Value versus *Values*:

Does Stock Liquidity Affect Corporate Environmental Policies?[*]

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Abstract

One fundamental challenge in sustainable investing is to distinguish *value* from *values* (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

(JEL: G1, G2, G3, Q5)

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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]

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 leverages revealed preferences, rather than self-disclosed mandates. It therefore avoids the widely discussed concern that many asset managers may brand themselves as *values* investors for advertisement purposes without giving up returns to make sustainable investments (Baker, Egan and Sarkar 2022). Second, our method does *not* rely on realized financial performance to infer willingness-to-pay.[4] Doing so would conflate investment skill with genuine nonpecuniary motives.[5] It would also require specifying an asset pricing model for climate-related risks (to account for the impact of sustainable investing on risk loadings), yet no consensus model exists. As an exogenous liquidity shock, the TSP affects the financial returns of treatment firms without altering their risk profile. This allows us to separate investors

[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 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] For example, one might attempt to define *values* investors as those who hold environmental fund mandates and achieve relatively low realized financial performance than their peers.

[5] For example, some low-skill fund managers, including those with little willingness-to-pay for environmental objectives, may strategically adopt environmental mandates to create a smoke screen for their investment skill signal, anticipating that outsiders cannot fully distinguish whether poor realized performance stems from low skill or high environmental commitment.

who optimize risk–return trade-offs (*value*) from those willing to forgo returns for nonpecuniary objectives (*values*) without muddling the specification of an asset pricing model.

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, 0.135 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.[6] 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 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 8.86% in their emission levels and a 5.35% rise in intensity.[7] It suggests that 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

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

[7] 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.

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 4.6 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,[8] 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* investors 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, 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, among green investors who have obtained Principles for Responsible Investment (PRI) signatory status, *value* investors demonstrate a higher likelihood of eventual PRI delisting compared to other green investors. This pattern is consistent with the substantial

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

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 establishing that the TSP reduced divestment intensity for treatment firms, we next show that its negative impact on environmental ratings was concentrated in firms more sensitive to exit threats. We capture this sensitivity through managerial focus on stock prices, proxied by wealth–performance sensitivity (WPS; Edmans, Gabaix, and Landier 2009). A one-standard-deviation increase in WPS is associated with an additional 1.747-point decline in environmental ratings, corresponding to 0.95 standard deviations—an economically and statistically significant effect.

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 8.29 basis points of portfolio weight in the quarter of the incident. As exit threats increased post-TSP, firms most vulnerable to exit threats began implementing policies to enhance their environmental performance. Specifically, treatment firms with one-standard-deviation higher managerial focus on equity prices saw environmental ratings rise by 0.34 points. Moreover, treatment firms reduced emissions by 6.68% and emission intensity by 11.3%, reflecting meaningful improvements in their environmental profiles.

To assess the external validity of our findings beyond the TSP, we extend the analysis to all U.S. publicly traded firms. Across the full market, we find that higher stock illiquidity (proxied using lagged percent quoted spread and relative effective spread) predicts weaker environmental performance, higher emissions, and greater emission intensity, especially in firms where managers' wealth is more sensitive to stock prices—consistent with the exit-threat governance channel. We further replicate our investor classification and show that investors whose divestment decisions are constrained by stock illiquidity display characteristics of financially motivated rather than norm-driven investors, mirroring again our TSP results. Together, these findings suggest that liquidity's influence on environmental outcomes, as well as our approach to distinguishing *value* from *values* investors, generalizes beyond TSP.

While TSP may have influenced environmental outcomes by raising firms' cost of capital, our objective is not to rule out this financing channel entirely, but to test against the alternative hypothesis that exit threats play no role. Several results suggest this alternative cannot fully explain our findings. First, we have explicitly controlled for firm-level investment across our empirical specifications. Second, environmental rating reversals at TSP's conclusion occur only among firms with high managerial sensitivity to stock prices—which a purely financing-based explanation does not predict. Third, when we directly control for firm-specific

cost of capital shocks, the significance of financing effects (proxied using the size of abnormal return around the initial implementation of TSP) weakens while the exit-threat mechanism remains robust. Thus, even after accounting for financing frictions, exit remains a key channel.

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). Our aim is not to dismiss this channel altogether, but to test whether the results could be explained without the exit mechanism. The evidence points otherwise. Specifically, TSP firms have historically had very low exposure to shareholder activism, measured using shareholder campaigns and 13D filings, on environmental issues. We also measure firms' *relative* exposure to exit versus voice using the level of coordination risk. Both theory (e.g., Edmans and Manso, 2011) and empirical evidence (Crane, Koch, and Michenaud 2019) indicate that a lack of coordination among investors should strengthen the exit threats by enhancing the trading intensity. Indeed, TSP's negative effects are concentrated among firms with high coordination risk, where voice is least effective and exit most relevant.

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.[9] 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. Prior empirical studies have sought to identify the causal impact of exit primarily through the second channel, showing that liquidity shocks affect firm performance—particularly among firms more exposed to exit threats (e.g., Bharath, Jayaraman, and Nagar 2013; Edmans, Fang, and Zur 2013).[10] These studies build on theoretical predictions by Edmans (2009) and Admati and Pfleiderer (2009) that reductions in liquidity should weaken

[9] Alternatively, one might attempt to classify *value* investors as those historically more responsive to quantitative mispricing signals. Cao, Titman, Zhan, and Zhang (2023) show that abnormal returns associated with mispricing signals are greater for stocks held more by green investors. However, this approach suffers 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.

[10] Another strand of studies tried to examine the impact of exit on environmental performance by exploiting E&S incidents. For example, Gantchev, Giannetti, and Li (2022) find that firms tend to improve their E&S policies following such incidents, and shareholders often divest after such 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.

investors' incentives to govern through exit. However, no empirical study has directly tested this core theoretical prediction. Our paper fills this gap by providing evidence that liquidity significantly influences investors' actual divestment behavior. 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.[11] 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 was 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 restricts dark-pool trading. The two-year TSP was fully implemented in October 2016. The program concluded officially on September 30, 2018.[12] Chung, Lee, and Rösch (2020) and Albuquerque, Song, and Yao (2020) show that TSP reduces liquidity for treatment stocks in contrast to control stocks.

2.2. Measuring Firms' Greenness

[11] 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.

[12] 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.

We derive firm-level environmental ratings from the 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.[13] 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.[14]

We further support our analysis with firms' carbon emissions data from the 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).

[13] 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).

[14] 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.

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. To convert annual emission levels to a quarterly basis, we simply divide the reported annual emissions by four.

To measure a firm's environmental profile using carbon emissions, we employ two proxies. 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 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 (market capitalization) in our sample is $809.956 million ($588.135 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, 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 A.1.

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. Leverage ratios tend to negatively predict environmental initiatives. 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. 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 versus 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 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 0.452. 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.[15] 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 TSP impaired institutional investors' ability to exert exit threats.

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

5.1. The Effect of Enacting TSP on Institutional Investors' Divestment

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 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

[15] 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.

enough to force management to undertake productive effort and dissuade investors from potential exiting. When institutional investors exhibit preferences towards environmental performance, better stock liquidity improves their capacity to affect the environmental policies of their portfolio firms. To assess this 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.[16] 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 previous quarter end. To classify an institution's portfolio as green, we require that at least 30% of its portfolio value must be covered by a MSCI IVA environmental rating.[17] Conversely, non-green institutional investors are characterized by having a below-median environmental rating for their portfolio or less than 30% of portfolio value receiving an environmental rating.[18]

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,

[16] 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; Baker, Egan, and Sarkar 2022).

[17] The sample median (15th percentile) [85th percentile] institution has 75% (30%) [89%] of its portfolio value receiving an environmental rating in a quarter. This method thus captures approximately 85% of institutional investor-quarter observations, covering those above roughly the 15th percentile.

[18] 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. Moreover, classifying investors with less than 30% of their portfolio value in firms with environmental ratings as non-green is consistent with Avramov, Cheng, Lioui, and Tarelli (2021), who show that investors preferring green firms also tend to avoid ESG uncertainty. Such uncertainty is likely most severe for stocks without an environmental rating. Nevertheless, excluding investors with less than 30% environmentally rated holdings does not alter our results.

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 specializing in assessing environmental, social, and governance (ESG) risks.[19] 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:

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

[19] 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.

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 [-1,0] and [-1,1] 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, 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. As captured by β_6, Column (1) shows that green institutions tend to reduce their portfolio weight by approximately 2.76 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 one quarter before the incident and persists for one quarter after the incident, resulting in a divesting intensity of 1.98 basis points and 2.01 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 17.5

basis points.[20] 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 4.6 basis points in the current quarter (Column 1), 3.23 basis points when accounting for one quarter preceding the incident (Column 2), and 2.75 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, we argue that if any green investors changed their behavior in response to the minor increase in transaction costs induced by the TSP, they are likely to be *value* investors.

5.2. Investor Classification

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 of Equation (2), where an investor's portfolio weight in a stock is regressed on the same set of

[20] 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.

control variables, along with firm and quarter fixed effects, using the TSP sample from October 2013 to September 2018. That is, we estimate:

$$PortWeight_{i,j,t+1} = \beta_1 TREAT_i \times POST_t + \beta_2 Env.Incident_{i,t+1} \quad (3)$$
$$+\beta_3 Env.Incident_{i,t+1} \times TREAT_i \times POST_t$$
$$+C_{i,t} + C_{j,t} + Firm_i + Investor_j + Quarter_{t+1} + \epsilon_{i,j,t+1}$$

A green investor j is classified as a *value* investor if they meet two criteria: (i): they divest following environmental incidents (indicated by $\beta_2 < 0$), and (ii) this divestment behavior is constrained by the TSP (indicated by $\beta_3 > 0$).

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.[21] 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:

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

if the TSP effectively identifies *value* investors, those who responded to the TSP should be less 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 29.4% of *value* investors compared to 50.3% of other green investors. Thus, those investors who responded to TSP—plausibly-*value* investors rather than *values* investors—are 41.6% (=(0.294-0.503)/0.503) 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 5% (=(0.194-0.204)/0.204) less likely to be bank trusts, and none are found among public pensions, corporate pensions, university endowments, or miscellaneous investors. Conversely, they represent nearly all investment companies in the green-investor group (8.8% of *value* investors versus just 0.1% of other green investors) and are 24.6% (=(0.618-0.496)/0.496) 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 utilizing a revealed preference approach, rather than relying on self-disclosed mandates. The mandate-based method is prone to the concern that many 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. Besides, 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. Finally, the adoption of environmental mandates may itself be endogenous. Low-skill fund managers—especially those with a low willingness-to-pay—may adopt such mandates strategically to obscure their true ability, exploiting the fact that outsiders cannot easily disentangle whether weak performance reflects poor skill or strong environmental commitment. As a result, managers with low willingness-to-pay could be misclassified as having high willingness-to-pay.

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, 39.3% of *value* investors are eventually delisted, compared to only 2.2% of other green investors.

5.3. The Effect of Lifting TSP on Institutional Investors' Divestment

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. Figure 2 shows the timeline for this sample period.

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 6 about here]

We report the regression results in Table 6. 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. This escalation in divestment intensity amounts to 8.29 basis points of portfolio weights in the incident quarter, 6.39 basis points when including one quarter before the incident, and 5.19 basis points after also accounting for one quarter after the incident.

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. This study contributes 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 rests 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.

Following the literature, we measure exit-threat exposure based on the notion that such threats are more effective when managers' personal wealth is more sensitive to the stock price (e.g., Edmans, Fang, and Zur, 2013). We proxy this sensitivity using the scaled wealth-

performance measure (WPS) of Edmans, Gabaix, and Landier (2009), which captures the dollar change in a CEO's wealth for a 100-percentage-point change in the stock price, scaled by annual pay.

We then estimate the conditional effect of TSP on environmental ratings at different levels of WPS. If the decline in environmental ratings is primarily driven by reductions in exit threats, we expect this effect to be stronger for firms where management has greater exposure to the stock price. Table 7 provides evidence supporting this hypothesis. As shown in Panel A, the interaction between *Treat* × *Post* and WPS is negative and statistically significant. In economic terms, a one standard-deviation increase in sensitivity to stock price is associated with a 1.747-point (=0.0178 × 98.158) decrease in environmental ratings. Panel B examines potential pre-trends by replacing the treatment indicator with a set of fiscal-year dummies, and setting the baseline year to two years before the start of the TSP. The interaction between *Treat* × *Post* and WPS is statistically significant only in the post-treatment period, suggesting the effect is not driven by pre-existing trends.

[Insert Table 7 about here]

We also 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.[22] Specifically, we use the same model specification as in Panel A with a revised sample period and the Post indicator replaced by the Lifting indicator. We represent the regression results in Panel C. The positive and significant coefficient of the interaction

[22] 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.

between *Treat* × *Lifting* and WPS indicates that when green investors' divestment intensity recovers after the TSP ends, firms with greater sensitivity to exit threats begin implementing policies that improve environmental performance.

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. In untabulated analyses, the results remain robust when managerial sensitivity to equity prices is measured using binary indicators, either by splitting firms at the median or into terciles.

7. 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 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 8 Columns (1) and (2) show that treatment firms increased their emission levels by up to 8.86% and their emission intensity by 5.35%. 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 6.68% (Column (3)) and emission intensity by 11.3% (Column (4)). Overall, these findings suggest that stock illiquidity has a *real* negative impact on corporate environmental policies.

[Insert Table 8 about here]

In Table A.2, 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. The GHGRP includes only firms with at least one facility emitting 25,000 metric tons or more of CO_2 annually, so the economically significant impact of the TSP on emissions could partly reflect the higher sensitivity of large polluters to governance pressures from investors.

8. Robustness Check

8.1. 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.[23] We estimate the following regression:

$$Illiquidity_{i,t} = \gamma_1 TREAT_i \times POST_t + C_{i,t} + Firm_i + Quarter_{t+1} + \eta_{i,t+1} \quad (4)$$

$$Env_{i,t+1} = \beta_1 \widehat{Illiquidity}_{i,t} + C_{i,t} + Firm_i + Quarter_{t+1} + \epsilon_{i,t+1} \quad (5)$$

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 (4), 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.[24] The first measure is the time-weighted percent quoted spread from the TAQ database. Specifically, at each time instance, it is calculated as

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

[24] 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).

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.

[Insert Table 9 about here]

Table 9 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., -1.736 × 0.149). Therefore, firms with more illiquidity stocks often perform poorly in environmental sustainability. Table A.3 shows that the results remain robust when restricting the sample to firms with small spreads.

8.2. Evidence from the Broader U.S. Market

While our TSP-based identification strategy provides a plausibly causal estimate of liquidity's effect on environmental performance, the pilot program's focus on smaller firms raises questions about the generalizability of these findings. To address external validity concerns, we extend our analysis to the universe of U.S. publicly traded firms from 2013 to 2018, examining whether the mechanisms we identify persist in a broader market context.[25]

We first establish that the relationship between stock illiquidity and environmental performance holds across the U.S. equity market. To do so, we estimate Equation (1) using lagged measures of illiquidity—specifically, the percent quoted spread and relative effective spread—as the primary explanatory variables, replacing the TSP treatment indicator (Treat × Post). To mitigate reverse causality and the risk that unobserved contemporaneous factors drive both liquidity and environmental outcomes, we implement two lag structures: a one-quarter lag and a one-year lag.

[Insert Table 10 about here]

Table 10 presents these baseline results. Panel A shows that firms with higher illiquidity exhibit significantly lower environmental ratings in subsequent periods. A one-standard-deviation increase in the relative effective spread corresponds to a 0.04-point decline (= 0.252 × 0.149) with a one-quarter lag, rising to 0.08 points (= 0.521 × 0.149) with a one-year lag. These effects are particularly pronounced for firms where management has higher equity-based compensation exposure: the interaction between illiquidity and CEO wealth-performance sensitivity (WPS) is negative and highly significant, consistent with the exit-threat governance

[25] We use 2013–2018 to ensure consistency with our TSP sample, though the results remain unchanged when extending the period to 2020 or beyond.

channel being most effective when managers' wealth is tied to stock price movements. Panels B and C extend the analysis to real environmental outcomes and find consistent results. Specifically, higher illiquidity increases both emissions and emission intensity, especially in firms with highly stock-price-sensitive management.

Having established that liquidity affects environmental performance through governance mechanisms in the broader market, we next assess whether our method for distinguishing *value* from *values* investors generalizes beyond the TSP sample. We replicate the investor classification exercise from Section 5.2, this time identifying green investors whose divestment behavior responds to general changes in stock illiquidity (i.e., percent quoted spread and relative effective spread) rather than TSP-induced shocks ($Treat \times Post$). Specifically, we classify investors as *value*-oriented if they divest following environmental incidents (indicated by a negative coefficient on $Env.Incident_{i,t+1}$), and this divestment is attenuated when stock liquidity declines (indicated by a positive coefficient on $Env.Incident_{i,t+1} \times Illiquidity_i$). To capture persistent behavioral patterns rather than transient responses, we primarily use illiquidity measures lagged by one year, with complementary quarterly-lag results reported in Table A.4.

[Insert Table 11 about here]

Table 11 shows strong consistency with our TSP-based findings. Whether using quoted spreads (Panel A) or effective spreads (Panel B) as illiquidity proxies, investors whose divestment behavior responds to transaction costs—our plausibly-*value* investors—exhibit characteristics consistent with financial rather than ethical motivation. They are 27.8% (=(0.333-0.461)/0.461) to 28.4% less likely to be norm-constrained institutions compared to other green investors. This pattern mirrors our TSP findings: public pensions and university

endowments are notably absent from the *value* investor category, while investment companies and independent investment advisors—institutions with explicit performance mandates—are significantly more prevalent. Furthermore, while *value* investors are initially as likely (or, using effective spreads, somewhat more likely) to obtain PRI signatory status, their subsequent delisting rates are much higher (27.3–38% versus 0.8–4.4% for other green investors). These findings suggest that the rising compliance costs of genuine ESG implementation tend to outweigh reputational benefits for financially motivated investors This pattern, again, parallels our TSP-based classification in Table 5.

Together, while the TSP-based analysis leverages a natural-experiment setup to provide a low-bias estimate of liquidity's effect on environmental performance, its small sample size may raise external validity concerns, which the broader U.S. sample analysis addresses by expanding the sample size, albeit with potential endogeneity concerns, thus making the two approaches complementary. The consistency between our TSP-based and full-market analyses supports the robustness of our method for identifying *value* investors based on their sensitivity to transaction costs. In both samples, these investors exhibit the same patterns: they are less common among norm-constrained institutions and display higher PRI delisting rates. The results also suggest that liquidity's impact on environmental performance likely extends across the equity market, not only among small-cap firms.

8.3. 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 A.5. We 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.

8.4. Different Treatment Groups

The Tick Size Pilot (TSP) introduces three distinct changes related to tick size: the quote rule, applicable to all test stocks (G1, G2, G3); the trade rule, which applies to test stocks in group two (G2) and group three (G3); and the trade-at rule, exclusively applicable to stocks in test group three (G3). Previous studies on TSP have consistently identified a statistically and quantitatively similar impact of TSP on stock liquidity across all three treatment groups (e.g., Albuquerque, Song, and Yao, 2020). These studies attribute changes in stock liquidity primarily to alterations in tick size for displayed quotes (quote rule, applicable to all three

groups), while the effects of requiring all trades to execute on a coarser price grid (trade and trade-at rules, relevant to G2 and G3) are found to be modest or negligible.

If the shifts in environmental policies post-TSP adoption are primarily driven by TSP-induced changes in stock liquidity, we should anticipate a quantitatively and statistically similar impact of TSP on environmental ratings across all three treatment groups. We investigate this possibility by estimating the change in environmental ratings after the implementation of TSP for each treatment group relative to the control group. The regression results of these subsample analyses are presented in Table A.6. Columns (1), (2), and (3) display the estimation results of Equation (1) over samples comprising only treatment group 1, 2, and 3, respectively, and the control group. Consistent with our expectations, the impact of TSP on environmental ratings is economically and statistically similar across all three treatment groups.

8.5. Subcategory of Environmental Performance

To gain a nuanced understanding of the impact of stock liquidity on various dimensions of environmental policies, we conduct a separate analysis of the influence of TSP on firms' risk management capabilities across four primary themes encapsulated in the MSCI environmental rating. The MSCI IVA environmental rating is formulated by evaluating firms' proficiency in addressing key issues within four themes, namely 1) Climate Change, 2) Natural Capital, 3) Pollution & Waste, and 4) Environmental Opportunities.[26] Table A.7 presents the regression results regarding the impact of TSP on environmental rating in each theme. We find that TSP

[26] Within the Climate Change theme, the key issues encompass carbon emissions, vulnerabilities to climate change, financing environmental impact, and product carbon footprint. The Natural Capital theme assesses demonstrated management capabilities in areas such as biodiversity & land use, raw material sourcing, and water stress. The Pollution & Waste theme encompasses issues spanning electronic waste, packaging material & waste, to toxic emissions & waste. The Environmental Opportunities theme scrutinizes the firm's capacity to exploit opportunities in clean technology, green building, and renewable energy.

negatively affects environmental performance across four different themes, although the effect on natural capital management is not statistically significant.

8.6. 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 at the implementation of TSP. 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.[27] This could occur even if the total level of investment, which we control for in our main regressions, remains unchanged.

Our goal is not to rule out the financing channel entirely, but rather to isolate the exit threat channel against the alternative hypothesis that what we capture is purely financing-driven. We argue this alternative is unlikely for three reasons.

First, we have explicitly controlled for firm-level investment throughout our empirical specifications to mitigate contamination from the financing channel.

Second, our results on the reversal in environmental ratings among firms with higher managerial interest in stock prices align more closely with the exit channel than with the financing channel. Specifically, following Albuquerque, Song, and Yao (2020), we estimate daily changes in stock liquidity and prices around the implementation and conclusion of TSP:

[27] 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.

$$Illiquidity_{i,t+1} \text{ or } AR_{i,t+1} \quad (6)$$
$$= \beta_1 TREAT_i \times Post\text{-}Week\ 1_t + \beta_2 TREAT_i \times Post\text{-}After\ Week\ 1_t$$
$$+ Firm_i + Quarter_{t+1} + C_{i,t} + \epsilon_{i,t+1}$$

Stock illiquidity ($Illiquidity_{i,t+1}$) is proxied by the daily percent quoted spread and relative effective spread, while changes in stock price are captured using abnormal returns ($AR_{i,t+1}$), computed based on CAPM and the Fama–French five-factor model. Consistent with Albuquerque, Song, and Yao (2020), we examine (i) the period from September 1 to November 30, 2016 for the initial TSP implementation, and (ii) the period from September 1 to November 30, 2018 for its conclusion. Model parameters necessary for computing abnormal returns are estimated over a 12-month pre-event window (September 2015–August 2016 for the 2016 implementation and September 2017–August 2018 for the 2018 conclusion). "Post–Week 1" captures immediate effects during the first week of implementation (October 17–21, 2016), while "Post–After Week 1" captures persistence (or any reversal) thereafter. Analogous indicators measure effects following the lifting of TSP on September 28, 2018.

Table A.8 shows that TSP's implementation produced an immediate drop in both stock prices (Panel B, Columns 1–2) and liquidity (Panel A, Columns 1–2), with neither reversing in the short run. This pattern is consistent with both financing and exit channels in predicting weaker environmental performance at TSP's onset. However, upon TSP's conclusion, stock liquidity immediately and persistently reversed (Panel A, Columns 3–4), while prices did not (Panel B, Columns 3–4). A purely financing-based explanation would predict that the absence of a stock price reversal should coincide with no reversal in environmental ratings around the

official end of TSP. Yet, as Table 7 shows, environmental ratings did reverse among firms with greater managerial sensitivity to stock prices, aligning more closely with the exit channel.

Besides, Albuquerque, Song, and Yao (2020) attribute the lack of a price reversal at TSP's conclusion to discount rates reverting gradually to pre-pilot levels well before the official end date. Even if true, this gradual adjustment should have led to a universal reversal in environmental ratings across all treated firms. Instead, we observe reversal only among those with high managerial sensitivity to equity prices, which the financing channel does not predict.

Third, the financing channel predicts that all TSP effects operate through firm-level cost of capital changes, leaving no independent role for managerial sensitivity to equity prices. We test this directly by controlling for firm-specific cost of capital changes, measured by abnormal returns during the first week of TSP implementation (October 17, 2016), and their interactions with treatment indicators. Table A.9 presents these results. Columns (1) and (4) show that firms experiencing larger return declines at TSP implementation indeed suffered greater environmental rating deterioration, supporting a financing channel role. However, Columns (2) and (5) suggest that when we additionally include interactions with managerial sensitivity to equity prices (WPS), the statistical significance of cost of capital effects becomes attenuated, while the WPS interaction remains significant and negative. The results remain robust if we additionally account for the interaction terms between firm fixed effects and WPS (Columns (3) and (6)) to separate the effects that we attribute to TSP from the time-invariant sensitivity of environmental policies to managerial interest in equity prices. Taken together, these findings suggest that, even after accounting for capital cost effects, the exit-threat mechanism continues to play a significant role.

8.7. 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.

As in Section 8.6, our goal is not to rule out the voice channel entirely but to demonstrate that the exit-threat channel remains the primary driver of our results. We argue that a purely voice-based explanation is unlikely, based on two sets of evidence: (i) the limited prevalence of environmental activism during our sample period (Section 8.7.1), and (ii) the stronger decline in environmental ratings among firms *relatively* more exposed to exit than to voice (Section 8.7.2).

8.7.1. Shareholder Activism

We first examine environmental activist campaigns. Using FactSet Shark Repellent and following the methodology of He, Kahraman, and Lowry (2023), we find that TSP firms historically had little exposure to environmental activism.[28] During our 2013-2018 sample period, only two environmental proposals were recorded, both targeting the same control firm

[28] 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".

and both failing to pass at annual shareholder meetings.[29] This limited activism exposure strongly suggests that voice mechanisms are unlikely to account for the observed TSP-induced decline in environmental ratings.

Furthermore, we examine the impact of the TSP-induced liquidity shock on the probability of an institutional investor acquiring an initial block (a stake of at least 5%) in a firm (Schedule 13D and Schedule 13G).[30] 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, doing so likely 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 institutional investors for environmental-related reasons. Between 2013–2018, institutional investors filed 201 Schedule 13Ds targeting TSP firms, 30 of which involved small pre-TSP spread firms. Manual review of Item 4

[29] 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 2017 and 2018.

[30] 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. I classify institutional-investor filers based on whether they filed 13F forms. This is achieved by matching the SEC's CIK code with mgrno using the WRDS linking table wrds_13f_link. Out of 14,456 historical 13D/G filers, 1,278 are matched to 1,325 13F institutional investors. Among these matched filers, 622 are classified as green institutional investors in at least one quarter during the sample period. Further removing amendments yields a total number of 26,837 13D/G filings by all institutions and 5,755 by green institutions. 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 1,317 13D filings and 21,776 13G filings by all institutions and 238 13D filings and 4,636 13G filings by green institutional investors.

disclosures in these 30 filings shows general discussions of "operations," "strategic direction," and "management," but none explicitly mentioned environmental, sustainability, ESG, or climate issues.

Recognizing that investors may underreport environmental motives, we also identify 13D filings by green investors. During 2013–2018, green investors filed 21 Schedule 13Ds targeting TSP firms, only 4 of which involved small-spread firms (2 treatment, 2 control).[31] This level of activity still seems too limited to explain the systematic decline in environmental ratings observed among smaller-spread firms.

Finally, TSP has constrained the ability of investors to purchase shares in a form *without* the option of engaging in voice. In Table A.10, we examine the impact of TSP on 13G 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.[32] The dependent variable in Columns (1) and (2) indicates whether any institutional investor has filed a 13G in a fiscal year.

Column (1) shows that TSP implementation reduces the propensity of institutional investors to acquire equity blocks under 13G forms in treatment firms. In Column (2), we assess

[31] Both 13D filings targeting control firms occurred in the pre-TSP period, whereas for treatment firms, green investors filed one 13D in the pre-TSP period and another during the TSP period.

[32] 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" 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. In the same vein, when studying the effect of lifting TSP, the "Lifting" indicator is assigned a value of zero for fiscal years ending before March 2019, and one otherwise.

the effect of lifting TSP by replacing the Post indicator with the Lifting indicator and adjusting the sample period to 2017–2020. The results indicate that after TSP ended, institutional investors in treatment firms were more likely to file 13G forms compared to the TSP period. Columns (3) and (4) replicate the analysis for green investors, with consistent though statistically weaker results.

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.

8.7.2. Relative Sensitivity to Exit versus Voice

We next test whether TSP's negative environmental effects were stronger among firms *relatively* more exposed to exit threats than to voice. If the voice channel dominated, we would expect the opposite.

We capture relative exposure using investor coordination risk, which reflects how easily institutional investors can align their actions. Following Edmans and Manso (2011)'s theoretical framework and Crane, Koch, and Michenaud (2019)'s empirical evidence, lower coordination risk (i.e., higher investor alignment) strengthens governance through voice, as investors are more able to coordinate collective interventions in forms of votes. Conversely, higher coordination risk facilitates the exit threat because the threat of exit is strongest when owners trade independently and aggressively, impounding their information into the price;

multiple investors that can credibly commit to cooperate should trade less aggressively to minimize price impact than investors who cannot cooperate.

Following the methodology of Crane, Koch, and Michenaud (2019), we construct two firm-level measures of ownership concentration among investor cliques—groups of institutional investors connected through overlapping holdings. The first measure of coordination risk is 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. Connections between investors are defined when both hold at least 5% of a common firm, using Thomson Reuters 13F data. We then define a High Coordination Risk indicator equal to one for firms in the lowest tercile of aggregate or top-clique ownership.

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 compute each blockholder's portfolio-level value-weighted environmental rating and then calculate the holdings-weighted standard deviation across investors: $\sqrt{\sum_{j=1}^{n}\left(w_j E_j - \overline{wE}\right)^2/(n-1)}$, 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.[33] We define High Coordination Risk as firms in the top tercile of this dispersion measure.

[33] 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.

Table A.11 shows that the negative effect of TSP is significantly larger for high-coordination-risk firms. Specifically, firms with low aggregate clique ownership (Column 1), low top clique ownership (Column 2), or high preference dispersion (Column 3) experience an additional 1.0–1.2 point drop in environmental ratings. This aligns more with the exit channel: higher coordination risk reduces investors' ability to govern through voice, leaving exit as the *relatively* more credible governance mechanism—one that is weakened by TSP's higher transaction costs. Finally, we examine whether lifting TSP improved outcomes for firms more reliant on exit. Using the Table 7 Panel C specification, Columns (4)–(6) show that treatment firms with high coordination risk experience greater post-TSP improvements in environmental ratings—again consistent with the exit-threat channel.

Together, the results from both subsections provide *suggestive* evidence that voice mechanisms cannot fully account for our primary findings. The limited prevalence of environmental shareholder activism, the patterns in block acquisition behavior, and the concentration of effects among firms most sensitive to exit threats all point to exit mechanisms as the *relatively* more primary channel through which stock liquidity affects corporate environmental policies.

9. 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.

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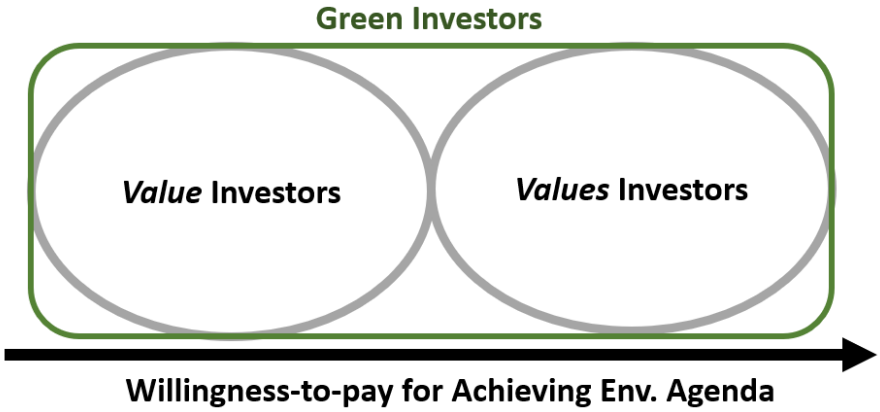
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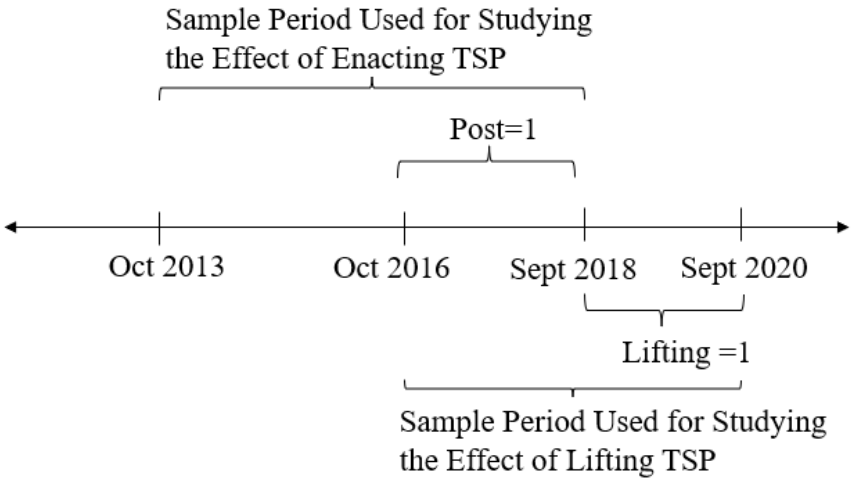
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Fig 1: *Value* versus *Values* in Investment Approaches



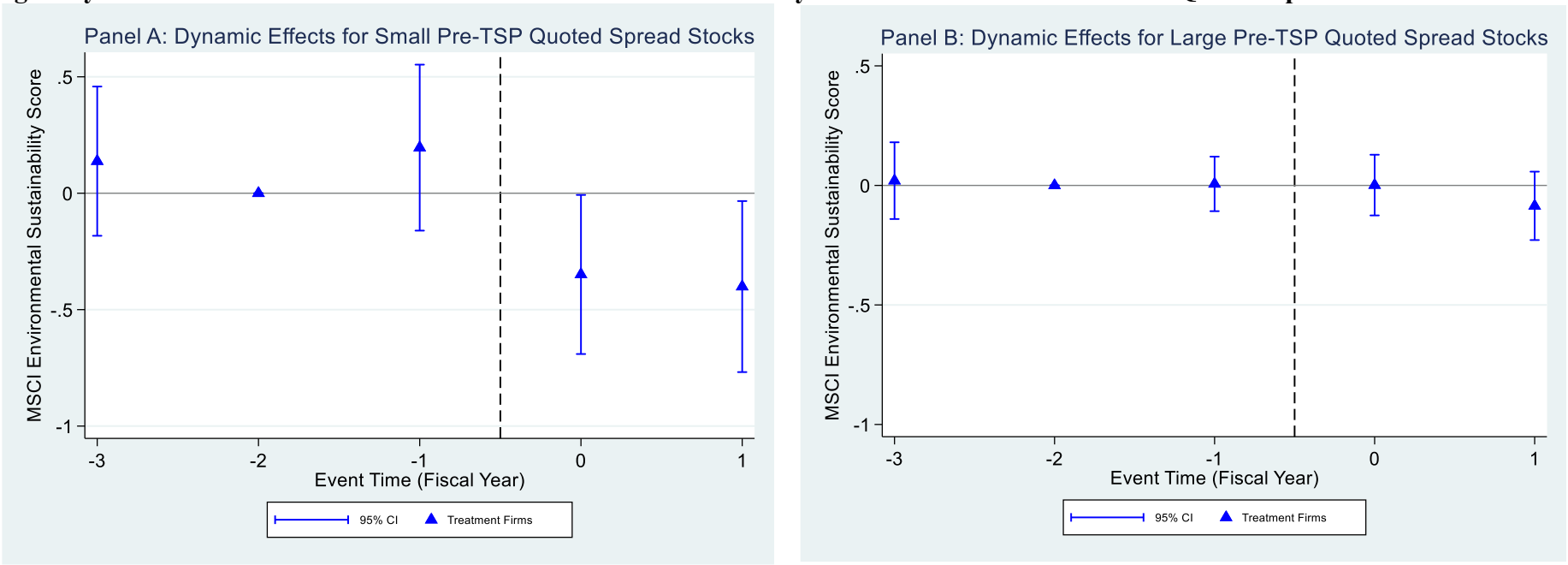
This figure depicts the spectrum of investment approaches taken by *value* investors and *values* investors. The horizontal axis represents the level of willingness to pay for advancing environmental objectives. While both *value* investors and *values* investors demonstrate significant environmental 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, 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

	N	Mean	SD	p25	Median	p75
Environmental Rating	9423	4.493	1.825	3.2	4.4	5.9
Ln(Emission Level)	573	3.414	1.455	2.332	2.949	4.034
Ln(Emission Intensity)	573	3.043	1.636	1.628	2.616	4.262
Quoted Spread ($)	7330	0.122	0.147	0.047	0.076	0.136
Quoted Spread (%)	7330	0.324	0.261	0.176	0.257	0.386
Effective Spread (%)	7330	0.2	0.149	0.113	0.16	0.236
Market Cap. ($mil)	9423	1276.068	957.895	588.135	1037.906	1699.144
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
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	0.016	0.127	0	0	0
WPS	6678	28.468	98.158	1.994	4.445	11.32
Total Clique Ownership	9423	11.752	10.442	4.116	8.503	16.249
Top Clique Ownership	9423	8.278	8.391	2.322	5.43	11.439
Holdings-Weighted SD	9306	0.103	0.045	0.079	0.093	0.114
HHI(Inst. Ownership)	9057	0.338	0.184	0.22	0.273	0.363
Average Env. Rating of Inst. Ownership	9306	5.35	0.222	5.222	5.354	5.502

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.

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

Dep. Var.: Environmental Rating	(1)	(2)	(3)	(4)
Treat × Post	-0.110***	-0.116***	-0.135***	
	(-3.091)	(-3.198)	(-3.247)	
Treat × Pre3				0.0435
				(0.608)
Treat × Pre1				-0.0608
				(-1.066)
Treat × Post1				-0.143**
				(-2.532)
Treat × Post2				-0.187***
				(-2.933)
Ln(Total Assets)	0.216***	0.201***	0.309***	0.309***
	(3.724)	(3.491)	(4.182)	(4.186)
Cash	-0.00615***	-0.00634***	-0.00450**	-0.00459**
	(-3.766)	(-3.809)	(-2.119)	(-2.161)
B/M Ratio	-0.0845	-0.0781	-0.0390	-0.0390
	(-1.595)	(-1.488)	(-0.662)	(-0.660)
Sales Growth	-0.000384***	-0.000382***	-0.000340	-0.000337
	(-3.618)	(-3.580)	(-1.210)	(-1.195)
Leverage	-0.00407***	-0.00408***	-0.00344*	-0.00333*
	(-2.862)	(-2.803)	(-1.766)	(-1.715)
Investment		-0.00166	0.000585	0.000814
		(-0.418)	(0.153)	(0.213)
Analyst Coverage			0.00683	0.00678
			(1.024)	(1.014)
Stock Volatility			-0.0488**	-0.0491**
			(-2.291)	(-2.298)
Observations	9,396	9,304	6,714	6,714
Adj. R^2	0.830	0.830	0.847	0.848
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes	Yes

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, 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

Table 3. Impact of TSP on Environmental Rating Conditional on Pre-TSP Quoted Spread

	(1)	(2)	(3)	(4)	Null: Small Spread = Large Spread
Dep. Var.: Environmental Rating	Small Spread	Large Spread	Small Spread	Large Spread	
Treat × Post	-0.452***	-0.0525			P = 0.002
	(-3.416)	(-1.125)			
Treat × Pre3			0.138	0.0198	
			(0.845)	(0.243)	
Treat × Pre1			0.196	0.00632	
			(1.080)	(0.109)	
Treat × Post1			-0.349**	0.00130	P = 0.042
			(-2.008)	(0.0202)	
Treat × Post2			-0.401**	-0.0856	P = 0.081
			(-2.146)	(-1.174)	
Observations	977	4,193	977	4,193	
Adj. R^2	0.746	0.850	0.747	0.850	
Controls	Yes	Yes	Yes	Yes	
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes	Yes	

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

Table 4. Institutional Investors' Portfolio Response to Environmental Incidents

Dep. Var.: Portfolio Weight (%)	(1)	(2)	(3)
Incident Event Window:	[0]	[-1,0]	[-1,1]
Env. Incident × Green Inst. Investor × Treat × Post	0.0460*	0.0323*	0.0275*
	(1.85)	(1.74)	(1.82)
Env. Incident × Green Inst. Investor	-0.0276***	-0.0198**	-0.0201**
	(-4.06)	(-2.00)	(-2.38)
Env. Incident × Non-Green Inst. Investor × Treat × Post	0.0409	-0.00710	0.0307
	(0.87)	(-0.17)	(0.92)
Env. Incident × Non-Green Inst. Investor	-0.0411	-0.0472	-0.0204
	(-1.34)	(-1.64)	(-0.92)
Green Inst. Investor × Treat × Post	-0.0207	-0.0228*	-0.0210
	(-1.64)	(-1.78)	(-1.62)
Treat × Post	0.0203*	0.0214*	0.0194
	(1.65)	(1.72)	(1.54)
Green Inst. Investor	0.0262***	0.0254***	0.0266***
	(2.75)	(2.66)	(2.78)
Observations	0.719	0.719	0.719
Adj. R^2	174203	174057	174203
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes
13F Inst. Investor FE	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes
Inst. Investor Controls	Yes	Yes	Yes

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 as of the previous quarter end, and zero otherwise. Green institutional investors are those with an above-median portfolio-level value-weighted environmental rating amongst all 13F institutional investors. 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 one quarters before the incident (event window: [-1,0]). To capture any staggered response, we also consider the event window of [-1,1]. 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

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

	Value Investors		Other Green Investors		Diff. in %
Investor Categories	Sample Size	Proportion (%)	Sample Size	Proportion (%)	
Norm-Constrained	238	0.294	1528	0.503	-0.209*** (P<0.001)
Bank Trust	238	0.197	1528	0.204	-0.007 (P=0.811)
Insurance Company	238	0.084	1528	0.052	0.032** (P=0.044)
Public Pension	238	0	1528	0.16	-0.16*** (P<0.001)
Corporate Pension	238	0	1528	0.012	-0.012* (P=0.084)
University Endowment	238	0	1528	0.01	-0.01 (P=0.113)
Miscellaneous	238	0.013	1528	0.065	-0.052*** (P=0.001)
Investment Company	238	0.088	1528	0.001	0.087*** (P<0.01)
Independent Investment Advisor	238	0.618	1528	0.496	0.012*** (P<0.01)
PRI Signatory	233	0.103	1555	0.135	-0.032 (P=0.176)
Delisted PRI Signatory	28	0.393	317	0.022	0.371*** (P<0.001)

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. Classification is conducted based on investor–firm–quarter holdings from the TSP firms, following the methodology described in Section 5.2. 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. 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 (i.e., 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 through 2022, and zero if the investor remained a signatory through 2022. The summary statistics are based on an investor-quarter sample covering October 2013 to September 2018 for investor type data, and 2014 to 2018 for PRI signatory status data. *** p<0.01, ** p<0.05, * p<0.1

Table 6. Reversals in Divestment Response Upon Lifting TSP

Dep. Var.: Portfolio Weight (%)	(1)	(2)	(3)
Incident Event Window:	[0]	[-1,0]	[-1,1]
Env. Incident × Green Inst. Investor × Treat × Lifting	-0.0829**	-0.0639**	-0.0519***
	(-2.53)	(-2.55)	(-2.66)
Env. Incident × Green Inst. Investor	-0.0742**	-0.0586**	-0.0561***
	(-2.29)	(-2.39)	(-2.92)
Env. Incident × Non-Green Inst. Investor × Treat × Lifting	0.0292	0.100*	0.0923**
	(0.59)	(1.81)	(1.99)
Env. Incident × Non-Green Inst. Investor	0.0106	0.0243	0.0157
	(0.58)	(1.33)	(1.05)
Green Inst. Investor × Treat × Lifting	0.0347***	0.0391***	0.0400***
	(3.29)	(3.67)	(3.72)
Treat × Lifting	-0.0225**	-0.0263***	-0.0263**
	(-2.26)	(-2.60)	(-2.56)
Green Inst. Investor	0.0268***	0.0290***	0.0299***
	(2.61)	(2.80)	(2.86)
Observations	151412	150979	151412
Adj. R^2	0.803	0.802	0.803
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes
13F Inst. Investor FE	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes
Inst. Investor Controls	Yes	Yes	Yes

This table reports the reversal in the impact of lifting TSP on the divesting intensity of institutional investors. The sample spans from October 2016 through September 2020. 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], [-1,0], and [-1,1]. 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. 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

Table 7. Threat of Exit: Scaled Wealth-Performance Sensitivity

Panel A: Conditional effect of enacting TSP

Dep. Var.: Environmental Rating	(1)
Treat × Post × WPS	-0.0178**
	(-2.365)
Treat × Post	-0.161
	(-0.975)
Treat × WPS	0.00713
	(0.582)
Post × WPS	0.000658*
	(1.851)
WPS	-0.00901
	(-0.840)
Observations	738
Adj. R^2	0.769
Controls	Yes
Fiscal Quarter FE & Firm FE	Yes

Panel B: Dynamic conditional effect of enacting TSP

Dep. Var.: Environmental Rating	(1)
Treat × Pre3 × WPS	-0.00612
	(-0.529)
Treat × Pre1 × WPS	-0.00982
	(-0.786)
Treat × Post1 × WPS	-0.0279***
	(-3.820)
Treat × Post2 × WPS	-0.0262***
	(-3.810)
Observations	738
Adj. R^2	0.773
Controls	Yes
Fiscal Quarter FE & Firm FE	Yes

Panel C: Conditional effect of lifting TSP

Dep. Var.: Environmental Rating	(1)
Treat × Lifting × WPS	0.00348*
	(1.819)
Treat × Lifting	-0.275***
	(-3.014)
Treat × WPS	-0.00936
	(-0.594)
Lifting × WPS	7.44e-06
	(0.0595)
WPS	-0.0121
	(-1.612)
Observations	600
Adj. R^2	0.927
Controls	Yes
Fiscal Quarter FE & Firm FE	Yes

This table reports the conditional effect of TSP on firms' environmental ratings, based on the CEO's scaled wealth–performance sensitivity (WPS). The dependent variable is the MSCI IVA environmental rating, measured at the firm–quarter level. WPS is defined as the dollar change in CEO wealth for a one percentage point change in firm value, divided by annual pay, following Edmans, Gabaix, and Landier (2009), and is measured at the end of the prior year. Panel A analyzes the conditional effect of *enacting* TSP by contrasting firms with different levels of WPS, where the treatment-period indicator (*Post*) equals one for fiscal quarters beginning in October 2016. Panel B extends this analysis by examining how the conditional effect of TSP evolves over time; both Panels A and B cover the period from October 2013 to September 2018. Panel C examines the conditional effect of *lifting* TSP, with the post-TSP indicator (*Lifting*) set to one for fiscal quarters beginning in October 2018, over a sample period from October 2016 to September 2020. All regressions include the same control variables as in Table 2. Standard errors are clustered at the 2-digit industry–by–fiscal quarter level, and t-statistics are reported in parentheses. Statistical significance is denoted by *** $p<0.01$, ** $p<0.05$, and * $p<0.1$.

Table 8. Real Impact of TSP

Dep. Var.:	(1) Emission Level	(2) Emission Intensity	(3) Emission Level	(4) Emission Intensity
Treat × Post	0.0886***	0.0535**		
	(3.025)	(2.169)		
Treat × Lifting			-0.0668**	-0.113***
			(-2.604)	(-4.757)
Ln(Total Assets)	-0.0678	-0.300***	0.305**	0.126
	(-0.699)	(-2.965)	(2.139)	(0.826)
Cash	-0.00301	-0.000723	0.00509	0.00433
	(-1.312)	(-0.305)	(1.551)	(1.177)
B/M Ratio	-0.0420	0.00888	0.0123	-0.00810
	(-0.554)	(0.124)	(0.258)	(-0.166)
Sales Growth	-0.00542***	-0.00834***	0.000183	-0.00243***
	(-3.452)	(-5.119)	(0.302)	(-4.333)
Leverage	0.00887***	0.00973***	-0.00899**	-0.00686**
	(2.843)	(3.119)	(-2.688)	(-2.073)
Investment	-0.00910***	-0.000436	0.00521	0.00866**
	(-2.766)	(-0.133)	(1.394)	(2.288)
Analyst Coverage	0.0256*	0.0112	0.0350***	0.0321***
	(1.957)	(0.822)	(5.242)	(6.624)
Stock Volatility	0.0655**	0.0571**	0.0207	0.0241
	(2.623)	(2.159)	(1.223)	(1.619)
Observations	605	605	498	498
Adj. R^2	0.950	0.966	0.976	0.981
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes	Yes

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). 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

Table 9. 2SLS Estimates of Stock Illiquidity's Impact on Environmental Rating
Panel A: First-Stage Regression

	(1)	(2)
Dep. Var.:	Quoted Spread (%)	Effective Spread (%)
Treat × Post	0.0906***	0.108***
	(5.694)	(8.275)
Ln(Total Assets)	-0.411***	-0.400***
	(-12.27)	(-15.07)
Cash	-0.00365***	-0.00305***
	(-3.943)	(-4.232)
B/M Ratio	0.488***	0.404***
	(12.70)	(11.83)
Sales Growth	-0.000432***	-0.000361***
	(-4.276)	(-4.234)
Leverage	0.00606***	0.00556***
	(6.908)	(7.849)
Investment	0.00489**	0.00340**
	(2.526)	(2.102)
Analyst Coverage	-0.00263	-0.00277*
	(-1.481)	(-1.960)
Stock Volatility	0.0617***	0.0461***
	(4.752)	(4.331)
Observations	8,176	8,176
Adj. R^2	0.857	0.848
Fiscal Quarter FE & Firm FE	Yes	Yes

Panel B: Second-Stage Regression

Dep. Var.: Environmental Rating	(1)	(2)
Proxies for Illiquidity:	Quoted Spread (%)	Effective Spread (%)
$\widehat{\text{Illiquidity}}$	-1.695**	-1.736***
	(-2.554)	(-2.633)
Total Assets)	-0.0209	0.0560
	(-0.173)	(0.536)
Cash	-0.00403	-0.00393
	(-1.578)	(-1.541)
B/M Ratio	0.0670	-0.00283
	(0.528)	(-0.0267)
Sales Growth	-0.000695	-0.000677
	(-1.605)	(-1.617)
Leverage	0.00271	0.00256
	(1.034)	(1.002)
Investment	0.00298	0.00229
	(0.652)	(0.504)
Analyst Coverage	0.000809	0.00181
	(0.0995)	(0.226)
Stock Volatility	-0.0455	-0.0462
	(-1.585)	(-1.636)
Observations	5,177	5,177
Adj. R^2	-0.145	-0.101
Fiscal Quarter FE & Firm FE	Yes	Yes

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 are 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

Table 10. Effect of Stock Illiquidity on Environmental Performance: Full Sample of U.S. Publicly-Traded Firms

Panel A: Effect of Stock Illiquidity on Environmental Rating

	Quoted Spread (%)				Effective Spread (%)			
Dep. Var.: Environmental Rating	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Illiquidity (1Q lag)	-0.216***		-0.0771		-0.252*		-0.00667	
	(-2.593)		(-0.633)		(-1.648)		(-0.0323)	
Illiquidity (1Y lag)		-0.412***		-0.237		-0.521***		-0.250
		(-3.908)		(-1.512)		(-3.182)		(-1.167)
Illiquidity (1Q lag) × WPS			-0.00268***				-0.00638***	
			(-3.084)				(-4.034)	
Illiquidity (1Y lag) × WPS				-0.00176**				-0.00580***
				(-2.294)				(-3.232)
Observations	15,115	15,122	12,630	12,633	15,115	15,122	12,630	12,633
Adj. R^2	0.846	0.847	0.848	0.848	0.846	0.846	0.848	0.849
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Effect of Stock Illiquidity on Emission Level

	Quoted Spread (%)				Effective Spread (%)			
Dep. Var.: Emission Level	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Illiquidity (1Q lag)	0.258**		0.284**		0.425***		0.514***	
	(2.537)		(2.418)		(2.871)		(2.947)	
Illiquidity (1Y lag)		0.291***		0.287***		0.371***		0.382***
		(3.624)		(3.432)		(3.649)		(3.486)
Illiquidity (1Q lag) × WPS			0.000624				0.00124	
			(1.153)				(1.321)	
Illiquidity (1Y lag) × WPS				0.00164***				0.00313***
				(2.819)				(2.964)
Observations	2,541	2,539	2,287	2,285	2,541	2,539	2,287	2,285
Adj. R^2	0.976	0.976	0.977	0.977	0.976	0.976	0.977	0.977
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel C: Effect of Stock Illiquidity on Emission Intensity

	Quoted Spread (%)				Effective Spread (%)			
Dep. Var.: Emission Intensity	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Illiquidity (1Q lag)	0.184*		0.193*		0.354**		0.404**	
	(1.956)		(1.793)		(2.580)		(2.511)	
Illiquidity (1Y lag)		0.277***		0.276***		0.390***		0.388***
		(3.458)		(3.303)		(3.745)		(3.475)
Illiquidity (1Q lag) × WPS			0.00142***				0.00262***	
			(2.615)				(2.693)	
Illiquidity (1Y lag) × WPS				0.00247***				0.00456***
				(4.237)				(4.145)
Observations	2,541	2,539	2,287	2,285	2,541	2,539	2,287	2,285
Adj. R^2	0.972	0.972	0.973	0.973	0.972	0.972	0.973	0.973
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table examines the impact of stock illiquidity on firms' environmental performance using the full sample of U.S. publicly-traded firms. Illiquidity is proxied by the percent quoted spread (Columns 1–4) and by the relative effective spread (Columns 5–8). Columns (1)–(2) and (5)–(6) report the unconditional effects of illiquidity. In Columns (1), (3), (5), and (7), illiquidity is measured over the previous fiscal quarter, whereas in Columns (2), (4), (6), and (8), it is measured over the previous fiscal year. Columns (3)–(4) and (7)–(8) report conditional effects based on managerial sensitivity to equity prices (WPS), defined as the dollar change in CEO wealth for a one-percentage-point change in firm value, scaled by annual pay (Edmans, Gabaix, and Landier, 2009), and measured at the end of the prior year. Panel A reports results for environmental ratings, with the dependent variable equal to the MSCI IVA environmental rating at the firm–quarter level. Panel B reports results for emission levels, where the dependent variable is the natural log of Scope 1 carbon emissions (thousands of metric tons). Panel C reports results for emission intensity, where the dependent variable is the natural log of Scope 1 carbon emissions scaled by revenue. The sample covers October 2013 to September 2018. All regressions include the same control variables as in Table 2. Standard errors are clustered at the 2-digit industry–by–fiscal-quarter level, and t-statistics are reported in parentheses. Statistical significance is denoted by *** p<0.01, ** p<0.05, and * p<0.1.

Table 11. Plausibly-*Value* Investors vs. Other Green Investors: Classifying Based on Full Sample of U.S. Publicly-Traded Firms

Panel A: Classification Based on Quoted Spread as a Proxy for Stock Illiquidity

	Value Investors		Other Green Investors		Diff. in %
Investor Categories	Sample Size	Proportion (%)	Sample Size	Proportion (%)	
Norm-Constrained	583	0.333	2258	0.461	-0.128*** (P<0.001)
Bank Trust	583	0.17	2258	0.201	-0.031* (P=0.094)
Insurance Company	583	0.033	2258	0.053	-0.02** (P=0.044)
Public Pension	583	0.065	2258	0.142	-0.077*** (P<0.001)
Corporate Pension	583	0	2258	0.017	-0.017*** (P=0.001)
University Endowment	583	0	2258	0.007	-0.007** (P=0.042)
Miscellaneous	583	0.065	2258	0.041	0.024** (P=0.014)
Investment Company	583	0.05	2258	0.019	0.031*** (P<0.001)
Independent Investment Advisor	583	0.617	2258	0.521	0.096*** (P<0.001)
PRI Signatory	599	0.167	2233	0.148	0.019 (P=0.246)
Delisted PRI Signatory	143	0.273	498	0.044	0.229*** (P<0.001)

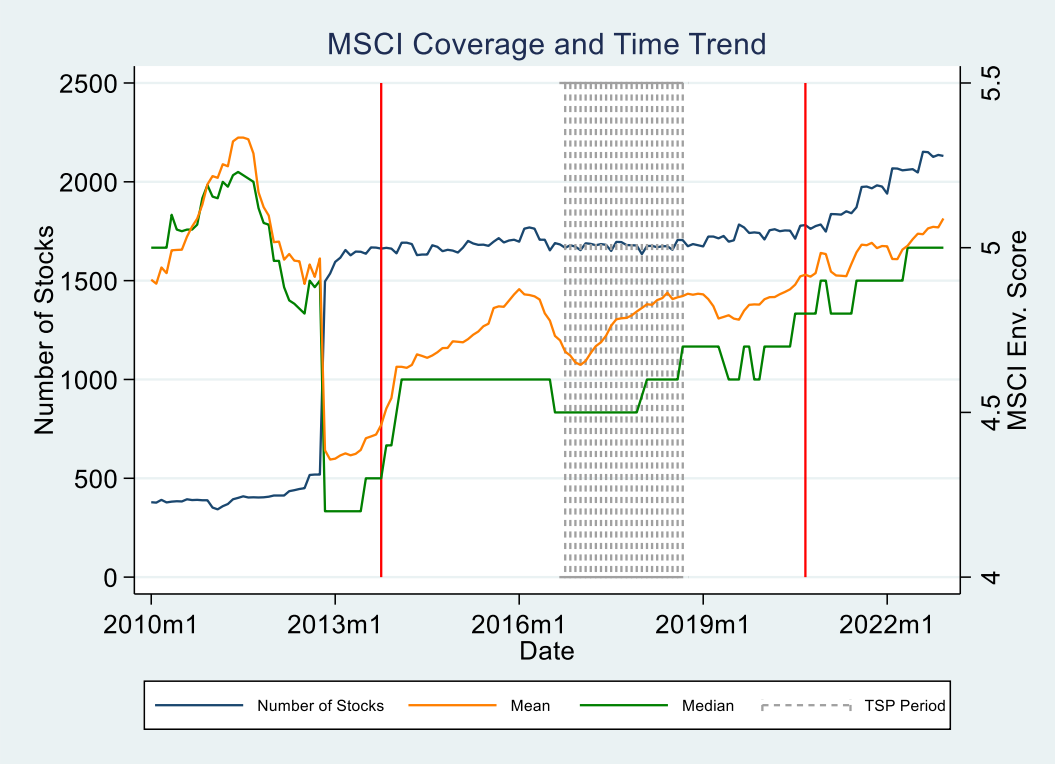
Panel B: Classification Based on Effective Spread as a Proxy for Stock Illiquidity

	Value Investors		Other Green Investors		Diff. in %
Investor Categories	Sample Size	Proportion (%)	Sample Size	Proportion (%)	
Norm-Constrained	492	0.327	2349	0.457	-0.13*** (P<0.001)
Bank Trust	492	0.154	2349	0.203	-0.049** (P=0.014)
Insurance Company	492	0.039	2349	0.051	-0.012 (P=0.259)
Public Pension	492	0.077	2349	0.136	-0.059*** (P<0.001)
Corporate Pension	492	0	2349	0.017	-0.017*** (P=0.004)
University Endowment	492	0	2349	0.007	-0.007* (P=0.066)
Miscellaneous	492	0.057	2349	0.044	P=0.013 (P=0.209)
Investment Company	492	0.059	2349	0.018	0.041*** (P<0.001)
Independent Investment Advisor	492	0.614	2349	0.525	0.089*** (P<0.001)
PRI Signatory	493	0.193	2339	0.143	0.05*** (P=0.005)
Delisted PRI Signatory	150	0.38	491	0.008	0.372*** (P<0.001)

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. Classification is conducted based on investor–firm–quarter holdings from the full sample of U.S. publicly traded firms, following the methodology described in Section 8.2. Stock illiquidity is proxied by the percent quoted spread lagged one year (Panel A) and by the relative effective spread lagged one year (Panel B). 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. 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 (i.e., 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 through 2022, and zero if the investor remained a signatory through 2022. The summary statistics are based on an investor-quarter sample covering October 2013 to September 2018 for investor type data, and 2014 to 2020 for PRI signatory status data. *** p<0.01, ** p<0.05, * p<0.1

APPENDIX

Fig A1: MSCI Coverage and Time Trend



The figure displays in the blue line the number of stocks in our sample. The green and orange lines illustrate the sample's median and mean values over time, respectively. 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 grey dashed area represents 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.
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).
Cash	Cash and Short-term investment (Compustat cheq) scaled by assets (Compustat atq).
B/M Ratio	(Book value of equity (Compustat ceqq))/(market value of equity).
Sales Growth	100 × sales (Compustat sale) by the end of the current fiscal year minus the sales two fiscal years ago divided by the sales two fiscal years ago.
Leverage	100 × 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).
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).
Analyst Coverage	The number of I/B/E/S analysts following the firm.
Stock Volatility	Standard deviation of daily stock returns (%).
Env. Incident	The occurrence of an environmental incident reported on news. All news is sourced from RepRisk.

Scaled WPS	The scaled wealth-performance sensitivity captures the dollar change in CEO wealth for a 100 percentage point change in firm value, divided by annual flow compensation. 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.
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 portfolio-level value-weighted environmental rating, and w_j denotes the percentage of shares held by blockholder j.

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

Dep. Var.:	(1) Emission Level	(2) Emission Intensity	(3) Emission Level	(4) Emission Intensity
Treat × Post	0.0771**	0.146***		
	(2.547)	(4.102)		
Treat × Lifting			-0.138***	-0.123***
			(-3.209)	(-3.095)
Ln(Total Assets)	0.234***	0.251**	0.440***	0.292**
	(2.772)	(2.386)	(4.349)	(2.595)
Cash	-0.00577*	-0.00210	-0.00137	-0.00386
	(-1.783)	(-0.437)	(-0.700)	(-1.685)
B/M Ratio	-0.0243	-0.0511*	0.0548***	0.0819***
	(-1.266)	(-1.924)	(2.819)	(2.952)
Sales Growth	0.00303***	-0.00146	-2.98e-06	-0.00541***
	(5.100)	(-1.338)	(-0.00279)	(-4.386)
Leverage	-0.00699**	-0.00701*	-0.00767**	-0.00568*
	(-2.054)	(-1.956)	(-2.728)	(-1.815)
Investment	-0.00476**	0.00122	-0.00276	-0.000823
	(-2.075)	(0.303)	(-0.938)	(-0.285)
Analyst Coverage	0.0111	0.00479	0.00331	-0.00604
	(1.295)	(0.439)	(0.263)	(-0.541)
Stock Volatility	0.0298**	-0.0216	0.00793	0.00555
	(2.242)	(-1.479)	(0.589)	(0.351)
Observations	130	130	192	192
Adj. R^2	0.997	0.991	0.991	0.990
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes	Yes

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

Table A3. 2SLS Estimates of Stock Illiquidity's Impact for Small-Spread Firms Only

Panel A: First-Stage Regression

	(1)	(2)
Dep. Var.:	Quoted Spread (%)	Effective Spread (%)
Treat × Post	0.277***	0.205***
	(12.11)	(13.38)
Ln(Total Assets)	-0.254***	-0.219***
	(-6.029)	(-7.254)
Cash	-0.00732***	-0.00511***
	(-5.091)	(-5.072)
B/M Ratio	0.248***	0.185***
	(7.962)	(8.125)
Sales Growth	-0.000337***	-0.000215***
	(-4.600)	(-3.865)
Leverage	0.00302**	0.00223**
	(2.097)	(2.265)
Investment	5.13e-05	-0.000893
	(0.0289)	(-0.781)
Analyst Coverage	-0.00185	-0.000761
	(-0.442)	(-0.285)
Stock Volatility	-0.00825	-0.00856
	(-1.020)	(-1.493)
Observations	1,278	1,278
Adj. R^2	0.736	0.796
Fiscal Quarter FE & Firm FE	Yes	Yes

Panel B: Second-Stage Regression

Dep. Var: Environmental Rating	(1)	(2)
Proxies for Illiquidity:	Quoted Spread (%)	Effective Spread (%)
$\widehat{\text{Illiquidity}}$	-1.785***	-2.366***
	(-3.333)	(-3.386)
Total Assets)	0.162	0.143
	(0.776)	(0.679)
Cash	0.00811	0.00684
	(1.285)	(1.092)
B/M Ratio	0.123	0.118
	(0.799)	(0.779)
Sales Growth	-0.00156***	-0.00150***
	(-2.864)	(-2.783)
Leverage	0.0299***	0.0299***
	(3.936)	(4.034)
Investment	-0.00191	-0.00520
	(-0.125)	(-0.339)
Analyst Coverage	0.0479**	0.0465**
	(2.149)	(2.114)
Stock Volatility	-0.00304	-0.0104
	(-0.0674)	(-0.233)
Observations	970	970
Adj. R^2	-0.138	-0.115
Fiscal Quarter FE & Firm FE	Yes	Yes

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. Compared to Table 9, this table focuses on firms with small pre-TSP spread. Standard errors are clustered at the 2-digit industry-by-fiscal quarter level. T-statistics are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A4. Plausibly-*Value* Investors vs. Other Green Investors: Classifying Based on Full Sample of U.S. Publicly-Traded Firms with Illiquidity Measures Lagged by One Quarter

Panel A: Classification Based on Quoted Spread as a Proxy for Stock Illiquidity

	Value Investors		Other Green Investors		Diff. in %
Investor Categories	Sample Size	Proportion (%)	Sample Size	Proportion (%)	
Norm-Constrained	654	0.321	2187	0.468	-0.147*** (P<0.001)
Bank Trust	654	0.17	2187	0.202	-0.032* (P=0.07)
Insurance Company	654	0.029	2187	0.054	-0.025*** (P=0.008)
Public Pension	654	0.057	2187	0.147	-0.09*** (P<0.001)
Corporate Pension	654	0	2187	0.018	-0.018*** (P=0.001)
University Endowment	654	0	2187	0.007	-0.007** (P=0.028)
Miscellaneous	654	0.066	2187	0.04	0.026*** (P=0.006)
Investment Company	654	0.044	2187	0.019	0.025*** (P<0.001)
Independent Investment Advisor	654	0.635	2187	0.513	0.122*** (P<0.001)
PRI Signatory	677	0.179	2155	0.143	0.036** (P=0.025)
Delisted PRI Signatory	165	0.236	476	0.046	0.19*** (P<0.001)

Panel B: Classification Based on Effective Spread as a Proxy for Stock Illiquidity

	Value Investors		Other Green Investors		Diff. in %
Investor Categories	Sample Size	Proportion (%)	Sample Size	Proportion (%)	
Norm-Constrained	581	0.289	2260	0.472	-0.183*** (P<0.001)
Bank Trust	581	0.148	2260	0.206	-0.058*** (P=0.002)
Insurance Company	581	0.033	2260	0.053	-0.02** (P=0.046)
Public Pension	581	0.045	2260	0.147	-0.102*** (P<0.001)
Corporate Pension	581	0	2260	0.017	-0.017*** (P=0.001)
University Endowment	581	0	2260	0.007	-0.007** (P=0.042)
Miscellaneous	581	0.064	2260	0.042	0.022** (P=0.024)
Investment Company	581	0.05	2260	0.019	0.031*** (P<0.001)
Independent Investment Advisor	581	0.661	2260	0.51	0.151*** (P<0.001)
PRI Signatory	579	0.273	2253	0.121	0.152*** (P<0.001)
Delisted PRI Signatory	191	0.204	450	0.049	0.155*** (P<0.001)

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. Classification is conducted based on investor–firm–quarter holdings from the full sample of U.S. publicly traded firms, following the methodology described in Section 8.2. Stock illiquidity is proxied by the percent quoted spread lagged one quarter (Panel A) and by the relative effective spread lagged one quarter (Panel B). 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. 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 (i.e., 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 through 2022, and zero if the investor remained a signatory through 2022. The summary statistics are based on an investor-quarter sample covering October 2013 to September 2018 for investor type data, and 2014 to 2020 for PRI signatory status data. *** p<0.01, ** p<0.05, * p<0.1

Table A5. Alternative Control Group

	(1)	(2)	(3)	(4)	Null: Small Spread = Large Spread
Dep. Var.: Environmental Rating	Small Spread	Large Spread	Small Spread	Large Spread	
Treat × Post	-0.410***	0.0639			P = 0.004
	(-2.818)	(0.853)			
Treat × Pre3			0.162	-0.205	
			(0.685)	(-1.466)	
Treat × Pre1			0.0807	0.0847	
			(0.369)	(0.741)	
Treat × Post1			-0.364*	0.0442	P = 0.088
			(-1.848)	(0.387)	
Treat × Post2			-0.431**	0.102	P = 0.029
			(-2.071)	(0.870)	
Observations	868	1,796	868	1,796	
Adj. R^2	0.777	0.849	0.778	0.850	
Controls	Yes	Yes	Yes	Yes	
Fiscal Quarter & Firm FE	Yes	Yes	Yes	Yes	

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 without 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

Table A6. Impact of TSP on Different TSP Treatment Groups

Dep. Var.:	(1)	(2)	(3)
Environmental Rating	G1 vs. C	G2 vs. C	G3 vs. C
Treat X Post	-0.125**	-0.135**	-0.143**
	(-2.365)	(-2.302)	(-2.365)
Observations	4,292	4,150	4,224
Adj. R^2	0.860	0.843	0.833
Controls	Yes	Yes	Yes
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes
ρ: G1 > G2		P=0.869	
ρ: G2 > G3		P=0.771	
ρ: G1 > G3		P=0.9002	

This table reports the impact of enacting TSP on firms in different treatment groups (i.e., G1, G2, G3) of TSP by presenting conditional results for subsample splits based on treatment group. In Col (1) ((2)) [(3)], we estimate the impact for G1 (G2) [G3] and the treatment indicator denotes whether the firm belongs to G1 (G2) [G3]. We report p-values from testing the statistical difference of the *Treat* X *Post* coefficients between the treatment group subsamples. 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

Table A7. Impact of TSP on Subcategory of MSCI Environmental Rating

Dep. Var.: Sub-Indices	(1) Climate Change Risk Management	(2) Natural Capital Management	(3) Pollution & Waste Management	(4) Environmental Opportunities Management
Treat X Post	-0.209***	-0.0370	-0.0923**	-0.134***
	(-4.930)	(-0.525)	(-2.001)	(-3.024)
Observations	4,705	2,121	2,416	3,226
Adj. R^2	0.792	0.863	0.881	0.817
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes

This table estimates the impact of TSP on different sub-indices that constitute a firm's MSCI IVA environmental rating. The dependent variables include risk management scores for Climate Change (Col (1)), Natural Capital (Col (2)), Pollution & Waste (Col (3)), and Environmental Opportunities (Col (4)). The main independent variable is the interaction terms between the treatment firm indicator (*Treat*) and treatment period indicator (*Post*). Across all specifications, we include control variables as used in Table 2. Firm fixed effects and fiscal quarter fixed effects are included. 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

Table A8. Effect of TSP on Stock Liquidity and Stock Price

Panel A: Effect of TSP on Stock Liquidity

	(1)	(2)	(3)	(4)
Dep. Var.:	Quoted Spread (%)	Effective Spread (%)	Quoted Spread (%)	Effective Spread (%)
Treat × Post - Week 1	0.232***	0.172***		
	(5.035)	(4.801)		
Treat × Post - After Week 1	0.272***	0.260***		
	(6.288)	(9.692)		
Treat × Lifting - Week 1			-0.283***	-0.168***
			(-5.862)	(-4.787)
Treat × Lifting - After Week 1			-0.320***	-0.185***
			(-7.715)	(-7.324)
Observations	4,473	4,473	3,887	3,887
Adj. R^2	0.524	0.649	0.488	0.641
Controls	Yes	Yes	Yes	Yes
Day FE & Firm FE	Yes	Yes	Yes	Yes

Panel B: Effect of TSP on Stock Price

	(1)	(2)	(1)	(2)
Dep. Var.:				
Abnormal Return (%)	CAPM	FF5M	CAPM	FF5M
Treat × Post - Week 1	-0.549*	-0.542*		
	(-1.758)	(-1.854)		
Treat × Post - After Week 1	-0.212	-0.289*		
	(-1.250)	(-1.761)		
Treat × Lifting - Week 1			0.179	0.0394
			(0.584)	(0.127)
Treat × Lifting - After Week 1			-0.0653	-0.0709
			(-0.753)	(-0.827)
Observations	4,473	4,473	3,950	3,950
Adj. R^2	0.068	0.011	0.051	0.009
Controls	Yes	Yes	Yes	Yes
Day FE & Firm FE	Yes	Yes	Yes	Yes

This table reports the effect of TSP on stock liquidity and price using daily-level regressions. Panel A focuses on the effect on stock liquidity, where the dependent variables for Columns (1) and (3) and Columns (2) and (4) are, respectively, the percent quoted spread and the relative effective spread. Panel B focuses on the effect on stock price, where the dependent variables for Columns (1) and (3) and Columns (2) and (4) are, respectively, daily abnormal returns calculated using the CAPM and Fama-French 5-factor model. Across both panels, Columns (1) and (2) examine the effect of enacting or implementing the TSP using a sample period from September 1, 2016 to November 30, 2016. "Post - Week 1" indicator equals one for dates in the first week of implementation (i.e., from October 17, 2016 to October 23, 2016, inclusive), and zero otherwise. "Post - After Week 1" indicator equals one for dates following the first week (i.e., from October 23, 2016 to November 30, 2016, inclusive), and zero otherwise. The model parameters necessary for computing abnormal returns used in Panel B are estimated over September 2015-August 2016. Across both panels, Columns (3) and (4) examine the effect of lifting the TSP using a sample period from September 1, 2018 to November 30, 2018. "Lifting - Week 1" indicator equals one for dates in the first week of implementation (i.e., from September 28, 2018 to October 4, 2018, inclusive), and zero otherwise. "Lifting - After Week

1" indicator equals one for dates following the first week (i.e., from October 5, 2018 to October 11, 2018, inclusive), and zero otherwise. The model parameters necessary for computing abnormal returns used in Panel B are estimated from the sample period of September 2017 to August 2018. Across all specifications, 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. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A9. Control for Changes in the Cost of Capital Around the TSP Enactment Date

	CAPM			FF5M		
Dep. Var.: Environmental Rating	(1)	(2)	(3)	(4)	(5)	(6)
Treat × Post × First-Week CAR (%)	0.104***	0.0584	0.0580	0.0820**	0.0451	0.0418
	(2.676)	(1.386)	(0.961)	(2.381)	(1.233)	(0.844)
Post × First-Week CAR (%)	-0.0617***	-0.0667***	-0.0682***	-0.0625***	-0.0692***	-0.0705***
	(-5.002)	(-4.896)	(-5.205)	(-4.889)	(-4.824)	(-5.119)
Treat × Post × WPS		-0.0174**	-0.0551***		-0.0174**	-0.0559***
		(-2.332)	(-4.072)		(-2.303)	(-4.052)
Treat × Post	-0.503***	-0.244	-0.0649	-0.0692***	-0.247	
	(-3.858)	(-1.529)	(-0.345)	(-4.824)	(-1.555)	
Treat × WPS		0.0122			0.0124	
		(0.978)			(0.984)	
Post × WPS		0.000567	0.000733**		0.000658*	0.000830**
		(1.607)	(2.020)		(1.859)	(2.292)
WPS		-0.0138			-0.0140	-0.0652
		(-1.248)			(-1.263)	(-0.351)
Observations	977	738	738	977	738	738
Adj. R^2	0.751	0.775	0.815	0.750	0.776	0.815
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE × WPS	No	No	Yes	No	No	Yes

This table examines the effect of TSP on firms' environmental ratings, conditional on changes in the cost of capital at the time of the initial enactment. The dependent variable is the MSCI IVA environmental rating at the firm–quarter level. In Columns (1) and (4), the conditional effect of TSP is estimated based on TSP-induced changes in the cost of capital, measured by the firm's cumulative abnormal return within one week of the enactment date (October 17, 2016), denoted as "First-Week CAR (%)". Abnormal returns are estimated using the CAPM in Columns (1)–(3) and the Fama–French five-factor model in Columns (4)–(6), with model parameters estimated over September 2015–August 2016. Columns (2) and (5) also estimates the conditional effect of TSP based on managerial sensitivity to equity prices (WPS). Compared to Columns (2) and (5), Columns (3) and (6) further include interaction terms between firm fixed effects and WPS. 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

Table A10. Block Acquisition Activities of Institutional Investors

Dep. Var.: 13G Filing	All Inst. Investors		Green Inst. Investors	
Indicator	(1)	(2)	(3)	(4)
Treat X Post	-0.368***		-0.237***	
	(-3.874)		(-4.026)	
Treat X Lifting		0.289**		0.0366
		(2.730)		(0.348)
Observations	261	153	261	153
Adj. R^2	-0.082	-0.059	-0.035	0.161
Fiscal Year FE & Firm FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

The dependent variable for Columns (1) and (2) ((3) and (4)) indicates whether there has been a 13G filing by any institutional investor (green institutional investor). It equals one if there has been a 13G filing by a green institutional investor (an institutional investor) against the firm in a 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. 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 zero for all fiscal years ending before March 2019, and one 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 additionally control for the firm's environmental score. We lag these control 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

Table A11. Exit versus Voice: Coordination Risk

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.: Environmental Rating	Total Clique	Top Clique	Opinion Dispersion on	Total Clique	Top Clique	Opinion Dispersion on
Proxies for Coordination Risk:	Ownership	Ownership	Env. Issues	Ownership	Ownership	Env. Issues
Treat × Post × High Coordination Risk	-1.047***	-1.017***	-1.162**			
	(-3.150)	(-3.316)	(-2.259)			
Treat × Post	-0.232	-0.223	-0.322**			
	(-1.607)	(-1.535)	(-2.488)			
Post × High Coordination Risk	1.189***	1.024***	1.367***			
	(4.428)	(4.038)	(3.074)			
Treat × Lifting × High Coordination Risk				0.577**	0.433**	0.471*
				(2.502)	(2.127)	(1.788)
Treat × Lifting				-0.158**	-0.152*	-0.0605
				(-1.969)	(-1.761)	(-0.689)
Lifting × High Coordination Risk				-0.255**	-0.266**	-0.338
				(-1.991)	(-2.104)	(-1.456)
Treat × High Coordination Risk	0.438	0.611**	0.672	-0.348**	-0.261*	-0.135
	(1.535)	(2.257)	(1.540)	(-2.016)	(-1.768)	(-0.600)
High Coordination Risk	-0.330	-0.495**	0.185	0.0899	0.0873	0.217
	(-1.359)	(-2.069)	(1.146)	(0.903)	(1.035)	(1.100)
Observations	977	977	967	772	772	763
Adj. R^2	0.752	0.750	0.766	0.918	0.917	0.918
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fiscal Quarter FE & Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
HHI(Inst. Ownership)	No	No	Yes	No	No	Yes
Average Env. Rating of All Inst.	No	No	Yes	No	No	Yes

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 Columns (1)-(3), I examine the effect of enacting TSP, so the sample spans from October 2013 through September 2018. Treatment period indicator (*Post*) equals one for all fiscal quarters starting from October 2016, and zero otherwise. In Columns (4)-(6), I examine the reversal in the effect of TSP upon the conclusion of TSP, so the sample spans from October 2016 through September 2020. The post-TSP indicator (*Lifting*) equals to one for fiscal quarters beginning in October 2018 and zero otherwise. In Columns (1) and (4), 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 Columns (2) and (5), the indicator is constructed analogously but based on the ownership share of the largest investor clique. Columns (3) and (6) define 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. Across all specifications, we include control variables as used in Table 2. In Columns (3) and (6), we additionally control for the Herfindahl–Hirschman index of institutional investor ownerships and the holdings-weighted average environmental rating of all institutions. Standard errors are clustered at the 2-digit industry-by-fiscal quarter level. T-statistics are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$