Value versus *Values*: Does Stock Liquidity Affect Corporate Environmental Policies?[*]

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Abstract

Distinguishing *value* from *values* has been a challenge in sustainable investing (Starks 2023). Leveraging the Tick Size Pilot Program (TSP)—a natural experiment that increased treatment firms' tick size from one cent to five cents—we find that green institutional investors with a relatively low willingness-to-pay for environmental objectives (i.e., *value* investors) significantly influence corporate environmental policies. During the TSP, these *value* investors reduced their divestment intensity following environmental incidents at treatment firms, relative to control firms. Treatment firms' environmental ratings declined, with the drop most pronounced among those highly exposed to exit threats on environmental issues.

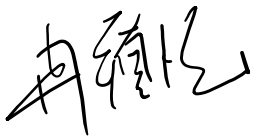
Keywords: Stock liquidity, Environment, *Value* versus *Values*, Institutional investors, Divest, Voice

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Disclosure Statement

The author declares that he has no relevant or material financial interests that relate to the research described in this paper.



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1. Introduction

Laura Starks' (2023) presidential address to the American Finance Association outlines a fundamental challenge to the literature of sustainable investing: separating the influences of *value* versus *values* investors. As shown in Figure 1, among investors who factor environmental concerns into their investment strategies (hereafter referred to as "green investors"), *values* investors might prioritize nonpecuniary objectives, potentially prompting them to sacrifice returns to achieve environmental goals. In contrast, *value* investors who assess environmental factors for their implications on risks and returns can also influence corporate environmental policies when environmental considerations hold financial significance. Without an explicit identification of these motives, it becomes challenging to grasp the impact of sustainable investing on investors, corporations, and asset markets.

[Insert Figure 1 about here]

In this paper, we aim to address the challenge by leveraging an exogenous liquidity shock, and demonstrate that *value* investors play a significant role in driving corporate environmental initiatives. Specifically, we conduct our analysis within the context of a laboratory-like experiment called the TSP, which increases the tick size of 1,200 randomly selected treatment firms from one cent to five cents during the pilot period (October 2016–September 2018), thereby exogenously reducing their liquidity. We first show that during the TSP, treatment firms experienced a significant decline in environmental ratings relative to control firms. We then provide evidence that the TSP-induced increase in transaction costs weakened green institutional investors' capacity to exert governance (via exit threats) on environmental issues. Because *values* investors have a high willingness-to-pay for environmental goals (Starks 2023), they should remain unaffected by a 4-cent increase in the tick size.[2] Conversely, green investors who responded to this small 4-cent increase must have a low willingness-to-pay and are therefore *value* investors. As a result, the TSP provides a conservative, lower-bound estimate of the *value* investor's impact on corporate environmental policies.[3]

[2] Barber, Morse, and Yasuda (2021) estimate that the impact investors' willingness-to-pay is between 2.5-3.7 percentage points. Other *values* investors may have a lower willing-to-pay, but 4-cent is certainly significantly below the hurdle to qualify as a *values* investor.

[3] When a portfolio firm experiences an environmental incident, *value* investors weigh the costs of divestment against the potential financial losses of maintaining their position. While some *value* investors may still choose to divest if they assign a relatively high financial penalty to poor environmental performance, the increased

Leveraging the TSP offers two advantages in separating *value* from *values*. First, by identifying investors whose trading behavior is sensitive to exogenous changes in transaction costs, our approach relies on revealed preferences and does not suffer from the widely discussed concern that some asset managers brand themselves as *values* investors for advertisement purposes without giving up returns to make sustainable investments (Baker, Egan and Sarkar 2022). Second, as an exogenous liquidity shock, the TSP affects the financial return of investing in treatment firms without muddling with risk considerations. For example, one difficulty in measuring risk-adjusted willingness-to-pay lies in the absence of a widely accepted asset pricing model for climate change risk. We circumvent the reliance on theoretical models, often constrained by restrictive assumptions, to gauge whether investor responses stem from optimizing risk-return trade-offs (*value* investors) or prioritizing nonpecuniary motives over returns (*values* investors).[4]

We first establish a negative *causal* effect of stock illiquidity on corporate environmental performance. Compared to control firms, the implementation of TSP decreased treatment firms' environmental rating by, on average, 0.132 on a scale from 0 to 10. The negative impact of TSP on environmental ratings was most pronounced for stocks with a smaller pre-TSP quoted spread, for which the TSP imposes a more binding constraint for liquidity.[5] The results hold when we implement a 2SLS analysis with the initiation of TSP used as an instrument for changes in stock liquidity over time. We find that one standard deviation increase in stock

transaction costs imposed by the TSP act as a constraint for those who place lower financial value on a firm's environmental policies. Therefore, our findings represent a conservative, lower-bound estimate of the influence *value* investors exert on shaping corporate environmental policies.

[4] As postulated by Starks (2023), *value* investors vis-à-vis *values* investors are more sensitive to financial payoffs of their investments. Thus, compared to *values* investors, *value* investors should be more responsive to quantitative mispricing signals. Cao, Titman, Zhan, and Zhang (2023) show that abnormal returns associated with these mispricing signals are greater for stocks held more by green investors. However, identifying *values* or *value* investors *ex-ante* by measuring investor-level sensitivity to mispricing signals may suffer from two limitations. First, widely used mispricing proxies, such as the Stambaugh, Yu, and Yuan (2015) score, often do not account for a firm's environmental performance. Second, even asset pricing models that explicitly incorporate environmental performance (e.g., Pedersen, Fitzgibbons, and Pomorski 2021; Pastor, Stambaugh, and Taylor 2022) face ongoing debate. It remains unclear whether return deviations from these models represent temporary mispricing or simply reflect model misspecification.

[5] Albuquerque, Song, and Yao (2020) find that TSP has a disproportionately greater impact on small-spread stocks' stock liquidity.

illiquidity, proxied by the relative effective spread, causes a 0.259-point deterioration in a firm's environmental rating. Moreover, we show the *real* environmental impact of stock liquidity. Since the TSP became enacted, treatment firms exhibited an increase of 9.13% in their emission levels and a 7.64% rise in intensity.[6] It suggests that a worse stock liquidity can exacerbate firm-level emission activities.

Next, we present evidence that the increased transaction costs during the TSP period limited green institutional investors' ability to exert governance—particularly through the threat of exit—on environmental issues. Specifically, we find that green investors tend to divest around environmental incidents, whereas non-green institutions are not responsive. A TSP-induced reduction in liquidity, however, decreases green investors' exit threat. Specifically, for a median firm facing an environmental incident, its green institutional investor tends to fully divest after the incident, whereas non-green investors are insensitive to such incidents. However, as TSP significantly raises transaction costs for treatment firms with a small pre-TSP spread, green investors under-divest their equity holdings in those firms by about 3.17 basis points compared to control firms following an environmental incident. The magnitude of constrained trading is economically significant given that the sample median portfolio weight is only 0.52 basis points.

Since the change in transaction costs introduced by TSP is capped at four cents per share,[7] the change in divestment intensity should primarily reflect the behavior of investors with a low willingness to pay, i.e., *value* investors. While it is difficult to establish a precise threshold distinguishing *value* investors from *values* investors, this four-cent cap serves as a *conservative* benchmark: our approach may under-identify *value* investors, but *values* investor should not perceive such a minor increase in transaction costs as a constraint. Hong and Kacperczyk (2009) and Barber, Morse, and Yasuda (2021) show that norm-constrained investors—such as banks,

[6] The effect of the TSP on emissions should be interpreted with caution. Specifically, we obtain firms' carbon emissions data from the Environmental Protection Agency (EPA)'s Greenhouse Gas Reporting Program (GHGRP), which limits the sample to firms with facilities emitting at least 25,000 metric tons of CO_2 annually. As a result, the economically significant impact of the TSP on emissions may partly reflect the greater sensitivity of large polluters to institutional investors' governance pressure.

[7] See Li and Ye (2024) to see a formal proof of the cap.

insurance companies, pension funds, and religious institutions—tend to have a very high willingness to pay, on average sacrificing 2.5%–6.2% in returns to meet environmental objectives. Indeed, we find that TSP has very limited impact on divestment intensity for norm-constrained investors.

Furthermore, *values* investors who have obtained Principles for Responsible Investment (PRI) signatory status demonstrate a higher likelihood of eventual PRI delisting compared to other green investors. This pattern is consistent with the substantial follow-up costs of maintaining PRI status, including mandatory annual fees and increasingly stringent compliance requirements. It also aligns with Gibson, Glossner, Krueger, Matos, and Steffen (2022) and Kim and Yoon (2023), who document that many U.S. institutional investors opportunistically adopt PRI signatory status for financial motives (e.g., to attract higher flows) without genuinely committing to sustainable investing. Our results, therefore, suggest that *value* investors initially secure PRI signatory status for its financial benefits but abandon it when confronted with escalating compliance obligations. These observations—that TSP respondents are less norm-constrained and more likely to withdraw from PRI signatory status—validate our approach of using liquidity shocks to identify investors at the lower end of the willingness-to-pay spectrum (*value* investors).

After showing that TSP reduces divestment intensity to treatment firms, we show that the negative effect of TSP on environmental ratings was more pronounced in firms with a sensitivity to exit threats. We measure sensitivity first based on the managerial focus on stock prices. Firms with a higher wealth-performance sensitivity (WPS, Edmans, Gabaix, and Landier 2009) experienced an additional decline in environmental ratings by 1.952 points, representing a significant change equivalent to 1.07 standard deviations in environmental ratings. We also measure the firm-level exposure to exit threats using the level of coordination risk. Crane, Koch, and Michenaud (2019) show that a lack of coordination among investors strengthens the exit threats by enhancing the trading intensity. We find that TSP adversely affected firms whose institutional investors may not coordinate well on environmental issues. These firms experienced an additional decrease in their environmental ratings by 1.162 points.

Combining evidence on investors' divestment behavior and firms' exposure to such potential divestment, we attribute the decline in environmental performance to higher transaction costs, which hindered *value* investors from exerting exit threats on environmental issues. We find the support of our economic channel again as TSP concluded in October 2018. After the TSP ended, green investors significantly increased their divestment intensity from treatment firms in response to environmental incidents. This increase in divestment intensity amounted to 5.42 basis points of portfolio weight in the quarter of the incident. As exit threats increased post-TSP, firms more vulnerable to exit threats began implementing policies to enhance their environmental performance. Specifically, we observed improvements in environmental ratings by 0.412 points and 0.454 points in treatment firms with greater managerial focus on equity prices and higher coordination risk, respectively. Additionally, treatment firms improved their environmental profiles by reducing emission levels by 7.02% and emission intensity by 12.5%.

In addition to governing through trading a firm's shares, known as "exit", institutional investors can also engage in "voice" via a public shareholder proposal or voting against directors. Stock liquidity may help improve the corporate environmental profile as it allows shareholders to enjoy a lower cost of activism when accumulating shares (Maug 1998; Kahn and Winton 1998; Winton and Li 2006). We find that voice is, however, less likely to be the main driver of the results because TSP firms have historically had low exposure to shareholder activism, measured using shareholder campaigns and 13D filings, on environmental issues.

We contribute to the literature on sustainable investing. As stressed by Starks (2023), understanding the distinct roles of *values* investors and *value* investors is crucial for interpreting the implications of sustainable investing on investment behavior, thereby informing relevant regulatory measures. Clear identification of investment incentives, however, is complicated. For example, classifying investors based on the presence of an ESG mandate is insufficient, as some asset managers market themselves as *values* investors for branding purposes without necessarily sacrificing returns for sustainability. Baker, Egan, and Sarkar (2022) highlight this issue, showing that ESG-mandated and non-ESG funds often hold similar portfolios and deliver comparable returns. Besides, it is even more challenging to identify the

influence of green investors with low willingness to pay (*value* investors), as they have little incentive to disclose their true willingness to pay, since doing so could potentially harm their reputation perceived by retail investors or affect fund flows. The TSP, an exogenous but small shock to transaction costs, allows us to identify green investors with low willingness to pay. To the best of our knowledge, we are the first to show that *value* investors matter for the environment.

Our paper also contributes to the literature that examines the effect of exit threats on corporate performance. The effectiveness of exit threats as a governance mechanism hinges on both (1) investors' incentives to exert credible exit threats and (2) firms' sensitivity to such threats. Edmans (2009) and Admati and Pfleiderer (2009) theoretically show that deteriorated liquidity can reduce investors' incentive to govern via exit threats. Empirical studies have since explored the causal impact of exit by showing that liquidity shocks influence firm performance—particularly for firms more sensitive to exit threats (e.g., Bharath, Jayaraman, and Nagar 2013; Edmans, Fang, and Zur 2013). However, no study has empirically examined whether liquidity affects investors' actual divestment behavior. Our paper fills in this gap. Specifically, we measure investors' environmental preferences through portfolio-level environmental ratings and demonstrate that negative liquidity shocks significantly reduce the divestment response of environmentally committed ("green") investors following corporate environmental incidents. This study is the first to empirically link an exogenous shock on stock liquidity with investors' actual divestment behavior, thereby completing the chain of evidence needed to show the causal impact of exit on corporate policies.

The United Nations Sustainable Stock Exchanges (UN SSE) Initiative conjectures that stock exchanges can enhance ESG performance through improved liquidity. Yet the positive correlation between stock liquidity and ESG performance can come from omitted variables or reverse causality: ESG expenditure and performance may increase firm's stock liquidity as they help reduce information asymmetry and attract more uninformed trading. We address the potential concern of reverse causality through an exogenous shock on liquidity. To the best of our knowledge, we are the first paper showing that the secondary market also significantly

influences environmental sustainability, which complements the existing literature that focuses exclusively on primary markets.

2. Institutional Background and Data

2.1. Institutional Background

We consider all 2,399 stocks that were subject to TSP.[8] They were randomly selected from the universe of Regulation National Market System (Reg NMS) securities upon meeting specific criteria, including a market capitalization of $3.0 billion or less, a closing price of at least $2.00, and a consolidated average daily volume of one million shares or less. The SEC announced the list of TSP securities on Sep 3, 2016. The list can be found on the websites of the listing exchanges and FINRA.

Amongst the 2,399 TSP stocks, 1,199 stocks were randomly assigned to the control group, and will continue quoting at their current tick size increment of one cent. The rest 1,200 stocks were assigned to the treatment group, which were further categorized into three treatment groups (G1, G2, and G3), each comprised of 400 treatment stocks. While all treatment stocks were subject to an increase in their minimum quote increment from one cent to five cents, stocks in groups 2 and 3 are required to trade in five-cent increments. Furthermore, group 3 stocks are subject to a "trade-at" prohibition, which increases the trading cost for non-displayed liquidity on lit exchanges and dark pool trades. The two-year TSP was fully implemented in October 2016, at which point all treatment stocks began trading with a tick size of five cents. The program concluded officially on September 30, 2018.[9] Chung, Lee, and Rösch (2020) and Albuquerque, Song, and Yao (2020) show that TSP reduces liquidity for stocks in the treatment group, in contrast to stocks in the control group.

[8] The JOBS Act mandated the SEC to undertake a study examining the repercussions of decimalization on both the number of initial public offerings and the liquidity of securities for small and middle capitalization companies. The SEC instructed then both FINRA and the National Securities Exchanges to collaboratively devise an experimental pilot program. The resultant TSP gained approval from the SEC in May 2015.

[9] The TSP was enacted around the same time the Paris Agreement was signed in April 2016 and became effective in December 2016, which heightened public awareness of environmental issues. This timing makes the TSP a more relevant instrument for studying the effect of liquidity on corporate environmental policies compared to other historical liquidity-related regulations, such as the 2001 Decimalization.

2.2. Measuring Firms' Greenness

We derive firm-level environmental ratings from MSCI ESG Intangible Value Assessment (IVA) (thereby referred to as MSCI) rating database. As the largest global provider of ESG ratings (Eccles and Stroehle 2018), with roughly 200 research analysts, MSCI covers over 7,000 companies and more than 650,000 equity and fixed-income securities worldwide.[10] Also, MSCI updates its environmental rating up to a monthly basis, whereas alternative raters like Asset4 and KLD only compute their ratings annually. The increased frequency of updates by MSCI allows for a more precise assessment of the impact of stock liquidity events on corporate environmental policies.

We measure the environmental rating using the "Environmental pillar score" from MSCI IVA data. The environmental rating, ranging from 0 to 10, signifies the weighted average of four Theme scores falling under the Environmental Pillar.[11]

We further support our analysis with firms' carbon emissions data from Environmental Protection Agency (EPA)'s Greenhouse Gas Reporting Program (GHGRP). In October 2009, the EPA introduced the GHGRP, requiring sources emitting 25,000 metric tons or more of CO2 greenhouse gases annually to report their emissions using EPA-prescribed estimation methodologies. Once the EPA verifies the submitted information, the information becomes publicly accessible through the Facility Level Information on GHGs Tool (FLIGHT). FLIGHT provides details at the plant level, including identity, geographical location, parent company ownership, North American Industry Classification System (NAICS) industry code, and the quantity of greenhouse gas emissions from the plant on an annual basis, starting in 2010.

[10] As plotted in Figure A1, the coverage of small U.S. stocks by MSCI IVA commenced at the close of 2012. Precisely, the count of U.S. stocks with available lagged MSCI ratings experienced a substantial surge, rising from approximately 500 to over 2000 by the conclusion of 2012. The broad coverage of firms in MSCI IVA far exceeds that of other ESG raters, such as Sustainalytics, as shown in Berg, Koelbel, and Rigobon (2022).

[11] The Environmental Pillar encompasses four crucial themes: 1) Climate Change, 2) Natural Capital, 3) Pollution & Waste, and 4) Environmental Opportunities. Climate Change encompasses issues such as carbon emissions, climate change vulnerability, financing environmental impact, and product carbon footprint. Natural Capital explores biodiversity and land use, raw material sourcing, and water stress. Pollution Waste evaluates performance in addressing concerns related to electronic waste, packaging material and waste, and toxic emissions and waste. Lastly, Environmental Opportunities assesses a firm's effectiveness in seizing opportunities in clean tech, green building, and renewable energy.

To measure a firm's environmental profile using carbon emissions, we employ two proxies. The first the log of thousands metric tons of Scope 1 carbon emissions (*Ln(emission level)*), namely the emission level. The second measure is the carbon intensity (*Ln(emission intensity)*), calculated by dividing metric tons of carbon emissions by firm revenue (in dollar) before taking a log transformation. We present and discuss the regression results of using GHGRP's emission data in Subsection 7.2.

2.3. Sample Construction and Summary Statistics

The sample period spans from October 2013 to September 2018 — three fiscal years preceding the TSP enactment and extends to the end of the TSP. We illustrate how the sample period is defined in Figure 2. We use quarterly fundamentals data from Compustat, supplemented by data from the annual fundamentals database when necessary. We source stock market data, including prices, returns, and liquidity, from CRSP, with TAQ utilized for a more detailed analysis of liquidity, employing the intraday effective spread measured in percentage terms. We collect institutional holdings data from the Thomson Reuters S34 database. We retrieve environmental incident news from RepRisk. Activist campaigns data came from FactSet SharkRepellent. We obtain CEO's scaled wealth-performance sensitivity (WPS) data from http://alexedmans.com/data/, with WPS representing the dollar change in CEO wealth for a hundred-percentage point change in firm value, divided by annual flow compensation.

[Insert Figure 2 about here]

The study commenced with 2,481 stocks, encompassing those added to and dropped from the TSP during its course. Subsequent integration of TSP data with the CRSP/Compustat Merged database and exclusion of financial and utility stocks resulted in 752 treatment stocks and 735 control stocks. Restricting the sample to stocks maintaining consistent treatment status from October 2016 through September 2018 yielded 655 treatment stocks and 669 control stocks. After integration with MSCI IVA data, the sample comprised 418 treatment stocks and 405 control stocks. After excluding stocks with missing firm-fundamentals control variables and those that have changed their fiscal year-end, the final TSP sample comprised 346 treatment stocks and 331 control stocks, resulting in a total of 9,423 firm-quarter observations. Table 1

presents summary statistics for firm-fiscal quarter observations in our sample. The median asset size in our sample is $809.956 million and the median environmental rating is 4.4.

[Insert Table 1 about here]

3. Impact of Stock Liquidity on Environmental Ratings

We employ the following model as our main regression specification, using firm-quarter observations:

$$Env_{i,t+1} = \beta_1 TREAT_i \times POST_t + Firm_i + Quarter_{t+1} + C_{i,t} + \epsilon_{i,t+1} \quad (1)$$

where $Env_{i,t+1}$ represents firm i's environmental rating in fiscal quarter $t+1$, $TREAT_i$ is a dummy variable that takes value of one for firms in the TSP treatment group and zero otherwise. $POST_t$ equals one if the fiscal quarter *t* began during the TSP (i.e., between Oct 2016 and Sept 2018), and zero otherwise. $Firm_i$ and $Quarter_{t+1}$, respectively, denote firm fixed effects and fiscal quarter fixed effects. Therefore, β_1 captures the causal effect of TSP-induced liquidity shock on the corporate environmental ratings. $C_{i,t}$ represents a vector of firm-fundamentals control variables: the size of firm (proxied by the log of total assets), cash ratio, dividend yield, book-to-market ratio, sales growth, leverage ratio, the amount of investments, analyst coverage, and stock return volatility. These control variables consider the potential impact of firms' growth and financial positions on environmental ratings, and the potential effect of TSP on firms' cost of capital. The definitions of control variables are presented in Table A1.

Table 2 Column (1) presents the regression estimate of Equation (1) over a sample period that spans Oct 2013 – Sept 2018. The negative β_1 estimate indicates that firms that experienced a negative stock liquidity shock tend to exhibit a worse environmental performance. The implementation of TSP decreased treatment firms' environmental rating by, on average, 0.132, compared to control firms.

[Insert Table 2 about here]

The coefficients of control variables are consistent with the literature. Cash reserves tend to negatively predict future environmental ratings. This suggests that companies might incur abatement expenses to enhance their environmental ratings, thereby reducing their contemporary cash reserves. Dividend yields tend to positively predict environmental

initiatives, while leverage ratios predict negatively. This is in line with Xu and Kim (2022); firms with relatively unconstrained financial conditions and less immediate financial liabilities are more capable of adopting better environmental policies. Additionally, we find that higher stock return volatility often correlates with lower environmental ratings.

Table 2 Column (2) examines whether the parallel trend assumption is satisfied prior to the start of the TSP. To do so, we estimate the temporal evolution of the TSP effect on treatment firms. We replace the treatment indicator with a series of dummy variables, each representing a different fiscal year in our sample period. The baseline year is set to two years before the start of the TSP. It is evident that the changes in environmental ratings of control and treatment firms are statistically indifferent from each other until the start of TSP, after which we witness a statistically significant and negative impact of TSP.

4. Conditional Impact of Stock Liquidity: Small Spread V.S. Large Spread

Albuquerque, Song, and Yao (2020) discover that the decline in stock liquidity induced by TSP is predominantly observed in stocks with a smaller quoted spread in dollars before the implementation of TSP. It is because the increased tick size serves as a more effective binding constraint on the bid-ask spread of stocks that have small bid-ask spreads before TSP starts. To further isolate the TSP's effect on environmental ratings through liquidity, we examine whether this effect is more pronounced within the subset of stocks with a smaller pre-TSP quoted spread. Following Albuquerque, Song, and Yao (2020), we classify the sample into two groups based on their average dollar quoted spread between March 1, 2016, and August 31, 2016. Firms with an average spread of three cents or less are categorized as the small-spread group, whereas those with a spread greater than three cents fall into the large-spread group.

Columns (1) and (2) of Table 3 show the results for the two groups of stocks. While the impact of TSP on environmental ratings is negative for both groups, it is statistically significant only for stocks with a smaller pre-TSP quoted spread. To further validate this estimation, we test the pre-treatment parallel-trend assumption for each pre-TSP quoted spread group by examining the dynamic effect of TSP. Columns (3) and (4) indicate that the environmental

ratings of treatment and control firms are not significantly different from zero at any point before the treatment period. Following the TSP's enactment, firms with a bid-ask spread constrained by the new tick size experience a significant drop in environmental ratings by 0.445. The dynamic effects for both groups are illustrated in Figure 3.

[Insert Table 3 about here]

[Insert Figure 3 about here]

Overall, the finding of a statistically significant and negative effect of TSP exclusively among small-spread stocks reinforces our identification of the stock liquidity's positive effect on corporate environmental decisions.[12] In the following sections, we focus on firms with a small pre-TSP spread, because the increased tick size serves as the most binding constraint for those firms. In Sections 5, we examine how the governance strategies of, respectively, voice and exit employed by *value* investors vis-à-vis *values* investors are affected by TSP.

5. The TSP and Institutional Investors' Divestment Response to Environmental Incidents

In this section, we examine the mechanism through which the decline in stock liquidity induced by the TSP led to a deterioration in environmental ratings. Higher liquidity strengthens institutional investors' governance on corporate policies because it enhances their incentives to acquire costly information and sell shares upon negative information (a governance mechanism known as "exit") (Admati and Pfleiderer, 2009; Edmans, 2009; Edmans and Manso, 2011; Edmans, Fang, and Zur, 2013). For such governance mechanism to be effective, investors' exit threats should be credible enough to force management to undertake productive effort and dissuade investors from potential exiting. When institutional investors exhibit preferences towards environmental performance, greater stock liquidity increases their capacity to influence the environmental policies of their portfolio firms. To assess this

[12] A competing hypothesis, which our results reject, suggests that higher illiquidity would discourage the exit of *short-term* investors in particular. As a result, managers would face less pressure to prioritize short-term stock prices and could instead focus more on long-term performance, including areas like ESG performance. While Chang, Tan, Yang, and Zhang (2018) find empirical support for this hypothesis, their findings are limited to the period of 1994-2013, which precedes the 2016 Paris Agreement—an event that brought environmental sustainability to the forefront of many fund managers' decision-making criteria. Moreover, their study relies on the 2001 decimalization of stock trading as the primary identification instrument. Unlike the 2016 TSP, the 2001 decimalization lacked an ex-ante control group of firms.

mechanism, we investigate the impact of TSP on institutional investors' divestment intensity following environmental incidents at affected firms.

We follow Cao, Titman, Zhan, and Zhang (2023) by adopting a revealed preference approach to capture institutional investors' preferences towards environmental policies.[13] Green institutional investors are identified as those with a portfolio-level environmental rating above the median among all 13F institutional investors, according to the Thomson Reuters S34 database, based on holdings and environmental ratings as of the current quarter. To classify an institution's portfolio as environmentally rated, we require that at least 30% of its portfolio value is assessed under the MSCI IVA environmental rating. The sample median (10th percentile) [90th percentile] institution has 69% (27%) [90%] of its portfolio value being environmentally rated, so this method captures approximately 90% of institutional investors, covering those above roughly the 10th percentile. Conversely, non-green institutional investors are characterized by having a below-median environmental rating for their portfolio.[14]

According to Starks (2023), green investors can be categorized into two groups: *value* investors and *values* investors. To the extent that *values* investors, as opposed to *value* investors, tend to have a greater willingness to pay for sustainability investments, those investors who are sensitive to TSP-induced changes in transaction costs are plausibly *value* investors. If TSP increases the transaction costs associated with exiting a firm, thereby reducing the credibility of the threat, we expect *value* investors to *under-divest* from treatment firms compared to control firms in response to negative environmental events during the TSP period.

We measure negative environmental events using the negative news coverage of a company's environmental policies sourced from RepRisk, a prominent business research provider

[13] By measuring the sustainability of an investor's past asset holdings, this approach does not suffer from the widely discussed concern that some asset managers brand themselves as sustainable without actually pursuing sustainable investments (e.g., Dumitrescu, Gil-Bazo, and Zhou 2022).

[14] By focusing on the response of green investors and defining them in this manner, we are likely including some environment-aware *value* investors but *all values* investors. This approach, if anything, makes our identification of the effect of *value* investors on environmental performance using TSP more conservative.

specializing in assessing environmental, social, and governance (ESG) risks.[15] In RepRisk, news are categorized into three main areas: environmental, social, and governance. RepRisk captures significant and dramatic incidents, like the BP Gulf of Mexico oil spill, as well as more routine infractions. Our analysis focuses on environmental-related incident news.

We test whether green institutions are more likely to reduce their holdings when a firm experiences an environmental incident, and the extent to which TSP has restricted green institutions' ability to response to negative information events, using the following equation:

$$\begin{aligned} PortWeight_{i,j,t+1} = {} & \beta_1 Green\ Investor_{j,t+1} + \beta_2 TREAT_i \times POST_t \\ & + \beta_3 Green\ Investor_{j,t+1} \times TREAT_i \times POST_t \\ & + \beta_4 NonGreenInvestor_{j,t+1} \times Env.Incident_{i,t+1} \\ & + \beta_5 NonGreenInvestor_{j,t+1} \times Env.Incident_{i,t+1} \times TREAT_i \times POST_t \\ & + \beta_6 Green\ Investor_{j,t+1} \times Env.Incident_{i,t+1} \\ & + \beta_7 Green\ Investor_{j,t+1} \times Env.Incident_{i,t+1} \times TREAT_i \times POST_t \\ & + C_{i,t} + C_{j,t} + Firm_i + Investor_j + Quarter_{t+1} + \epsilon_{i,j,t+1} \end{aligned} \quad (2)$$

where $PortWeight_{i,t+1}$ is the firm i's weight (%) in a 13F investor j's portfolio in quarter $t+1$. $Green\ Investor_{i,t+1}$ ($NonGreenInvestor_{j,t+1}$) equals one for green (non-green) institutional investors, and zero otherwise. $Env.Incident_{i,t+1}$ is the environmental incident indicator. We first construct an incident indicator denoting whether an environmental incident occurred during the current quarter (event window of [0]). We also use event windows of [-2,0] and [-2,1] that account for potential run-ups in investor trading and allow for staggered responses. $C_{i,t}$ includes all control variables as in Table 2 and other possible combinations between $Green\ Investor_{j,t+1}$, $NonGreenInvestor_{j,t+1}$, $Env.Incident_{i,t+1}$, $TREAT_i$, and $POST_t$. We also control for institutional investor-level characteristics, including log portfolio size, turnover ratio, portfolio return, portfolio-level environmental rating, and portfolio flow,

[15] RepRisk provides intelligence services to the world's largest investors, delivering insights into any adverse information related to companies' business practices, including environmental degradation and other related risks. Since 2007, RepRisk has compiled daily updates of negative news counts on company-specific issues. Each incident is counted only once, and its impact is categorized based on the most influential source where it appears.

as of the last quarter. $Firm_i$, $Investor_j$, $Quarter_{t+1}$, respectively, denotes firm, investor, and fiscal quarter fixed effects.

Green institutional investors are more inclined to decrease their equity holdings in response to an environmental incident of a firm, compared to their non-green counterparts. Specifically, in Table 4, the dependent variable is the percentage of shares held by an institution as of a calendar quarter end, using the TSP sample spanning from October 2013 to September 2018. As captured by β_6, Column (1) shows that green institutions tend to reduce their portfolio weight by approximately 3.34 basis points when a portfolio firm experiences an environmental incident in the current quarter. Columns (2) and (3) show that this divestment response by green investors starts two quarters before the incident and persists for one quarter after the incident, resulting in a divesting intensity of 2.26 basis points and 2.22 basis points, respectively. These divestments are economically significant, particularly given the sample median portfolio weight of 0.52 basis points and mean portfolio weight of 16.2 basis points.[16] Put differently, for a median firm upon exposing to an environmental incident, its green institutional investor tends to fully divest after the incident. Conversely, non-green investors are insensitive to environmental incidents, as evidenced by the statistical insignificance of β_4.

[Insert Table 4 about here]

More importantly, with the initiation of TSP, green institutions tend to *under-divest* their equity holdings in response to an environmental incident, compared to control firms. Specifically, as demonstrated by β_7, they under-divest by 3.17 basis points in the current quarter (Column 1), 3.05 basis points when accounting for two quarters preceding the incident (Column 2), and 2.81 basis points when also including one quarter following the incident (Column 3). This result supports the notion that TSP restricted green investors' ability to exert exit threats during the TSP period. Building on Starks' (2023) framework separating *value* from *values* investors,

[16] The sample median of 0.52 basis points seems small because our sample is primarily constituted by small and median-sized firms owing to the TSP setup. For these TSP firms, even minor adjustments in portfolio weights by institutional investors can result in significant shifts in shareholdings. In comparison, large firms tend to require greater shifts in investment to impact ownership significantly, making smaller firms more susceptible to corporate governance influence through trading.

we argue that if any green investors change their behavior in response to the minor increase in transaction costs induced by the TSP, they are likely to be *value* investors.

To further validate the use of the TSP to identify investors with a low willingness to pay for environmental initiatives (i.e., *value* investors), we now create an investor-level label indicating whether an investor is a *value* investor. Specifically, we estimate an investor-level regression based on Equation (2), where an investor's portfolio weight in a stock is regressed on the same set of control variables, along with firm and quarter fixed effects, using the TSP sample from October 2013 to September 2018. A green investor *j* is classified as a *value* investor if they meet two criteria: (1): they divest following environmental incidents (indicated by a negative coefficient on $Green\ Investor_{j,t+1} \times Env.Incident_{i,t+1}$), and (2) this divestment behavior is constrained by the TSP (indicated by a positive coefficient on $Green\ Investor_{j,t+1} \times Env.Incident_{i,t+1} \times TREAT_i \times POST_t$).

Next, we analyze whether, compared to other green investors, *value* investors are more likely to be norm-unconstrained institutions. Hong and Kacperczyk (2009) and Barber, Morse, Yasuda (2021) show that pension funds, universities, and religious organizations are more norm-constrained and, as a result, have a high willingness-to-pay for environmental initiatives than other types of institutional investors because of the public nature of their investments, their diverse constituencies, and their heightened exposure to public scrutiny (e.g., protests or picketing by dissatisfied groups). We follow Hong and Kacperczyk (2009) and Barber, Morse, and Yasuda's (2021) definition of norm-constrained investors, and use Bushee's (1998) investor-type data for 13F institutions.[17] Specifically, norm-unconstrained institutions include investment companies (type 3) and independent investment advisors, including hedge funds (type 4). In contrast, norm-constrained institutions comprise bank trusts (type 1), insurance companies (type 2), corporate/private pension funds, public pension funds, university and foundation endowments, and miscellaneous entities (type 5). Our hypothesis is straightforward: if the TSP effectively identifies *value* investors, those who responded to the TSP should be less

[17] We thank Brian Bushee for making the institutional investor classification data available via his website: https://accounting-faculty.wharton.upenn.edu/bushee/.

likely to be norm-constrained compared to those who did not. In contrast, if our method merely selects investors randomly based on statistical noise, the distribution of investor types should be indistinguishable between the two groups.

Table 5 shows that norm-constrained investors comprise only 17.9% of value investors compared to 52.4% of other green investors. Thus, those investors who responded to TSP—plausibly *value* investors rather than *values* investors—are 65.8% (=(0.179-0.524)/0.524) less likely to be a norm-constrained investor than green investors who do not respond to TSP (p-value < 0.001). This finding supports the validity of our method in distinguishing *value* investors, who are driven by financial considerations, from *values* investors, who prioritize ethical objectives.

[Insert Table 5 about here]

Next, following Bushee (1998), we use his classification system which consists of five investor types that are further broken down into eight investor categories: bank trusts, insurance companies, public pensions, corporate pensions, university endowment, miscellaneous investors, investment companies, and independent investment advisors. The first six categories are norm-constrained investors, while the last two are norm-unconstrained. Our findings indicate that, except for insurance companies, *value* investors are less likely to be among norm-constrained investors. Specifically, they are 66.1% (=(0.079-0.233)/0.233) less likely to be bank trusts, and none are found among public pensions, corporate pensions, university endowments, or miscellaneous investors. Conversely, they account for all investment companies within in green-investor group and are 26.3% (=(0.696-0.476)/0.476) more likely to be independent investment advisors. This finding aligns with the fact that unlike norm-constrained investors, such as public pension funds, portfolio managers in investment companies and independent investment advisors are not subject to multiple conflicting objectives or extensive state and local influence, allowing them to focus more on portfolio's financial performance (e.g., Hong and Kacperczyk, 2009).

These results also support the findings of Barber, Morse, and Yasuda (2021), who identify impact funds in the venture capital and private equity industry through dual-objective fund

mandates. However, our method improves upon theirs by directly quantifying each investor's willingness to pay for environmental objectives based on revealed preferences when facing an exogenous liquidity shock. Unlike mandate-based classification, our approach address two limitations. First, some asset managers may market themselves as *values* investors by issuing environmental fund mandates for branding purposes while continuing to prioritize financial returns. For example, Baker, Egan, and Sarkar (2022) show that funds with an ESG mandate and those without such a mandate tend to hold similar stocks and generate comparable realized returns. Second, many green investors—particularly those with low-to-medium willingness to pay—have little incentive to disclose their true willingness to pay, as doing so could harm their perceived reputation among retail investors or affect fund flows.

Furthermore, established in 2006 under United Nations endorsement, the Principles for Responsible Investment (PRI) aims to leverage the financial power of institutional investors to advance sustainable development goals. By signing the PRI principles, investors publicly commit to integrating responsible investing practices into their operations. Table 5 reveals that while *value* investors are equally likely as other green investors to initially obtain PRI signatory status, they face significantly higher delisting rates in subsequent years. This pattern aligns with the increasingly stringent obligations required to maintain signatory status: annual membership fees, comprehensive implementation reporting, and—following a 2018 regulatory tightening—three key requirements that must be met within two years: responsible investment policies covering at least 50% of assets, dedicated personnel overseeing policy implementation, and verifiable executive-level commitment (PRI 2020). Non-compliance with these requirements triggers removal from the registry. Gibson, Glossner, Krueger, Matos, and Steffen (2022) and Kim and Yoon (2023) show that, in the US, PRI signatory status has been used opportunistically by institutional investors to attract fund flows without committing to the substantial follow-up costs of genuine ESG implementation. This insight explains why PRI membership may initially appeal to *value* investors for its potential financial benefits, but the significant costs of maintaining compliance often led to their eventual delisting. Our data

strongly supports this conjecture: conditional on having obtained PRI signatory status, 18% of *value* investors are eventually delisted, compared to only 1.4% of other green investors.

Taken together, the findings in Section 5 indicate that TSP has substantially constrained *value* investors' capacity to divest upon receiving negative information about a portfolio firm's environmental policies. Consequently, the TSP-induced decline in stock liquidity has impaired the effectiveness of exit threats as a governance tool. These results highlight the challenge of identifying the causal impact of divestment in the absence of exogenous variation in stock liquidity.[18] Moreover, this study makes a novel contribution to the exit literature by providing the first direct evidence on how stock liquidity affects investors' actual divestment behavior.

6. Firm-Level Sensitivity to Exit Threats

The effectiveness of exit threats as a governance tool lies on two components: the investors' credibility to divest and firms' own sensitivity to exit threats. In this subsection, we provide evidence that the decline in environmental ratings induced by TSP is more pronounced for firms with higher levels of exposure to exit threats.

The first measure of exit-threat exposure lies on the manager's concern for the firm's stock price. The threat of exit is stronger if the manager is more sensitive to the stock price. We investigate if our main findings are more significant for companies where the management has a greater stake in the firm's stock price, proxied by the scaled wealth-performance measure of Edmans, Gabaix, and Landier (2009). It captures the dollar change in CEO's wealth for a 100-percentage point change in the stock price, scaled by annual pay (WPS). We then construct a high-WPS indicator which equals one (zero) for those firms with WPS values above (below) in the highest sample tercile.

[18] For instance, Gantchev, Giannetti, and Li (2022) show that firms improve E&S policies after E&S incidents, and shareholders tend to divest following the incidents. However, without an exogenous liquidity shock on the effectiveness of exit threats, it is hard to isolate the role of exit threats per se. For example, the improved E&S policies after incident could be driven by reputational concerns and heightened regulatory scrutiny, so that firms could start adopting better E&S policies without shareholder divestments.

Table 6 shows that the adverse impact of TSP on environmental ratings is primarily found in companies with higher WPS. The coefficient for the interaction term *Treat X Post* is statistically insignificant, whereas the interaction between *Treat X Post* and the high-WPS indicator shows a significant and negative coefficient. In terms of economic impact, those with a high sensitivity to stock prices tend to experience a 1.922 (=1.952 - 0.030) decrease in environmental ratings. In contrast, companies with low price sensitivity do not show such a decline. This result lends credence to the effectiveness of threat of exit in affecting portfolio firms' environmental policies.

[Insert Table 6 about here]

Our second measure of exit-threat exposure is investor coordination risk, which reflects the ability of institutional investors to effectively align their actions and values against management. Coordination risk decreases when institutional investors are more interconnected or share similar preferences. Crane, Koch, and Michenaud (2019) demonstrate that lower investor clique ownership enhances governance through exit threats by amplifying trading intensity. Following their methodology, we construct two measures of clique ownership to capture this dynamic. The first measure of coordination risk is the aggregate ownership by all institutional investor cliques for each firm. The second measure is the total ownership in each firm by the single institutional investor clique with the largest ownership stake. We follow Crane, Koch, and Michenaud (2019) and use year-end holdings from the Thomson Reuters 13F database to identify the clique and network structure of institutional investors, where a connection exists between two investors if each owned at least 5% in one common firm at the end of the prior year. After constructing the measure of cliques, we construct a High-Coordination Risk indicator, which equals one for those firms with the lagged measure in the lowest sample tercile, and zero otherwise.

We also measure the coordination risk based on the dispersion of environmental preferences among institutions. Following Hwang, Titman, and Wang (2022), Cao, Titman, Zhan, and Zhang (2023), and Dasgupta, Huynh, and Xia (2023), we construct a continuous measure of environmental preferences of blockholders by computing the value-weighted average environmental rating at the end of each quarter for each institutional blockholder, considering

their quarter-end holdings in each portfolio company and each company's MSCI IVA environmental rating, and then calculating the holdings-weighted standard deviation of these environmental ratings, i.e., $\sqrt{\sum_{j=1}^{n}\left(w_j E_j - \overline{wE}\right)^2 /(n-1)}$, where E_j denotes investor j's portfolio-level value-weighted environmental rating and w_j denotes the percentage of shares held by investor j in a given quarter.[19] The High-Coordination Risk indicator now equals one for those firms with the lagged opinion dispersion measure in the highest sample tercile, and zero otherwise.

Table 7 shows that the negative effect of enacting TSP is significantly greater for firms with high investor coordination risk: the coefficients for the interaction term between Treat X Post and High-Coordination Risk are negative for all three measures. Specifically, Column (1) ((2)) indicates that firms with low total (top) investor clique ownership experience an additional reduction in their environmental ratings by 1.043 (1.014) points. Similarly, Column (3) shows that firms with institutional investors holding relatively divergent opinions on environmental issues see a further downgrade of 1.162 points in their environmental ratings. These findings support the exit theory in explaining the decline in environmental ratings following TSP. Increased transaction costs hinder institutional investors from making credible exit threats, especially in firms with higher ex-ante exposure to exit threats.

[Insert Table 7 about here]

Overall, the results in Section 6 show that firms with a greater ex-ante sensitivity to exit threats experience a more pronounced deterioration in their environmental performance. Combining the investor-level evidence from Section 5 with the firm-level evidence from Section 6, we demonstrate that the reduction in exit threats from *value* investors contributes to the TSP-induced decline in environmental performance. These findings underscore the significant role that *value* investors play in shaping environmental policies.

[19] When using the third measure, we also control for the Herfindahl–Hirschman index to account for the concentration of institutional investor ownerships. We additionally control for the holdings-weighted average environmental rating of all institutions, "Average Env. Rating of All Inst.", which is calculated using $\overline{wE} = \sum_{j=1}^{n} w_j E_j$ where E_j denotes institution j's portfolio-level value-weighted environmental rating, and w_j denotes the lagged percentage of shares held by institution j as of the most recent quarter.

7. Robustness Check

7.1. Reversals Upon Lifting TSP

If TSP constrains investors' capacity to divest, then we anticipate a reversal in green investors' divestment intensity in response to negative environmental events following the end of TSP in October 2018. To examine this hypothesis, we estimate Equation (2) with a revised sample period that spans from October 2016 through September 2020, covering the enactment of TSP through two fiscal years after its conclusion. The timeline for this sample period is illustrated in Figure 2. We also substitute the Post indicator with the Lifting indicator, which equals one for all fiscal quarters starting from October 2018, and zero otherwise.

[Insert Table 8 about here]

We report the regression results in Table 8 Panel A. We find that in the post-TSP period, compared to the TSP period, green investors significantly increase their divestment intensity from small-spread treatment firms more than from small-spread control firms in response to an environmental incident. Specifically, Panel A shows that this escalation in divestment intensity amounts to 5.42 basis points of portfolio weights in the incident quarter, 4.98 basis points when including two quarters before the incident, and 4.49 basis points after also accounting for one quarter after the incident.

Furthermore, we investigate whether there is an improvement in environmental performance among treatment firms that were vulnerable to exit threats, as green investors' exit threats recover post-TSP. Specifically, we use the same model specification as in Tables 6 and 7, with a revised sample period and the Post indicator replaced by the Lifting indicator.[20] We represent the regression results in Table 8 Panel B. In Column (1), we observe a 0.412-point increase in environmental ratings among treatment firms with higher managerial interest in equity prices. This finding is consistent with Table 6, where the TSP-induced decline in environmental ratings was seen exclusively in firms with higher scaled wealth-performance sensitivity. Columns (2), (3), and (4) show that, following the conclusion of TSP, treatment firms with

[20] As the yearly WPS database from http://alexedmans.com/data/ only extends to the fiscal year 2018, the most recent fiscal year with WPS data in our regressions would be 2019 without any imputation. To address this data availability challenge in studying the conditional effect of lifting TSP, we carry the latest available WPS of a firm forward to the end of our sample period.

high coordination risk among institutional investors tend to improve their environmental performance.

Taken together, we provide evidence supporting our earlier conclusions from Sections 5 and 6 that the TSP has limited green investors—particularly *value* investors—in their ability to leverage exit threats against treatment firms. Green investors' divestment intensity recovers after the TSP ends. Firms with greater sensitivity to exit threats begin implementing policies that improve environmental performance after the recovery of the divestment intensity.

7.2. Real Impact of TSP

We now assess the *real* impact of TSP by employing a more direct measure of a firm's environmental profile—carbon emission levels and emission intensity. Firms' carbon emission levels and intensity are crucial environmental metrics for institutional investors, providing a clear estimate of the likelihood of violating U.S. environmental policies and the subsequent legal enforcement costs (Seltzer, Starks, and Zhu, 2022). According to Krueger, Sautner, and Starks (2020), a majority of institutional investors (at least 55%) consider regulatory risk related to carbon emissions and their financial implications as their foremost concern today.

We collect plant-level emission data from the GHGRP. To establish firm-level emission data, we match the EPA plant-level dataset with annual financial fundamentals data from Compustat based on the names of parent companies. After removing firms with missing total assets and sales and firms in the financial industry (Standard Industrial Classification code (SIC) 6000-6999) and utility industry (SIC 4900-4999), our EPA emission sample comprises of 433 firms over the sample period of 2013-2018. Restricting to the TSP sample results in 605 firm-quarter observations for 23 treatment stocks and 17 control stocks.

We employ two proxies to measure a firm's carbon emissions. The first is the log of thousands metric tons of Scope 1 carbon emissions (*Ln(emission level)*), namely the emission level. The second measure is the carbon intensity (*Ln(emission intensity)*), calculated by dividing metric tons of carbon emissions by firm revenue (in dollars) before taking a log transformation. The

sample median log of emission levels is 4.36. The sample median log of emission intensity in our sample is 4.21.

Table 9 Columns (1) and (2) show that treatment firms increased their emission levels by up to 9.13% and their emission intensity by 7.64%. The limited availability of emission data, however, prevents us from conducting subsample analyses, such as splitting data based on pre-TSP bid-ask spreads. Next, in Table 9 Columns (3) and (4), we examine the effect of lifting TSP on treatment firms' emission policies. We replace the Post indicator with the Lifting indicator and adjust the sample period to span from October 2016 through September 2020. The results show that as the TSP concluded in October 2018, treatment firms began improving their environmental profile, reducing their emission levels by 7.02% (Column (3)) and emission intensity by 12.5% (Column (4)). Overall, these findings suggest that stock illiquidity has a *real* negative impact on corporate environmental policies.

[Insert Table 9 about here]

In Table A2, we estimate the impact of TSP on both Scope 1 and Scope 2 carbon emission levels, as well as emission intensity. Scope 2 emission data is sourced from Asset4. Despite the smaller sample size with available Scope 1 and 2 emission data, the conclusions hold: treatment firms' carbon profiles deteriorated during the TSP but improved once the TSP was lifted. We also note that the effect of the TSP on emissions should be interpreted with caution. Specifically, the GHGRP includes only firms with at least one facility emitting 25,000 metric tons or more of CO_2 annually. Consequently, the economically significant impact of the TSP on emissions could partly reflect the higher sensitivity of large polluters to governance pressures from institutional investors.

7.3. Instrumental Variable Analysis

In this subsection, we use TSP as an instrument for stock illiquidity in a two-stage least squares (2SLS) analysis. This approach enables a direct quantification of the sensitivity of

environmental performance to changes in stock liquidity—a quantification that has long been complicated by potential reverse causality concerns.[21] We estimate the following regression:

$$Illiquidity_{i,t} = \gamma_1 TREAT_i \times POST_t + C_{i,t} + Firm_i + Quarter_{t+1} + \eta_{i,t+1} \quad (3)$$

$$Env_{i,t+1} = \beta_1 \widehat{Illiquidity}_{i,t} + C_{i,t} + Firm_i + Quarter_{t+1} + \epsilon_{i,t+1} \quad (4)$$

where $Env_{i,t+1}$represents firm i's environmental rating in fiscal quarter $t+1$. $\widehat{Illiquidity}_{i,t}$ is the fitted illiquidity value ($Illiquidity_{i,t}$) obtained from estimating Equation (3), where $TREAT_i \times POST_t$ serves as an exogenous instrumental variable. A statistically significant and negative β_1 implies that greater liquidity leads to improved environmental policies.

We employ two illiquidity proxies.[22] The first measure is the time-weighted percent quoted spread from the TAQ database. Specifically, at each time instance, it is calculated as the difference between the prevailing ask price and bid price divided by the midpoint. For each security, the average quoted spread for the day is defined as a weighted average across all spreads during the day, where each spread is weighted by the number of seconds it is in place. The quarterly percent quoted spread for each security is obtained by averaging the daily estimates across all trading days within the fiscal quarter. The second measure is the relative effective spread from the TAQ database. Specifically, for each executed trade, the relative effective spread is the ratio of the difference between the execution price of a trade and the midpoint of the prevailing bid-ask spread (the effective spread) divided by the midpoint of the prevailing bid-ask spread. The daily relative effective spread is a share-volume-weighted average of the relative effective spread of all trades taking place during the day for a given stock. To convert daily data into fiscal-quarterly measures of stock illiquidity, we take a quarterly arithmetic average of daily relative effective spread for a stock.

[21] The reverse causality concern complicates direct quantification, as ESG investments and performance might enhance stock liquidity by reducing information asymmetry.

[22] Both measures are constructed based on high-frequency data. Utilizing high frequency-founded measures has merits in that illiquidity measures calculated using low frequency stock returns are often compared to benchmark illiquidity measures computed using the high frequency data to gauge their effectiveness (e.g., Hasbrouck 2009; Goyenko, Holden, and Trzcinka 2009).

Table 10 Panel A displays the first-stage regression results for both small-spread and large-spread firms, over the sample period of 2013-2018. Consistent with Albuquerque, Song, and Yao (2020), we identify a significant and negative impact of TSP on stock liquidity across both liquidity measures. Furthermore, Table 10 Panel B presents the second-stage regression results. The regressions across Columns (1)-(2) show a statistically significant and negative effect of stock illiquidity on the environmental rating of a firm. Specifically, for one standard deviation increase in the relative effective spread in the last fiscal quarter, the firm tends to experience a drop in environmental rating by around 0.259 (i.e., -1.735×0.149). Therefore, firms with more illiquidity stocks often perform poorly in environmental sustainability.

[Insert Table 10 about here]

7.4. Cost of Capital As An Alternative Channel

Albuquerque, Song, and Yao (2020) find that small-spread stocks affected by the larger tick size experienced a stock price decline of between 1.75% and 3.2% relative to a control group. This suggests that even without changes in the effectiveness of institutional investors' corporate governance, firms subject to the tick size pilot (TSP) may still opt for less environmentally friendly projects if TSP *directly* increased their cost of capital, given that such projects are often more capital-intensive.[23] This could occur even if the total level of investment, which we control for in our main regressions, remains unchanged.

[Insert Table 11 about here]

In Table 11, we examine this possibility by controlling for the firm's abnormal return within one month of the TSP implementation date (October 17, 2016) and its interactions with the Treat, Post, and Treat × Post. Abnormal returns are calculated using the Fama-French 3-factor model, with parameters estimated over the sample period from September 2015 to August 2016. While the interaction between "TSP Enactment Abnormal Return" and the Treat × Post variable is insignificant across most specifications, it is positive in Column (2), supporting the idea that financial constraints can lead to weaker environmental performance (Xu and Kim,

[23] The cost-of-capital channel represents a distinct mechanism from the exit threat: whereas exit threat operates *ex-ante* through the anticipation of governance-driven costs (such as future capital constraints or declines in CEO's personal wealth), the cost of capital channel reflects an *ex-post* financing constraint that directly limits a firm's ability to pursue capital-intensive environmental initiatives.

2022). The significant negative coefficient on the high-exposure indicator in interaction with Treat × Post across all models indicates that the exit-based explanation for the decline in environmental performance continues to hold after accounting for changes in capital costs.

7.5. Voice As An Alternative Channel

Improved stock liquidity can also enhance a firm's environmental profile through the governance channel of "voice". By mitigating the free-rider problem among blockholders engaged in monitoring, liquidity facilitates block formation (Kyle and Vila, 1991; Kahn and Winton, 1998; Maug, 1998) and lowers the costs of activism for active blockholders. This allows them to acquire shares at prices that do not yet incorporate the anticipated value increase resulting from their privately known actions (Maug, 1998; Kahn and Winton, 1998; Winton and Li, 2006). In this subsection, we examine the role of the voice mechanism.

We first focus on activist campaigns that have related to environmental issues. We collect activist campaigns from FactSet Shark Repellent and identify environment-related campaigns following the methodology of He, Kahraman, and Lowry (2023).[24] TSP firms have historically had low exposure to shareholder activism on environmental issues. During the 2013-2018 sample period, only two environmental proposals were recorded and both proposals failed to pass in the annual shareholder meeting.[25] The limited exposure to environmental campaigns indicates that "voice" is unlikely to play a significant role in influencing observed TSP-induced decline in environmental ratings.

[24] We focus on "environmental" shareholder proposals, which have one of the following words in campaign_synopsis of the FactSet SharkRepellent Database: "Environment", "Green", "Climate", "Reserve", "Sustainability", "Food", "Waste", "Wasting", "GHG", "Toxic", "Emission", "Fossil fuel", "Greenhouse", "Water", "Carbon", "Energy", "Renewable", "coal", "Packaging", "Chemical", "Hydraulic fracturing", "Wood", "Sea level", "Pipeline controversy", "Flood', "Methane", "Warm", "Warming", "ESG", "Petrochemical", "Livestock", "Agriculture", "Plastic", "Paris agreement", "Neonicotinoids", "Paris goals", "Pollution", "Paris aligned", "Genetically engineered", "Deforestation", "Pesticide", "2 degree", "Net zero", "Natural gas", "Use of fur", "IEA 2ºC", "2-degree", "Nuclear power", "Ecosystem".

[25] Both proposals were initiated by the same activist group, As You Sow, against a large-spread control firm, Sanderson Farms, Inc. These proposals focused on reducing the routine use of medically important antibiotics in poultry and addressing water resource risks. The campaigns were launched annually in January 2017 and 2018.

Furthermore, we examine the impact of the TSP-induced liquidity shock on the probability of a green institutional investor acquiring an initial block (a stake of at least 5%) in a firm (Schedule 13D and Schedule 13G).[26] Blockholders intending to engage in intervention must file a Schedule 13D, as it legally empowers them to participate in the specified form of activism outlined in Item 4 of the filing. Those aiming to maintain a passive stance can opt for a 13G filing, likely doing so due to the associated benefits, such as reduced litigation risk and a less adversarial management team in the target firm. Consequently, the voice theory posits that liquidity promotes jawboning and, consequently, a 13D filing, while the exit theory predicts that liquidity will favor a 13G filing.

Consistent with our findings regarding activist campaigns, TSP firms have experienced limited activism-driven block acquisitions from green institutional investors. During the 2013-2018 period, green investors filed 57 13D forms, with only 13 directed at TSP firms.[27] None of the targeted TSP firms had a small pre-TSP quoted spread, however. This limited incidence of green investor activism suggests it may not be significant enough to account for the decline in environmental ratings, which is most pronounced among firms with smaller spreads.[28]

Moreover, we find that TSP has constrained the ability of investors to purchase shares in a form *without* the option of engaging in voice. In Table A3, we examine the impact of TSP on 13G

[26] To obtain institutional filings (13D & 13G), we manually collect historical 13D/G filings (and their amendments) to construct a comprehensive dataset of block acquisitions for all U.S. firms between 2013 and 2018. Then, we remove historical 13D/G filers report under the identity of individual investor ("in"). Next, I match the filer names with the names of institutional investors in Thomson Reuters S34 database. Similar to what we did in the Section 4.1, we focus on green institutions. Out of 18,494 institutions, 2,505 are matched to 3,272 historical 13D/G filers. Out of 6,557 green institutional investors, 1,165 are matched to 1,559 historical 13D/G filers. The number of matched 13D/G filers is higher than the number of 13F institutional investors because 13F forms are reported at the family level whereas 13D/G forms can be reported at the subsidiary level. Also, 13D/G filer names may change over time. This steps yields a total number of 15,927 13D/G filings by all institutions and 2,173 by green institutions, after removing amendments. Then, for each firm, we retain the first Schedule 13 filing within a two-year window because subsequent filings could be influenced by the initial filing rather than liquidity, or the first filing could jointly drive both liquidity and a subsequent filing. This steps lead to a database that comprise of 609 13D filings and 10,188 13G filings by all institutions and 57 13D filings and 1,859 13G filings by green institutional investors.

[27] Of these 13 Schedule 13D filings directed at TSP firms by green investors, 6 targeted treatment firms and 7 targeted control firms. This scarcity of 13D filings also restricts us from conducting valid regression analyses.

[28] Examining 13D filings by *all* institutional investors from 2013 to 2018, we identify 18 filings targeting small-spread TSP firms, with seven directed at control firms and 11 at treatment firms. After manually checking Item 4 Purpose of Transaction, we find none of these filings explicitly intended to influence environmental policies.

filing activities—a type of block acquisition without the option to engage in voice. To account for the common end-of-year reporting associated with 13G filings, we employ fiscal year-firm level regressions, adjusting quarterly control variables in Table 2 to their annual equivalents.[29] The dependent variable for Columns (1) and (3) ((2) and (4)) indicates whether there has been a 13G filing by a green institutional investor (an institutional investor).[30] Columns (1) and (2) demonstrates that the implementation of TSP results in a decline by around 17.2% (19.6%) in the propensity of green investors (all institutional investors) to acquire equity blocks under 13G forms in treatment firms. In Columns (3) and (4), we examine the effect of lifting TSP by substituting the Post indicator with the Lifting indicator and adjusting the sample period to include all fiscal years from 2017 to 2020.[31] The Lifting indicator is assigned a value of one for fiscal years starting from October 2018 onwards, and zero otherwise.[32] The results indicate that after the end of the TSP, there is an increase in the filing of 13G forms among institutional investors in treatment firms compared to the TSP period. In contrast, the filing of 13D forms remains economically insignificant. During the 2018-2020 period, none of 13D filings explicitly aimed to influence environmental policies, nor were any submitted by green investors.

[29] There are distinct reporting timelines for 13D and 13G filings. A 13D form must be filed within 10 days of the transaction, whereas a 13G form has a 45-day post-year-end filing deadline. Consequently, the "Post-Enacting" indicator is set to one for all fiscal years beginning from March 2017 onward, capturing transactions immediately affected by TSP, and zero for prior years. This timing ensures the allocation of blocks acquired during the calendar year 2016 to the pre-TSP period. The analysis spans fiscal years from January 2013 to December 2018. The end date of December 2018 is chosen to include fiscal years beginning in January 2018, thereby ensuring that many block acquisitions occurred in the calendar year 2017 are covered in our analysis.

[30] We proceed with the use of two-way fixed effect OLS regression, rather than non-linear models like Logit or Probit. This choice is based on Wooldridge (2002, Chap 15), which suggests that a linear probability model adequately approximates the average partial effect when the main variable of interest is within a limited range (in our case, [0,1]). Additionally, employing a linear probability model is less prone to estimation convergence issues when accounting for a substantial number of firm and fiscal quarter fixed effects.

[31] We exclude fiscal years beginning before March 2017 to avoid the confounding effect of a large cluster of block acquisitions made in 2016 but only filed in February 2017.

[32] Our asymmetric timing of indicators reflects both reporting requirements and expected economic behaviors around liquidity shocks. The "Post-Enacting" indicator begins in March 2017 (rather than October 2016) to prevent misclassification of blocks acquired before TSP implementation but reported with a lag in early 2017 due to the 45-day post-year-end filing deadline for 13G forms. This adjustment is critical since TSP imposed a negative liquidity shock that hindered block acquisitions, making it methodologically problematic to attribute pre-TSP acquisitions to the post-TSP period. Conversely, the "Lifting" indicator begins in October 2018, precisely aligned with TSP's termination, because we anticipate an immediate positive market response to improved liquidity conditions. When TSP ended, institutional investors could quickly resume block acquisitions given the sudden improvement in trading conditions. Our conclusions remain qualitatively unchanged if we instead use January 2019 as the beginning date of the "Lifting" indicator, which would capture the reporting period when many block acquisitions made in calendar year 2018 begin to appear in official filings.

Overall, results in this subsection suggest that the TSP-induced increase in transaction costs for treatment firms led to a decline in their exposure to institutional investors who do not intend to directly engage through "voice" and therefore rely more on "exit" as a governance mechanism. However, the evidence from 13G filings should be viewed only as suggestive due to long reporting lags, the relatively short two-year duration of the TSP for year-level 13G analysis, and the limitation to precisely identify the intent behind block acquisitions—unlike in our analysis of investors' divestment response to environmental incidents.

7.6. Alternative Control Group

Rindi, and Werner (2019) have uncovered a spillover effect of TSP on the control group, where stock liquidity also deteriorated for control stocks, albeit to a lesser extent compared to treatment firms, post-TSP, even without a change in tick size for these stocks. While neglecting this spillover effect would make our results more conservative by reducing the relative TSP-induced liquidity change, we assess the robustness of our findings concerning the selection of the control group.

We construct an alternative control group by matching treatment firms with companies in the Compustat universe that are not control firms of TSP. Matching criteria is the propensity score generated based on firm characteristics, including lagged environmental rating, lagged liquidity (proxied by yearly relative effective spread) and yearly counterparts of all control variables used in Table 2, two fiscal years prior to the treatment year. We compute propensity scores through a firm-fiscal year Logit regression for the Compustat sample, spanning from three years before the treatment year to one year prior to the treatment year. We perform one-to-one matching without replacement, using a caliper of 0.048 (0.25 of the standard deviation of the estimated propensity score). We estimate Equation (1) based on this control group and our treatment group. The results are presented in Table A4. We consistently observe a statistically significant and negative impact of TSP on the environmental ratings of treatment firms, with the effects concentrated among stocks with a small pre-TSP spread. The difference between the decline in environmental ratings of small- and large-spread firms is statistically significant.

8. Conclusion

By leveraging an exogenous liquidity shock, the tick size pilot (TSP) program, we find that a more liquid stock market positively affects environmental policies for firms. We then show that the threat of exit by blockholders drives the TSP-induced decline in environmental ratings. Specifically, green institutional investors tend to divest those firms when the firms experience events that increase investors' discontent with a firm's environmental policies. For a median firm facing an environmental incident, its green institutional investors tend to fully divest following the event. During the TSP period, however, such divesting intensity becomes significantly smaller when trading TSP treatment firms experience an increase in transaction costs. We also present firm-level evidence: the TSP-induced decline in environmental ratings is greater among firms with an ex-ante greater exposure to exit threats. Above all, because *value* investors have a lower willingness-to-pay to enhance non-pecuniary goals thereby having a greater sensitivity to TSP-induced increases in transaction costs, these results present novel evidence that *value* investors play a significant role in shaping corporate environmental policies.

References

Admati, Anat R., and Paul Pfleiderer, 2009, The "Wall Street Walk" and shareholder activism: Exit as a form of voice, *The Review of Financial Studies* 22, 2645–2685.

Albuquerque, Rui, Shiyun Song, and Chen Yao, 2020, The price effects of liquidity shocks: A study of the SEC's tick size experiment, *Journal of Financial Economics* 138, 700–724.

Baker, Malcolm, Mark L. Egan, and Suproteem K. Sarkar, 2022, How do investors value ESG? National Bureau of Economic Research Working Paper No. w30708.

Barber, Brad M., Adair Morse, and Ayako Yasuda, 2021, Impact investing, *Journal of Financial Economics* 139, 162–185.

Berg, Florian, Julian F. Koelbel, and Roberto Rigobon, 2022, Aggregate confusion: The divergence of ESG ratings, *Review of Finance* 26, 1315–1344.

Bharath, Sreedhar T., Sudarshan Jayaraman, and Vikram Nagar, 2013, Exit as governance: An empirical analysis, *The Journal of Finance* 68, 2515–2547.

Bushee, Brian J., 1998, The influence of institutional investors on myopic R&D investment behavior, *Accounting Review* 73, 305–333.

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.

Chang, Xin, Weiqiang Tan, Eric Yang, and Wenrui Zhang, 2018, Stock liquidity and corporate social responsibility, 31st Australasian Finance and Banking Conference.

Crane, Alan D., Andrew Koch, and Sebastien Michenaud, 2019, Institutional investor cliques and governance, *Journal of Financial Economics* 133, 175–197.

Chung, Kee H., Albert J. Lee, and Dominik Rösch, 2020, Tick size, liquidity for small and large orders, and price informativeness: Evidence from the Tick Size Pilot Program, *Journal of Financial Economics* 136, 879–899.

Dasgupta, Sudipto, Thanh D. Huynh, and Ying Xia, 2023, Joining forces: The spillover effects of EPA enforcement actions and the role of socially responsible investors, *The Review of Financial Studies* 36, 3781–3824.

Dumitrescu, Ariadna, Javier Gil-Bazo, and Frank Zhou, 2022, Defining greenwashing, Available at SSRN 4098411.

Eccles, Robert G., and Judith C. Stroehle, 2018, Exploring social origins in the construction of ESG measures, Available at SSRN 3212685.

Edmans, Alex, 2009, Blockholder trading, market efficiency, and managerial myopia, *The Journal of Finance* 64, 2481–2513.

Edmans, Alex, Vivian W. Fang, and Emanuel Zur, 2013, The effect of liquidity on governance, *The Review of Financial Studies* 26, 1443–1482.

Edmans, Alex, Xavier Gabaix, and Augustin Landier, 2009, A multiplicative model of optimal CEO incentives in market equilibrium, *The Review of Financial Studies* 22, 4881–4917.

Edmans, Alex, and Gustavo Manso, 2011, Governance through trading and intervention: A theory of multiple blockholders, *The Review of Financial Studies* 24, 2395–2428.

Gantchev, Nickolay, Mariassunta Giannetti, and Rachel Li, 2022, Does money talk? Divestitures and corporate environmental and social policies, *Review of Finance* 26, 1469–1508.

Gibson, Rajna, Simon Glossner, Philipp Krueger, Pedro Matos, and Tom Steffen, 2022, Do responsible investors invest responsibly? *Review of Finance* 26, 1389–1432.

Goyenko, Ruslan Y., Craig W. Holden, and Charles A. Trzcinka, 2009, Do liquidity measures measure liquidity? *Journal of Financial Economics* 92, 153–181.

Hasbrouck, Joel, 2009, Trading costs and returns for US equities: Estimating effective costs from daily data, *The Journal of Finance* 64, 1445–1477.

He, Yazhou Ellen, Bige Kahraman, and Michelle Lowry, 2023, ES risks and shareholder voice, *The Review of Financial Studies* 36, 4824–4863.

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 Yuxi Wang, 2022, Investor tastes, corporate behavior, and stock returns: An analysis of corporate social responsibility, *Management Science* 68, 7131–7152.

Kahn, Charles, and Andrew Winton, 1998, Ownership structure, speculation, and shareholder intervention, *The Journal of Finance* 53, 99–129.

Kim, Soohun, and Aaron Yoon, 2023, Analyzing active fund managers' commitment to ESG: Evidence from the United Nations Principles for Responsible Investment, *Management Science* 69, 741–758.

Krueger, Philipp, Zacharias Sautner, and Laura T. Starks, 2020, The importance of climate risks for institutional investors, *The Review of Financial Studies* 33, 1067–1111.

Kyle, Albert S., and Jean-Luc Vila, 1991, Noise trading and takeovers, *The RAND Journal of Economics* 22, 54–71.

Li, Sida, and Mao Ye, 2024, Discrete price, discrete quantity, and the optimal nominal price of a stock, Working paper.

Maug, Ernst, 1998, Large shareholders as monitors: Is there a trade-off between liquidity and control? *The Journal of Finance* 53, 65–98.

Pástor, Ľuboš, Robert F. Stambaugh, and Luke A. Taylor, 2022, Dissecting green returns, *Journal of Financial Economics* 146, 403–424.

Pedersen, Lasse Heje, Shaun Fitzgibbons, and Lukasz Pomorski, 2021, Responsible investing: The ESG-efficient frontier, *Journal of Financial Economics* 142, 572–597.

Principles for Responsible Investment (PRI), 2020, Signatories delisted for not meeting the minimum requirements, Retrieved March 14, 2025, from https://www.unpri.org/reporting-and-assessment/signatories-delisted-for-not-meeting-the-minimum-requirements/6480.article

Rindi, Barbara, and Ingrid M. Werner, 2019, US tick size pilot, Unpublished working paper, Bocconi University and Ohio State University.

Seltzer, Lee H., Laura Starks, and Qifei Zhu, 2022, Climate regulatory risk and corporate bonds, National Bureau of Economic Research Working Paper No. w29994.

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

Starks, Laura T., 2023, Presidential address: Sustainable finance and ESG issues—Value versus values, *The Journal of Finance* 78, 1837–1872.

Van der Beck, Patrick, 2022, Flow-driven ESG returns, Swiss Finance Institute Research Paper No. 21-71.

Winton, Andrew, and Sida Li, 2006, When do institutional investors become activists? Trading incentives and shareholder activism, Unpublished working paper.

Wooldridge, Jeffrey M., 2002, Econometric analysis of cross section and panel data, MIT Press, Cambridge, MA.

Xu, Qiping, and Taehyun Kim, 2022, Financial constraints and corporate environmental policies, *The Review of Financial Studies* 35, 576–635.

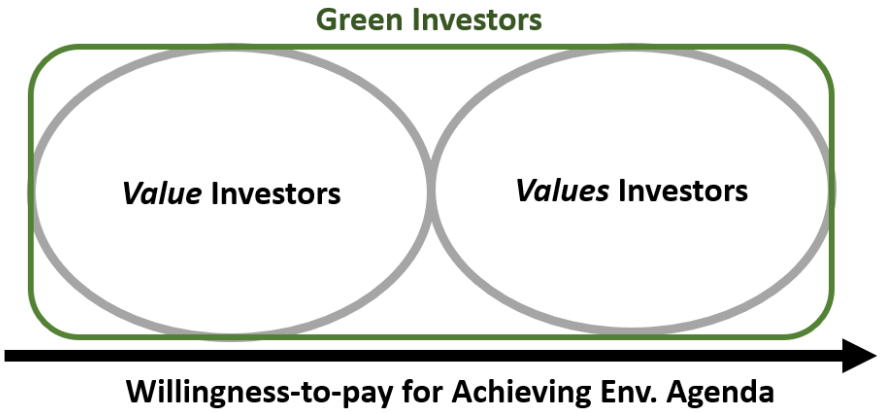


Fig 1: *Value* versus *Values* in Investment Approaches. This figure depicts the spectrum of investment approaches taken by *value* investors and *values* investors. The horizontal axis represents the level of willingness to pay for advancing environmental objectives. While both *value* investors and *values* investors demonstrate significant environmental consciousness by disproportionately holding more stocks with strong environmental profiles, *values* investors exhibit a greater willingness to sacrifice financial returns to achieve their environmental goals compared to *value* investors.

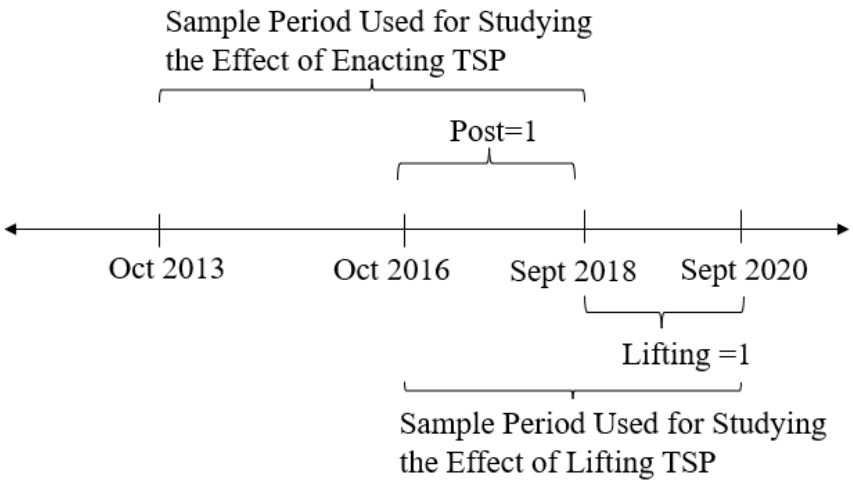


Fig 2: Timeline for Sample Periods. The figure plots the timeline for the different dates used to define the sample period. The study comprises of two parts. The first part studies the impact of implementing TSP, using a sample period from October 2013 to September 2018—three fiscal years preceding the TSP enactment and extends to the end of the TSP. In the second part, we examine the effect of lifting TSP, based on a sample period from October 2016 to September 2020, covering the TSP enactment year until two years after TSP becomes lifted.

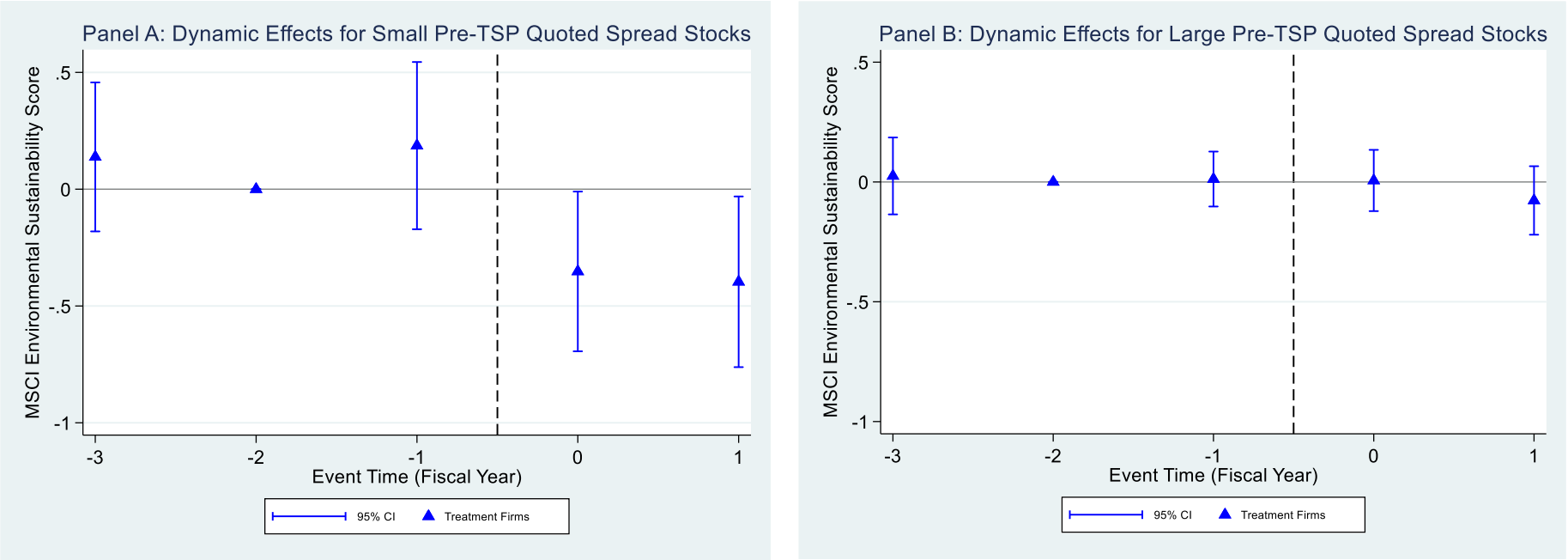


Fig 3: Dynamic Effects of TSP on MSCI Environmental Sustainability Score Conditional on Pre-TSP Quoted Spread. The figure displays the dynamic effect of TSP through time based on whether the stock has a small or large pre-TSP quoted spread. The stock has a small pre-TSP quoted spread if the average daily quoted spread between March 1, 2016 and August 31, 2016 is smaller than or equal to 3 cents. Both left and right figures plots the β_k estimates of the dynamic difference-in-difference analysis : $Y_{i,t} = \beta_{-3}D_{i,t-3} + \beta_{-1}D_{i,t-1} + \beta_0 D_{i,t} + \beta_{+1}D_{i,t+1} + Firm_i + Quarter_t + C_{i,t-1} + \varepsilon_{i,t}$ where $Y_{i,t}$ denote the environmental rating of firm i at fiscal quarter t, $D_{i,t+k}$ indicates whether the fiscal quarter t is in the kth fiscal year after the firm i became treated. The omitted benchmark year is year $t-2$. The x-axis is k and the y-axis is $\widehat{\beta_k}$, with their corresponding 95% pointwise confidence intervals. $Firm_i$ and $Quarter_t$, respectively, denote firm fixed effects and fiscal quarter fixed effects. $C_{i,t-1}$ represents a vector of control variables, including the firm size, cash ratio, dividend yield, book-to-market ratio, sales growth, leverage ratio, investment, analyst coverage, and stock return volatility. The detailed definitions of control variables are presented in the Appendix. The left (right) figure plots the estimation for a sample of stocks with a small (large) pre-TSP quoted spread. The dashed vertical line indicates the start of TSP.

Table 1. Summary Statistics

In this table, we present descriptive statistics for treatment and controls firms included in the program. The sample spans from October 2013 through September 2018. The definition of each variable is presented in the Appendix.

	N	Mean	SD	p25	Median	p75
Environmental Rating	9423	4.493	1.825	3.2	4.4	5.9
Ln(Emission Level)	573	4.746	1.503	3.642	4.295	5.407
Ln(Emission Intensity)	573	4.331	1.729	2.855	3.946	5.637
Quoted Spread ($)	7330	0.122	0.147	0.047	0.076	0.136
Quoted Spread (%)	7330	0.324	0.261	0.176	0.257	0.386
Effective Spread (%)	7330	0.2	0.149	0.113	0.16	0.236
Total Assets ($mil)	9423	1273.316	1429.989	423.276	809.956	1656.2
Ln(Total Assets)	9423	6.71	0.950	6.048	6.697	7.412
Cash	9423	18.308	19.610	3.636	11.423	25.432
Dividend Yield	9423	0.012	0.022	0	0	0.015
B/M Ratio	9423	0.474	0.375	0.251	0.41	0.622
Sales Growth	9423	22.94	77.116	-2.177	10.192	29.092
Leverage	9423	21.403	20.630	0.699	17.905	33.746
Investment	9332	0.629	2.748	-0.125	0.245	1.474
Analyst Coverage	9423	5.685	3.977	3	5	8
Stock Volatility	6796	2.019	0.772	1.503	1.862	2.363
Env. Incident	9423	.016	0.127	0	0	0
WPS	6678	28.468	98.158	1.994	4.445	11.32
Total Clique Ownership	9423	11.771	10.468	4.119	8.505	16.258
Top Clique Ownership	9423	8.293	8.416	2.325	5.438	11.445
Holdings-Weighted SD	9310	.103	0.046	.079	.093	.114
HHI(Inst. Ownership)	9053	.34	0.185	.221	.274	.364
Average Env. Rating of Inst.	9310	5.353	0.217	5.225	5.356	5.503

Table 2. Impact of 2016 Tick Size Pilot on Corporate Environmental Rating

This table reports the effect of 2016 tick size pilot on the corporate environmental rating. The dependent variable is the MSCI IVA environmental rating for each firm and fiscal quarter. In Column (1) (Column (2)), we estimate the overall (dynamic) impact of TSP on the corporate environmental rating. The treatment period indicator (*Post*) equals one for all fiscal quarters starting from October 2016, and zero otherwise. *Pre3* equals one for all fiscal quarters that are three fiscal years prior to the enactment quarter, and zero otherwise. *Pre1* equals one for all fiscal quarters that are one fiscal year prior to the enactment quarter, and zero otherwise. *Post1* equals one for the enactment quarter and the subsequent three fiscal quarters, and zero otherwise. *Post2* equals one for all fiscal quarters that are one fiscal year after the enactment quarter, and zero otherwise. We control for firm fundamentals, including firm size, cash ratio, dividend yield, book-to-market ratio, sales growth, leverage ratio, investments, analyst coverage, and stock return volatility. All control variables lagged by one fiscal quarter. We include both firm and fiscal quarter fixed effects. The sample spans from October 2013 through September 2018. Standard errors are clustered at the 2-digit industry-by-fiscal quarter level. T-statistics are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Dep Var: Environmental Rating	(1)	(2)
Treat X Post	-0.132***	
	(-3.194)	
Treat X Pre3		0.0458
		(0.638)
Treat X Pre1		-0.0530
		(-0.927)
Treat X Post1		-0.137**
		(-2.422)
Treat X Post2		-0.179***
		(-2.797)
Ln(Total Assets)	0.321***	0.321***
	(4.342)	(4.338)
Cash	-0.00445**	-0.00454**
	(-2.100)	(-2.139)
Dividend Yield	1.973***	1.874***
	(2.855)	(2.710)
B/M Ratio	-0.0505	-0.0500
	(-0.859)	(-0.849)
Sales Growth	-0.000346	-0.000345
	(-1.226)	(-1.213)
Leverage	-0.00370*	-0.00357*
	(-1.892)	(-1.840)
Investment	0.000781	0.000994
	(0.204)	(0.260)
Analyst Coverage	0.00731	0.00726
	(1.097)	(1.085)
Stock Volatility	-0.0535**	-0.0535**
	(-2.499)	(-2.492)
Observations	6,714	6,714
Adj. R^2	0.848	0.848
Constant	Yes	Yes
Fiscal Quarter FE	Yes	Yes
Firm FE	Yes	Yes

Table 3. Impact of TSP on Environmental Rating Conditional on Pre-TSP Quoted Spread
This table reports the effect of 2016 tick size pilot on the corporate environmental rating conditional on the size of pre-TSP quoted spread. We estimate the overall and dynamic impacts of TSP on the corporate environmental rating, utilizing a sample split based on whether the firm's average pre-TSP daily quoted spread (between March 1, 2016 and August 31, 2016) is smaller than or equal to 3 cents. Columns (1) and (3) ((2) and (4)) present regression results for stocks with a small (large) pre-TSP spread. The dependent variable is the MSCI IVA environmental rating for each firm and fiscal quarter. The treatment period indicator (*Post*) equals one for all fiscal quarters starting from October 2016, and zero otherwise. *Pre3* equals one for all fiscal quarters that are three fiscal years prior to the enactment quarter, and zero otherwise. *Pre1* equals one for all fiscal quarters that are one fiscal year prior to the enactment quarter, and zero otherwise. *Post1* equals one for the enactment quarter and the subsequent three fiscal quarters, and zero otherwise. *Post2* equals one for all fiscal quarters that are one fiscal year after the enactment quarter, and zero otherwise. The illustration of Columns (3) and (4) estimates is presented in Fig 3. Across all specifications, we include control variables as used in Table 2. The sample spans from 2013 through 2018. Standard errors are clustered at the 2-digit industry-by-fiscal quarter level. T-statistics are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	Null: Small Spread = Large Spread
Dep Var: Environmental Rating	Small Spread	Large Spread	Small Spread	Large Spread	
Treat X Post	-0.445***	-0.0508			P = 0.002
	(-3.382)	(-1.084)			
Treat X Pre3			0.138	0.0251	
			(0.851)	(0.307)	
Treat X Pre1			0.187	0.0122	
			(1.024)	(0.208)	
Treat X Post1			-0.352**	0.00611	P = 0.037
			(-2.023)	(0.0938)	
Treat X Post2			-0.396**	-0.0772	P = 0.075
			(-2.132)	(-1.059)	
Observations	977	4,193	977	4,193	
Adj. R^2	0.746	0.850	0.746	0.850	
Fiscal Quarter & Firm FE	Yes	Yes	Yes	Yes	
Firm Controls	Yes	Yes	Yes	Yes	

Table 4. Institutional Investors' Portfolio Response to Environmental Incidents

This table examines how TSP limits 13F investors from divesting from firms that encounter a negative environmental event. The dependent variable is the percentage of shares held by an institutional investor as of a calendar quarter end. "Green Inst. Investor" equals one if the investor is a green institutional investor, and zero otherwise. Green institutional investors are those with an above-median portfolio-level value-weighted environmental rating amongst all 13F institutional investors as of the current quarter. The environmental incident is captured by the occurrence of an environmental incident reported on news sourced from RepRisk. We first construct an incident indicator denoting whether an environmental incident occurred during the current quarter (event window of [0]). We construct the second incident indicator to account for the possibility of a run-up trading by including two quarters before the incident (event window: [-2,0]).To capture any staggered response, we also consider the event window of [-2,1]. The sample spans from October 2013 through September 2018. The treatment period indicator (*Post*) equals one for all fiscal quarters starting from October 2016, and zero otherwise. Across all specifications, we include control variables as used in Table 2. We additionally control for institutional investor-level characteristics, including log portfolio size, turnover ratio, portfolio return, portfolio-level environmental rating, and portfolio flow, all lagged by one quarter. Institution fixed effects, firm fixed effects and fiscal quarter effects are included. Standard errors are clustered at the investor-by-fiscal quarter level. T-statistics are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Dep. Var.: Portfolio Weight (%)	(1)	(2)	(3)
Incident Event Window:	[0]	[-2,0]	[-2,1]
Env. Incident X Green Inst. Investor X Treat X Post	0.0317**	0.0305**	0.0281**
	(2.08)	(2.11)	(2.22)
Env. Incident X Green Inst. Investor	-0.0334***	-0.0226**	-0.0222**
	(-4.44)	(-2.23)	(-2.45)
Env. Incident X Non-Green Inst. Investor X Treat X Post	0.0759	0.0363	0.0638**
	(1.64)	(1.10)	(2.16)
Env. Incident X Non-Green Inst. Investor	-0.0170	0.00401	0.0136
	(-0.61)	(0.20)	(0.75)
Green Inst. Investor X Treat X Post	-0.0196	-0.0211	-0.0190
	(-1.56)	(-1.64)	(-1.45)
Treat X Post	0.0115	0.0115	0.00956
	(0.94)	(0.91)	(0.75)
Green Inst. Investor	-0.00136	-0.0000841	0.00124
	(-0.19)	(-0.012)	(0.17)
Observations	147049	146941	147049
Adj. R^2	0.718	0.718	0.718
Fiscal Quarter FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
13F Inst. Investor FE	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes
Inst. Investor Controls	Yes	Yes	Yes

Table 5. Plausibly-*Value* Investors vs. Other Green Investors

This table summarizes the 13F portfolio-level characteristics of green investors, including their likelihood of being constrained by social norms, their category—bank, insurance company, public pension, miscellaneous, investment company, or independent investment advisor— whether they are PRI signatories in a given year, and whether they eventually withdraw their PRI signatory status. These characteristics are reported distinguished by whether an investor is plausibly a value investor, as classified in Section 5. The "Sample Size" columns show the total number of investor-quarter observations in each group (Value Investors vs. Other Green Investors) from which the proportions are calculated. The "Proportion (%)" columns indicate the percentage of investors in each group that fall into each category. For example, of the 280 Value Investor observations, 17.9% are norm-constrained. An investor is norm-constrained if the investor is a bank trust (type 1), an insurance company (type 2), a public pension fund, a corporate/private pension fund, a university and foundation endowment, or miscellaneous (type 5). An investor is deemed a PRI signatory in a year if it holds PRI signatory status during that year, and is coded as 0 otherwise (either because it never signed up or has withdrawn). Delisted From PRI Signatory is an indicator that equals one if an investor initially joined as a PRI signatory but subsequently withdrew, and zero if the investor never withdrew after signing up. The summary statistics are based on an investor-quarter sample covering October 2013 to September 2020 for investor type data, and 2014 to 2020 for PRI signatory status data. *** p<0.01, ** p<0.05, * p<0.1

	Value Investors		Other Green Investors		Diff. in %
Investor Categories	Sample Size	Proportion (%)	Sample Size	Proportion (%)	
Norm-Constrained	280	0.179	1638	0.524	-0.345*** (P<0.001)
Bank Trust	280	0.079	1638	0.233	-0.154*** (P<0.001)
Insurance Company	280	0.1	1638	0.056	0.044*** (P=0.004)
Public Pension	280	0	1638	0.186	-0.186*** (P<0.001)
Corporate Pension	280	0	1638	0.014	-0.014*** (P<0.001)
University Endowment	280	0	1638	0.009	-0.009 (P=0.121)
Miscellaneous	280	0	1638	0.028	-0.028*** (P=0.005)
Investment Company	280	0.125	1638	0	0.125*** (P<0.001)
Independent Investment Advisor	280	0.696	1638	0.476	0.22*** (P<0.001)
PRI Signatory	276	0.17	1664	0.16	0.01 (P=0.681)
Delisted PRI Signatory	61	0.18	355	0.014	0.166*** (P<0.001)

Table 6. Threat of Exit: Scaled Wealth-Performance Sensitivity

This table reports the conditional effect of TSP on environmental ratings based on whether the firm CEO has a higher scaled wealth-performance sensitivity. The High-WPS indicator equals one for those firms with scaled wealth–performance sensitivity (dollar change in CEO wealth for a one percentage point change in firm value, divided by annual pay as in Edmans, Gabaix, and Landier (2009)) values in the highest tercile, and zero otherwise. WPS is taken at the end of the prior year. The dependent variable is the MSCI IVA environmental rating for each firm and fiscal quarter. The sample spans from October 2013 through September 2018. The treatment period indicator (*Post*) equals one for all fiscal quarters starting from October 2016, and zero otherwise. We include control variables as used in Table 2. Standard errors are clustered at the 2-digit industry-by-fiscal quarter level. T-statistics are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Dep Var: Environmental Rating	(1)
Treat X Post X High WPS	-1.952***
	(-4.916)
Treat X Post	0.0303
	(0.192)
Treat X High WPS	-0.596
	(-1.308)
Post X High WPS	0.946***
	(3.292)
High WPS	0.261
	(0.725)
Observations	738
Adj. R^2	0.765
Controls	Yes
Constant	Yes
Fiscal Quarter FE	Yes
Firm FE	Yes

Table 7. Threat of Exit: Coordination Risk

This table reports the conditional effect of TSP on environmental ratings based on whether there is a significant amount of coordination risk among investors. In Column (1), the High Coordination Risk indicator equals one for firms in the lowest tercile of lagged cliques' ownership, following the methodology of Crane, Koch, and Michenaud (2019), and zero otherwise. In Column (2), the indicator is constructed analogously but based on the ownership share of the largest investor clique. Column (3) defines High Coordination Risk as firms in the highest tercile of opinion dispersion on environmental issues, with zero otherwise. The dependent variable is the MSCI IVA environmental rating for each firm and fiscal quarter. treatment period indicator (*Post*) equals one for all fiscal quarters starting from October 2016, and zero otherwise. Across all specifications, we include control variables as used in Table 2. In Column (3), we additionally control for the Herfindahl–Hirschman index of institutional investor ownerships and the holdings-weighted average environmental rating of all institutions. The sample spans from October 2013 through September 2018. Standard errors are clustered at the 2-digit industry-by-fiscal quarter level. T-statistics are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)
Dep Var: Environmental Rating			Opinion
Proxies for Coordination Risk:	Total Clique Ownership	Top Clique Ownership	Dispersion on Env. Issues
Treat X Post X High Coordination Risk	-1.043***	-1.014***	-1.162**
	(-3.134)	(-3.306)	(-2.259)
Treat X Post	-0.229	-0.219	-0.316**
	(-1.589)	(-1.513)	(-2.462)
Treat X High Coordination Risk	0.433	0.606**	0.667
	(1.520)	(2.242)	(1.534)
Post X High Coordination Risk	1.186***	1.020***	1.383***
	(4.416)	(4.026)	(3.081)
High Coordination Risk	-0.327	-0.491**	0.180
	(-1.354)	(-2.059)	(1.123)
Observations	977	977	967
Adj. R^2	0.751	0.750	0.766
Controls	Yes	Yes	Yes
Constant	Yes	Yes	Yes
Fiscal Quarter FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
HHI(Inst. Ownership)	No	No	Yes
Average Env. Rating of All Inst.	No	No	Yes

Table 8. Reversals Upon Lifting TSP

This table reports the reversal in the effect of TSP upon the conclusion of TSP. The sample spans from October 2016 through September 2020. In Panel A, we assess the impact of lifting TSP on the divesting intensity of institutional investors. The environmental incident is captured by the occurrence of an environmental incident reported on news sourced from RepRisk. We construct three incident indicators, respectively, denoting an event window of [0], [-2,0], and [-2,1]. The post-TSP period indicator (*Lifting*) equals one for all fiscal quarters starting from October 2018, and zero otherwise. Across all specifications, we include control variables as used in Table 5. In Panel B, we examine the impact of lifting TSP on environmental ratings conditional on different level of exposure to exit threats. The dependent variable is the MSCI IVA environmental rating for each firm and fiscal quarter. In Column (1), the High-Exposure indicator equals one for those firms with scaled wealth–performance sensitivity (dollar change in CEO wealth for a one percentage point change in firm value, divided by annual pay as in Edmans, Gabaix, and Landier (2009)) values in the highest sample tercile, and zero otherwise. WPS is taken at the end of the prior year. In Column (2), the High Coordination Risk indicator equals one for firms in the lowest tercile of lagged cliques' ownership, following the methodology of Crane, Koch, and Michenaud (2019), and zero otherwise. In Column (3), the indicator is constructed analogously but based on the ownership share of the largest investor clique. Column (4) defines High Coordination Risk as firms in the highest tercile of opinion dispersion on environmental issues, with zero otherwise. Across all Column (1)–(3), we include control variables as used in Table 2. In Column (4), we control for variables as used in Table 7 Column (3). In Panel A, standard errors are clustered at the investor-by-fiscal-quarter level. In Panel B, standard errors are clustered at the 2-digit industry-by-fiscal quarter level. T-statistics are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Panel A: Reversal in Divesting Intensity Upon Lifting TSP

Dep. Var.: Portfolio Weight (%)	(1)	(2)	(3)
Incident Event Window:	[0]	[-2,0]	[-2,1]
Env. Incident X Green Inst. Investor X Treat X Lifting	-0.0542***	-0.0498***	-0.0449***
	(-3.89)	(-4.28)	(-3.94)
Env. Incident X Green Inst. Investor	-0.0387***	-0.0363***	-0.0384***
	(-6.59)	(-5.30)	(-5.53)
Env. Incident X Non-Green Inst. Investor X Treat X Lifting	-0.0133	0.0505	0.0480
	(-0.26)	(1.57)	(1.59)
Env. Incident X Non-Green Inst. Investor	-0.00419	0.0456***	0.0333**
	(-0.22)	(2.77)	(2.23)
Green Inst. Investor X Treat X Lifting	0.0322***	0.0367***	0.0381***
	(3.20)	(3.57)	(3.68)
Treat X Lifting	-0.0198**	-0.0229**	-0.0235**
	(-2.09)	(-2.35)	(-2.39)
Green Inst. Investor	0.0218***	0.0271***	0.0273***
	(2.65)	(3.23)	(3.23)
Observations	126444	126116	126444
Adj. R^2	0.832	0.832	0.832
Fiscal Quarter FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
13F Inst. Investor FE	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes
Inst. Investor Controls	Yes	Yes	Yes

Panel B: Reversal in Environmental Ratings Upon Lifting TSP

Dep Var: Environmental Rating	(1)	(2)	(3)	(4)
Proxies for Exposure to Exit Threat:	WPS	Total Clique Ownership	Top Clique Ownership	Opinion Dispersion on Env. Issues
Treat X Lifting X High Exposure	0.412**	0.578**	0.432**	0.454*
	(2.330)	(2.514)	(2.125)	(1.694)
Treat X Lifting	-0.349***	-0.158**	-0.152*	-0.0620
	(-3.430)	(-1.967)	(-1.766)	(-0.708)
Treat X High Exposure	-0.205	-0.348**	-0.261*	-0.126
	(-0.947)	(-2.014)	(-1.775)	(-0.556)
Lifting X High Exposure	-0.427***	-0.255**	-0.265**	-0.341
	(-3.266)	(-1.986)	(-2.087)	(-1.486)
High Exposure	0.336**	0.0898	0.0880	0.211
	(2.481)	(0.904)	(1.044)	(1.082)
Observations	600	772	772	763
Adj. R^2	0.927	0.918	0.917	0.917
Controls	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes
Fiscal Quarter FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
HHI(Inst. Ownership)	No	No	No	Yes
Average Env. Rating of All Inst.	No	No	No	Yes

Table 9. Real Impact of TSP

This table reports the effect of 2016 tick size pilot on firm carbon emission activities. The dependent variable is the log transformed thousands of metrics tons of Scope 1 carbon emissions (*Ln(Emission Level)*) for Columns (1) and (3), and the log transformed metrics tons of Scope 1 carbon emissions scaled by revenue in dollar (*Ln(Emission Intensity)*) for Columns (2) and (4). Emission data is retrieved from EPA. In Columns (1)-(2), we examine the effect of enacting TSP. The sample spans from October 2013 through September 2018. The treatment period indicator (*Post*) equals one for all fiscal quarters starting from October 2016, and zero otherwise. In Columns (3)-(4), we examine the effect of lifting TSP. The sample spans from October 2016 through September 2020. The main independent variable is the interaction terms between the treatment firm indicator (*Treat*) and treatment period indicator (*Lifting*). The treatment period indicator (*Lifting*) equals one for all fiscal quarters starting from October 2018, and zero otherwise. Across all specifications, we include control variables as used in Table 2. Standard errors are clustered at the fiscal quarter level. T-statistics are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)
Dep. Variable:	Emission Level	Emission Intensity	Emission Level	Emission Intensity
Treat X Post	0.0913***	0.0764**		
	(3.054)	(2.581)		
Treat X Lifting			-0.0702**	-0.125***
			(-2.337)	(-4.525)
Ln(Total Assets)	-0.0624	-0.329***	0.355**	0.177
	(-0.590)	(-2.733)	(2.076)	(0.915)
Cash	-0.00260	0.000653	0.00442	0.00422
	(-1.102)	(0.240)	(1.326)	(1.206)
Dividend Yield	0.605***	1.434***	-0.667	-0.823
	(3.014)	(4.649)	(-1.200)	(-1.062)
B/M Ratio	-0.0451	-0.00422	0.0163	-0.00809
	(-0.581)	(-0.0552)	(0.299)	(-0.135)
Sales Growth	-0.00535***	-0.00847***	-4.16e-05	-0.00313***
	(-3.313)	(-4.797)	(-0.0576)	(-4.502)
Leverage	0.00897***	0.0105***	-0.00973***	-0.00772**
	(2.784)	(3.054)	(-2.818)	(-2.210)
Investment	-0.00934***	0.000375	0.00503	0.00891**
	(-2.755)	(0.110)	(1.202)	(2.035)
Analyst Coverage	0.0243*	0.0113	0.0384***	0.0347***
	(1.777)	(0.764)	(5.418)	(6.356)
Stock Volatility	0.0653**	0.0535*	0.0240	0.0292*
	(2.545)	(1.927)	(1.358)	(1.798)
Observations	605	605	498	498
Adj. R^2	0.949	0.964	0.976	0.981
Constant	Yes	Yes	Yes	Yes
Fiscal Quarter FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes

Table 10. 2SLS Estimates of Stock Illiquidity's Impact on Environmental Rating

This table reports the 2SLS estimates of stock illiquidity's effect on the corporate environmental rating. In Panel A, we present estimates of Equation (3), the first-stage regression of the two-stage least square analysis. The dependent variables for Columns (1) and (2) are, respectively, the percent quoted spread and the relative effective spread. The main independent variables is the interaction term between the treatment firm indicator (*Treat*) and treatment period indicator (*Post*). The treatment period indicator (*Post*) equals one for all fiscal quarters starting from October 2016, and zero otherwise. In Panel B, we display estimates of Equation (4), the second-stage regression. The dependent variable is the MSCI IVA environmental rating for each firm and fiscal quarter. The main independent variables for Columns (1) and (2) are two instrumented stock illiquidity proxies: the percent quoted spread and the relative effective spread. Across all specifications, we include control variables as used in Table 2. The sample spans from October 2013 through September 2018. Standard errors are clustered at the 2-digit industry-by-fiscal quarter level. T-statistics are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Panel A: First-Stage Regression

	(1)	(2)
Dep. Variable:	Quoted Spread (%)	Effective Spread (%)
Treat X Post	0.0891***	0.107***
	(5.625)	(8.248)
Ln(Total Assets)	-0.423***	-0.405***
	(-12.32)	(-15.01)
Cash	-0.00371***	-0.00308***
	(-4.017)	(-4.261)
Dividend Yield	-1.587***	-0.591
	(-4.744)	(-1.424)
B/M Ratio	0.500***	0.409***
	(12.90)	(11.89)
Sales Growth	-0.000414***	-0.000354***
	(-4.072)	(-4.134)
Leverage	0.00617***	0.00560***
	(6.999)	(7.870)
Investment	0.00487**	0.00339**
	(2.516)	(2.096)
Analyst Coverage	-0.00268	-0.00279**
	(-1.504)	(-1.977)
Stock Volatility	0.0632***	0.0467***
	(4.880)	(4.376)
Observations	8,176	8,176
Adj. R^2	0.857	0.848
Constant	Yes	Yes
Fiscal Quarter FE	Yes	Yes
Firm FE	Yes	Yes

Panel B: Second-Stage Regression

Dep. Var: Environmental Rating	(1)	(2)
Proxies for Illiquidity:	Quoted Spread (%)	Effective Spread (%)
$\widehat{\text{Illiquidity}}$	-1.694**	-1.735***
	(-2.546)	(-2.625)
Total Assets)	-0.00908	0.0674
	(-0.0756)	(0.647)
Cash	-0.00397	-0.00387
	(-1.558)	(-1.522)
Dividend Yield	1.614*	1.558*
	(1.756)	(1.757)
B/M Ratio	0.0577	-0.0118
	(0.458)	(-0.111)
Sales Growth	-0.000711	-0.000692*
	(-1.636)	(-1.647)
Leverage	0.00241	0.00227
	(0.916)	(0.885)
Investment	0.00312	0.00243
	(0.682)	(0.534)
Analyst Coverage	0.000924	0.00192
	(0.114)	(0.240)
Stock Volatility	-0.0489*	-0.0495*
	(-1.700)	(-1.748)
Observations	5,177	5,177
Adj. R^2	-0.144	-0.101
Constant	Yes	Yes
Fiscal Quarter FE	Yes	Yes
Firm FE	Yes	Yes

Table 11. Changes in the Cost of Capital Around the TSP Enactment Date

We examine the impact of TSP on environmental ratings conditional on changes in the cost of capital initially experienced around the TSP initial enactment. The TSP-induced changes in the cost of capital is measured using the firm's abnormal return within one month of the TSP implementation date (i.e., 17 Oct 2016), referred to as "TSP Enactment Abnormal Return". Abnormal returns are calculated using the Fama-French 3-factor model, with parameters estimated from the sample period of September 2015 to August 2016. The dependent variable is the MSCI IVA environmental rating for each firm and fiscal quarter. In Column (2), the High-Exposure indicator equals one for those firms with scaled wealth–performance sensitivity values in the highest sample tercile, and zero otherwise. WPS is taken at the end of the prior year. In Column (3), the High- Exposure indicator equals one for firms with cliques' ownership in the lowest tercile, and zero otherwise. In Column (4), the indicator is constructed analogously but based on the ownership share of the largest investor clique. In Column (5), the High-Exposure indicator equals one for those firms with the lagged Opinion Dispersion on Env. Issues in the highest tercile, and zero otherwise. We include control variables as used in Table 2. In Column (5), we also control for variables used in Table 7 Column (3). The sample spans from October 2013 through September 2018. Standard errors are clustered at the 2-digit industry-by-fiscal quarter level. T-statistics are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Dep Var: Environmental Rating	(1)	(2)	(3)	(4)	(5)
Proxies for Exposure to Exit Threat:		WPS	Total Clique Ownership	Top Clique Ownership	Opinion Dispersion on Env. Issues
Treat X Post X TSP Enactment Abnormal Return	-0.885	3.448***	-0.740	-1.039	-0.124
	(-0.957)	(2.964)	(-0.720)	(-0.990)	(-0.125)
Post X TSP Enactment Abnormal Return	-1.178	-4.050***	-1.726**	-1.288	-1.511*
	(-1.446)	(-4.203)	(-2.075)	(-1.504)	(-1.728)
Treat X Post X High Exposure		-2.063***	-0.814**	-0.755**	-1.456**
		(-5.023)	(-2.177)	(-2.211)	(-2.566)
Treat X Post	-0.497***	-0.0409	-0.332**	-0.325**	-0.349***
	(-3.777)	(-0.247)	(-2.197)	(-2.126)	(-2.836)
Treat X High Exposure		-0.416	0.362	0.529*	0.598
		(-0.953)	(1.262)	(1.923)	(1.404)
Post X High Exposure		1.141***	1.215***	0.999***	1.506***
		(3.836)	(4.367)	(3.853)	(2.967)
High Exposure		0.0794	-0.313	-0.471**	0.222
		(0.233)	(-1.312)	(-1.990)	(1.367)
Observations	977	738	977	977	967
Adj. R^2	0.749	0.769	0.755	0.753	0.767
Controls	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
Fiscal Quarter FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
HHI(Inst. Ownership)	No	No	No	No	Yes
Average Env. Rating of All Inst. Investors	No	No	No	No	Yes

APPENDIX

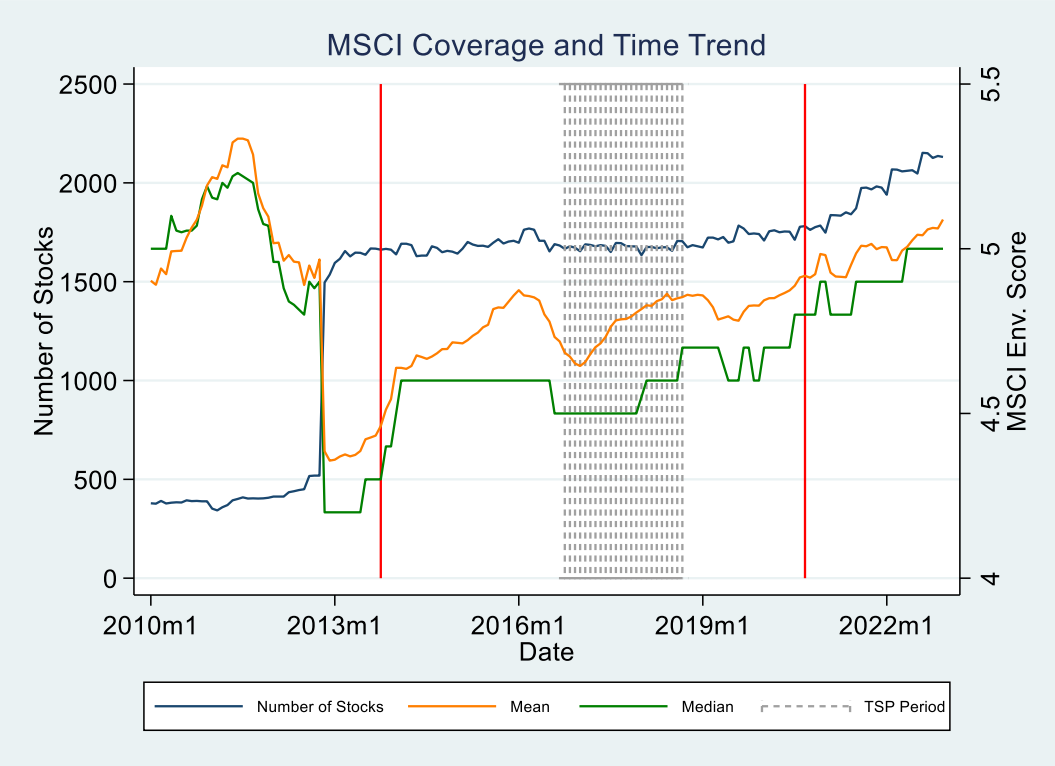


Fig A1: MSCI coverage and Time Trend. The figure displays the number of stocks in our sample with MSCI environmental scores at the end of each month, represented by the blue line. The left red line marks October 2013, the starting point of our sample when examining the effect of enacting TSP. The starting point is chosen to ensure a three-year pre-treatment period leading up to the enactment month of October 2016. When examining the effect of enacting TSP, our sample spans from October 2013 through September 2018. The right red line indicates September 2020, which is the endpoint of our sample when examining the effect of lifting TSP. The end point is chosen to ensure a two-year period after TSP becomes lifted in September 2018. When examining the effect of lifting TSP, our sample spans from October 2016 through September 2020. The green and orange lines illustrate the sample's median and mean values over time, respectively. The grey dashed area represent the TSP period which spans from October 2016 through September 2018.

Table A1. Definitions of Variables

Variable	Definition
Environmental Rating	Environmental pillar score for each firm by the end of fiscal quarter provided by MSCI IVA. It ranges from 0 to 10, where 0 indicates a low environmental sustainability and 10 indicates a high environmental sustainability.
Ln(Emission Level)	The log of 1 plus thousands metric tons of Scope 1 carbon emissions based on hand-matched firms' carbon emissions data from Environmental Protection Agency (EPA)'s Greenhouse Gas Reporting Program (GHGRP).
Ln(Emission Intensity)	The log of 1 plus emission intensity based on hand-matched firms' carbon emissions data from Environmental Protection Agency (EPA)'s Greenhouse Gas Reporting Program (GHGRP). Emission intensity is computed by dividing metric tons of carbon emissions by firm revenue (in dollar).
Quoted Spread ($)	The time-weighted average of dollar quoted spread for each day. When computing pre-TSP small-spread indicator, we take a simple arithmetic mean over daily quoted spreads between March 1, 2016 and August 31, 2016.
Quoted Spread (%)	The time-weighted average of percent quoted spread for each day per fiscal quarter, lagged by one fiscal quarter.
Effective Spread (%)	For each executed intraday trade, the relative effective spread is the ratio of the difference between the execution price of a trade and the midpoint of the prevailing bid-ask spread (the effective spread) divided by the midpoint of the prevailing bid-ask spread. The daily relative effective spread is a share-volume-weighted average of the relative effective spread of all trades taken place during the day for a given stock. To convert intraday data into fiscal-quarterly measures if stock illiquidity, we take a quarterly arithmetic average of daily relative effective spread for a stock.
Ln(Total Assets)	Log of total assets (Compustat atq) lagged by one fiscal quarter.
Cash	Cash and Short-term investment (Compustat cheq) scaled by assets (Compustat atq).
Dividend Yield	(Common dividend (Compustat dvc) + preferred dividend (Compustat dvp))/(market value of equity + preferred stock (Compustat pstk)). Every item is taken at the end of last fiscal year.
B/M Ratio	(Book value of equity (Compustat ceqq))/(market value of equity). Every item is taken at the end of last fiscal quarter.
Sales Growth	100 X sales (Compustat sale) by the end of last fiscal year minus the sales three fiscal years ago divided by the sales three fiscal years ago.
Leverage	100 X long-term debt (Compustat dlttq) plus debt in current liabilities (Compustat dlcq) scaled by the sum of long-term debt, debt in current liabilities, and total stockholders' equity (Compustat atq). Every item is lagged by one fiscal quarter.
Investment	The lagged changes in gross property, plant, and equipment (Compustat annual item PPEGTQ) plus lagged changes in inventory (item INVTQ), divided by lagged total assets (item ATQ). Every item is lagged by one fiscal quarter.

Analyst Coverage	The number of I/B/E/S analysts following the firm by the end of the last fiscal year.
Stock Volatility	Standard deviation of daily stock returns (%) over the last fiscal quarter.
Env. Incident	The occurrence of an environmental incident reported on news. All news is sourced from RepRisk.
Scaled WPS	The scaled wealth-performance sensitivity by the end of the last fiscal year. It captures the dollar change in CEO wealth for a 100 percentage point change in firm value, divided by annual flow compensation and measured at the end of the fiscal year. See Edmans, Gabaix, and Landier (2009).
Total Clique Ownership	The aggregate ownership by all institutional investor cliques for each firm as defined in Crane, Koch, and Michenaud (2019).
Top Clique Ownership	The total ownership in each firm of only the single institutional investor clique with the largest ownership stake in the firm, as defined in Crane, Koch, and Michenaud (2019).
Opinion Dispersion on Env. Issues	The holdings-weighted standard deviation of investor-level environmental rating is $\sqrt{\sum_{j=1}^{n}\left(w_j E_j - \overline{wE}\right)^2 /(n-1)}$, where E_j denotes institution j's portfolio-level value-weighted environmental rating, w_j denotes the percentage of shares held by institution j, and $\overline{wE}$ the arithmetic mean of $w_j E_j$.
HHI (Inst. Ownership)	The Herfindahl–Hirschman index of institutional ownership, lagged by one fiscal quarter.
Average Env. Rating of All Inst. Investors	The holdings-weighted average environmental rating of all institutional investors for each firm is calculated using $\sum_{j=1}^{n} w_j E_j$ where E_j denotes blockholder j's lagged portfolio-level value-weighted environmental rating, and w_j denotes the lagged percentage of shares held by blockholder j.

Table A2. Impact of TSP on Scope 1 + 2 Emission Level and Performance

This table reports the effect of 2016 tick size pilot on firm carbon emission activities. The dependent variable is the log transformed thousands of metrics tons of Scope 1 and 2 carbon emissions (*Ln(Emission Level)*) for Columns (1) and (3) and the log transformed metrics tons of Scope 1 and 2 carbon emissions scaled by revenue in dollar (*Ln(Emission Intensity)*) for Columns (2) and (4). Scope 1 emission data is retrieved from EPA, and Scope 2 emission data is collected from Asset4. In Columns (1) and (2), we examine the effect of enacting TSP. The sample spans from October 2013 through September 2018. The treatment period indicator (*Post*) equals one for all fiscal quarters starting from October 2016, and zero otherwise. In Columns (3) and (4), we examine the effect of lifting TSP. The sample spans from October 2016 through September 2020. The main independent variable is the interaction terms between the treatment firm indicator (*Treat*) and treatment period indicator (*Lifting*). The treatment period indicator (*Lifting*) equals one for all fiscal quarters starting from October 2018, and zero otherwise. Across all specifications, we include control variables as used in Table 2. Standard errors are clustered at the fiscal quarter level. T-statistics are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)
Dep. Variable:	Emission Level	Emission Intensity	Emission Level	Emission Intensity
Treat X Post	0.111***	0.197***		
	(3.456)	(5.203)		
Treat X Lifting			-0.178***	-0.199***
			(-4.085)	(-4.658)
Ln(Total Assets)	0.199**	0.205*	0.506***	0.389***
	(2.563)	(1.905)	(5.413)	(3.765)
Cash	-0.00572*	-0.00206	-0.00176	-0.00510**
	(-1.968)	(-0.492)	(-0.834)	(-2.053)
Dividend Yield	-8.298***	-13.88***	-4.490***	-8.440***
	(-4.226)	(-3.005)	(-4.613)	(-6.500)
B/M Ratio	-0.00992	-0.0257	0.0580***	0.0882***
	(-0.503)	(-1.098)	(2.759)	(3.233)
Sales Growth	0.00322***	-0.00128	-0.000800	-0.00681***
	(4.798)	(-1.196)	(-0.777)	(-5.928)
Leverage	-0.00549	-0.00465	-0.00659**	-0.00396
	(-1.596)	(-1.461)	(-2.310)	(-1.315)
Investment	-0.00483**	0.00100	-0.00510*	-0.00531**
	(-2.308)	(0.304)	(-1.836)	(-2.235)
Analyst Coverage	-0.0125	-0.0340**	0.00264	-0.00683
	(-1.395)	(-2.391)	(0.194)	(-0.583)
Stock Volatility	0.0298**	-0.0209*	0.00753	0.00459
	(2.373)	(-1.856)	(0.590)	(0.304)
Observations	130	130	192	192
Adj. R^2	0.997	0.993	0.991	0.991
Constant	Yes	Yes	Yes	Yes
Fiscal Quarter FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes

Table A3. Block Acquisition Activities of Institutional Investors

The dependent variable for Columns (1) and (3) ((2) and (4)) indicates whether there has been a 13G filing by a green institutional investor (an institutional investor). It equals one if there has been a 13G filing by a green institutional investor (an institutional investor) against the firm in the current fiscal year, and zero otherwise. Green institutional investors are those with an above-median portfolio-level value-weighted environmental rating amongst all 13F institutional investors as of the current quarter. In Columns (1) and (2), we examine the effect of TSP on block acquisition activities of institutional investors when TSP becomes enacted. The sample includes all fiscal years spanning from 2013 through 2018. The treatment period indicator (*Post*) equals one for all fiscal years starting from March 2017, and zero otherwise. In Columns (3) and (4), we examine the effect of lifting TSP on block acquisition activities. The sample includes all fiscal years spanning from 2017 through 2020. The post-TSP period indicator (*Lifting*) equals one for all fiscal years starting from October 2018, and zero otherwise. *Treat* is the treatment firm indicator. Across all specifications, we include the fiscal-year counterparts of quarterly control variables as used in Table 2 and we lag these variables by one fiscal year. Standard errors are clustered at the fiscal year level. T-statistics are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)
Dep. Var.:	Green Inst. Investors	All Inst. Investors	Green Inst. Investors	All Inst. Investors
Treat X Post	-0.172***	-0.194**		
	(-3.967)	(-2.454)		
Treat X Lifting			0.201***	0.147*
			(11.35)	(1.889)
Observations	261	261	153	153
Adj. R^2	-0.067	0.016	-0.075	-0.142
Fiscal Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes

Table A4. Alternative Control Group

This table reports the effect of 2016 tick size pilot on the corporate environmental rating conditional on the size of pre-TSP quoted spread. We estimate the overall and dynamic impacts of TSP on the corporate environmental rating, utilizing a sample split based on whether the firm's average pre-TSP daily quoted spread (between March 1, 2016 and August 31, 2016) is smaller than or equal to 3 cents. Column (1) and (3) ((2) and (4)) present regression results for stocks with a small (large) pre-TSP spread. The dependent variable is the MSCI IVA environmental rating for each firm and fiscal quarter. The treatment period indicator (*Post*) equals one for all fiscal quarters starting from October 2016, and zero otherwise. *Pre3* equals one for all fiscal quarters that are three fiscal years prior to the enactment quarter, and zero otherwise. *Pre1* equals one for all fiscal quarters that are one fiscal year prior to the enactment quarter, and zero otherwise. *Post1* equals one for the enactment quarter and the subsequent three fiscal quarters, and zero otherwise. *Post2* equals one for all fiscal quarters that are one fiscal year after the enactment quarter, and zero otherwise. The sample includes all treatment firms in the TSP and control firms matched using one-to-one matching with replacement. Across all specifications, we include control variables as used in Table 2. The sample spans from 2013 through 2018. Standard errors are clustered at the 2-digit industry-by-fiscal quarter level. T-statistics are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	Null: Small Spread = Large Spread
Dep Var: Environmental Rating	Small Spread	Large Spread	Small Spread	Large Spread	
Treat X Post	-0.410***	0.0572			P = 0.005
	(-2.831)	(0.765)			
Treat X Pre3			0.159	-0.186	
			(0.672)	(-1.332)	
Treat X Pre1			0.0897	0.0828	
			(0.408)	(0.722)	
Treat X Post1			-0.359*	0.0473	P = 0.089
			(-1.823)	(0.414)	
Treat X Post2			-0.428**	0.0948	P = 0.032
			(-2.066)	(0.804)	
Observations	868	1,796	868	1,796	
Adj. R^2	0.777	0.851	0.778	0.851	
Fiscal Quarter & Firm FE	Yes	Yes	Yes	Yes	
Firm Controls	Yes	Yes	Yes	Yes	