    | -0.291<br>(-1.33) | -0.322<br>(-1.50)    | -0.056*<br>(-1.66)     | -0.050<br>(-1.50)    | -0.462*<br>(-1.69)        | -0.531*<br>(-1.90)   |
| Short Target                    | -0.176<br>(-0.76) | -0.209<br>(-0.94)    | 0.174*<br>(1.85)  | 0.196**<br>(2.08)    | 0.028*<br>(1.86)       | 0.026*<br>(1.79)     | 0.277**<br>(2.27)         | 0.360***<br>(2.78)   |
| ESG Score                       | 1.626**<br>(2.45) | 1.060<br>(1.64)      | -0.074<br>(-0.56) | 0.028<br>(0.23)      | -0.028<br>(-1.32)      | -0.009<br>(-0.44)    | 0.043<br>(0.27)           | 0.130<br>(0.82)      |
| Ln(ME)                          |                   | 0.102<br>(0.60)      |                   | -0.273***<br>(-4.88) |                        | -0.056***<br>(-5.69) |                           | -0.301***<br>(-5.19) |
| Ln(BM)                          |                   | 0.307**<br>(2.34)    |                   | -0.056<br>(-1.64)    |                        | -0.013*<br>(-1.89)   |                           | -0.115***<br>(-2.95) |
| Institutional Ownership         |                   | 9.946***<br>(12.73)  |                   | -0.100<br>(-0.87)    |                        | -0.029<br>(-1.47)    |                           | 0.093<br>(0.61)      |
| Analyst                         |                   | 0.043***<br>(2.87)   |                   | 0.001<br>(0.41)      |                        | 0.001<br>(1.09)      |                           | -0.000<br>(-0.12)    |
| Leverage                        |                   | -1.110*<br>(-1.78)   |                   | 0.216<br>(1.32)      |                        | 0.046<br>(1.60)      |                           | 0.168<br>(0.80)      |
| Loss                            |                   | -0.297***<br>(-3.80) |                   | 0.077**<br>(2.56)    |                        | 0.010**<br>(1.99)    |                           | 0.035<br>(0.79)      |
| Firm Fixed Effects              | Yes               | Yes                  | Yes               | Yes                  | Yes                    | Yes                  | Yes                       | Yes                  |
| Time Fixed Effects              | Yes               | Yes                  | Yes               | Yes                  | Yes                    | Yes                  | Yes                       | Yes                  |
| Adj R-squared                   | 0.855             | 0.862                | 0.571             | 0.571                | 0.350                  | 0.333                | 0.205                     | 0.207                |
| Observations                    | 203,608           | 162,198              | 203,608           | 162,198              | 203,558                | 162,157              | 162,004                   | 131,637              |

# Supplementary Appendix for “Short Sellers and Social Responsibility Ratings” Variable Definitions

| <i>Short-Selling Activity Measures</i> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Short Interest Ratio                   | Daily average of shares on loan relative to the total shares outstanding within a month.                                                                                                                                                                                                                                                                                                                                                                                 |
| Utilization Ratio                      | Each day, we use shares on loan scale by lendable shares to get daily utilization ratio, then take average within a month.                                                                                                                                                                                                                                                                                                                                               |
| Lendable Shares                        | Daily average of shares available for lending on a given day relative to a firm’s total shares outstanding within a month.                                                                                                                                                                                                                                                                                                                                               |
| Lending Fee                            | Daily average of transaction-weighted rate reported by Markit and expressed in percentage per annum within a month.                                                                                                                                                                                                                                                                                                                                                      |
| ERR Short Selling Risk                 | The standard deviation of daily lending within a month.                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Put-call Volatility Ratio              | We keep the middle-term ATM options with maturity between 30 days to 60 days and absolute delta between 0.4 and 0.6. For each stock each day, we calculate the average of implied volatility for call options and put options, weighted by option interest. Daily put-call ratio is the ratio of implied volatility of put option and implied volatility of call option. Put-call ratio is defined as the average of put-call ratio within a month.                      |
| <i>Short-Selling Signals</i>           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Predicted Short Selling Demand         | Using the estimated coefficient in Table 3 Panel B of <a href="#">Drake, Rees, and Swanson (2011)</a> , we calculate out of sample predicted short-selling demand every quarter using the following formula: $Predicted\ Short\ Selling\ Demand = -1.777 \times SUE + 1.527 \times TACCR + 1.974 \times CAPEX + 0.080 \times LNMVE - 0.698 \times EP - 0.245 \times BTM + 4.198 \times TURN + 0.410 \times SG + 0.014 \times LTG - 2.138 \times FREV - 0.096 \times MOM$ |
| Short Target                           | At the end of each quarter, all available stocks are sorted into five quintiles based on predicted short selling demand. Short target is a dummy that equals one for stocks in the fifth quintile, i.e., stocks that have the strongest predict short selling signals, and zero otherwise.                                                                                                                                                                               |
| <i>ESG Measures</i>                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| ESG Score                              | ESG score is annually updated score from Refinitiv ESG database, based on relative performance of ESG factors with the company’s sector (for environmental and social) and country of incorporation (for governance) ( <a href="#">Refinitiv (2023)</a> ). The range of ESG score is between 0 and 1 after scaled by 100.                                                                                                                                                |

|                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Green Score                                  | Following <a href="#">Pástor, Stambaugh, and Taylor (2022)</a> , the unadjusted greenness score of firm $i$ at the end of quarter $t$ is $G_{i,t} = -(10 - Escore_{i,t}) \times Eweight_{i,t}/100$ , where $Escore_{i,t}$ and $Eweight_{i,t}$ are from company $i$ 's most updated MSCI rating data at the end of quarter $t$ . The Green score we use in our analysis is $g_{i,t} = G_{i,t} - \overline{G_t}$ , where $\overline{G_t}$ is the value-weighted average of $G_{i,t}$ across all the firms $i$ . |
| <i>Institution Holding Change Measures</i>   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Mutual Fund Number Change                    | Difference between the logarithm of mutual funds holding the stock this quarter and last quarter.                                                                                                                                                                                                                                                                                                                                                                                                             |
| Mutual Fund Ownership Change                 | Difference between total mutual fund ownership this quarter and last quarter.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Institution Number Change                    | Difference between the logarithm of 13F institutions holding the stock this quarter and last quarter.                                                                                                                                                                                                                                                                                                                                                                                                         |
| Institutional Ownership Change               | Difference between total 13F institutional ownership this quarter and last quarter.                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <i>Stock Characteristics</i>                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Ln(ME)                                       | The natural logarithm of the market value of the firm's equity at the end of last year.                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Ln(BM)                                       | The natural logarithm of book equity for the fiscal year-end in a calendar year divided by market equity at the end of December of that year, as in <a href="#">Fama and French (1992)</a> .                                                                                                                                                                                                                                                                                                                  |
| Institutional Ownership                      | The percentage of common stocks owned by institutions in the previous quarter.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Analyst                                      | The number of analysts following the firm in the previous month.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Leverage                                     | Total liabilities scaled by the total assets at the end of the most recent fiscal year.                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Loss                                         | A dummy variable equal to one if the net income at the end of the most recent fiscal year is negative, and zero otherwise.                                                                                                                                                                                                                                                                                                                                                                                    |
| Socially Responsible Institutional Ownership | We first calculate the value-weighted size-adjusted ESG score as the socially responsible score for all the institutions. Then we define socially responsible (SR) institutions (one-third of all) based on their scores. SRIO is the number of shares held by SR institutions divided by the total number of shares held by all the institutions.                                                                                                                                                            |

**Table A1: Short selling activities around Russell 1000/2000 inclusion events**

This table reports panel regression results of short-selling activities around the Russell 1000/2000 Index inclusion events. The event window is (-6, +6) months excluding the event month. The dependent variables include *Short Interest Ratio* and *Utilization Ratio*. The treated group contains the 1001<sup>st</sup> to 1050<sup>th</sup> stocks in terms of market capitalization at the end of May, which will be included in the Russell 2000 index. The control group contains the 951<sup>st</sup> to 1000<sup>th</sup> stocks in terms of market capitalization at the end of May, which will be included in the Russell 1000 index. Each quarter, we calculate out-of-sample predicted short interest using the estimates from [Drake, Rees, and Swanson \(2011\)](#). Each month, stocks are sorted into quintiles based on their predicted short interest as of the most recent quarter-end. *Short Target* is a dummy equal to one for stocks in quintile 5, representing those with the highest predicted short interest. All regressions include firm-fixed effects and time-fixed effects. The t-statistics in the brackets are calculated from robust clustered standard errors by the firm. \*\*\*, \*\*, and \* denote significance at the 0.01, 0.05, and 0.10 levels, based on a two-sided test. The sample period is from January 2006 to December 2022.

|                                           | Short Interest Ratio |                     | Utilization Ratio    |                     |
|-------------------------------------------|----------------------|---------------------|----------------------|---------------------|
|                                           | (1)                  | (2)                 | (3)                  | (4)                 |
| Post $\times$ Treat $\times$ Short Target | 1.362**<br>(2.13)    | 1.269**<br>(2.05)   | 2.680<br>(1.61)      | 2.793*<br>(1.68)    |
| Post $\times$ Treat                       | 0.346**<br>(2.21)    | 0.243<br>(1.52)     | 1.227*<br>(1.89)     | 1.004<br>(1.50)     |
| Post $\times$ Short Target                | -0.124<br>(-0.30)    | -0.111<br>(-0.28)   | 1.077<br>(1.00)      | 0.869<br>(0.81)     |
| Treat $\times$ Short Target               | 1.292**<br>(2.32)    | 1.174**<br>(2.35)   | 3.963**<br>(2.46)    | 3.555**<br>(2.52)   |
| Short Target                              | 0.372<br>(0.80)      | 0.084<br>(0.22)     | 0.733<br>(0.53)      | -0.184<br>(-0.16)   |
| Post                                      | -0.310***<br>(-2.72) | -0.272**<br>(-2.15) | -1.392***<br>(-3.14) | -1.227**<br>(-2.56) |
| Treat                                     | 0.143<br>(0.48)      | 0.159<br>(0.59)     | 0.086<br>(0.08)      | 0.252<br>(0.24)     |
| Controls                                  | No                   | Yes                 | No                   | Yes                 |
| Firm Fixed Effects                        | Yes                  | Yes                 | Yes                  | Yes                 |
| Time Fixed Effects                        | Yes                  | Yes                 | Yes                  | Yes                 |
| Adj R-squared                             | 0.733                | 0.774               | 0.704                | 0.734               |
| Observations                              | 11,216               | 10,030              | 11,216               | 10,030              |