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Do Firms Manage Their CSR Reputation? Evidence from Twitter

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Do Firms Manage Their CSR Reputation? Evidence from Twitter

Abstract

Using a machine learning approach to process 11 million tweets posted by S&P 1500 firms from 2011 through 2016, we find that poor corporate social responsibility (CSR) performance firms tweet more about CSR activities and use tweets that are shorter, and with more passive voice and extreme tone. Good CSR performance firms tweet less about CSR, yet gain twice more followers per CSR tweet than poor CSR performance firms. Good CSR performance firms also experience a greater decrease in institutional ownership along with higher increases in bid-ask spread and stock return volatility after joining Twitter than do poor CSR performance firms. Our findings suggest that poor CSR performance firms play a greenwashing strategy, but this strategy is not effective in leading to capital market consequences.

Key Words: Social media; Twitter; Dissemination; Corporate social responsibility; Prosocial.

JEL Codes: G14; L30; M14; M15; M40

Do Firms Manage Their CSR Reputation? Evidence from Twitter

1 Introduction

The demand for corporate social responsibility (CSR) has become increasingly prominent in recent years. Such demand motivates firms to communicate their commitment on socially responsible activities to their key stakeholders. While many firms truly invest in CSR activities and communicate such investment accordingly (termed as the good-citizen motive), some other firms may exaggerate their CSR investment by disclosing more than what they actually do (termed as the greenwashing hypothesis)¹. The latter firms take advantage of information asymmetry and use communication as an opportunity to build up good corporate reputation.

Few prior studies provide evidence separating the two types of firms because CSR activities are typically communicated through press releases and sustainability reports which are attended and read by sophisticated institutional investors. The information asymmetry needed to take advantage of greenwashing in this context was consequently limited. However, the emergence of social media as a new information dissemination channel provides both incentives and opportunities for firms to broadcast their CSR activities to a broader audience. Firms' social media accounts are largely followed by individuals and disclosure costs are low. We thus explore whether firms disseminate information about their CSR activities on social media strategically. More specifically, we are interested in testing the greenwashing hypothesis, i.e., that poor CSR performance firms are more likely to discuss CSR related topics on Twitter, and in examining how

¹ Greenwashing is not unusual in practice as the Chair of the International Accounting Standards Board (IASB), Hans Hoogervorst, pointed out "... we should not expect sustainability reporting to be very effective in inducing companies to prioritise planet over profit. Greenwashing is rampant." See <https://www.ifrs.org/news-and-events/2019/04/speech-iasb-chair-on-sustainability-reporting/>.

firms use presentation style in their CSR related tweets. Furthermore, we investigate whether disseminating CSR activities on Twitter attracts more Twitter followers and whether it has capital market consequences.

Firms engage in CSR activities for different reasons (e.g., Ariely et al., 2009; Bénabou and Tirole 2006, 2010). Some studies suggest that firms can be more profitable in the long run by being good corporate citizens, i.e., doing well by doing good, because long-term investors monitor firms closely and correct management's short-term behavior actively (e.g., Eichholtz et al., 2010; Elliott et al., 2014; Khan et al., 2016). Empirically, however, the evidence on whether CSR activities bring immediate financial benefits to firms remains mixed (e.g., Lys et al., 2015). Other studies argue that individuals demand firms to initiate socially responsible activities on their behalf. Investors or employees may respond favorably to costly CSR investments even when these investments have no positive impact on future cash flows (e.g., Martin and Moser, 2016; Burbano, 2016). Accordingly, firms may boost their CSR activities in response to investors' sentiment on CSR performance (Naughton et al., 2019). An increasing number of firms publish annual CSR reports that provide detailed information about their CSR activities and achievements, which are released through websites or other traditional media.² Regardless of the reasons that firms engage in CSR activities, they have strong incentives to communicate their CSR activities to investors, because executing on CSR commitment is expensive whereas broadcasting such commitment has little cost.

As an interactive social media outlet, Twitter has been widely used by firms to communicate news or activities to stakeholders, thus recent studies examine how firms use Twitter to enhance disclosure (Blankespoor et al., 2014; Lee et al., 2015, Jung et al., 2018, Tang 2018;

² According to The Governance and Accountability Institute, 85% of S&P 500 companies published sustainability reports in 2017, up from 20% in 2011.

Crowley et al., 2019).³ Twitter adopts a “push” approach, allowing firms to initiate communication directly with their followers rather than requiring the followers to request information from the sender. This feature particularly benefits individuals who have little resources to search for information in the traditional “pull” information system. The timely and interactive features for information dissemination on Twitter not only provide opportunities for managers to disclose CSR activities, but are also attractive to firms intending to implement a greenwashing strategy through intensively promoting their CSR efforts or trying to mimic good CSR firms’ disclosures (Yoon et al., 2006; Clarkson et al., 2008; Delmas and Burbano 2011).

Using a sample of 936 of S&P 1500 firms whose CSR performance is ranked by MSCI ESG Research Inc. and that have active Twitter accounts from 2011 to 2016, we show that firms with poor CSR performance are more likely to disseminate their CSR activities on Twitter, thus supporting the greenwashing hypothesis. We single out CSR tweets from these firms’ 11 million tweets using a Latent Dirichlet Allocation (LDA) based approach. We also find that the tweets from poor CSR performance firms are shorter and are more likely to use passive voice and extreme tone. This finding further suggests the strategic intention in tweeting. Not only do these firms boost their posting frequency of CSR tweets, but they also choose a presentation style in CSR tweets that is different from other firms’ CSR tweets.

We next examine the effect of strategic tweeting about CSR activities. We find that, on average, each CSR tweet by good CSR performance firms attracts twice as many new followers than each CSR tweet by poor CSR performance firms. This evidence seems to suggest that Twitter users, or potential followers of firms’ accounts, are able to recognize greenwashing behavior, perceiving a difference in CSR tweets between poor CSR performance firms and good CSR

³ Throughout this study we refer to disclosure and dissemination interchangeably, as, in light of the SEC’s April 2, 2013 clarification, new disclosures are now legally allowed on Twitter.

performance firms. Finally, we examine the capital market consequences of CSR tweets. Our predictions about the direction of the change in bid-ask spread and stock volatility after firms join Twitter are mixed. On one hand, tweets help mitigate information asymmetry, so bid-ask spreads and stock volatility should decrease (Blankespoor et al., 2014). On the other hand, tweets are expected to attract more attention from individuals and greenwashing behavior from poor CSR performance firms adds noise to the information content of CSR tweets, so bid-ask spreads and stock volatility may increase. The former factor (increased attention from individuals) predicts a decrease in institutional ownership due to an influx of retail investors, while the latter factor (noise due to greenwashing) could be stronger for poor CSR performance firms. Empirically, we find that good CSR performance firms experience a greater decrease in institutional ownership along with higher bid-ask spread and stock return volatility after joining Twitter than do poor CSR performance firms. This evidence suggests that some firms' use of a greenwashing strategy does not fully diminish the information content of CSR tweets.

We conduct a battery of additional tests to rule out other explanations. We document that our findings are not due to financial incentives as our results are robust to controlling for financial information related tweets and significant corporate events (8-K filings). Davidson et al. (2019) show that more than half of the variation in CSR scores can be explained by CEO fixed effects; however, we find that our findings are not affected by including CEO and CFO fixed effects. In addition, we find that the firms disclosing more CSR activities on Twitter are more likely to manage earnings upward. Since manipulating CSR disclosures and managing earnings share a common root in one's value system, the high correlation provides further support for the greenwashing hypothesis.

Our study makes several contributions to the literature. First, we contribute to the CSR literature by providing the large sample evidence on greenwashing. While the academic literature has long argued that firms may exaggerate their true CSR activities (Delmas and Burbano, 2011), our paper is the first study to show that poor CSR performance firms have strong incentives to use and actually do use a greenwashing strategy. Prior literature relies on theory or experiments to study CSR disclosure behavior, whereas the novel setting of social media allows us to directly observe corporate dissemination of CSR activities and the resulting response by investors on a large scale. The unique features of Twitter and firms' widespread use of the social media platform offers us an opportunity to provide a more complete picture of CSR disclosure using archival data. Individuals cluster on Twitter, so the potential benefits of adopting a greenwashing strategy are high; meanwhile, regulation of social media is relatively loose, so potential costs including litigation cost are relatively low. High benefits and low costs make it easier to play a manipulation game such as greenwashing.

Second, we contribute to the disclosure literature in general. Recent accounting studies on social media primarily focus on corporate use of social media to disclose financial or product-related information. However, in capital markets with limited attention, Twitter is an ideal platform to distribute CSR information and enhance social value by attracting more individual investors. This also suggests that the content of proactive information disclosure should match with the features of disclosure platform and the people who follow the platform.

Finally, our study shows the power of machine learning in processing unstructured short text data. A significant number of studies on textual analysis are emerging in accounting and finance, however, these studies focus on media articles, firm annual reports, analyst reports, etc. A dictionary approach and LDA are two common approaches used in these studies. Several studies

examining tweets use a dictionary approach; our study is one of the first to adopt an LDA approach to processing millions of tweets. With the combination of a new approach and new large sample text data, we are able to show a phenomenon that is otherwise very hard to detect.

The rest of the paper is organized as follows. Section 2 reviews related literature and develops our hypotheses. Section 3 describes our data and research design. Section 4 presents main results and additional analyses. Section 5 concludes.

2 Literature Review and Hypothesis Development

A number of economic studies provide theories and conduct experiments to understand economic agents' prosocial behavior. The general conclusion is that CSR is consistent with profit maximization in a competitive market (Besley and Ghatak 2007), individuals reward prosocial activities. For example, Bénabou and Tirole (2006) develop a theory of prosocial behavior that combines heterogeneity in individual altruism and greed with concerns for social reputation or self-respect. Besley and Ghatak (2005) find that providing incentives for employee engagement in prosocial activities can help attract motivated employees, and Burbano (2016) finds a similar conclusion that workers are willing to accept relatively lower salary from socially responsible firms. Eichholtz et al. (2010) show that premiums in effective rental rate for commercial building with a "green rating" are seven percent higher per square foot than otherwise identical buildings.

Traditional accounting and finance research has been debating on whether corporate prosocial behavior is merely a response to shareholder demand.⁴ A number of prior studies document the benefits of CSR investment or CSR disclosures for shareholders by examining how

⁴ There has been a growing interest in corporate sustainability issues by the investors. The number of signatories to the United Nations Principles for Responsible Investment (UNPRI) reached more than 1,300 in 2015, representing more than \$35 trillion of assets under management (Serafeim 2015).

corporate CSR-related policies affect firms' cost of capital, valuation, and analyst coverage. Clarkson et al. (2011) find that significant improvements (declines) in environmental performance in the prior periods can lead to improvements (declines) in financial performance in the subsequent periods. Dhaliwal et al. (2011) show that firms with superior CSR performance experience a reduction in their cost of equity capital and attract dedicated institutional investors and analyst coverage. Cheng et al. (2014) report that firms with better environmental performance face significantly lower capital constraints. Interestingly, Elliott et al. (2014) suggest that CSR performance disclosures increase the estimate of firm's fundamental value but only when investors have not explicitly assessed the details of CSR activities. Furthermore, Khan et al. (2016) find the positive impact of CSR on firm valuation only comes from the firms with good ratings on material sustainability issues. This discrimination on the nature of CSR activities is also documented in Kruger (2015), which shows that the market reacts to positive and negative CSR events differently, and CSR news with stronger legal and economic information content generates a more pronounced investor reaction.

In addition to the evidence on the value implications of CSR, prior studies further investigate the benefits for firms with strong CSR performance in unique business settings. For example, in mergers and acquisitions, existing research shows that CSR creates value for acquiring firms' shareholders (Deng et al., 2013). Specifically, acquirers with higher CSR scores enjoy higher merger announcement returns, larger increases in post-merger long-term operating performance and positive long-term stock returns. Mergers by acquirers with higher CSR scores take less time to complete and are less likely to fail. Lins et al. (2017) show that high CSR rating firms outperform low CSR rating firms in stock returns by four to seven percent during the period of financial crisis (2008-2009). High-CSR firms enjoy higher profitability, growth, and sales per

employee, and are able to raise more debt during the crisis period. The findings suggest that investors trust these high-CSR firms even more when they suffer from negative shocks.

Collectively, the mounting empirical evidence suggests that firms' CSR activities benefit their shareholders, supporting the argument of "doing well by doing good." Meanwhile, researchers also show that firms engage in CSR activities for reasons that go beyond shareholder value maximization. Lys et al. (2015) argue that CSR activities have information in signaling future financial performance. Acknowledging the challenges in examining important CSR questions using archival data, in their experiments Martin and Moser (2016) find that subjects respond positively to the CSR disclosures although these disclosures do not indicate positive future earnings or cash flows. Such stakeholder view is widely documented in studies that examine the importance of social norms in shaping economic behavior and market outcomes besides CSR activities. Hong and Kacperczyk (2009) find that "sin stocks" are less held by norm-constrained institutions such as pension plans as compared to mutual or hedge funds that are natural arbitrageurs, and these stocks also receive less analyst coverage. Liu et al. (2014) show that institutional investors' shareholdings and analyst coverage of sin stocks increase with the degree of social norm acceptance.

Another theme of research focuses on the driving factors of CSR activities. One such factor is the views of the individuals running firms. If corporate insiders view CSR more positively, their firms are more likely to invest in CSR activities. Supporting this idea, Davidson et al. (2019) find that CEO fixed effects explain 59 percent of the variation in CSR scores, whereas firm fixed effects explain 23 percent of the variation. Prior literature also documents an inverse relationship between CSR performance and corporate behaviors such as earnings management, misconduct, and insider trading. Kim et al. (2012) find that not only are socially responsible firms less likely to manage

earnings through accruals and real activities, they are also less likely to become the subjects of Securities and Exchange Commission (SEC) investigations. Christensen (2016) finds that firms that issue CSR reports are less likely to engage in high-profile misconduct (e.g., bribery, kickbacks, discrimination) and, when high-profile misconduct does occur, firms that issue CSR reports experience less negative stock price reactions. This evidence suggests that CSR reporting protects shareholder value. A similar notion can be found in the insider trading setting. Gao et al. (2014) find that executives of CSR-conscious firms are less likely to strategically trade prior to future news events and profit significantly less from their trades compared to the executives of other firms.

Given these benefits associated with, and the demand for, CSR activities, it is in the shareholders' interest to disclose CSR information to signal firms' future financial prospects to attract investors and potential employees. However, the implementation of CSR activities is not the same across all firms. While good CSR performance firms have an incentive to disseminate their CSR activities, less socially responsible firms should have an equally strong or even stronger incentive to promote their CSR activities. Such mimicking behavior is suggested by prior studies. For example, Clarkson et al. (2008) discuss the relationship between environmental performance and environmental disclosure. By claiming to be "green" without truthfully implementing business practices to minimize environmental impact, the mimicking firms create a misleading picture of their environmental friendliness. Firms often disclose that they have an environmental policy and that firms are committed to protecting the environment. Such claims can be genuine when put in specific context but they can also be deceiving as they lack credibility and concrete evidence. Such a greenwashing strategy works better in a setting when the benefits of disclosure are high and the costs are low, such as on Twitter. Delmas and Burbano (2011) discuss the drivers of greenwashing.

Over the past decade, social media has transformed the way firms communicate information with their stakeholders. Twitter, in particular, is an increasingly popular and mature platform where companies share information with their present and potential investors.⁵ Recent accounting literature responds to the trend. Blankespoor et al. (2014) first find that firms can reduce information asymmetry by using Twitter to disseminate their news. Lee et al. (2015) find that corporate social media attenuates the negative price reaction to product recall announcements. Jung et al. (2018) provide evidence on the strategic choice of information dissemination of quarterly earnings news through social media. They find that firms are less likely to disseminate earnings news through social media when the news is negative, and that the pattern is stronger among firms with high litigation risk. Crowley et al. (2019) provide comprehensive evidence showing how firms strategically manage the timing and format of tweets around earnings announcement, accounting filings, and other important corporate events.

While Twitter may not be the first outlet where firms announce their CSR information to the public, it is a platform well suited for promoting corporate CSR activities. Dissemination on Twitter has a very low cost, yet like marketing, tweeting is an effective vehicle to bring individuals' attention to CSR issues. Such individuals have limited resources to verify these activities. In such a setting, a greenwashing strategy should work more effectively. We also expect greenwashing to be prevalent and stronger among less socially responsible firms as the benefits of greenwashing are higher for them as compared to good CSR performance firms. As a result, there should be a negative association between CSR scores and firms' CSR dissemination on social media.

⁵ In its report of Investigation Pursuant to Section 21(a) of the Securities Exchange Act of 1934: Netflix, Inc., and Reed Hastings issued on April 2, 2013, the SEC embraced the corporate use of social media and stated that "we appreciate the value and prevalence of social media channels in contemporary market communications, and the Commission supports companies seeking new ways to communicate and engage with shareholders and the market. See <http://www.sec.gov/litigation/investreport/34-69279.htm>.

The above discussions on prior research and predictions lead to our first hypothesis stated in the alternative form:

H1: Firms' number of CSR tweets is negatively associated with firms' CSR performance.

Not only might firms take advantage of unique features of Twitter to tweet more CSR activities, they may also choose the presentation style of their tweets to enhance the effect of their disclosures. The accounting literature has documented that managers choose presentation style strategically and their choices are reflected through tone, specificity, optimism, etc., and presentation style has a significant impact on the effect of disclosure (e.g., Li 2008, Hope, Hu, and Lu 2016). Prior studies on CSR examine how the CSR activities are described and presented to stakeholders and investors (e.g., Martin and Moser 2016, Elliott et al., 2017). On one hand, firms adopting a greenwashing strategy have incentives to hide their strategy by maintaining a more neutral appearance in their disclosures, and thus these firms may adopt more passive tone and post shorter tweets. On the other hand, these firms are more likely to choose extreme and positive tone to increase the impact of their dissemination. We explore the differences in tweeting style between less and more socially responsible firms in our second hypothesis, which is stated as follows:

H2: Poor CSR performance firms are more likely to use shorter tweets, passive voice, and extreme tone.

One view in the CSR literature suggests that firms engage in prosocial behavior because people want corporations to do good on their behalf and that corporations respond to this demand (Besley and Ghatak, 2005). Bénabou and Tirole (2010) suggest that information and transaction costs are likely to be lower if CSR activities are delegated through corporations rather than if investors do them on their own or through other channels such as charitable organizations. This

delegation view predicts that firms' CSR activities are appealing to the individuals who are interested in social responsibility and sustainability issues.

Since Twitter account followers are mainly individuals, CSR tweeting may generate capital market consequences different from the effect of disclosures on other channels.⁶ Like other disclosures, Tweets may also reduce information asymmetry. Blankespoor et al. (2014) indeed show that bid-ask spread is reduced in a short window around financial news announcement and the effect only exists for firms that are not highly visible. However, implementing a greenwashing strategy adds noise to the information content of CSR tweets. In addition, unlike the disclosure of fundamental information that will likely change information asymmetry and investors' valuation of the firms, disclosing CSR activities on Twitter may serve a different purpose, such as promoting companies and spreading goodwill to their stakeholders. Since the primary objective of CSR dissemination is no longer to reduce information asymmetry about firm fundamentals, the fact that investors are well informed about firms' CSR activities does not imply that they are well informed about firms' future earnings or cash flows. Prior studies also document the link between a firm's investor base and stock return volatility. For example, Bushee et al. (2003) show that open conference calls are associated with a greater increase in small trades and higher price volatility during the call period. Attracting more individual investors who are usually less informed than institutional investors may lead to an increase in stock return volatility and bid-ask spread.

The above discussion suggests two possibilities: The first possibility is good CSR performance firms attract more individuals, so their institutional ownership decreases and their bid-ask spread and return volatility increase after joining Twitter; the second possibility is that there is no capital market consequence because of the noise in information content of CSR tweets

⁶ We acknowledge that Twitter followers are not necessarily investors, but it is reasonable to assume that the number of investors following a firm increases with the number of followers the firm has.

due to poor CSR performance firms greenwashing. It may be possible that the effect is even opposite if poor CSR performance firms' mimicking behavior dominates. Ex ante, we state our third hypothesis on capital market consequences in the alternative form:

H3: Good CSR firms experience a greater decrease in institutional ownership and a higher increase in bid-ask spread and return volatility after joining Twitter than do poor CSR performance firms.

3 Research Design

3.1 Data and Sample Selection

We construct our sample from multiple databases. The initial sample consists of all public firms in the S&P 1500 at any point from January 2011 through September 2016. We hand-collect the Twitter handles of all these firms and, based on these, identify Twitter IDs via Twitter API 2.0 associated with each account.⁷ We identified 1,443 Twitter accounts by September 2016. After removing accounts that make their tweets only available to followers and accounts that have never tweeted, our initial sample contains 1,350 companies' Twitter accounts. We first checked the number of tweets for each account in our sample period and used the Twitter API 2.0 to download all publicly available tweets associated with those Twitter accounts. For the 614 accounts with more than 3,200 tweets at the start of our collection period, we purchased a complete set of tweets for each company from GNIP, which is one of the world's largest social data providers and was acquired by Twitter in 2014.⁸

⁷ Unlike Twitter handles which can be changed with mergers or rebranding, Twitter IDs are a permanent identifier. We use IDs to track companies across multiple Twitter handles.

⁸ GNIP's data price was partially based on the number of Twitter IDs, so we only purchased those accounts with the number of tweets exceeding 3,200. As public access is limited to the 3,200 most recent tweets per account, we downloaded tweets from firms with fewer than 3,200 tweets using the Twitter API 2.0 as of January 1, 2017. For all

MSCI ESG STATS, formerly known as KLD Research & Analytics, Inc., is a dataset that provides information on firms' performance on each of three dimensions: (1) environmental performance; (2) social performance including community, human rights, employee relations, diversity, and product; and (3) governance performance. For example, its environmental performance ratings include both strengths (i.e., strengths in areas such as environmental opportunities, waste management, packaging materials & waste, climate change, etc.) and concerns (i.e., concerns in areas such as toxic spills & releases, agriculture chemicals, climate change, impact of products & services, etc.). We combined our initial Twitter sample with the MSCI ESG STATS dataset, Compustat (financial information), and CRSP (stock market data). After excluding firms in the financial industry and firms with missing information, our final sample contains 936 unique firms.

Table 1, Panel A, summarizes the sample selection process. Panel B shows the distribution of the years that firms opened a Twitter account. While Twitter officially went online in 2006, 2009 is the peak year that our sample S&P 1500 firms opened Twitter accounts. 306 firms started to use Twitter during our sample period from 2011-2016.

3.2 Tweet and CSR Measures

3.2.1 Tweet Measures

We extract information on the usage of Twitter for each firm, including Twitter adoption date, number of followers by the end of 2016, daily tweets initiated by the firm, and the content of each tweet. To identify whether a tweet contains information on social responsibility activities, we apply the Twitter-LDA algorithm of Zhao et al. (2011). This algorithm is based on the Latent Dirichlet Allocation (LDA) algorithm of Blei et al. (2003) which provides a way to categorize the

tweets after January 1, 2017, we download them using the Twitter API 2.0. For tweets purchased from GNIP, we acquired the tweets in May 2017.

thematic content, or topics, within documents in an automated, researcher bias-free manner. Twitter-LDA extends the basic LDA model to work with shorter ‘documents’ in the form of tweets, short text snippets of at most 140 characters, by incorporating correlations between words across Twitter users. We run this algorithm to detect 100 topics among the companies’ tweets.⁹ We then manually classify the topics, identifying two CSR-related topics. We use the Twitter-LDA topics to classify every tweet into a topic, based on the highest weighted topic for the tweet. The first CSR related topic (topic 27) contains words such as “water,” “food,” “today,” “global,” “sustainability,” and “sustainable.” The second CSR related topic (topic 40) contains words such as “support,” “community,” “helping,” “donate,” “local,” and “volunteers.” Topic 27 largely focuses on sustainability and natural resources, while topic 40 picks up community service aspects of CSR. Other topics picked up by the Twitter-LDA algorithm include advertising, analytics, customer support, energy, flight, healthcare, hiring, politics, small business, and stock markets, among others. Appendix A provides examples of firms’ CSR tweets for both CSR topics. Some tweets (Adobe, Ball Corporation, HP, Navigant, and Tyson Foods) include hyperlinks to CSR news already disclosed elsewhere, whereas others (such as the tweet by DSM) only include text or images without pointing users to other sources of information. Appendix B presents details of the Twitter LDA topics.

Our tweet measure, *CSR tweets*, is the number of CSR tweets we are able to retrieve in a year. To control for the continuous increase of Twitter accounts in our sample period every year, we adopt a second tweet measure, *CSR tweets (scaled)*, which is calculated as the number of CSR tweets posted by a given firm in a year scaled by its number of active days in the year of Twitter adoption or by 365 for the accounts created in previous years, multiplied by 100. CSR tweets are

⁹ We run the Twitter-LDA model for varying numbers of topics. We found 100 topics to be the fewest number of topics which allowed for clean isolation of CSR content.

those tweets identified by the LDA algorithm and classified as topic 27 or 40, our CSR-related topics. We also derive several general tweeting measures: *Tweets* is the number of tweets in a year. To capture the popularity of a Twitter account, *Followers* measures the log of one plus the total number of followers at the end of 2016. *Twitter Age* is defined as the number of days between the start of a Twitter account and the end of a given year scaled by 365.

3.2.2 CSR Measures

MSCI ESG STATS dataset compiles CSR ratings for three areas: environmental, social, and governance. For each issue, MSCI ESG provides indicators of strengths and concerns. To construct a composite CSR measure, we assign equal weight to the different issues. We define *Lag CSR strength* as the sum of strengths in the MSCI ESG STATS database in the previous year and *Lag CSR score* as the number of total strengths minus the number of total concerns in the previous year.

3.3 Model Specifications

To test H1, we estimate model (1) to examine the relationship between a firm's use of Twitter and its CSR score.

$$\begin{aligned} \text{Tweets measure} = & \beta_0 + \beta_1 \text{Lag CSR measure} + \beta_2 \text{Size} + \beta_3 \text{Lev} + \beta_4 \text{ROA} + \beta_5 \text{MTB} + \\ & \beta_6 \text{Advertising} + \varepsilon \end{aligned} \quad (1)$$

Tweets measure is either *CSR tweets* or *CSR tweets (scaled)*. We use two independent variables for *Lag CSR Measure*, one is *Lag CSR strength* and the other is *Lag CSR score*. We use lagged CSR measures because we expect that the level of tweeting in the current year may be affected by how the firm performs in CSR areas in the prior year. Our first hypothesis predicts that the sign for β_1 is negative because we expect to observe greenwashing, i.e., that firms with worse CSR performance tweet more about their CSR activities in the next period. The control variables include

measures of firm-characteristics: firm size (*Size*), leverage as defined by total liabilities divided by total assets (*Lev*), return on assets (*ROA*), market-to-book ratio (*MTB*), and advertising expenses scaled by sales (*Advertising*). We further include firm- and year-fixed effects. Appendix C provides detailed definitions of each variable.

To test H2, we estimate model (2) to examine how firms choose the style and tone of their tweets while tweeting about CSR activities.

$$\begin{aligned} \text{Style} = & \beta_0 + \beta_1 \text{Lag CSR measure} + \beta_2 \text{CSR tweets (scaled)} + \beta_3 \text{Size} + \beta_4 \text{Lev} + \\ & \beta_5 \text{ROA} + \beta_6 \text{MTB} + \beta_7 \text{Advertising} + \beta_8 \text{Non-CSR Style} + \varepsilon \end{aligned} \quad (2)$$

The dependent variable, *Style*, consists of four variables, *CSR tweet length*, *CSR tweet passive*, and two CSR tweet extreme tone measure - negative and positive tone. *CSR tweet length* measures the average number of words used per CSR tweet, while *CSR tweet passive* measures the percent of CSR tweets that are written in passive voice. The tone measures, *CSR tweet positive* and *CSR tweet negative*, measure the percent of words in CSR tweets that are positive or negative, respectively. The independent variable is *Lag CSR measure* as in model 1. Hypothesis 2 predicts that β_1 is positive for tweet length and negative for passive voice and extreme tone. We use a similar set of control variables as in Equation (1) except that in Equation (2) we also control for the style of non-CSR tweets (*Non-CSR Style*).

To test H3, we first estimate model (3) to examine whether CSR performance affects the popularity of a Twitter account:

$$\begin{aligned} \text{Followers} = & \beta_0 + \beta_1 \text{Lag CSR measure} + \beta_2 \text{Size} + \beta_3 \text{Lev} + \beta_4 \text{ROA} + \beta_5 \text{MTB} + \\ & \beta_6 \text{Advertising} + \beta_7 \text{Twitter age} + \varepsilon \end{aligned} \quad (3)$$

The dependent variable is log of one plus the number of followers by the end of 2016 (*Followers*).¹⁰ We use three measures for the independent variable *CSR measure*. For each firm, we take the value of CSR performance in the year before opening a Twitter account and calculate *CSR strength* and *CSR score*, respectively. We measure control variables in the year before the start of Twitter account except for *Twitter age*. *Twitter age* is the number of days from the start of Twitter account to the end of 2016, divided by 365. We also include industry fixed effects and Twitter adoption year fixed effect.

Since firms open Twitter accounts in different years, we adopt a difference-in-differences (DID) approach to examine whether a firm's CSR performance affects its institutional ownership, bid-ask spread, and return volatility through its Twitter activities. We choose the period from eight quarters before to eight quarters after a firm's Twitter adoption date for each firm. We focus on this window around the adoption date to better identify the capital market consequences of disseminating CSR activities on Twitter. To test H3, we estimate model (4):

$$\begin{aligned} \text{Market Measure} = & \beta_0 + \beta_1 \text{Lag CSR measure} + \beta_2 \text{Post} + \beta_3 \text{Lag CSR measure} \times \text{Post} + \\ & \beta_4 \text{Size} + \beta_5 \text{Lev} + \beta_6 \text{ROA} + \beta_7 \text{MTB} + \beta_8 \text{QRet} + \varepsilon \end{aligned} \quad (4)$$

The dependent variable, *Market Measure*, includes institutional ownership, bid-ask spread, and return volatility. Institutional ownership is measured as the number of shares held by institutional investors divided by total number of shares outstanding at the end of the quarter. Following Corwin and Schultz (2012), we estimate bid-ask spread from daily high and low prices, and then we define *Spread* as the average value of daily bid-ask spreads during a quarter multiplied by 100. We measure return volatility (*Volatility*) as the standard deviation of daily stock returns for a quarter. *Post* is an indicator variable that takes a value of one after a firm adopts Twitter and zero otherwise.

¹⁰ Change in followers is not available for each year during 2011-2016.

Our variable of interest is the interaction between *Lag CSR Measure* and *Post*. Hypothesis 3 predicts that the changes in firms' institutional ownership, bid-ask spread, and stock volatility would be different for firms with different CSR performance. We expect β_3 to be positive in the regression with institutional ownership as the dependent variable and negative in the bid-ask spread and volatility regressions if the greenwashing strategy is successful, i.e., poor CSR performance firms post more CSR activities on Twitter and attract more individual followers. In contrast, if good CSR performance firms attract more individual followers, the sign of β_3 will be opposite. We include a similar set of variables to control for firm characteristics and quarterly stock returns (*QRet*) to control for firms' stock market performance. We also control for firm- and year-quarter-fixed effects.

4 Empirical Results

4.1 Descriptive Statistics

Table 2 reports the summary statistics for the variables used in our main analyses. Panel A describes firm-year observations during 2011-2016. On average, our sample firms have been on Twitter for 4.41 years and post 12 tweets about their CSR activities each year, which is a small fraction of the annual number of their tweets (2,565). By the end of 2016, the average number of followers is 183,073. The average number of CSR strengths for our sample firms is 2.67, with a net CSR score of 1.15. Panel B presents stock market measures for 7,342 and 6,917 firm-quarter observations before and after sample firms join Twitter, respectively. On average, sample firms have better quarterly returns, lower daily bid-ask spread and lower return volatility after joining Twitter. The changes are dramatic. For instance, daily bid-ask spread decreases from 0.98 percent to 0.80 percent in the period after Twitter account adoption, representing a 19 percent decrease.

This change in spread is consistent with the findings of Blankespoor et al. (2014).

4.2 Testing H1

Table 3 reports the regression results testing H1, the greenwashing hypothesis, testing whether a firm performing poorly on CSR in the previous period tweets more about CSR activities in the next period. The dependent variable is *CSR tweets*, and the variables of interest are *Lag CSR strength* and *Lag CSR score*. H1 predicts that the sign for the two variables of interest is negative. Columns (1) and (2) show that the coefficients for *Lag CSR strength* and *Lag CSR score* are both negative (-0.163 and -0.149) and statistically significant at the 1% level ($t = 2.65$ and 2.79). The evidence supports the first hypothesis, i.e., those firms with fewer CSR strengths and lower CSR scores are more likely to disseminate their CSR activities on social media next year compared to better CSR firms. Our discussion in the hypothesis development section highlighted two possibilities, the good citizen view and the greenwashing hypothesis. We interpret this result as evidence supporting the greenwashing hypothesis – that firms with lower CSR scores post more CSR tweets in order to create a (misleading) reputation of being a green firm. We also find that the coefficients for the three control variables, *Size*, *ROA*, and *advertising* follow the expected signs. These variables are all significantly positively associated with CSR tweets, suggesting that larger firms, more profitable firms, and firms spending more on advertising expenses are more likely to post CSR tweets.

Table 3 suggests that firms with poor CSR performance are more likely to use social media to their advantage in communicating CSR information. Besides greenwashing, the finding is subject to several alternative explanations, which will be discussed below.

4.2.1 Financial Tweets

CSR activities are typically non-financial, but they are often included and discussed in financial reports such as 10-K and 10-Q reports. Firms tweet around the major financial events such as earnings announcements and the filings of financial statements. Following Crowley et al. 2019, we define a variable *Fin tweets*, which is equal to the number of a firms' tweets discussing financial information during the year. We then construct *Fin tweets (scaled)* using the same transformation as we used for *CSR tweets (scaled)*. We control for financial tweets in our regression and report the result in column (1) of Table 4. As expected, the sign of the coefficient for the variable *Fin tweets (scaled)* is significantly positive with a *t*-stat equal to 4.64. This suggests that when there are financial tweets, firms are more likely to tweet CSR activities. However, controlling for financial tweets does not take away the effect of greenwashing; the coefficient for *Lag CSR strength* remains significantly negative ($t = 2.59$).

4.2.2 Major Corporate Events

It has been debated whether the information disclosed on Twitter is new. If the activities are not new, then tweets are only used to disseminate existing information and these tweets may be a proxy for other corporate events. To test such a possibility, we collected all 8-K filings from SEC EDGAR. We developed four measures related to 8-K filings using the full text of all such filings. *CSR 8-K content* and *Total 8-K content* represent the amount of content in 8-K filings related to CSR or other issues, respectively. These measures are based on our LDA model of tweet content, applying the dictionaries produced by Twitter-LDA to the 8-K filings. We also measure the total number of 8-K filings (*Total 8-K count*) and the number of 8-K filings where the most prevalent topic is a CSR topic (*CSR 8-K count*). Columns (2) and (3) of Table 4 present the results with the controls for 8-K content and counts. These variables are all insignificant, suggesting that

disseminating CSR activities on Twitter is not associated with other major corporate events which require filing 8-K reports. *Lag CSR strength* remains significantly negative.

4.2.3 CEO and CFO Fixed Effects

The decision to conduct or disclose CSR activities are made by corporate insiders. Davidson et al. (2019) documents that CEO fixed effects can explain 59 percent of the variation in CSR scores while firm fixed effects only explain 23 percent of the variation. Meanwhile, it is known that the disclosure decisions are often made by CFOs, and we thus control for either CEO or CFO fixed effect in the regressions reported in columns (4) and (5) of Table 4. Our results are robust. Column (6) of Table 4 is the most comprehensive specification controlling for firm, year, CEO and CFO fixed effects. The variable, *Lag CSR strength*, remains significantly negative throughout.

While we only present the results in Table 4 from regressing *CSR tweets (scaled)* on *Lag CSR strength*, the results are robust after we replace *Lag CSR strength* with *Lag CSR score* in all regressions.

4.3 Testing H2

Our second hypothesis states that firms with low CSR scores are more likely to use shorter tweets, passive voice and extreme tone. We regress four dependent variables, *CSR tweet passive*, *CSR tweet length*, *CSR tweet negative*, and *CSR tweet positive* on *Lag CSR strength* and *Lag CSR score*. Extreme tone includes both negative and positive tone. H1 supports the existence of greenwashing, suggesting that poor CSR performance firms communicate their CSR activities positively. We thus expect the effect from positive tone is stronger than negative tone. Besides controlling for the variables in earlier regressions, we also control for passive voice, length, and

negative and positive tone from non-CSR tweets. These non-CSR tweets are expected to capture the style of firms' general tweets, serving as a good benchmark for these tests.

Table 5 presents the regression results. Column (1) shows that *CSR tweet passive* is negatively associated with *Lag CSR strength* and positively associated with *Non-CSR passive*. This suggests that the firms performing poorly in CSR are more likely to use passive voice in their CSR tweets after controlling for general voice in their other tweets. The results are robust to using *Lag CSR score* in the regression. No control variables are significant. Columns (3) and (4) show that CSR tweet length is positively associated with *Lag CSR strength* ($t = 1.97$) and *Lag CSR score* ($t = 2.37$), suggesting that the CSR tweets from firms with poor CSR performance are on average shorter than CSR tweets from other firms. The coefficient for non-CSR length is significantly positive, consistent with our expectations that the length of CSR tweets is highly correlated with the length of other firm level tweets.

Columns (5) to (8) show the association between CSR extreme tone and CSR strength and score. They are negatively associated. The evidence indicates that firms with poor CSR performance use more extreme tone, i.e., their CSR tweets are either more negative or more positive. A chi-squared test shows that the effect of CSR performance is stronger for positive tone than for negative tone ($p = 0.018$ and $p = 0.076$ when using *Lag CSR strength* and *Lag CSR score*, respectively). The coefficient for negative tone on *Lag CSR strength* is -0.038 and for positive tone on *Lag CSR strength* is -0.128. The effect of positive tone is over three times stronger than the effect of negative tone. Interestingly, CSR negative tone is positively associated with non-CSR negative tone, but CSR positive tone is not associated with non-CSR positive tone.

In sum, the evidence presented in Table 5 supports Hypothesis 2 – poor CSR performance firms not only tweet more but also strategically choose the presentation style of their CSR tweets.

4.4 Testing H3

Our Hypothesis 3 tests the capital market consequence of joining Twitter for the firms with varying CSR performance. We first examine the relationship between firms' number of Twitter followers and CSR performance. Specifically, we examine whether firms with good CSR performance tend to attract more followers on Twitter. Table 6 presents the regression results. As expected, columns (1) and (2) show that the coefficients on *Lag CSR strength* and *Lag CSR score* are both positive and significant at 0.250 ($t=7.82$) and 0.161 ($t=4.80$), respectively. The results suggest that a firm with better CSR performance attracts more followers after it opens a Twitter account. Most of control variables are positively associated with the number of Twitter followers by the end of 2016. This evidence suggests that Twitter users tend to follow large firms, high leverage firms, firms advertising heavily and joining Twitter earlier. Columns (3) to (6) show the regressions for both low CSR and high CSR strength and score sub-groups (split at the median). The dependent variable is the number of followers and the variable of interest is *CSR tweets*. The regressions show that for both poor and good CSR performance groups, the coefficient for *CSR tweets* is significant. However, the magnitude of the coefficient on *CSR tweets* for the poor CSR group is only about half that of the good CSR group. Comparing the low CSR strength group (column 3) with the high CSR strength group (column 4), the coefficient is 0.035 for the former and 0.067 for the latter. The difference suggests that although high CSR firms do not tweet CSR activities as frequently as low CSR firms, their CSR tweets attract more followers per CSR tweet. They attract followers through quality instead of quantity. It may also explain why poor CSR performance firms tweet CSR activities more heavily, as they do not attract as many followers per CSR tweet as good CSR performance firms.

Next, we examine the capital market consequences after firms create Twitter accounts in Table 7 by implementing a difference-in-differences research design. The regressions in Table 7 provide evidence on the change in institutional ownership, bid-ask spread and return volatility after firms join Twitter. Columns (1) and (2) use *Spread* as the dependent variable. The coefficient on the interaction term, $Post \times Lag\ CSR\ strength$, is the variable of interest. It is positive and significant at 0.005 ($t = 5.07$). The result indicates that, compared with firms with fewer CSR strengths in prior year, firms with more CSR strengths are associated with larger bid-ask spread after these firms adopt Twitter. Column (2) reveals similar results when we repeat the analysis by replacing the independent variable with *Lag CSR score*. We also find significant results on control variables. Specifically, larger firms, firms with low leverage and better performing firms as well as firms with high past returns firms enjoy lower bid-ask spreads after joining Twitter.

Columns (3) and (4) present regression results when using return volatility as the dependent variable. We find positive and significant coefficients on the interaction term of *Post* with the two CSR measures, suggesting that firms with good CSR performance experience an increase in return volatility after joining Twitter, relative to firms with poor CSR performance. The results are robust when using *Lag CSR score* as a proxy for CSR performance.

Columns (5) and (6) examine how CSR performance affects institutional ownership after the adoption of Twitter. The interaction terms of *Post* and the two CSR measures are negatively associated with institutional ownership at the one percent significance level. The results indicate that, after firms join Twitters, institutional ownership for the firms with higher CSR scores decreases more. These results are consistent with the findings in Table 6. The good CSR performance firms may have attracted more individual followers and thus experienced an increase in bid-ask spread and volatility along with a decrease in institutional ownership. The evidence in

Tables 6 and 7 overall support Hypothesis 3. In other words, poor CSR performance firms adopt a greenwashing strategy and strategically choose their CSR tweet presentation style, but the impact of their mimicking behavior on capital markets is not as effective as the CSR tweets by good CSR performance firms.

4.5 Greenwashing and Earnings Management

By claiming to be socially responsible without truthfully investing money and resources to improve CSR metrics, firms can deliver deceiving messages to naïve investors. Hemingway and MacLagan (2004) argue that managers might engage in CSR activities to cover up the impact of corporate misconduct. For example, Enron was a huge corporate giver, particularly to the Houston area, and one of the most impressive ‘glossy brochures’ documenting the multiple facets of a firm’s CSR benevolence is the one issued in 2007 by the American International Group (Bénabou and Tirole 2010). In this subsection, we examine whether there is an association with the likelihood of earnings management and greenwashing. We expect that firms employing greenwashing are also more likely to manage earnings, so we expect the firms with poor CSR performance are more likely to manage earnings.

We proxy for earnings management using the residuals at the industry-year level (*Dis Accruals*) estimated using the McNichols (2002) model, which combines the determinants from both the Jones (1991) model and the Dechow and Dichev (2002) model. We then examine the relation between earnings management and CSR tweet activities during 2011-2016. Untabulated results show that the coefficient on CSR tweets is positive and significant, consistent with greenwashing being associated with earnings management. On the other hand, the coefficient on the interaction between CSR tweets and CSR strengths or CSR score is negative and significant, suggesting that firms with strong CSR performance are less likely to manage earnings upward.

This evidence is consistent with the findings in Christensen (2016) that firms issuing CSR reports are less likely to engage in high-profile misconduct. Taken together, it appears that CSR tweets are more positively associated with earnings management for poor CSR performance firms, i.e., when greenwashing is most likely being employed. Thus, we interpret our results in this section as evidence consistent with the greenwashing explanation.

5. Conclusion

Our study investigates how social media reveals individuals' demand for corporate prosocial behavior and whether firms disseminate CSR activities on social media strategically. We find that firms with poor CSR performance in the prior period post more tweets about their CSR activities, consistent with the greenwashing hypothesis. Moreover, tweeting style is also different across the firms with different degrees of CSR performance. Firms with poor CSR performance use shorter tweets, more passive voice in their tweets, and adopt more extreme tone, particularly positive tone. Although firms with poor CSR performance tweet more CSR activities, we show that firms with good CSR performance attract more followers per tweet. The evidence suggests that some individuals are able to distinguish the quality of CSR disclosures. We find that firms with stronger CSR performance experience a greater increase in bid-ask spread and return volatility along with a greater decrease in institutional ownership, relative to firms with poor CSR performance after joining Twitter.

Our study adds to both the voluntary disclosure literature and the CSR literature by presenting some of the first evidence on how firms manage their CSR reputation on social media and document its capital market consequences. We test the greenwashing hypothesis and find its existence on Twitter. Firms with poor CSR performance appear to be more aggressive in disseminating CSR information. Greenwashing can have a negative effect on the credibility of

green disclosure and socially responsible firms, making stakeholders reluctant to reward firms' socially responsible performance. Our study provides new insights on CSR practices, i.e., firms manage their CSR reputation by engaging in CSR activities as well as disseminating CSR activities strategically.

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Appendix A. Examples of CSR Tweets

Sustainability and natural resource tweet examples (Topic 27)

Adobe: @Adobe, ID 63786611

12 Sept 2012, 9:01 AM

“#FunFact: At our #SanJose headquarters, 98% of solid waste is diverted from landfill through #recycling <http://adobe.ly/SpZrOS> #CSR”

DSM: @DSM, ID 249548988

22 Oct 2015, 12:30 PM

“With the American Business Act on Climate Pledge, we tied our exec compensation to meeting #sustainability targets”

Ball Corporation: @BallCorpHQ, ID 22986858

17 Nov 2015, 9:14 AM

“Ball Announces Notable Progress Toward 10-Year Carbon Footprint Reduction Target: <http://ow.ly/2bwk8v> #sustainability #cut4carbon”

Community service tweet examples (Topic 40)

HP: @HP, ID 17193794

14 Apr 2011, 1:08 PM

“Help victims of the #Japan crisis with #HP. Your donation will help those who are most in need: <http://bit.ly/fzKFFg> ^RM”

Navigant: @Navigant, ID 238291579

6 Dec 2011, 3:39 PM

“Visit our Virtual Kitchen & decorate a Cookie for a Cause! For every cookie posted, we will donate \$1 (up to \$10,000) <http://holiday.navigant.com/>”

Tyson Foods: @TysonFoods, ID 15836048

8 Aug 2014, 11:01 Am

“We're proud supporters! > The Children & the Egg: Can a Simple Snack Change Lives in Rwanda? <http://bit.ly/1u6acHQ> via @modfarm #eggucation”

Appendix B. Twitter LDA Approach

To run the Twitter-LDA algorithm, we preprocess all words in tweets to be lowercase (for dimensionality reduction), remove links, remove usernames, remove pure numbers, and remove non-alphanumeric symbols (except for “-” which can be used in compound words and “#” which is used to indicate hashtags on Twitter). We also require tweets to be in English to be included. We then provide lists of all tweets by Twitter ID to the Twitter-LDA algorithm, which leverages correlations between words across tweets and across Twitter IDs to generate its topics. We provide the algorithm with the tweets of all S&P 1500 firms that we identified, including those removed in the analysis, as larger samples help to limit noise in the topic classification.

The following table displays the top 20 words in each of the two CSR topics from the Twitter-LDA algorithm. The words are listed in order, from highest to lowest weighting.

Number	Topic	Top 20 words
27	CSR	water, gas, energy, oil, ceo, industry, food, today, world, global, video, read, #monsanto, technology, #energy, #sustainability, production, solutions, great, booth
40	CSR	support, proud, employees, community, today, great, day, team, food, helping, school, work, kids, local, donate, volunteers, program, join, learn, event

To contrast, the following table presents the top 10 words from five of the other 98 topics generated by the Twitter-LDA algorithm.

Number	Topic	Top 10 words
9	Customer support	team, contact, hear, issue, dm, support, issues, working, assistance, assist
22	Healthcare	health, care, learn, patients, data, #healthit, healthcare, #healthcare, clinical
25	Stock markets	bell, #nasdaq, opening, ring, closing, #nyse, today, nyse, sale, rings
51	Analytics	data, customer, business, #bigdata, digital, learn, #digital, experience, #analytics, blog
100	Energy	energy, power, learn, home, save, gas, solar, customers, electric, check

To assign tweets to topics, we determine the score for each of the 100 topics for each tweet. The topic with the highest score is then assigned to be the topic of the tweet. Thus, for a tweet to be categorized as a CSR tweet, it must have Topic 27 or Topic 40 as its highest scoring topic.

Appendix C. Variable Definitions

Variable	Definitions
<i>Advertising</i>	Advertising expense scaled by sales
<i>CSR 8-K content</i>	Weighted amount of CSR-related 8-K text in a year, using weighted dictionaries from the Twitter-LDA model used for classifying <i>CSR tweets</i>
<i>CSR 8-K count</i>	Number of 8-K filings in a year where the topic with the most content in the filing was a CSR topic, based on an 8-K's weighted content score (see appendix B)
<i>CSR tweets</i>	Number of CSR tweets in a year; if a tweet's weighted content score (see appendix B) is highest for Topic 27 or in Topic 40, we regard it as a CSR tweet
<i>CSR tweets (scaled)</i>	Number of CSR tweets in a year, scaled by 365 or active days in the year of Twitter adoption, multiplied by 100
<i>CSR tweet length</i>	Count of the number of words in a CSR tweet, averaged across all CSR tweets in a year
<i>CSR tweet negative</i>	The percent of words in CSR tweets over a given time period that are negative using the Harvard IV dictionary (matching on both word and part of speech)
<i>CSR tweet passive</i>	Calculated per CSR tweet as 1 if the tweet contains a past participle of a verb, and 0 otherwise. Averaged across all tweets in a year
<i>CSR tweet positive</i>	The percent of words in CSR tweets over a given time period that are positive using the Harvard IV dictionary (matching on both word and part of speech)
<i>Dis Accruals</i>	The residuals from McNichols (2002) model
<i>Fin tweets</i>	An indicator equals to "1" if at least one of the firm's tweets discusses financial information on a given day, 0 otherwise
<i>Followers</i>	Log of one plus total number of followers at the end of 2016
<i>Inst Own</i>	Number of shares held by institutional investors at the end of the quarter divided by shares outstanding.
<i>Lag CSR score</i>	Number of strengths minus number of concerns in MSCI ESG dataset in the previous year
<i>Lag CSR strength</i>	Sum of strengths in MSCI ESG database in the previous year
<i>Lev</i>	Total liabilities divided by total assets
<i>MTB</i>	Market value of common equity over its book value
<i>Non-CSR length</i>	Count of the number of words in a non-CSR tweet, averaged across all non-CSR tweets in a year
<i>Non-CSR negative</i>	The percent of words in non-CSR tweets over a given time period that are negative using the Harvard IV dictionary (matching on both word and part of speech)
<i>Non-CSR passive</i>	Calculated per non-CSR tweet as 1 if the tweet contains a past participle of a verb, and 0 otherwise. Averaged across all tweets in a year
<i>Non-CSR positive</i>	The percent of words in non-CSR tweets over a given time period that are positive using the Harvard IV dictionary (matching on both word and part of speech)
<i>Post</i>	An indicator variable that takes a value of one after a firm joins Twitter and zero otherwise

<i>QCSR tweets</i>	Number of CSR tweets posted by a given firm in each quarter, divided by number of trading days each quarter
<i>QRet</i>	Quarterly stock returns
<i>ROA</i>	Income before extraordinary items scaled by average assets
<i>Size</i>	Log of total assets, where total assets is in millions of USD
<i>Spread</i>	Average daily bid-ask spread for each quarter, measured by the approach in Corwin and Schultz (2012), multiplied by 100
<i>Total 8-K content</i>	Weighted amount of non-CSR-related 8-K text in a year, using weighted dictionaries from the Twitter-LDA model used for classifying <i>CSR tweets</i>
<i>Total 8-K count</i>	Total number of 8-K filings filed in a year
<i>Turnover</i>	Trading volume scaled by number of shares outstanding for each quarter
<i>Tweets</i>	Number of tweets posted by a firm in a given year
<i>Twitter age</i>	Number of days from the start of a Twitter account to the end of 2016, deflated by 365
<i>Volatility</i>	Standard deviation of daily stock returns for each quarter

Table 1 Sample Selection**Panel A: Sample Selection**

Firms with Twitter information during 2011-2016	1350
Less: firms with missing MSCI data	(94)
Less: financial firms	(230)
Less: firms with missing financial data	(90)
Final sample:	936

Panel B: Industry Distribution by Twitter Adoption Year for Sample Firms

Industry	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Agriculture, Forestry & Fishing	1	0	1	0	0	0	0	0	0	0	2
Mining	0	1	10	3	8	5	3	1	3	2	36
Construction	0	3	2	2	2	1	3	2	0	0	15
Manufacturing	4	54	158	57	69	35	22	23	8	2	464
Transportation & Public Utilities	4	13	59	18	18	6	8	5	0	1	132
Wholesale Trade	0	2	6	7	5	2	1	1	3	1	28
Retail Trade	2	21	50	11	12	0	2	2	0	0	100
Services	8	33	82	18	26	10	5	2	6	1	191
Total	19	127	368	116	140	59	44	36	20	7	936

Notes:

Panel A presents the sample selection criteria. Panel B presents industry distribution by Twitter adoption year for our sample firms.

Table 2 Summary Statistics

Panel A: 2011-2016 firm-year observations						
VARIABLES	N	Mean	p25	p50	p75	s.d.
Tweets	4158	2565	143	501.5	1453	15527
Twitter age	4158	4.409	2.838	4.390	5.882	2.012
CSR tweets	4158	11.96	1	5	13	24.29
CSR tweets (scaled)	4158	3.334	0.274	1.370	3.562	6.685
Followers (log)	933	9.002	7.349	8.836	10.41	2.432
Lag CSR strength	4158	2.667	0	1	4	3.565
Lag CSR score	4158	1.151	-1	0	2	3.179
Size	4158	10.08	7.217	8.510	10.33	4.873
Lev	4158	0.552	0.401	0.557	0.693	0.220
ROA	4158	0.059	0.027	0.056	0.095	0.075
Advertising	4158	0.015	0	0.001	0.015	0.029
MTB	4158	4.070	1.671	2.640	4.263	22.11
CSR tweet passive voice	3042	0.149	0	0.0770	0.222	0.214
CSR tweet length	3042	15.43	14	15.50	17	2.686
CSR tweet negative tone	3042	1.112	0	0.407	1.581	1.786
CSR tweet positive tone	3042	7.943	5.357	7.575	10.06	4.654

Panel B: Firm-quarter observations before and after joining Twitter								
VARIABLES	Before			After			Mean Diff	χ^2
	N	Mean	Median	N	Mean	Median		
QRet	7342	0.017	0.028	6917	0.059	0.064	-0.041***	128.87***
Spread	7342	0.981	0.838	6917	0.796	0.700	0.185***	307.57***
Volatility	7342	0.027	0.023	6917	0.023	0.020	0.005***	215.71***

Notes:

This table contains summary statistics for the variables used in the main analyses. See Appendix C for variable definitions. *** indicates significance at 1% level.

Table 3 CSR Tweets and CSR performance

VARIABLES	Predicted Signs	CSR tweets (scaled)	
		(1)	(2)
Lag CSR strength	-	-0.163*** (2.65)	
Lag CSR score	-		-0.149*** (2.79)
Size	+	0.421* (1.69)	0.402* (1.64)
Leverage	?	-2.618 (-1.43)	-2.601 (-1.42)
ROA	+	2.796* (1.64)	2.875* (1.69)
MTB	?	-0.002 (-0.64)	-0.002 (-0.65)
Advertising	+	52.969* (1.91)	53.556* (1.92)
Constant		0.054 (0.02)	-0.038 (-0.01)
Firm FE		Yes	Yes
Year FE		Yes	Yes
Observations		4,158	4,158
Adjusted R ²		0.487	0.487
Number of Firms		936	936

Notes:

This table presents results from regression of firms' CSR-related tweets on their CSR scores. Columns (1) and (2) show the regression results using *CSR tweets (scaled)* as the dependent variable, while columns (3) and (4) show the regression results using *CSR tweets (scaled, log)* as the dependent variable. Heteroskedasticity-robust t statistics are reported. See Appendix C for variable definitions. ***, **, and * indicate significance at 1%, 5%, 10% levels, respectively (two-tailed tests).

Table 4 CSR Tweets and CSR performance: Robustness

VARIABLES	CSR tweets (scaled)					
	(1)	(2)	(3)	(4)	(5)	(6)
Lag CSR strength	-0.145*** (2.59)	-0.162*** (2.65)	-0.162*** (2.64)	-0.151** (2.38)	-0.195*** (2.84)	-0.183** (2.56)
Fin tweets (scaled)	0.449*** (4.64)					0.337*** (3.15)
CSR 8-K content		-0.335 (-0.37)				-0.785 (-0.93)
Total 8-K content		0.009 (0.40)				0.033* (1.73)
CSR 8-K count			-0.583 (-1.21)			
Total 8-K count			0.006 (0.27)			
Size	0.523** (1.97)	0.419* (1.68)	0.418* (1.68)	0.347* (1.71)	0.269 (1.26)	0.276* (1.90)
Leverage	-1.716 (-1.04)	-2.659 (-1.43)	-2.643 (-1.44)	-1.331 (-1.01)	-3.218 (-1.60)	-1.255 (-0.77)
ROA	0.808 (0.45)	2.786 (1.62)	2.813 (1.64)	2.414 (1.62)	3.263* (1.65)	1.395 (0.80)
MTB	-0.001 (-0.48)	-0.002 (-0.63)	-0.002 (-0.64)	-0.002 (-1.14)	-0.001 (-0.71)	-0.001 (-0.93)
Advertising	31.704* (1.70)	53.235* (1.92)	53.068* (1.92)	23.272 (1.15)	52.709 (1.41)	4.762 (0.36)
Constant	-1.875 (-0.69)	0.074 (0.03)	0.019 (0.01)	0.494 (0.23)	1.976 (0.89)	0.850 (0.52)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
CEO FE				Yes		Yes
CFO FE					Yes	Yes
Observations	4,158	4,158	4,158	4,141	4,136	4,135
Adjusted R ²	0.546	0.487	0.487	0.611	0.512	0.642
Number of Firms	936	936	936	934	934	934

Notes:

This table presents robustness checks on results from regression of firms' CSR-related tweets on their CSR scores. Columns (1) through (6) show the regression results using *CSR tweets (scaled)* as the dependent variable. Heteroskedasticity-robust t statistics are reported. See Appendix C for variable definitions. ***, **, and * indicate significance at 1%, 5%, 10% levels, respectively (two-tailed tests).

Table 5 CSR Tweet Style and CSR performance

VARIABLES	CSR tweet passive		CSR tweet length		CSR tweet negative		CSR tweet positive	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lag CSR strength	-0.005** (2.15)		0.051** (1.97)		-0.038* (1.78)		-0.128*** (2.71)	
Lag CSR score		-0.004* (1.76)		0.055** (2.37)		-0.038** (2.05)		-0.092** (2.08)
Non-CSR passive	0.312** (2.54)	0.314** (2.56)						
Non-CSR length			0.501*** (11.54)	0.500*** (11.53)				
Non-CSR negative					0.214*** (2.77)	0.211*** (2.74)		
Non-CSR positive							0.100 (1.01)	0.099 (1.02)
Size	0.018 (1.10)	0.018 (1.05)	0.198 (1.37)	0.204 (1.42)	-0.109 (-0.74)	-0.114 (-0.77)	-0.352* (-1.77)	-0.380** (-1.97)
Leverage	0.005 (0.08)	0.005 (0.08)	1.036 (1.33)	1.056 (1.36)	-1.380* (-1.74)	-1.392* (-1.76)	-1.010 (-0.57)	-1.010 (-0.57)
ROA	0.021 (0.20)	0.023 (0.22)	0.571 (0.48)	0.587 (0.49)	0.574 (0.66)	0.569 (0.65)	1.650 (0.83)	1.716 (0.86)
MTB	-0.000 (-1.57)	-0.000 (-1.56)	0.002* (1.73)	0.002* (1.76)	-0.000 (-1.25)	-0.000 (-1.30)	-0.001 (-0.81)	-0.001 (-0.78)
Advertising	-0.641 (-1.11)	-0.617 (-1.07)	-9.878 (-1.11)	-9.898 (-1.11)	-6.128 (-0.68)	-6.044 (-0.67)	24.785 (1.64)	25.571* (1.69)
Constant	-0.069 (-0.38)	-0.069 (-0.38)	5.366*** (3.10)	5.385*** (3.12)	2.894* (1.75)	2.898* (1.74)	11.500*** (4.64)	11.513*** (4.75)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,042	3,042	3,042	3,042	3,042	3,042	3,042	3,042
Adjusted R ²	0.0573	0.0568	0.211	0.212	0.0611	0.0614	0.116	0.115
Number of firms	803	803	803	803	803	803	803	803

Notes:

This table presents results from regression of firms' CSR-related tweets' style characteristics on their CSR scores. Heteroskedasticity-robust t statistics are reported. See Appendix C for variable definitions. ***, **, and * indicate significance at 1%, 5%, 10% levels, respectively (two-tailed tests).

Table 6 Twitter Followers and CSR performance

VARIABLES	Followers (log)		Followers (log)		Followers (log)	
	(1)	(2)	Poor CSR strength (3)	Good CSR strength (4)	Poor CSR net (5)	Good CSR net (6)
Lag CSR strength	0.250*** (7.82)					
Lag CSR score		0.161*** (4.80)				
CSR tweets (scaled)			0.035*** (2.66)	0.067*** (4.11)	0.027** (2.04)	0.079*** (4.62)
Size	0.081*** (3.04)	0.124*** (4.01)	0.078** (2.00)	0.165*** (3.84)	0.237*** (2.72)	0.134*** (3.58)
Leverage	1.167*** (3.42)	1.344*** (3.86)	0.928** (2.16)	1.390** (2.56)	0.972* (1.66)	1.169** (2.55)
ROA	0.792 (0.87)	0.943 (1.00)	0.414 (0.38)	1.208 (0.72)	0.803 (0.62)	2.100 (1.44)
MTB	-0.005 (-0.23)	-0.003 (-0.12)	0.038** (2.54)	-0.019 (-0.86)	0.064*** (3.15)	-0.015 (-0.71)
Advertising	12.515*** (3.83)	13.185*** (3.88)	15.172*** (2.81)	11.003** (2.07)	15.118** (2.46)	14.302*** (3.11)
Twitter age	0.596*** (14.90)	0.629*** (15.40)	0.490*** (10.55)	0.653*** (9.59)	0.535*** (9.48)	0.585*** (10.77)
Constant	2.895*** (7.63)	2.507*** (6.34)	3.653*** (8.10)	2.156*** (3.36)	2.173*** (2.93)	2.652*** (5.12)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
χ^2 difference			2.81* [0.0935]		6.66*** [0.0099]	
Observations	661	661	366	283	259	381
Adjusted R ²	0.587	0.551	0.562	0.568	0.601	0.535
Number of firms	661	661	366	283	259	381

Notes:

This table presents results from regression of firms' 2016 level of *followers (log)* on their CSR performance and CSR tweets. Columns (3) and (4) show the regression results split on the median of *Lag CSR strength*, and columns (5) and (6) show the regression results split on the median of *Lag CSR score*. Heteroskedasticity-robust t statistics are reported. See Appendix C for variable definitions. ***, **, and * indicate significance at 1%, 5%, 10% levels, respectively (two-tailed tests).

Table 7 Capital Market Consequences of Joining Twitter

VARIABLES	Spread		Volatility		Inst Own	
	(1)	(2)	(3)	(4)	(5)	(6)
Post	-0.013 (-1.56)	0.001 (0.13)	-0.000* (-1.87)	0.000 (0.04)	0.000 (0.04)	-0.004* (-1.84)
Lag CSR strength	-0.002 (-0.89)		-0.000*** (-3.10)		-0.001 (-1.51)	
Post × Lag CSR strength	0.005*** (5.07)		0.000*** (5.91)		-0.002*** (-4.44)	
Lag CSR score		-0.001 (-0.81)		-0.000*** (-2.60)		-0.000 (-0.43)
Post × Lag CSR score		0.005*** (4.82)		0.000*** (5.30)		-0.002*** (-3.66)
Size	-0.111*** (-8.07)	-0.113*** (-8.26)	-0.002*** (-2.65)	-0.002*** (-2.84)	0.031*** (4.86)	0.032*** (4.91)
Leverage	0.268*** (7.49)	0.268*** (7.47)	0.009*** (6.47)	0.009*** (6.42)	-0.004 (-0.28)	-0.005 (-0.36)
ROA	-0.688*** (-6.74)	-0.691*** (-6.76)	-0.020*** (-6.56)	-0.020*** (-6.59)	0.088*** (3.51)	0.089*** (3.57)
MTB	0.000 (0.36)	0.000 (0.30)	-0.000 (-1.42)	-0.000 (-1.46)	-0.000*** (-2.74)	-0.000*** (-2.62)
QRet	0.101*** (6.47)	0.100*** (6.39)	0.002*** (2.87)	0.002*** (2.79)	-0.001 (-0.15)	-0.000 (-0.09)
Constant	1.627*** (15.16)	1.638*** (15.30)	0.034*** (7.16)	0.034*** (7.26)	0.529*** (10.42)	0.525*** (10.33)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,249	14,249	14,249	14,249	14,249	14,249
Adjusted R ²	0.816	0.816	0.788	0.788	0.895	0.895
Number of firms	921	921	921	921	921	921

Notes:

This table presents regression results showing the effect on bid-ask spread, return volatility, and institutional ownership after firms join Twitter. Heteroskedasticity-robust t statistics are reported. See Appendix C for variable definitions. ***, **, and * indicate significance at 1%, 5%, 10% levels, respectively (two-tailed tests).