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Standing Out from the Crowd via CSR Engagement: Evidence from Non-Fundamental-Driven Price Pressure

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Abstract

We test the signaling view of corporate social responsibility (CSR) engagement using two complementary quasi-natural experiments that impose exogenous negative pressure on stock prices. Firms under such adverse price pressure increase CSR activities compared to otherwise similar firms. This effect concentrates among firms with stronger signaling incentives, namely, those facing greater information asymmetry, more product market competition, higher shareholder litigation risk, and higher stock price crash risk. Firms under the exogenous negative price pressure mainly improve CSR strengths, including costly environmental investments. We also find that CSR engagement attracts socially responsible investors and lowers the cost of capital for signaling firms.

I. Introduction

Firms increasingly engage in social responsibility and sustainability initiatives. Despite the prevalence of corporate social responsibility (CSR) practices, academic

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literature has not reached a consensus on firms' incentives for CSR engagement.[1] Existing literature proposes various motivations including the incentives to signal (e.g., Glazer and Konrad (1996), Bolton and Kacperczyk (2021)), to streamline business activities and attract a quality workforce (e.g., Bénabou and Tirole (2010)), to achieve reputation insurance or a halo effect (e.g., Hong and Liskovich (2015)), and to deliver managerial private benefits (e.g., Friedman (1970)). It has proven difficult to empirically distinguish among these views primarily due to the lack of randomized experiments for a clean identification. Our study attempts to overcome this empirical hurdle and test the signaling motive of CSR by exploiting two complementary and independent quasi-natural experiments that exogenously enhance a firm's incentive to signal via CSR.

We hypothesize that when firms experience exogenous negative price shocks unrelated to fundamentals, they are motivated to increase their CSR to signal their financial strength to both shareholders and other important stakeholders. This is because such negative price pressure could adversely impact various aspects of the firms' operations. In particular, uninformed investors and other stakeholders, such as a firm's employees, customers, and suppliers, might misinterpret the negative price movements due to exogenous shocks as indications for worsening fundamentals and consequently sever their business relationships with the firm. Losing these stakeholders could hurt a firm's competitiveness in the industry.[2] Since these stakeholders often use various metrics of a firm's CSR to guide their business relations (e.g., Baron (2008), Arnold, Horner, Martin, and Moser (2017), and Dai, Liang, and Ng (2021)), signaling a firm's financial health via CSR has a unique advantage in that such signals can simultaneously reach a broad range of stakeholders.[3] Distinct from signaling firm virtue via CSR, that is, building up CSR reputation in normal times to hedge against the impact of potential future negative events (e.g., Lins, Servaes, and Tamayo (2017)), the affected firms in our settings take additional CSR actions *in response to* exogenous, non-fundamental-driven negative price pressure to help prevent the misinterpretation of the shocks.[4] The signaling activity is most likely motivated by the need to convey firms' financial health rather than their virtue. In other words, firms under exogenous negative price shocks strive to convince their investors and stakeholders of their healthy (nonworsening) fundamentals.

[1]We use "corporate social responsibility," "corporate citizenship," "environmental, social, and governance," and "sustainability" interchangeably throughout the article to describe a firm's engagement in environmental (E) and social (S) issues. See Liang and Renneboog (2021) for a comprehensive discussion on CSR activities.

[2]It is worth noting that even shocks temporary in nature might cause permanent harm to the affected firms because of the high costs in switching, replacing, or building relationships with these various categories of stakeholders.

[3]Specifically, CSR can serve as a strategic signal to recruit and retain potential employees (Greening and Turban (2000)), improve worker productivity (Baron (2008)), attract customers who are willing to pay a premium for "socially desirable" products (e.g., Baron (2001)), and improve operational efficiency along the supply chain (Dai et al. (2021)). Furthermore, firms' CSR efforts can interact with both retail and professional investors' investment decisions (Arnold et al. (2017), Kim, Wan, Wang, and Yand (2019)) and have important implications for tax authorities (Hoi, Wu, and Zhang (2013)).

[4]This is because the marginal benefits of CSR engagement are enhanced under such adverse circumstances.

To test the signaling of the financial health hypothesis, we exploit two independent exogenous events that negatively affect a firm's stock price, namely, the U.S. Securities and Exchange Commission (SEC)'s Regulation SHO program and mutual fund fire sales. In addition, as discussed in detail below, we take advantage of the different nature of our two settings to differentiate between ex ante and ex post signaling via CSR.

Our first identification strategy is Regulation SHO, an SEC program that suspends the uptick rule on short sale transactions for a randomly selected group of firms (pilot firms) and hence exogenously increases short selling price pressure on the stocks of these firms.[5] Since Regulation SHO is announced (in June 2004) by the SEC before its actual implementation (in May 2005), firm managers know ahead of the actual implementation whether they are on the pilot list which will be more prone to increased short-selling pressure (Alexander and Peterson (2008)) and a higher likelihood of bear raids (Goldstein and Guembel (2008)).[6] After learning about their status, managers of pilot firms become more conscious of the potential adverse impact of the program and can take preemptive actions such as conducting CSR to signal their financial health. This unique feature motivates us to exploit Regulation SHO to test the ex ante signaling via CSR.[7]

Applying a difference-in-differences (DiD) approach, we examine the effect of Regulation SHO on CSR. We follow Cao, Liang, and Zhan (2019) to compile an adjusted CSR score (CSRSCORE) for each firm that focuses on environmental and social engagements from the MSCI KLD Database. Consistent with the ex ante signaling hypothesis, pilot firms significantly increase CSRSCORE relative to control firms during the implementation of Regulation SHO.

To help strengthen the ex ante signaling explanation, we conduct two cross-sectional analyses. First, we examine the treatment effect of Regulation SHO across firms with differential levels of vulnerability. The intuition is that firms more vulnerable to the potential negative price movement (and the consequent confusion among investors/stakeholders) induced by Regulation SHO should have stronger incentives to signal because of the enhanced marginal benefits of signaling via CSR. We proxy for firm vulnerability by using both the intensity of product market competition and the ex ante shareholder litigation risk, and find that the effect of Regulation SHO on CSR concentrates among more vulnerable firms.

Second, we focus on firms' information environments. Firms with weaker information environments are expected to have stronger incentives to signal via CSR. Insufficient and uncertain information about a firm makes it more difficult for shareholders and other stakeholders to evaluate the firm and understand the negative price pressure, which increases the marginal benefits of signaling via CSR. Using industry-level analyst coverage, analyst forecast dispersion, and postearnings

[5]The uptick rule prohibits short sales when stock prices are declining. Previous studies show that the uptick rule significantly constrains short-selling activities (e.g., Alexander and Peterson (2008)).

[6]Anecdotal evidence suggests that firm managers regularly oppose the removal of short-selling constraints. For example, in a survey conducted by NYSE in 2008, 85% of firms' top executives (e.g., CEOs and CFOs) and investor relation officers called for the reinstitution of the uptick rule.

[7]Note that our definition of "ex ante signaling" is different from the precautionary CSR motive even without any knowledge about possible negative price shocks (i.e., the motive to achieve reputation insurance or halo effect in normal times).

announcement drift to measure the information environment that a firm operates in, we find that the effect of Regulation SHO on CSR concentrates among firms with weaker information environments. Overall, the results from these cross-sectional analyses further support the ex ante signaling explanation of CSR engagement.

Signaling theories highlight the importance of the credibility of signals. Hence, to shed light on this issue, we perform several additional tests. First, we differentiate voluntary engagement in CSR activities from CSR activities driven by regulatory compliance. Voluntary engagement is plausibly more credible to the signal recipients than compliance. To differentiate between these two types of CSR investments, we separately examine the strength and concern components of CSR scores in the KLD database. Strengths refer to positive indicators, and concerns refer to negative indicators used by the KLD. As shown by Cao et al. (2019), strengths tend to capture a firm's voluntary engagement in CSR, while concerns largely reflect a firm's negative externalities. We find that pilot firms both increase CSR strengths and reduce concerns to a greater degree than control firms during Regulation SHO. Second, costly signals are more effective in deterring mimicking. To the extent that environmental engagements tend to be costly, signaling in the environmental dimension of CSR can be particularly credible. To examine this mechanism, we directly analyze the environmental subcategory of the KLD CSR score. To help sharpen the test, we guide this analysis with Sustainability Accounting Standards Board (SASB)'s Materiality Map, which identifies industries that have environmental engagements as top priorities. Focusing on these industries, we find that pilot firms increase their environmental CSR to a greater extent than control firms during Regulation SHO. Third, using data from ASSET4, we find some supporting evidence that pilot firms are more likely to improve their engagement in environmental R&D projects during Regulation SHO. These results, taken together, suggest that pilot firms use credible CSR signals when they are under the negative price pressure exogenously imposed by Regulation SHO.[8]

Since credible signaling is costly, firms that signal are expected to enjoy some benefits. The theoretical literature shows that firms with better CSR profiles have lower cost of equity capital (e.g., Heinkel, Kraus, and Zechner (2001), Albuquerque, Koskinen, and Zhang (2019), and Pástor, Stambaugh, and Taylor (2021)). Hence, we estimate the implied cost of equity capital following Gordon and Gordon (1997) and Hou, van Dijk, and Zhang (2012) and find suggestive evidence that increased CSR engagement under negative price shocks helps lower the affected firms' cost of equity capital. One mechanism for the lower cost of capital after CSR signaling is to attract more socially responsible institutional investors. Following the methodology of Hwang, Titman, and Wang (2021), we find that

[8]Note that CSR investments can be both "symbolic/showy" and "costly/expensive," which have different implications for our results. For example, increasing workforce diversity or community services is more symbolic and less costly than other dimensions of CSR activities. Although such engagements may not be effective in deterring mimicking, they can be implemented in a timelier manner and be more effective in building trust with employees, customers, and suppliers, as well as hiring talents with diverse backgrounds to foster creativity, especially when firms are under the non-fundamental driven negative price pressure. On the other hand, some dimensions of CSR activities such as improvements of environmental friendliness can be more effective in deterring mimicking due to their costly nature. The relative merits of different CSR dimensions as signals are likely to be firm-specific.

socially responsible institutional investors, relative to other types of institutions, increase their holdings in firms that indeed signal via CSR after experiencing non-fundamental-driven price pressure.

Our second setting to test the signaling motive of CSR is mutual fund fire sales. Prior literature shows that mutual fund fire sales (i.e., sales of portfolio stocks due to mutual funds' unexpected large redemptions) generate substantial negative price pressure that persists for several quarters (e.g., Coval and Stafford (2007)).[9] Similar to the setting of Regulation SHO, negative price shocks induced by mutual fund fire sales increase the net benefits of CSR signaling. Different from Regulation SHO, the setting of mutual fund fire sales can help shed light on firms' ex post signaling motives (e.g., public relation (PR) practices in CSR). Because firm managers do not have prior knowledge that their firms' stocks are under the pressure of mutual fund fire sales, that is, they learn about this fact ex post, they increase CSR to help mitigate the adverse situation. This ex post signaling explanation predicts that firms engage more in CSR in response to large negative price shocks induced by mutual fund outflows. Our findings are consistent with this prediction. Further supporting the ex post signaling view, we find that the effect of mutual fund fire sales on CSR concentrates among firms that are more vulnerable to stock price crash risk.

Our study makes important contributions to the growing literature that aims to better understand why firms engage in CSR activities in the first place. This literature mostly focuses on the value implications (i.e., consequences) rather than the determinants of CSR. However, the empirical evidence on the value implications of CSR is inconclusive.[10] This is not surprising because studying the consequences of CSR itself cannot fully pin down the motives behind such activities: it merely reflects a net result of the pros and cons of making CSR investments. In contrast, our study, by focusing on the determinants of CSR, shows that adverse situations unrelated to fundamentals could incentivize firms to actively engage in CSR to signal their financial strength. Furthermore, we use two complementary quasi-natural experiments to examine both ex ante signaling and ex post signaling with CSR. Our study thus complements recent studies by Flammer and Kacperczyk (2019), who find that firms respond strategically to defend against unfavorable *fundamental-related* shocks. Our finding is also different from the insurance effect (e.g., Lins et al. (2017)) and/or the halo effect (Hong and Liskovich (2015)), which argue that firms engage in CSR in normal times to create a positive public image (i.e., signal their virtue) to hedge against possible future unfavorable situations.

[9]We confirm that such price pressure also exists in our sample period. To the extent that price reversals following the fire sales reflect price pressure rather than information, our measure (in the fashion of Coval and Stafford (2007) and Sulaeman and Wei (2019)) captures non-fundamental-driven negative price pressure and is less subject to the concern using the procedure in Edmans, Goldstein, and Jiang (2012) as discussed in Berger (2023) and Wardlaw (2020).

[10]For example, some studies find that CSR can be value-enhancing as argued by Bénabou and Tirole (2010) (see, e.g., Edmans (2011), Deng, Kang, and Low (2013), Servaes and Tamayo (2013), Ferrell, Liang, and Renneboog (2016), and Lins et al. (2017)). Others show that CSR destroys firm value, which is consistent with the agency view proposed by Friedman (1970) (see, e.g., Krueger (2015), Masulis and Reza (2015), and Cronqvist and Yu (2017)). Karpoff, Lott, and Wehrly (2005) show no reputational penalties for firms that violated environmental regulations. Given mixed evidence on the value consequences of firms' CSR investments, it is not surprising that evidence on socially responsible funds is also mixed (e.g., Starks, Venkat, and Zhu (2020)).

II. Sample and Variable Construction

Our main measure of a firm's CSR engagements comes from the CSR ratings compiled by the MSCI KLD Stats Database (formerly KLD Research & Analytics, Inc.). This database is widely used to study U.S. firms' CSR activities (e.g., Deng et al. (2013), Hoi et al. (2013)). To assess how socially responsible a firm is, KLD examines many positive indicators (i.e., strengths) and negative indicators (i.e., concerns) in seven major categories, including employee relations, product quality and safety, community relations, environment, human rights, diversity, and corporate governance (see Table IA1 in the Supplementary Material for details). Within a category, a binary rating equal to 1 (0) is assigned to indicate the presence (absence) of strengths and concerns of each issue.

To empirically measure a firm's CSR activity, we follow Cao et al. (2019)'s approach and construct an adjusted summary score, CSRSCORE, which reflects the net strengths of a firm's environmental (E) and social (S) engagements and accounts for the variation in the total number of issues considered by KLD each year.[11]

Our alternative data source of CSR is Thomson Reuters ASSET4, which has a broader coverage of international firms than KLD but a smaller coverage of U.S. firms. We use ASSET4 to check the robustness of our main finding (Chatterji, Durand, Levine, Touboul (2016)). We calculate a comparable CSRSCORE as the sum of resource use score, emissions score, environmental innovation score, workforce score, human rights score, community score, and product responsibility score. We also use ASSET4 for some analysis of environmental R&D activity.

We employ two quasi-natural experiments to test the signaling explanation of CSR engagement. The first identification strategy is the SEC's Regulation SHO pilot program that suspended the uptick rule of short selling. To conduct this pilot program, the SEC started from the list of Russell 3000 stocks as of June 25, 2004, and selected those listed on the national exchanges, including NYSE, NASDAQ NM, and AMEX. The SEC also excluded stocks that went public or had spin-offs after Apr. 30, 2004. The remaining stocks were sorted into three groups by the exchanges on which they are traded and ranked within each exchange based on the average daily dollar volume over the 1 year prior to the issuance of the pilot order on July 28, 2004 (SEC Release No. 50104). From each ranked group, the SEC selected every third stock to be a pilot stock and publicly listed these stocks in the pilot order. This procedure generates a stratified random sample of pilot stocks (consisting of about one-third of the Russell 3000 stocks), and the remaining stocks (about two-thirds of the Russell 3000 index) are the control group where the uptick rule still applies. The pilot study intends to examine directly how the removal of the uptick rule affects short selling. It is considered exogenous in our setting because it was not initiated to influence corporate decisions (such as CSR) in any particular direction.

Following the above procedure of the SEC's pilot order, we start with the Russell 3000 Index in June 2004 and exclude stocks not listed on the NYSE, AMEX, or NASDAQ NM, and stocks that went public or had spin-offs after

[11] We exclude governance (G) because the rating of corporate governance has a significant change in 2006 to include factors related to accounting, transparency, and political accountability. This change can introduce measurement errors in the corporate governance rating during our sample period.

Apr. 30, 2004. Out of the remaining 2,952 stocks, we identify 986 pilot stocks according to the published list of the SEC's pilot order, and the remaining 1,966 stocks comprise the initial control sample. We generate two indicator variables for our empirical analysis. PILOT is an indicator variable that equals 1 for treatment firms (i.e., pilot stocks in our sample) and 0 for control firms. DURING is an indicator variable that equals 1 if a firm's fiscal year ends between Jan. 1, 2005, and Dec. 31, 2006, and 0 if it ends between Jan. 1, 2002, and Dec. 31, 2003. Note that it can take some time for firms to implement CSR activities and get reflected in the year-end KLD scores. In other words, firms can start reacting to Regulation SHO before 2005, but some of those actions only manifest in later years' KLD scores when they materialize.

Our second identification strategy to test the signaling explanation of CSR under non-fundamental-driven negative price pressure uses large mutual fund outflow-driven trading (i.e., fire sales) events during the sample period of 1991 to 2015. Mutual fund information is collected from two sources. First, quarter-end values of portfolio holdings by U.S. mutual funds are obtained from the Thomson Reuters Mutual Fund Holdings Database. Second, mutual fund returns and total net asset values are obtained from the CRSP Survivorship Bias Free Mutual Fund Database.

Prior literature shows that large mutual fund outflow-driven trading can exert substantial negative price pressure on the affected firms over an extended period (Coval and Stafford (2007)) and can impact these firms' real activities (e.g., Edmans et al. (2012), Lou and Wang (2018)). These studies show that such outflows mostly capture the reduction of a fund's existing positions in its portfolio stocks mechanically driven by investor redemptions and are unlikely to reflect mutual funds' discretionary trading decisions based on anticipated deteriorating firm fundamentals. Following Coval and Stafford (2007) and Sulaeman and Wei (2019), we first measure the net flow to mutual fund j during month t as

$$\text{FLOW}_{j,t} = \frac{\text{TNA}_{j,t} - \text{TNA}_{j,t-1}\left(1+R_{j,t}\right)}{\text{TNA}_{j,t-1}}, \tag{1}$$

where $\text{TNA}_{j,t}$ is the total net asset value of fund j at the end of month t and $R_{j,t}$ is the monthly return of fund j over month t. We then construct a stock-level price pressure measure to capture the price pressure generated by mutual fund flow-driven trades. Specifically, the flow-driven price pressure measure of stock i in quarter q is constructed as

$$\text{QTRPRESSURE}_{i,q} = \frac{\sum_j \max\left(0, \Delta\text{HOLDING}_{i,j,q}\right) \cdot \max\left(0, \text{FLOW}_{j,q}\right) - \sum_j \max\left(0, -\text{HOLDING}_{i,j,q}\right) \cdot \max\left(0, -\text{FLOW}_{j,q}\right)}{\text{VOLUME}_{i,q-1}}, \tag{2}$$

where $\text{HOLDING}_{i,j,q}$ is the change in the number of stock i's shares held by fund j in quarter q.[12] $\text{FLOW}_{j,q}$ is the net flow for fund j in quarter q calculated in equation (1), and $\text{VOLUME}_{i,q-1}$ is the trading volume of stock i in quarter $q-1$.

[12]Mutual funds were only required to disclose their holdings semi-annually until 2003, when the SEC started to require them to report holdings quarterly. Some mutual funds choose to report holdings

We then compute the annual pressure measure, PRESSURE, by summing up $QTRPRESSURE_{i,q}$ over a fiscal year. Since large negative price pressure is expected to affect firms, we sort sample firm-years based on PRESSURE and generate an indicator variable NEGPRESSURE, equal to 1 if the annual pressure measure is in the bottom tercile of the sample firm-years, and 0 otherwise. We use NEGPRESSURE in our empirical analysis.

Other sources of data include the following: We obtain information on stock price and return from CRSP. Financial statement data are from Compustat. We exclude firms in the financial and utility industries because some subcategories of CSR in these heavily regulated industries may not reflect firm-specific decisions. We also use institutional ownership data from Thomson Reuters' 13F filings, analyst coverage from the Institutional Brokers Estimate Systems (I/B/E/S) database, anti-takeover provisions and board structure from RiskMetrics, and the CEO pay-performance sensitivity data from Professor Alex Edmans' website.

We include a vector of firm characteristics that are associated with CSR in our multivariate analysis. We compute all variables for firm *i* over its fiscal year *t*. Our control variables include firm size (the natural logarithm of book value assets), profitability, leverage, growth opportunities (Tobin's Q), cash flows, cash holdings (cash over total assets), investments in intangible assets (R&D expenditures over total assets), capital expenditures over assets, advertising expenditures over assets, stock liquidity, financial constraints, and institutional ownership. We include total assets because larger firms possess more resources to engage in CSR activities. Tobin's Q and leverage are included because low-risk, mature firms have a higher tendency to invest in CSR. We also include cash flows, cash holdings, and return on assets (ROA) to proxy for firm performance. Capital expenditures might be associated with CSR negatively if they leave a firm with fewer resources to invest in CSR. Alternatively, they might have a positive association with CSR if investments in high-quality equipment improve employee relations. Further, firms with higher R&D expenditures are also found to undertake more CSR-related activities. Advertising expenses are controlled for because they are associated with customer relations.[13] We control for institutional ownership, which is correlated with CSR (Starks et al. (2020)). We include the stock illiquidity measure from Fong, Holden, and Trzcinka (2017) and the financial constraint measure from Whited and Wu (2006) to control for potential effects of the negative price pressure on firm liquidity and financial constraints that may in turn influence CSR. We winsorize all continuous variables at their 1st and 99th percentiles. The Appendix provides the details of variable definitions.

III. Setting 1: Regulation SHO

We first test the ex ante signaling of financial health via CSR under the negative price pressure induced by Regulation SHO. The relaxation of short sale

monthly. When there is no monthly holding report, we use the most recent available holding report. Roughly about 60% of the sample report holdings quarterly.

[13]Controlling for advertising expenses and R&D expenses also serves the purpose of controlling for potential signaling from these two channels. In untabulated analysis, we also control for dividends and stock repurchases, which are not direct determinants of CSR but are potential signaling mechanisms, and our findings remain similar.

constraints by Regulation SHO exposes pilot firms to heavier and easier short-selling threats and larger downside risk (e.g., Diether, Lee, and Werner (2009)). Such changes likely prompt managers of pilot firms to signal their financial strength ex ante (i.e., without being actually shorted) using CSR. Note that the Regulation SHO program is preannounced (in June 2004) by the SEC before its actual implementation (in May 2005), which means pilot firm managers know ahead of the implementation time whether they are on the pilot list and thus are more prone to more short selling pressure. These managers, in turn, become more conscious of the adverse feedback effect of this shock and can take preemptive actions such as CSR to help mitigate such impact. They engage more in CSR to signal that the increased short selling and the associated negative price pressure induced by Regulation SHO are not driven by deteriorating fundamentals. That is, this ex ante signaling hypothesis suggests that pilot firms increase CSR to signal firm financial health to help preempt potential undesirable ramifications induced by the negative price pressure.

A. Main Analysis

Panel A of Table 1 presents the summary statistics for the sample of firm years in the Regulation SHO setting. CSRSCORE has a mean (median) of −0.148 (−0.125), indicating that an average firm in this sample has more CSR concerns than strengths. An average firm has a ROA of 0.121 and over 70% of its shares are held by institutional investors.[14] Furthermore, to draw causal inferences on the changes in CSR activities due to the regulatory shock to short selling, we check whether the treatment group (i.e., pilot firms) is similar to the control group (i.e., nonpilot firms) prior to the implementation of Regulation SHO. Panel B of Table 1 shows that pilot firms and control firms are similar in CSRSCORE and other fundamental characteristics at the fiscal year end immediately before the announcement month of the pilot program (July 2004). For example, pilot firms have a mean CSRSCORE of −0.136 while control firms have a mean value of −0.125. The *t*-statistic of 0.652 shows that the difference in CSR is statistically insignificant. This test confirms the randomness of the policy experiment and gives us confidence that changes in CSR likely come from the impact of the pilot program rather than some predetermined firm characteristics. Other firm features are also similar between the pilot and control firms.

Figure 1 suggests a parallel trend before the announcement of Regulation SHO, followed by an increase in CSR by pilot firms once the program is in place. Note that given the program was announced in July 2004, firm managers did not know that SEC was planning to conduct such a test before it was announced and had no knowledge of whether a given firm would be picked as a pilot. Hence, the majority of the real changes in CSR could only happen once the program became publicly announced (i.e., not in 2003 or 2004). Also, given the lag in reporting the outcomes of CSR engagement in KLD, the action in CSR is more pronounced in 2005 and 2006.

[14]Because the SEC pilot program is based on Russell 3000, the sample firms tend to be held by many institutional investors.

TABLE 1

Summary Statistics and Diagnostic Tests

Panel A of Table 1 reports the summary statistics for variables constructed based on the difference-in-differences (DiD) estimation sample of Russell 3000 index firms from 2002 to 2006. Our sample construction in the Regulation SHO setting is discussed in Section II. All variables are defined in the Appendix. Panel B reports diagnostics tests for the difference-in-differences (DiD) analysis. It compares the characteristics of treatment (pilot) and control firms at their fiscal year ends immediately before the announcement month of the pilot program (July 2004).

Panel A. Summary Statistics

Variable	Mean	P25	Median	P75	Std. Dev.	No. of Obs.
CSRSCORE	−0.148	−0.333	−0.125	0.039	0.373	5,872
ASSETS ($B)	4.5978	0.418	1.061	3.040	12.477	5,872
ROA	0.121	0.080	0.129	0.184	0.131	5,872
LEVERAGE	0.184	0.004	0.155	0.289	0.183	5,872
TOBINQ	2.179	1.330	1.748	2.542	1.373	5,872
CASHFLOW	0.576	0.189	0.443	0.938	2.491	5,872
CASHRATIO	0.195	0.034	0.114	0.289	0.209	5,872
R&DASSETS	0.041	0.000	0.004	0.055	0.074	5,872
CAPEXASSETS	0.051	0.019	0.034	0.062	0.054	5,872
ADVASSETS	0.013	0.000	0.000	0.011	0.030	5,872
INSTOWN	0.707	0.585	0.748	0.864	0.205	5,872
FHT	0.001	0.000	0.001	0.001	0.001	5,872
WWINDEX	−0.215	−0.372	−0.298	−0.213	0.331	5,872

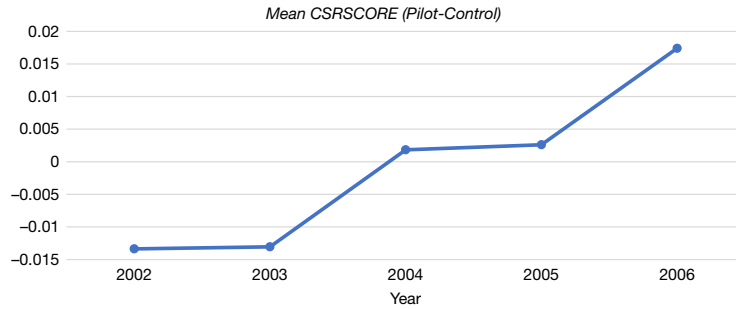
Panel B. Diagnostic Test

	Pilot			Control			Difference	
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	*t*-Stat.	Wilcoxon
CSRSCORE	−0.136	0.000	0.317	−0.125	0.000	0.335	0.652	0.656
ASSETS ($B)	3.190	0.669	9.727	3.642	0.618	11.916	0.813	0.462
ROA	0.101	0.118	0.139	0.089	0.113	0.162	1.564	1.294
LEVERAGE	0.187	0.157	0.192	0.186	0.151	0.193	0.157	0.293
TOBINQ	2.401	1.819	1.739	2.294	1.752	1.583	1.319	0.632
CASHFLOW	0.214	0.355	2.912	0.324	0.339	2.695	0.788	0.529
CASHRATIO	0.219	0.133	0.232	0.224	0.126	0.234	0.422	0.445
R&DASSETS	0.048	0.006	0.085	0.052	0.009	0.090	0.917	0.787
CAPEXASSETS	0.046	0.031	0.050	0.044	0.029	0.050	0.703	1.242
ADVASSETS	0.010	0.000	0.027	0.010	0.000	0.026	0.152	1.185
INSTOWN	0.613	0.641	0.224	0.609	0.653	0.235	0.324	0.017
FHT	0.002	0.001	0.002	0.002	0.001	0.003	1.039	1.044
WWINDEX	−0.112	−0.271	0.457	−0.089	−0.277	0.494	0.975	0.045

FIGURE 1

Mean Difference in CSRSCORE Between Pilot and Control Firms

Figure 1 shows the mean difference in CSRSCORE between pilot and control firms. The sample period is from 2002 to 2006. CSRSCORE is the sum of yearly adjusted community activities, diversity, employee relations, human rights, product, and environmental record KLD CSR Scores. Adjusted CSR is estimated by scaling the raw strength and concern scores of each category by the number of items of strength and concerns of that category in the year and then taking the net difference between adjusted strengths and concerns scores for that category.



We next conduct a multivariate analysis to formally examine the effect of the exogenous regulatory shock to short selling threat on firms' engagement in CSR activities. Specifically, we estimate various forms of the following difference-in-differences (DiD) model:

$$\text{CSRSCORE}_{i,j,t} = \alpha + \beta_1 \text{PILOT}_i \times \text{DURING}_t + \beta_2 \text{PILOT}_i + \gamma Z_{i,t} + \theta \text{Industry}_j \times \text{Year}_t + \varepsilon_{i,j,t}, \quad (3)$$

where *i, j, t* index firm, industry, and time, respectively. CSRSCORE, PILOT, and DURING are defined earlier. *Z* is the vector of firm characteristics discussed in Section II. Because Ioannou and Serafeim (2019) show that CSR practices converge within an industry over time, we include Industry × Year fixed effects in the regression, where the industry is defined at the 2-digit SIC level. The existing literature and our diagnostic tests for the Regulation SHO in Table 1 show that Regulation SHO is a truly randomized policy experiment targeting ex ante similar pilot and control firms; thus, the inclusion of firm fixed effects might not be necessary when we compare the outcomes of the two groups of firms.[15] The coefficient estimate on PILOT × DURING is the DiD estimator that captures the change in CSR by pilot firms relative to nonpilot firms due to Regulation SHO. POST is dropped from the equation because it is perfectly correlated with and thus fully absorbed by the Industry × Year fixed effects. We cluster standard errors by both firm and year to address possible correlations among residuals both within firm and across time.

Table 2 reports the regression estimation results. Importantly, across all models, PILOT × DURING is positive and statistically significant, indicating that pilot firms, compared to control firms, significantly increase CSR engagement under the negative price pressure from short selling. For example, in column 6, the coefficient on PILOT × DURING is 0.035, suggesting that pilot firms increase CSRSCORE by 0.035 more than control firms after the implementation of Regulation SHO. Given that the adjusted CSR score has a mean of −0.136 and a standard deviation of 0.317, the change in CSR is nontrivial. These results are consistent with the ex ante signaling explanation.

We conduct some additional analysis of the signaling of financial health (as opposed to the signaling of virtue). Specifically, we compare the level of CSR (CSRSCORE), operating performance (ROA), and cash flow to assets ratios (CASHFLOW) between two groups of pilot firms in the pre-Regulation-SHO period. One group (i.e., the "signaling" group) consists of pilot firms that indeed increase their CSR around Regulation SHO, and the other nonsignaling group contains pilot firms that do not. Table 3 reports the results. We find that pilot firms that indeed increase CSR have better ex ante financial profiles but lower CSR scores than those pilots that do not. That is, the signaling firms were financially sound with lower CSR scores and they choose to invest more in CSR when shocked by Regulation SHO. This provides further evidence supporting the signaling of financial health explanation.

[15]Nevertheless, we still check our baseline results after adding firm fixed effects and our main inference remains similar. These results are reported in Panel A of Table IA2 in the Supplementary Material.

TABLE 2

Multivariate Difference-in-Differences Test

Table 2 reports the results of the multivariate difference-in-differences (DiD) test on how the exogenous shock to short selling, Regulation SHO, affects CSRSCORE. CSRSCORE is the sum of yearly adjusted community activities, diversity, employee relations, human rights, product, and environmental record KLD CSR Scores. Adjusted CSR is estimated by scaling the raw strength and concern scores of each category by the number of items of strength and concerns of that category in the year and then taking the net difference between adjusted strengths and concerns scores for that category. PILOT is an indicator variable that equals 1 for treatment firms (i.e., pilot stocks), and 0 for control firms (i.e., nonpilot stocks). DURING is an indicator variable that equals 1 if a firm's fiscal year ends between Jan. 1, 2005, and Dec. 31, 2006, and 0 if it ends between Jan. 1, 2002, and Dec. 31, 2003. All other variables are defined in the Appendix. Robust standard errors clustered by both firm and year are displayed in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: CSRSCORE					
	1	2	3	4	5	6
PILOT × DURING	0.026***	0.031**	0.023***	0.030***	0.028***	0.035***
	(0.001)	(0.009)	(0.001)	(0.006)	(0.001)	(0.007)
PILOT	−0.019	−0.023	−0.019	−0.024	−0.022	−0.027
	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)
ln(ASSETS)		0.008		0.019		0.021
		(0.015)		(0.017)		(0.017)
ROA		0.246*		0.197*		0.197*
		(0.099)		(0.095)		(0.090)
LEVERAGE		−0.140**		−0.111**		−0.117**
		(0.041)		(0.038)		(0.038)
TOBINQ		0.018		0.018		0.019
		(0.010)		(0.010)		(0.009)
CASHFLOW		−0.002		−0.004		−0.005
		(0.003)		(0.002)		(0.002)
CASHRATIO		0.067		0.060		0.072
		(0.048)		(0.043)		(0.041)
R&DASSETS		0.509**		0.296*		0.261*
		(0.132)		(0.115)		(0.115)
CAPEXASSETS		−0.284*		0.303*		0.385**
		(0.118)		(0.147)		(0.147)
ADVASSETS		0.649*		0.684**		0.598*
		(0.258)		(0.241)		(0.238)
INSTOWN		0.060		0.033		0.036
		(0.036)		(0.045)		(0.046)
FHT		−5.254		−9.848		−10.670
		(8.487)		(6.671)		(6.739)
WWINDEX		−0.000		0.004		0.028
		(0.014)		(0.019)		(0.022)
Industry FE	No	No	Yes	Yes	No	No
Year FE	Yes	Yes	Yes	Yes	No	No
Industry × year FE	No	No	No	No	Yes	Yes
No. of obs.	5,955	5,872	5,955	5,872	5,955	5,872
R^2	0.023	0.060	0.109	0.135	0.136	0.163

To provide further evidence on ex ante signaling, we use a smaller but cleaner sample. Specifically, we conduct a multivariate difference-in-differences (DiD) test on how Regulation SHO affects CSR before the actual implementation date (i.e., Jan. 1, 2005). We define a new indicator variable PRIOR that equals 1 if a firm's fiscal year ends between July 1, 2004, and Dec. 31, 2004, and 0 if it ends between Jan. 1, 2002 and Dec. 31, 2003. This shorter event window is after the public announcement (i.e., July 1, 2004) but before the actual implementation of Regulation SHO. If pilot firms increase some of their CSR in this period, then it suggests a cleaner preemptive action and lends further support to ex ante signaling.

TABLE 3

Signaling Financial Health or Virtue?

Table 3 reports the regression results of the pre-Regulation-SHO pilot firm characteristics on their CSR signaling behavior. The dependent variables in columns 1–3 are the adjusted CSR score (CSRSCORE), operating performance (ROA), and cash flow to assets ratios (CASHFLOW) in the pre-Regulation-SHO period, respectively. PILOTSIGNAL is an indicator variable that equals 1 if a firm is a pilot stock that increases its CSR around Regulation SHO, and 0 if it is a pilot stock that does not. We include the same set of control variables (other than ROA and CASHFLOW themselves) as in Table 2, measured at the pre-Regulation-SHO period. Each regression includes a separate intercept and industry-by-year fixed effects. Standard errors clustered by the firm are displayed in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variables		
	CSRSCORE	ROA	CASHFLOW
	1	2	3
PILOTSIGNAL	−0.103***	0.027***	0.496***
	(0.039)	(0.008)	(0.177)
Controls	Yes	Yes	Yes
Industry × year FE	Yes	Yes	Yes
No. of obs.	762	1,075	1,058
R^2	0.237	0.675	0.433

Our findings are consistent with this prediction and reported in Panel B of Table IA2 in the Supplementary Material.[16]

B. Cross-Sectional Analyses

To strengthen the ex ante signaling explanation, we conduct two sets of cross-sectional tests based on firms' signaling incentives that vary with their vulnerability to downward price movement and with the strength of their information environments.

First, the need to signal via CSR depends on a firm's vulnerability to the enhanced short-selling threat from Regulation SHO and the corresponding price decline. As detailed below, more vulnerable firms presumably have stronger incentives to signal via CSR because the marginal benefits of signaling are greater under such negative price pressure.

We use both the intensity of product market competition and the ex ante shareholder litigation risk to proxy for firms' vulnerability. We posit that the degree of product market competition affects a firm's signaling incentives. A firm faced with more fierce competition in the product market finds it imperative to signal via CSR activities to defend against the threat from negative price pressure from short sellers, because such signaling can help mitigate potential adversity from losing large shareholders, key employees, suppliers, and major customers and thus help guard its market share and sustain its competitive position. On the other hand, firms facing less rivalry have fewer incentives to signal via CSR as they already have relatively secure market power. We use the sales-based Herfindahl index (HINDEX) as a proxy for the competitive environment that a firm operates in. A lower value of

[16]To further confirm that the observed increase in CSR is indeed driven by Regulation SHO rather than by pure chance or other unobservable pre-2004 shocks, we conduct a placebo test (untabulated) by using 2002 as the "pseudo-event" year (i.e., assuming 2002 was the year when Regulation SHO started). Specifically, we take the set of the actual pilot and non-pilot firms and perform the DiD analysis on their CSR scores around the "pseudo-event" year. We find no significant changes in CSR for pilot firms relative to control firms around the pseudo-event.

HINDEX indicates a more competitive product market (with less market power concentration). We expect the effect of Regulation SHO concentrates among firms operating in industries with a low Herfindahl index.

We also posit that firms facing higher shareholder litigation risk are more vulnerable to the potential price decline from Regulation SHO, and thus have stronger incentives to use CSR to signal. This is because such firms are more likely to suffer from litigation damages from shareholder lawsuits (Hope, Hu, and Zhao (2017)), making signaling with CSR more useful under the short-selling threat. We compute the litigation risk (LITIGATIONRISK) based on model 2 in Kim and Skinner (2012), which estimates the probability of securities class actions against a firm based on corporate attributes. To ensure that this litigation risk is measured ex ante, we calculate it using information that is lagged by 1 year. A higher (lower) value of LITIGATIONRISK indicates a higher (lower) likelihood of being sued by shareholders. We expect the effect of Regulation SHO concentrates among firms with high shareholder litigation risk.

Columns 1 and 2 in Panel A of Table 4 present the estimation results of cross-sectional tests using subsamples partitioned on the Herfindahl index (top and bottom terciles of firm-years). PILOT× DURING has a positive and significant coefficient for firms operating in industries with a low HINDEX. In contrast, PILOT× DURING is insignificant for firms in industries with a high HINDEX.

Columns 3 and 4 in Panel A of Table 4 report the estimation results using subsamples partitioned on the prior year's litigation risk (top and bottom terciles of firm-years). As can be seen, PILOT× DURING is significantly positive for firms with high LITIGATIONRISK but is not significant for firms with low LITIGATIONRISK. These results indicate that the needs to signal via CSR are stronger among firms that are more vulnerable to the potentially adverse effect of Regulation SHO.

Second, we expect that firms with a weaker information environment are more susceptible to the negative price pressure induced by Regulation SHO and thus have stronger incentives to signal via CSR. This is because signaling by a more opaque firm, given the relative scarcity or uncertainty of information about the firm, likely generates higher marginal benefits in helping outsiders assess the true value of the firm under the negative price shock.

To measure firms' general information environments, we use a variety of industry-level proxies, including analyst coverage, analyst forecast dispersion, and post-earnings announcement drift (PEAD). First, in the spirit of Chang, Dasgupta, and Hilary (2006), we use the number of analysts covering a firm to proxy for the information asymmetry between managers and outside investors. Less analyst coverage indicates a poorer information environment. Second, we use analyst forecast dispersion to proxy for information asymmetry based on the findings of Chemmanur et al. (2018). Analyst forecast dispersion is calculated as the standard deviation of the annual earnings forecast scaled by the absolute value of the consensus forecast. It captures the degree of disagreement among financial analysts covering a given firm about its earnings. Higher disagreement among analysts indicates more information uncertainty about the firm. Third, we use PEAD as an alternative proxy since it is correlated with information asymmetry (e.g., Livnat and Mendenhall (2006), Cao, Titman, Zhan, and Zhang (2023)).

TABLE 4

Signaling Needs

Table 4 reports the results of the multivariate difference-in-differences (DiD) tests using subsamples partitioned on a firm's signaling needs. The dependent variable is CSRSCORE. PILOT is a dummy variable that equals 1 for treatment firms (i.e., pilot stocks), and 0 for control firms (i.e., nonpilot stocks). DURING is an indicator variable that equals 1 if a firm's fiscal year ends between Jan. 1, 2005, and Dec. 31, 2006, and 0 if it ends between Jan. 1, 2002, and Dec. 31, 2003. All models include the same controls defined in Table 2. In Panel A, we examine subsamples (top and bottom terciles of firm years) based on industry competitiveness and litigation risk. In Panel B, we examine subsamples (top and bottom terciles of firm-years) based on the industry average of analyst coverage, analyst dispersion, and post-earnings announcement drift. All variables are defined in the Appendix. Standard errors clustered by both firm and year are displayed in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Cross-Sectional Analysis Based on Vulnerability

	Dependent Variable: CSRSCORE			
Partitioning Variables	HINDEX		LITIGATIONRISK	
	High	Low	High	Low
	1	2	3	4
PILOT × DURING	−0.001	0.085***	0.083***	0.021
	(0.015)	(0.009)	(0.014)	(0.022)
PILOT	0.001	−0.063**	−0.074**	−0.014
	(0.023)	(0.022)	(0.021)	(0.025)
Controls	Yes	Yes	Yes	Yes
Industry × year FE	Yes	Yes	Yes	Yes
No. of obs.	1,891	1,959	1,688	1,893
R^2	0.199	0.179	0.271	0.197

Panel B. Cross-Sectional Analysis Based on the Information Environment

	Dependent Variable: CSRSCORE					
Variables	INDANALYST		INDDISPERSION		INDPEAD	
	High	Low	High	Low	High	Low
	1	2	3	4	5	6
PILOT × DURING	0.009	0.043**	0.026**	0.008	0.060***	0.007
	(0.039)	(0.015)	(0.008)	(0.020)	(0.014)	(0.028)
PILOT	−0.028	−0.008	−0.035	0.006	−0.036	0.002
	(0.039)	(0.016)	(0.019)	(0.027)	(0.018)	(0.033)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry × year FE	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	2,206	2,051	2,296	2,117	1,974	2,081
R^2	0.149	0.186	0.133	0.182	0.144	0.147

Following the literature, we adjust raw stock returns with the contemporaneous returns of the size-matched portfolios sorted by NYSE breakpoints. We then accumulate the daily abnormal returns over 40 trading days after the announcements. A larger absolute value of the cumulative abnormal returns indicates a poorer information environment where investors are slower to incorporate new information into the market price. Based on the above proxies, firms in industries characterized with less analyst coverage, larger dispersion of earnings forecasts, and larger drifts following earnings announcements are more susceptible to information asymmetry. It follows that such firms are expected to have stronger incentives to signal via CSR under Regulation SHO.

Panel B of Table 4 presents the estimation results of cross-sectional tests using subsamples partitioned on the above three proxies for information environments (top and bottom terciles of firm-years). Across all proxies, PILOT× DURING carries a positive and significant coefficient among firms with weaker information

environments (columns 2, 3, and 5) but an insignificant coefficient among firms with better information environments (columns 1, 4, and 6).

Overall, these cross-sectional tests further support the hypothesis that firms engage in ex ante signaling via CSR when they are subject to exogenous negative price pressure unrelated to fundamentals, and such signaling concentrates among firms with stronger signaling incentives.

C. The Signaling Mechanism

We next examine the credibility of the CSR signal to further shed light on the signaling mechanism. First, we compare voluntary engagement to compliance in CSR activities. Voluntary engagement is plausibly more credible than compliance. To proxy for voluntary engagement and compliance, we examine CSR strengths and concerns separately. Cao et al. (2019) show that CSR strengths tend to capture a firm's voluntary engagement while CSR concerns largely reflect a firm's negative externalities. For instance, as illustrated in Table IA1 in the Supplementary Material, a key strength item under the environment category in KLD is based on whether a firm derives much revenue from providing innovative remediation products, environmental services, or products that promote the efficient use of energy, or it has developed innovative products with environmental benefits. On the other hand, environmental concerns include, among other things, hazardous waste, regulatory problems, and climate change issues.

We modify equation (3) to examine the effect of Regulation SHO on CSR strengths and concerns separately. The dependent variables are replaced with CSRSTRENGTHS and CSRCONCERNS, respectively. CSRSTRENGTHS (CSRCONCERNS) is the sum of yearly adjusted community activities, diversity, employee relations, human rights, product, and environmental CSR Strengths Scores (CSR Concerns Scores). Columns 1 and 2 in Panel A of Table 5 report the results on strengths and concerns, respectively. PILOT × DURING is significant and positive in column 1, suggesting that pilot firms, relative to control firms, increase their CSR strengths during Regulation SHO.[17]

Next, to the extent that environmental engagements are particularly costly, signaling in the environmental dimension of CSR can be credible (Spence (1973), Leland and Pyle (1977)). We conduct two tests that focus on signaling via environmental CSR. In the first test, we guide our analysis with SASB's Materiality Map to help sharpen the test. Specifically, we follow the map to identify industries with environmental engagements as top priorities and focus on environmental CSR (ENVCSRSCORE) for firms in these industries.[18] ENVCSRSCORE is calculated

[17]Meanwhile, column 2 shows that pilot firms also decrease CSR concerns more than control firms do. However, as we show later (in Table IA6 in the Supplementary Material), the effect of negative price pressure on CSR concerns does not sustain in the mutual fund fire sale setting while the effect on strengths is still strong and significant in that setting.

[18]Khan, Serafeim, and Yoon (2016) show that not all ESG issues matter equally to all firms and what matters most to a given firm depends on the materiality of a particular issue. We use the SASB materiality interactive map (https://materiality.sasb.org/) and focus on industries where environmental issues are likely to be material. Specifically, we examine industries with at least three out of the six environmental issues that are material. The six categories in the environmental dimension are GHG emissions, air quality, energy management, water and wastewater management, waste and hazardous materials management, and ecological impacts. For our purpose, we classify the following industries (their SIC codes)

TABLE 5

Signaling Mechanisms

Table 5 tests the signaling mechanism in the Regulation SHO setting. In Panel A, the dependent variables are CSRSTRENGTHS in column 1, CSRCONCERNS in column 2, and ENV CSRSCORE in column 3, using data from KLD. CSRSTRENGTHS is the sum of yearly adjusted community activities, diversity, employee relations, human rights, product, and environmental record KLD STATS CSR Strengths Scores. CSRCONCERNS is the sum of yearly adjusted community activities, diversity, employee relations, human rights, product, and environmental record KLD STATS CSR Concerns Scores. EnvCSRSCORE is calculated by scaling the raw environmental strengths and concerns scores by the number of items of environmental strengths and concerns in the year and then taking the net difference between adjusted strengths and concerns. In Panel B, the dependent variables are CSRSCORE and EnvRD using data from ASSET4. The ASSET4 summary CSRSCORE includes resource use score, emissions score, environmental innovation score, workforce score, human rights score, community score, and product responsibility score in each year. ENVRD is an indicator variable equal to 1 if the firm engages in training employees on environmental issues or develops clean technology, and 0 otherwise. PILOT is a dummy variable that equals 1 for treatment firms (i.e., pilot stocks in our sample), and 0 for control firms (i.e., nonpilot stocks in our sample). DURING is an indicator variable that equals 1 if a firm's fiscal year ends between Jan. 1, 2005, and Dec. 31, 2006, and 0 if it ends between Jan. 1, 2002, and Dec. 31, 2003. All variables are defined in the Appendix. Standard errors clustered by both firm and year are displayed in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A. CSR Strengths, Concerns, and Environmental Dimension Using Data from KLD

	Dependent Variables		
	CSRSTRENGTHS	CSRCONCERNS	ENVCSRSCORE
	1	2	3
PILOT × DURING	0.022***	−0.017**	0.011**
	(0.003)	(0.006)	(0.004)
PILOT	−0.026**	0.005	−0.011
	(0.009)	(0.011)	(0.011)
Controls	Yes	Yes	Yes
Industry × year FE	Yes	Yes	Yes
No. of obs.	5,837	5,837	1,330
R^2	0.411	0.310	0.100

Panel B. CSRSCORE and Environmental R&D Using Data from ASSET4

	Dependent Variables	
	CSRSCORE	ENVRD
	1	2
PILOT × DURING	3.346*	0.061*
	(1.375)	(0.025)
PILOT	−8.248**	−0.015
	(2.473)	(0.021)
Controls	Yes	Yes
Industry × year FE	Yes	Yes
No. of obs.	1,249	1,252
R^2	0.450	0.223

by scaling the raw environmental strengths and concerns scores by the number of items of environmental strengths and concerns in the year and then taking the net difference between adjusted strengths and concerns. Column 3 in Panel A of Table 5 shows that pilot firms increase their environmental CSR engagement more than control firms after the implementation of Regulation SHO.

In the second test, we capture a firm's R&D initiatives on environmental issues using data from ASSET4. We first confirm our main finding that pilot firms increase their CSR more than control firms during Regulation SHO in column 1 in Panel B

as those treating environmental engagements as top priorities: metal mining (10), coal mining (12), oil and gas extraction (13), mining and quarrying of nonmetallic minerals, except fuels (14), pulp (2,611), chemicals and allied products (28), solar (3,433), electricity, gas, steam and air conditioning supply (35), semiconductor (3,674), electric, gas and sanitary services (49), and containers and packaging (5,113).

of Table 5. Despite the smaller sample and weaker test power, our main inference using this alternative data set on CSR engagements remains unchanged.

To test signaling via engagements in environmental CSR, we generate an indicator variable equal to 1 if a firm engages in training employees on environmental issues or develops renewable/clean technology, and 0 otherwise. Training of employees on environmental issues can incur both indirect and direct costs. First, there is an indirect cost in training since employees have to use their work time (i.e., foregone productivity) to be trained. This opportunity cost can be meaningful in magnitude. Second, firms often need to hire outside specialists to train their employees, which also imposes direct costs on the firm. The notion is that these investments allow firms to credibly signal that they are committed to undertaking actions to improve their environmental footprint. Column 2 reports the results. PILOT × DURING is positive and significant at the 10% level, suggesting that pilot firms are more likely than control firms to engage in environmental R&D projects under Regulation SHO.[19]

Taken together, these analyses suggest that pilot firms engage in CSR activities that exhibit high credibility when they are under the negative price pressure induced by Regulation SHO.

D. Alternative Explanations

One possible alternative explanation for our main finding could be an agency-based story. If the increased short-selling pressure from Regulation SHO disciplines the management of pilot firms and thus reduces their under-investment in CSR due to managerial shirking, that is, their preference for a "quiet life" (Bertrand and Mullainathan (2003)), we would also see an increase in CSR. Short sellers can discipline managers because their short sales can lead to potential future adverse events and further decrease the stock price, which partially measures managerial performance. In addition to disciplining through stock prices, short sellers also play a disciplinary role by reducing earnings management (Fang, Huang, and Karpoff (2015)), detecting financial frauds (Karpoff and Lou (2010)), and incentivizing higher-quality innovation (He, Ren, and Tian (2022)). Hence, short sellers could potentially help mitigate the agency conflicts due to the managerial incentives to shirk CSR investments. This disciplining explanation could lead to the same empirical pattern.

To test whether the above alternative explanation drives our results, we partition our sample based on measures of agency conflicts and perform our baseline regression analysis on the subsamples. If the disciplining explanation is valid and short selling is a substitute for other corporate governance mechanisms as previous studies suggest, we would expect a more pronounced positive effect of Regulation SHO on CSR for firms with more severe agency problems (i.e., weaker corporate governance) because the marginal disciplining effect of short selling would be stronger for such firms.

[19]We adopt a linear probability model instead of probit/logit models due to a large number of fixed effects (at the Industry × Year level) that are typically handled poorly by maximum-likelihood based econometric models such as probit or logit. We also estimate probit/logit with separate year and industry fixed effects and our finding sustains.

We use the following measures to proxy for the severity of agency conflicts: the CEO pay-performance sensitivity (PPS), the percentage of independent board members (PCTINDEP), whether the board has a corporate governance committee (CGOVCOMM), and the Entrenchment Index (EINDEX) following Bebchuk et al. (2009). Results reported in Panel A of Table IA3 in the Supplementary Material show that the effect of Regulation SHO on CSR is pronounced only among firms with few agency issues, strong boards, and good governance, opposite to the prediction of the agency-based explanation.[20]

Another possible explanation for our main finding is that Regulation SHO may have a direct effect on the stock liquidity and financial performance of pilot firms, which then indirectly affects CSR. Note that we have controlled for stock liquidity and financial performance in all regressions, and PILOT× DURING remains significant, suggesting that the effect of Regulation SHO on CSR goes beyond the possible influence of stock liquidity and financial constraints on CSR.

To further address this possibility, we conduct a multivariate analysis to examine whether Regulation SHO directly affects the stock liquidity and financial constraints of pilot firms more than control firms in our setting. Specifically, we estimate equation (3) with measures of stock liquidity and financial constraint as the dependent variables and drop corresponding control variables. We examine conventional liquidity proxies such as the relative effective spread (RES), the FHT impact measure estimated based on Fong et al. (2017), and the AMIHUD illiquidity measure (Amihud (2002)). In terms of financial constraints, we examine the WWINDEX from Whited and Wu (2006) and the size and age index (SAINDEX) from Hadlock and Pierce (2010). With the DiD estimation, we can formally investigate whether Regulation SHO has any direct effect on stock liquidity and financial constraints. The results, reported in Panel B of Table IA3 in the Supplementary Material, indicate no evidence that Regulation SHO directly impacts pilot firms' stock liquidity and financial constraints compared to control firms.

IV. Additional Discussion

A. Signaling via CSR and Cost of Equity Capital

Firms that choose to incur signaling costs are expected to reap some benefits. One potential benefit of signaling with CSR is the lowered cost of equity capital. The theoretical literature on sustainable investing shows that firms with better ESG/CSR profiles have lower cost of equity capital arising from their better risk sharing among investors, increased pricing power, or hedging against environmental risk (e.g., Heinkel et al. (2001), Albuquerque et al. (2019), and Pástor et al. (2021)). Hence, we expect firms that indeed increase CSR to signal to experience a reduction in the cost of equity capital.

To test this prediction, we follow Gordon and Gordon (1997) and Hou et al. (2012) to construct the implied cost of equity capital. We then merge the implied

[20]Although it is interesting that the signaling effect manifests more in firms with better governance, we do not speculate on the reason due to a lack of formal theoretical literature on this relation.

TABLE 6

Signaling Benefits: Implied Cost of Equity Capital and Institutional Holdings

Table 6 reports the regression results of CSR signaling benefits. In Panel A, the dependent variable is ICC_{t+1}, which is the implied cost of equity for a firm in the 1 year after Regulation SHO. CSRSIGNAL is an indicator variable that equals 1 if a firm is a pilot stock that increases its CSR during Regulation SHO, and 0 otherwise (i.e., if it is either a nonpilot stock or a pilot stock that does not increase its CSR around Regulation SHO). AFTER is an indicator variable that equals 1 if the fiscal year ending date is between July 1, 2006, and June 30, 2007 (which is the ending date of the pilot program), and 0 if the fiscal year ending date is between Jan. 1, 2005, and June 30, 2006. We include the same set of control variables as in Table 2. Each regression includes a separate intercept. Panel B reports the regression results of institutional investors' holding in response to CSR signaling. For each institutional investor, we analyze its average dollar holding or average fractional ownership of the sample of pilot and nonpilot firms during the 1-year period after Regulation SHO but before July 2007. ln($HOLD) is the natural logarithm of an institution's average quarterly dollar holding (in millions) of a sample firm within 1 year after Regulation SHO. %HOLD is similarly defined, except that we analyze the institution's average percentage ownership (in percentage points) of a sample firm. SRI is a dummy variable that equals 1 if an institution is a socially responsible institution following the definition of Hwang et al. (2021). Specifically, we first calculate, for each institution-quarter, the (market capital) weighted average size-adjusted CSR strengths of the firms that the institution holds in its portfolio. Then we take the average of the eight quarterly values over the *during-Regulation-SHO* period and rank the institutions. Finally, we take the top tercile group of institutions and define them to be socially responsible (i.e., SRI is equal to 1). Standard errors clustered by both firm and year are displayed in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Implied Cost of Equity Capital

	Dependent Variable: ICC_{t+1}		
	1	2	3
CSRSIGNAL × AFTER	−0.005**	−0.006**	−0.006**
	(0.002)	(0.002)	(0.002)
CSRSIGNAL	0.001	0.003	0.003
	(0.003)	(0.003)	(0.002)
Controls	Yes	Yes	Yes
Industry FE	No	Yes	No
Year FE	Yes	Yes	No
Industry × year FE	No	No	Yes
No. of obs.	2,703	2,703	2,703
R^2	0.187	0.215	0.240

Panel B. Institutional Holdings

	Dependent Variables			
	ln($HOLD)	%HOLD	ln($HOLD)	%HOLD
	1	2	3	4
CSRSIGNAL × SRI	0.093**	0.051***	0.098**	0.053***
	(0.047)	(0.018)	(0.046)	(0.018)
CSRSIGNAL	−0.027	−0.036***		
	(0.032)	(0.012)		
Controls	Yes	Yes	No	No
Institution FE	Yes	Yes	Yes	Yes
Firm FE	No	No	Yes	Yes
No. of obs.	187,408	187,408	194,557	194,557
R^2	0.575	0.507	0.599	0.516

cost of equity capital measures with our Regulation SHO sample and the mutual fund fire sale sample to assess the potential benefits of CSR signaling.[21]

Panel A of Table 6 presents the regression results of the implied cost of equity capital after signaling via CSR. The dependent variable is the implied cost of equity capital (ICC) for a firm in the 1 year after Regulation SHO. CSRSIGNAL is an indicator variable that equals 1 if a firm is a pilot stock that increases its CSR during Regulation SHO, and 0 otherwise (i.e., if it is either a nonpilot stock or a pilot stock

[21]Details of the construction of a firm's implied cost of equity capital are provided in the Supplementary Material. The need to use nonmissing data (i.e., earnings, dividend payment, and accruals) for the next 5 years to estimate year *t*'s implied cost of equity capital leads to fewer observations (relative to the baseline estimation) for this analysis.

that does not increase its CSR following the implementation of Regulation SHO). AFTER is an indicator variable that equals 1 if the fiscal year ending date is between July 1, 2006, and June 30, 2007 (which is the ending date of the pilot program) and 0 if the fiscal year ending date is between Jan. 1, 2005, and June 30, 2006. We find a consistent negative coefficient on CSRSIGNAL, indicating that pilot firms that increase their CSR during Regulation SHO period experienced a reduction of around 50–60 basis points in their ICC.[22]

To see the overall valuation impact, we examine both a firm's ROA as an accounting-based measure of operating cash flows (profitability) and Tobin's Q as a market-based measure of firm value. We find some suggestive evidence that firms engaging in CSR signaling under the negative price pressure have higher Q than nonsignaling firms, but not significantly different ROA. These results, reported in Table IA4 in the Supplementary Material, indicate that the improved firm value mainly comes from the lowered cost of capital (i.e., the denominator of the valuation formula) rather than from the enhanced cash flows (i.e., the numerator).

B. Signaling via CSR and Socially Responsible Investors

Firms that indeed increase CSR under negative price pressure are likely to attract more socially responsible investors (e.g., Heinkel et al. (2001)). We test this conjecture by defining socially responsible institutions (SRIs) following Hwang et al. (2021).

Panel B of Table 6 reports the regression results of institutional holdings in response to CSR signaling. For each institutional investor, we analyze its average dollar holding or average fractional ownership of the sample of the pilot and nonpilot firms during the year after the end of the pilot program (i.e., June 30, 2007). ln($HOLD) is the natural logarithm of an institution's average quarterly dollar holding (in millions) of a sample firm during that year. %HOLD is similarly defined, except that we analyze the institution's average percentage ownership (in percentage points) of a sample firm. SRI is a dummy variable that equals 1 if an institution is a socially responsible institution following the definition of Hwang et al. (2021). Specifically, we first calculate, for each institution quarter, the value-weighted average of the size-adjusted CSR strengths of the firms that the institution holds in its portfolio. Then we take the average of the eight quarterly values over the Regulation-SHO period (i.e., years 2005–2006) and rank the institutions. Finally, we take the top tercile group of institutions and define them to be socially responsible (i.e., SRI is equal to 1). Institution, year, and/or firm fixed effects are included in some specifications. We find that the coefficient on CSRSIGNAL × SRI is significantly positive, indicating that socially responsible institutional investors increase their holdings (more than nonsocially responsible ones) in firms that signal via CSR under the negative short-selling price pressure.

Overall, the above analyses offer some suggestive evidence of the beneficial outcomes of signaling via CSR: the reduction in the cost of equity capital and the increase in socially responsible investors among firms that indeed choose to

[22]We caution that the analysis here, although theoretically motivated, is only suggestive due to possible endogeneity concerns because CSRSIGNAL is based on the actual change in CSR, which may be driven by a firm's anticipation of lower cost of capital.

increase CSR under negative non-fundamental-driven price pressure. The main takeaway is that signaling financial health via CSR can offer incremental benefits to shareholders of firms under exogenous negative price pressure.

V. Setting 2: Mutual Fund Fire Sales

In this section, we use the events of mutual fund fire sales to further test the signaling hypothesis. Different from the Regulation SHO setting, the setting of mutual fund fire sales can help test ex post signaling via CSR. As discussed earlier, since firm managers do not have prior knowledge that their firms' stocks are under the fire sale pressure from mutual funds, they respond to the negative price shock by engaging in CSR ex post to signal their firms' financial health. Managers have incentives to engage in such ex post CSR signaling because they are concerned that uninformed investors and stakeholders might misinterpret these unexpected large negative price shocks due to mutual fund fire sales as an indicator of poor fundamentals and take actions that can adversely affect the firm. In particular, if key stakeholders perceive the firm to be in trouble, customers may stop purchasing from the firm, talented employees may jump ship to rival firms, and current shareholders may sell their shares, which could further exacerbate price declines. Hence, the marginal benefits of engaging in ex post signaling in response to such exogenous negative price pressure increase.[23] We postulate that firms experiencing mutual fund fire sales would increase CSR relative to those without such price pressure.

To test our main prediction, we employ the following regression specification:

$$\text{CSRSCORE}_{i,j,t} = \alpha + \beta \text{NEGPRESSURE}_{i,t} + \gamma Z_{i,t} + \theta \text{Industry}_j \times \text{Year}_t + \varepsilon_{i,j,t}, \quad (4)$$

where *i,j,t* index firm, industry, and year, respectively. NEGPRESSURE, the key independent variable, and *Z*, a vector of firm-level control variables, are defined earlier. Industry × Year represents industry (at the 2-digit SIC level) by year fixed effects. To address possible correlations among residuals within the firm, we follow the literature on mutual fund fire sales and cluster standard errors by the firm. We also require firm years in this test to have positive mutual fund ownership. Table IA5 in the Supplementary Material reports the summary statistics of our sample in the setting of mutual fund fire sales.

To examine the effect of fire-sale-driven price pressure on CSR, we estimate the above equation. Table 7 shows that the estimated coefficient on NEGPRESSURE ranges from 0.021 to 0.041, statistically significant across all models. Column 6 reports results with the full specification based on equation (4). NEGPRESSURE carries a positive coefficient of 0.024, statistically significant at the 1% level. These results suggest that firms engage significantly more in CSR in response to large fire-sale-driven price pressure, consistent with the ex post signaling hypothesis.

A potential concern with the above specification is that firms may be different in their fundamentals before fire sales. Note that our regressions have already

[23] Showing one's book to the investors and stakeholders may not work effectively if the information asymmetry pertains to unobservable/expected fundamentals or unverifiable signals received by the management, in which case a simple claim of having non-worsening fundamentals tends to be treated as cheap talks.

TABLE 7

Effect of Mutual Fund Outflow-Driven Negative Price Pressure on CSR

Table 7 reports the regression results of mutual fund outflow-driven negative price pressure on CSR. The dependent variable is CSRSCORE. NEGPRESSURE is an indicator variable that equals 1 if the annual mutual fund outflow-driven pressure is in the bottom tercile of the entire sample, and 0 otherwise. We include the same set of control variables as in Table 2 in some columns. All variables are defined in the Appendix. Each regression includes a separate intercept, and different combinations of fixed effects. Standard errors clustered by the firm are displayed in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: CSRSCORE					
	1	2	3	4	5	6
NEGPRESSURE	0.041***	0.028***	0.035***	0.021***	0.039***	0.024***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)
Controls	No	Yes	No	Yes	No	Yes
Industry FE	No	No	Yes	Yes	No	No
Year FE	Yes	Yes	Yes	Yes	No	No
Industry × year FE	No	No	No	No	Yes	Yes
No. of obs.	33,834	32,056	33,832	32,056	33,832	32,056
R^2	0.086	0.127	0.127	0.167	0.180	0.220

controlled for various firm characteristics. To further ensure covariate balance, we employ an entropy balancing technique, a quasi-matching approach that maintains the entire sample and weights each observation such that the postweighting distributional properties of treatment and control observations are virtually identical (Hainmueller (2012), Hoepner, Oikonomou, Sautner, Starks, and Zhou (2020)).[24] The results, reported in Table IA6 in the Supplementary Material, are both qualitatively and quantitatively similar to those reported in Table 7, alleviating the concern that our findings are driven by potential differences between treated and control firms, and further supporting our conjecture that firms engage in ex post signaling via CSR in response to large negative price pressure induced by fire sales.

We next examine the cross-sectional variation in signaling incentives. We postulate that increasing CSR engagement as an ex post strategy can be more beneficial to firms that are more vulnerable to the sudden negative price movement. To represent such vulnerability, we adopt a proxy that captures firm-specific stock price crash risk. The intuition is that managers of firms under the negative price pressure induced by mutual fund fire sales have stronger incentives to engage in ex post CSR activities if their stock prices have a higher risk of crashing.

Following Chen, Hong, and Stein (2001), we estimate a firm's stock price crash risk by estimating the down-to-up volatility (DUVOL). A higher value of DUVOL means a higher price crash risk. To carry out the empirical investigation, we partition the full sample into subsamples based on the prior year's DUVOL, and estimate the baseline regression for the subsamples. Observations in the top (bottom) tercile are grouped into HIGHCRASHRISK (LOWCRASHRISK). We expect that the effect of mutual fund fire sales on CSR to concentrate among firms with high stock price crash risk.

[24]We also use a conventional propensity-score matching (PSM) approach to conduct the analysis and our inference remains the same. The main advantage of the entropy balancing method over the PSM approach is the former's ability to ensure covariate balance while maintaining the sample size and thus the test power.

TABLE 8

Stock Price Crash Risk and CSR

Table 8 reports the regression results of mutual fund outflow-driven negative price pressure on CSR using subsamples partitioned on a firm's stock price crash risk. The dependent variable is CSRSCORE. NEGPRESSURE is an indicator variable that equals 1 if the annual mutual fund outflow-driven pressure is in the bottom tercile of the entire sample, and 0 otherwise. Control variables are the same as those in Table 2. We examine subsamples (top and bottom terciles of firm-years) based on the prior year's stock price crash risk. All variables are defined in the Appendix. Standard errors clustered by the firm are displayed in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: CSRSCORE	
	HIGHCRASHRISK	LOWCRASHRISK
	1	2
NEGPRESSURE	0.042**	0.023
	(0.020)	(0.015)
Controls	Yes	Yes
Industry × year FE	Yes	Yes
No. of obs.	8,619	8,781
R^2	0.286	0.289

Table 8 reports the estimation results. Column 1 presents the results for the subsample of HIGHCRASHRISK. The coefficient on NEGPRESSURE is significant and positive, suggesting that experiencing a large negative price pressure from mutual fund fire sales prompts firms to increase CSR investments. Column 2 reports an insignificant coefficient on NEGPRESSURE for the subsample of LOWCRASHRISK. These results suggest that the effect of fire-sale-driven price pressure on CSR concentrates among firms that are more vulnerable to the unexpected negative price movement, further supporting the ex post signaling explanation of CSR engagement.

We next conduct additional analyses parallel to those in Table 5 to examine signaling mechanisms in the mutual fund setting. We find firms under negative price pressure signaling credibly via increasing CSR strength and environmental CSR and are more likely to engage in environmental R&D projects. These results are reported in Table IA7 in the Supplementary Material.

We also analyze the benefits of ex post signaling. We first examine the ICC of a firm in the year following the negative price pressure induced by the fire sales. A firm signals if its annual mutual fund outflow-driven price pressure is in the bottom tercile of its distribution and it increases its CSR from the previous year to the current year. We find that signaling firms experience a reduction in their ICC compared to those firms that do not signal via CSR. These results are reported in Panel A of Table IA8 in the Supplementary Material.

Next, we examine the holdings of socially responsible investors in response to signaling firms that are subject to the fire sales' pressure. We find that socially responsible institutional investors increase their holdings (more than nonsocially responsible ones) in firms that increased CSR under the negative price pressure. Panel B of Table IA8 in the Supplementary Material reports the estimation results. Collectively, these results suggest that ex post signaling via CSR can help firms enjoy the benefits of lower cost of equity capital and attract more CSR-conscious investors.

VI. Conclusion

CSR engagement has gained increasing popularity, but how to disentangle various motives for CSR is an important yet empirically challenging issue. We use two complementary quasi-natural experiments, Regulation SHO and mutual fund fire sales, to formally test the signaling of financial health via CSR when firms experience exogenous negative price shocks.

We first test the ex ante signaling role of CSR using the Regulation SHO setting. Since pilot firm managers have prior knowledge that their stocks are on the pilot list and thus more prone to increased short selling, they have incentives to take preemptive actions such as CSR before further stock price decline. We hypothesize and find that pilot firms increase their CSR more than control firms during Regulation SHO. We further examine cross-sectional variation in the incentives of ex ante signaling in CSR and hypothesize that the positive effect of Regulation SHO on CSR should concentrate among firms with higher vulnerability and a more opaque information environment. We find that is indeed the case. We further show that pilot firms' CSR signals are credible because they increase CSR strengths and engage in costly environmental CSR initiatives and environmental R&D projects. Lastly, we present some evidence that firms signaling via CSR under exogenous negative price pressure enjoy signaling benefits such as a lower cost of equity capital and more investment from socially responsible investors.

We then examine the mutual fund fire sale setting to test the ex post signaling role of CSR. Since managers learn about mutual fire sales only after the fact, they engage in more ex post CSR. Our analysis shows that firms experiencing fire-sale-driven negative price pressure engage in CSR significantly more than firms not facing such pressure, consistent with the ex post signaling view of CSR. We further find that the effect mostly manifests in firms with high firm-specific future stock price crash risk.

Collectively, our findings suggest that managers use CSR to signal their firms' financial health to shareholders and other stakeholders in adverse situations. As such, our study presents new evidence in support of the signaling motivation of CSR. Our findings are relevant to the ongoing debate on why firms invest in CSR and how CSR impacts shareholders and other stakeholders.

Appendix. Definition of Variables

Measures of Corporate Social Responsibility (CSR) Activities

CSRSCORE: The sum of yearly adjusted community activities, diversity, employee relations, human rights, product, and environmental record KLD CSR Scores. Adjusted CSR is estimated by scaling the raw strength and concern scores of each category by the number of items of strength and concerns of that category in the year and then taking the net difference between adjusted strengths and concerns scores for that category.

CSRSCOREASSET4: The ASSET4 summary CSR score includes Resource Use Score, Emissions Score, Environmental Innovation Score, Workforce Score, Human Rights Score, Community Score, Product Responsibility Score in each

year *t*, specifically the sum of tresgenrrs, tresgeners, tresgenpis, tresgsowos, tresgsohrs, tresgsocos, and tresgsoprs.

Key Variables of Interest

PILOT: An indicator variable equal to 1 for pilot stocks, and 0 for control firms.

DURING: An indicator variable that equals 1 if a firm's fiscal year ends between Jan. 1, 2005, and Dec. 31, 2006, and 0 if it ends between Jan. 1, 2002, and Dec. 31, 2003.

NEGPRESSURE: An indicator variable equal to 1 if the annual pressure measure is in the bottom tercile of the sample firm-years, and 0 otherwise.

Other Variables

LNASSETS: Natural logarithm of firm *i*'s book value of total assets (AT) measured at the end of fiscal year *t*.

ROA: Firm *i*'s return-on-assets ratio, defined as operating income before depreciation (OIBDP) divided by book value of total assets (AT), measured at the end of fiscal year *t*.

LEVERAGE: Firm *i*'s leverage ratio, defined as book value of debt (DLTT + DLC) divided by book value of total assets (AT) measured at the end of fiscal year *t*.

TOBINQ: Firm *i*'s market-to-book ratio during fiscal year *t*, calculated as (market value of equity (PRCC × CSHO) plus book value of assets (AT) minus book value of equity (CEQ) minus balance sheet deferred taxes (TXDB, set to 0 if missing)) divided by book value of assets (AT).

CASHFLOW: Firm *i*'s income before extraordinary items (IB) plus depreciation and amortization (DP), divided by the lagged net property, plant and equipment (PPENT).

CASHRATIO: Cash and short-term investments (CHE) divided by book value of total assets (AT), measured at the end of fiscal year *t*.

R&DASSETS: Firm *i*'s research and development expenditure (XRD) divided by book value of total assets (AT) measured at the end of fiscal year *t*, set to 0 if missing.

CAPEXASSETS: Firm *i*'s capital expenditure (CAPX) scaled by book value of total assets (AT) measured at the end of fiscal year *t*.

ADVASSETS: Firm *i*'s advertising expenditure (XAD) scaled by book value of total assets (AT) measured at the end of fiscal year *t*, set to 0 if missing.

INSTOWN: Firm *i*'s total institutional ownership at the end of fiscal year *t*.

FHT: Firm *i*'s stock liquidity measure estimated based on Fong et al. (2017) over fiscal year *t*.

RES: Firm *i*'s annual average of relative effective spreads over fiscal year *t*.

AMIHUD: Firm *i*'s Amihud illiquidity measure obtained by dividing the daily absolute value of return with daily dollar volume, averaged over fiscal year *t*.

WWINDEX: Firm *i*'s Whited and Wu index measured at the end of fiscal year *t*, calculated as $-0.091 \times$ ((income before extraordinary items + depreciation and

amortization)/(assets)) ((IB + DP)/AT)) − 0.062 × (indicator set to 1 if the sum of common dividends (DVC) and preferred dividends (DVP) is positive, and 0 otherwise) + 0.021 × leverage((DLTT)/(AT)) − 0.044 × log(assets) (log(AT)) + 0.102 × average industry sales (SALE) growth (estimated separately for each 3-digit SIC industry and each year, with sales growth defined as above) − 0.035 × sales growth.

SAINDEX: The size and age index (SAindex) following Hadlock and Pierce (2010).

INDANALYST: Industry average of the number of analysts covering a firm.

INDDISPERSION: Industry average of the standard deviation of the annual earnings forecast scaled by the absolute value of the consensus forecast.

INDPEAD: Industry average of PEAD calculated in the fashion of Livnat and Mendenhall (2006).

DUVOL: The down-to-up volatility. A firm's firm-specific future stock price crash risk following Chen, Hong, and Stein (2001).

HINDEX: Herfindahl index based on sales for each 4-digit SIC industry *j* where firm *i* belongs, measured at the end of fiscal year *t*.

LITIGATIONRISK: Based on model 2 of Kim and Skinner (2012), measured at the end of the prior year.

PPS: The dollar change in CEO wealth for a 100 percentage point change in firm value, divided by annual flow compensation.

EINDEX: The sum of six corporate charter anti-takeover provisions for firm *i* in fiscal year *t*, where the six anti-takeover provisions are staggered boards, limits to bylaw amendments, limits to charter amendments, supermajority requirements for mergers, poison pills, and golden parachutes.

PCTINDEP: The percentage of firm *i*'s board of directors that are independent from (i.e., unaffiliated with) the management.

CGOVCOMM: A dummy variable that equals 1 if firm *i*'s board has a corporate governance committee, and 0 otherwise.

Supplementary Material

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