Green Disclosures? Social Media and Prosocial Behavior

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Abstract

This study investigates how social media reveals individuals' demand for the disclosure of corporate prosocial behavior and whether the disclosures benefit the firms involved in such behavior (green firms). Our paper is motivated by (1) previous researchers' call to be open to the possibility that corporate responsibility activities and related disclosures are driven by both shareholders and non-shareholder constituents (Moser and Martin 2012) and by (2) a growing interest in how recent changes in technology affects disclosure (Miller and Skinner 2015). We find that green firms are more likely to join Twitter early and have more tweets about their prosocial behavior. Accordingly, green firms attract more followers on Twitter and experience a significant increase in individual investor holdings after joining Twitter. However, the significant increase of liquidity for green firms after the adoption of Twitter is accompanied by the increase in stock return volatility. The findings suggest that disclosures of prosocial behavior on social media generate unexpected costs to the firms due to the unique profile of social media followers.

1. Introduction

Classic economic theory suggests that the invisible hand of the market harness consumers' and corporations' pursuit of self-interest to the pursuit of efficiency, and that the state corrects market failures whenever externalities stand in the way of efficiency (Pigou 1920, Benabou and Tirole 2010).[1] However, recently there has been a rising demand for individual and corporate social responsibility as an alternative to state intervention in response to market failures. Moser and Martin (2012) encourage accounting researchers to take a broader perspective of corporate social responsibilities (CSR) besides the traditional shareholder-value maximization view. Meanwhile, social media such as Facebook, Linkedin, and Twitter, have been transforming our society over the past decade.[2] Miller and Skinner (2015) provide a discussion on papers that study how recent changes in technology, capital markets, and the media affect and are affected by firms' disclosure policies, and call for future research to continue to explore these issues.

In our paper, we explore corporate use of social media to disclose their green investments and the resulting capital market consequences to provide a deeper understanding of the economics of corporate and individual prosocial behavior. More specifically, we examine whether green firms utilize social media as a channel to disclose their environmental strategies and whether such disclosure practices affect the composition of a firm' investor base and hence its stock turnover and stock return volatility. We define green firms as businesses functioning in a capacity where positive externality is made to the environment and society in general.

[1] A recent example of state correcting market failures is that on November 14, 2014, the US president Obama moved to thrust climate change to the center of the global political agenda in the middle of the Brisbane G20 meetings pledging $3 billion to a global climate fund.

[2] As of February 2014, there are 1.23 billion active users in Facebook, 277 million in Linkedin, and 243 million in Twitter. Data source: http://expandedramblings.com/index.php/resource-how-many-people-use-the-top-social-media/#.UySOWfldXTs.

Our study focuses on firm's disclosures on Twitter rather than on other social media platforms such as Facebook or Linkedin. We make this choice for the following nonexclusive reasons. First, Twitter focuses on the sharing of opinion and information rather than on reciprocal social interaction or friendship as Facebook does. Second, the posts on Twitter are more timely than on other social media platforms, and thus Twitter is more likely to provide relevant and important information for capital market participants. Therefore, Twitter users are more likely to be potential investors for firms. In comparison, Facebook users are more likely to be customers and Linkedin is mainly used for professional networking.

We draw on two traditional views of corporate social responsibility (CSR) to understand firms' disclosures of prosocial behavior on social media (Ariely et al. 2009, Benabou and Tirole 2010). The first view, offered by some advocates of CSR, is that being a good corporate citizen can make a firm more profitable. In other words, CSR is about taking a long-term perspective to maximizing profits and but involve a loss of profit in the short run. However, a large body of finance literature suggests that firms often suffer from a short-term bias due to improperly structured managerial incentives or due to managers' career concerns. Therefore, if firms can reduce information asymmetry by disclosing environmental strategies on Twitter, their CSR policies can be more efficiently incorporated into prices and consequently attract more investors. The second view maintained by many social scientists is that social norms are important in shaping economic behavior and market outcomes, at times even overriding the profit motive (e.g., Hong and Kacperczyk 2009). Scholars of this view argue that companies may make CSR investments even when doing so would decrease shareholder values. Some stakeholders demand that corporations do good on their behalf rather than doing it on their own or through charitable organizations, simply because they value the societal benefits associated with CSR activities. The

disclosure of firms' good behaviors reaches more individuals through Twitter, and thus green green firms are expected to attract investors that want corporations to do good on their behalf.[3]

Using a sample of 447 of the largest US public firms whose environmental performance is ranked by *Newsweek*, we conduct several tests to investigate whether green firms utilize Twitter to disclose their environmental strategies and whether they benefit from such disclosures. We measure a firm's greenness using the 2012 green score provided by *Newsweek*.[4] *Newsweek* provides an annual environmental ranking of the 500 largest US public firms. This score is derived from three component scores: an Environmental Impact Score, an Environmental Management Score, and an Environmental Disclosure Score, weighted at 45 percent, 45 percent, and 10 percent, respectively. We extract the dates that a firm joined Twitter and search for green *tweets* in the most recent 3,000 tweets. We define green *tweets* as tweets that contain any of the following words "ecosystem", "ecology", "ecological", "environment", "environmental", "green", "sustainable", and "sustainability." Appendix A provides examples of firms' green *tweets*.

Our first test investigates whether green firms choose to adopt Twitter early and whether they make use of Twitter to disclose their green strategies. In the past decades, many firms have been allocating substantial resources to environmental sustainability strategies, and they widely disclose their strategies to the public through different channels such as corporate website, media, corporate social responsibility reports, etc.. Compared to traditional disclosure channels, social media provide an additional and unique platform for firms to disclose such practices. Twitter adopts a "push" approach, allowing firms to initiate the communication to their information subscribers directly. Twitter thus serves as a free channel that allows information to be much more

[3] Another traditional view on corporate pro-social behavior is that such behaviors are motivated by management's or the board members' own desire to engage in philanthropy regardless of its impact on firms' future profit. We focus our discussion on the first two views because they are more relevant to our study.
[4] http://www.newsweek.com/2012/10/22/newsweek-green-rankings-2012-u-s-500-list.html.

accessible and quick to travel. This particularly benefits individuals who have little resources to search for information under the traditional pull systems. Hence, we expect firms with higher green scores to adopt Twitter earlier, and have more tweets about their environmental strategies. Consistent with our prediction, we find that firms with higher green scores, on average, have been on Twitter longer and tweeted more about their environmental strategies.

Our second test examines the effect of the above disclosures. More specifically, we examine whether firms with higher green scores attract more followers on Twitter and whether they attract more individual and transient institutional investors after adopting Twitter than do those with lower green scores. Economic and psychology theories suggest that individuals are motivated to engage in prosocial behaviors for various reasons such as (1) genuine, intrinsic altruism, (2) material incentives (e.g., benefits of tax deduction), or (3) green social- and self-esteem concerns (Benabou and Tirole 2010). Combined with the argument that individuals demand that corporations engage in philanthropy on their behalf, we expect green firms to attract more individual and transient institutional investors after they make their good behaviors known through Twitter. Consistent with our prediction, we document that firms' green scores are positively associated with the number of followers on Twitter and that firms with higher green scores experience a greater increase in individual investor holdings and in transient institutional investor holdings after joining Twitter.

Our third test examines the capital market consequences of green firms drawing more individual and transient institutional investors. Consistent with our expectation that stock turnover increases as a result of an increase in holdings by individual investors and transient institutional investors, we also find that green firms experience a greater increase in stock return volatility than do *non green* firms after the adoption of Twitter, suggesting that disclosures about environmental

strategies on Twitter could lead to an indirect costs, namely, drawing a less stable investor base that causes an increase in stock price volatility. The findings are similar to those in Bushee and Noe (2000), who show that improved corporate disclosure practices attract a shortsighted institutional investor base and, consequently, increase stock return volatility. Our findings highlight a tradeoff that green firms face – the benefits of promoting their good behaviors on social media and the unintended capital market consequences associated with such promotion.

Our study makes two important contributions. First, we contribute to the voluntary disclosure literature by documenting unintended consequences of disclosures on social media. A number of studies document the benefits associated with improved disclosures in general and CSR disclosures specifically through traditional channels, including lower financing costs (Botosan 1997, Sengupta 1998, and Botosan and Plumlee 2002), increased analyst forecast accuracy (Dhaliwal et al. 2011), lower bid-ask spreads (Welker 1995, Healy, Hutton, and Palepu 1999, and Leuz and Verrecchia 2000) and greater earnings response coefficients (Price 1998). Similar to Bushee and Noe (2000), we show that improved disclosure is not always beneficial when disclosures are made on a specific platform such as a social media platform on which the users are dominated by individuals. Our study also provides initial evidence on how firms utilize social media as a platform to disclose their prosocial behaviors. It is different from several existing studies focusing on capital market consequences of firms' financial disclosure on social media (e.g., Blankespoor et al. 2014, Jung et. 2014, Lee et al. 2015). Firms' prevalent use of social media offers us an opportunity to provide a more complete picture of CSR disclosures using archival data as called by Moser and Martin (2010).

Second, we contribute to the large economic literature by providing further understanding of the economics of individual and corporate social responsibility. While previous literature relies

on theories or experiments to study individuals' behaviors, showing that contributions to prosocial behaviors are associated with image concern (e.g., Benabou and Tirole 2006; Lacetera and Macis 2008; Della Vigna, List, and Malmendier 2009), the novel setting of social media allows us to directly observe corporate prosocial behaviors on a large scale. Our findings demonstrate one potential tradeoff of disclosing corporate prosocial behavior on social media: the benefit of enhancing image value versus the risk of forming an unstable investor base.

The rest of the paper is organized as follows. Section 2 reviews the literature and develops hypotheses. Section 3 describes the sample and research design. Section 4 presents the main empirical analysis. Section 5 concludes.

2. Background and Literature Review

Our research is related to two broad streams of literature – the accounting literature on corporate social responsibility research, the emerging accounting literature on firm disclosure on social media.

2.1 Corporate Social Responsibility Research in Accounting

Our research is related to the literature that studies corporate and individual prosocial behavior. A great number of economic studies provide theories and conduct experiments to understand economic agents' prosocial behavior. Benabou 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. Ariely et al. (2009) experimentally test how extrinsic incentives interact with image motivation by diluting the signaling value of prosocial behavior. Besley and Ghatak (2005) suggest that providing incentives for employee engagement in prosocial activities

can help attract motivated employees, and Besley and Ghatak (2007) develop a model to show that CSR is consistent with profit-maximization in competitive markets.

Traditional accounting research often takes the view that corporate proscocial behavior is merely a response to shareholder demand. A number of accounting studies documents the benefits of CSR investment or CSR disclosures for shareholders by examining how corporate environmental policies affect firms' cost of capital, analyst coverage, and access to finance (e.g., Clarkson et al. 2011, Dhaliwal et al. 2012, Kim et al. 2012). For example, 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 social responsibility performance experience a reduction in the 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.

Moser and Martin (2012) encourage future accounting research to be open to the possibility that CSR activities and related disclosures are driven by both shareholders and non-shareholder constituents. They also acknowledge the challenges in examining important CSR questions using archival data. Martin and Moser (2015) demonstrate this non-shareholder view in an experiment setting. More specifically, they find that potential investors respond positively to the CSR disclosure although CSR disclosures do not indicate positive future earnings or cash flows and that managers anticipate investors' reaction and therefore overwhelmingly disclose their green investment.

The non-shareholder view is widely documented in papers that study 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 also have higher expected returns. A more recent study by Liu et al. (2014) shows that institutional investors' shareholdings and analyst coverage of sin companies increase with the degree of social norm acceptance. Our study extends and complements this literature by focusing on the other end of the spectrum – firms' prosocial behavior rather than sin stocks, and providing new evidence on the effects of social norms on markets.

Our paper complements this research by empirically examining the disclosure behavior of green firms on a unique social media platform dominated by individual investors. As a result, we can infer how the individual demand for social responsibility can affect corporate disclosure using archival data.

2.2 Social Media as a New Disclosure Channel

Most prior studies of voluntary disclosure on traditional disclosure channels document that firms benefit from improved corporate disclosure practices. For example, improved disclosure is associated with lower equity and debt costs, bid-ask spreads and greater earnings response coefficients (e.g., Welker 1995, Botosan 1997, Price 1998, Sengupta 1998, Healy et al. green 1999, Botosan and Plumlee 2000, Leuz and Verrecchia 2000, etc.). Only a few papers show the undesirable consequences of improved disclosure. A classic example is Bushee and Noe (2000) who find that AIMR disclosure raking improvements result in higher transient ownership and thus experience subsequent increase in stock return volatility.

In the past decade, social media has transformed the way firms communicate information to stakeholders. In light of the increasingly pervasive use of social media in marketing campaigns, it is not surprising that the impact of social media on corporate marketing and sales has been

substantially studied in recent marketing literature. For instance, Kumar et al. (2013) show that social media can be used to generate growth in sales, return on investment, and positive word of mouth. Toubia and Stephen (2013) provide an in-depth investigation of the motivations of users to contribute content to Twitter. Besides serving as a tool to communicate with customer, Twitter is also becoming a platform where companies share information with the investors. In its report on April 2, 2013, the Securities Exchange Commission (SEC) in the US states that "An increasing number of public companies are using social media to communicate with their shareholders and the investing public. 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."[5]

Miller and Skinner (2015) provide a discussion on the papers that study how recent information technology revolutions transform the way information about firms is produced, disseminated, and processed, and they encourage future research to continue to explore these important issues. Blankespoor et al. (2014) use a sample of 141 technology firms and find that firms can reduce information asymmetry by using Twitter to disseminate their news. Lee et al. (2015) examine how corporate social media affects the capital market consequences of firms' disclosure in the context of consumer product recalls and they find that corporate social media attenuates the negative price reaction to recall announcements. A recent working paper by Jung et al. Wang (2014) provides the first large-sample evidence on the determinants and market consequences of the decision to disseminate quarterly earnings news through social media, and document several interesting findings. For example, firms are more likely to disseminate earnings news through social media when the news is positive, suggesting that some firms are opportunistic

[5] Report of Investigation Pursuant to Section 21(a) of the Securities Exchange Act of 1934: Netflix, Inc., and Reed Hastings. http://www.sec.gov/litigation/investreport/34-69279.htm.

in their use of social media. In addition, Bollen et al. (2011) document that sentiment, as expressed in large-scale collections of daily Twitter posts, can be used to predict stock returns. However, despite the enormous interest in social media, we know little about whether firms' use of Twitter as a platform to disseminate non-financial information has an impact on the financial markets. It is important to understand how the market responds to firms' green actions after firms make their environmental strategies more visible on social media. By focusing a different type of disclosures, i.e., green disclosures, our paper extends the growing disclosure literature on social media by delivering an important message – disclosures of prosocial behavior on social media can generate unintended costs.

3. Hypothesis Development

Society has revealed a mounting emphasis on environmental sustainability and firms respond by heavily implementing eco-friendly strategies. By the end of 2017, the amount U.S. firms will spend on green projects is expected to reach $44 billion (Verdantix 2013). Meanwhile, the availability of social media provides an additional and free channel for firms to make their green actions more visible to the public. If firms' prosocial actions are associated with good firm performance in the long run, it is in the firms' interests to disclose such information to signal their future prospect. Therefore, we expect firms with higher green scores to be more likely to adopt Twitter earlier and to disclose their environmental actions on Twitter. Our first set of hypotheses is thus stated as follows:

H1a: Firms with higher green scores are more likely to adopt Twitter early.

H1b: Firms with higher green scores are more likely to disclose their environmental actions on Twitter.

Economic and psychology theories suggest that individuals behave prosocially for intrinsic, extrinsic, and image motivation. In addition, it is also argued that people want corporations to do good on their behalf and that corporate responds to the demand (Besley and Ghatak 2005). An important reason discussed in Benabou and Tirole (2010) is that information and transaction costs are likely to be lower if delegation goes through corporations than doing it on their own or through other channels (e.g., charitable organizations). For example, a firm may be able to draw on its technical expertise or exploits complementarities to deliver goods and services to those in need more efficiently than governments or other philanthropic "intermediaries" could. Based on these arguments, if individuals have desires to engage in pro-social behavior and corporates can serve as delegates to do good on their behalf, we expect green firms to attract more followers on Twitter and more individual investors. In addition, Bushee and Noe (2000) argue that transient institutions valuing more forthcoming disclosure practices because such practices lessen the price impact of trades, facilitating the realization of short-term trading gains and therefore, we expect to see an increase in transient institutional investor holdings. The above discussion leads to our second set of hypotheses:

H2a: Firms with higher green scores have more followers on Twitter.

H2b: green firms experience a greater increase in individual investor holdings after joining Twitter than do non- firms.

H2c: green firms experience a greater increase in transient institutional investor holdings after joining Twitter than do non- firms.

We further examine whether green firms' liquidity improves after joining Twitter. Prior studies have documented the link between a firm's investor base and its stock return volatility. Bushee and Noe (2000) find that increases in transient institutional ownership are associated with

increases in stock return volatility. In addition, Bushee et al. (2003) show that open calls are associated with a greater increase in small trades (consistent with individuals trading on information released during the call) and higher price volatility during the call period. Based on the positive relation between unstable investor base and stock return volatility and the previous prediction about change in the investor base after green firms adopt Twitter, we expect green firms to experience an increase in stock turnover and return volatility due to the change in investor base after joining Twitter. The above discussion leads to our third set of hypotheses:

H3a: green firms experience a greater increase in stock turnover after joining Twitter than do non- firms.

H3b: green firms experience a greater increase in stock return volatility after joining Twitter than do non- firms.

4. Research Design

4.1 Sample Selection and Data

We start our sample with the 500 largest US public firms that *Newsweek* provides annual environmental ranking for in 2012. The firms ranked by *Newsweek* in each year are slightly different, and we rely one year's ranking to maximize our sample size because the green scores are sticky. Our sample period spans from 2005 to 2013, with 2005 being the year Twitter is officially set up. We collect the dates a firm joined Twitter and tweets about environmental strategies using a Python program. Requiring non-missing firm characteristics from Compustat quarterly data, our sample in the first analysis includes 447 firms. Table 1 describes detailed sample selection procedures. We obtain stock market data from CRSP, institutional investor data from Thomson Reuters Institutional (13F) Holdings, types of institutional investors from Brian

Bushee's website, and detailed trade and quote data from the NYSE TAQ database.[6] The sample size for other analyses ranges from 11,146 firm-quarters to 11,490 firm-quarters, depending on the analysis being performed.

4.2 Model Specifications

To test H1a, H1b and H2a, we estimate model (1) to examine the relation between a firm' age on Twitter, the number of tweets on environmental strategies, or the number of Twitter followers and its green score:

$$TwitterAge = \beta_0 + \beta_1 Green + \beta_2 Size + \beta_3 MtoB + \beta_4 Leverage + \beta_5 ROA + IndustryFE + \varepsilon$$ green green green green green green green green green green green green green

(1)

DepVar is *TwitterAge*, *LogGreenTweets* or *LogFollowers*. *TwitterAge* is The number of days between Nov 3, 2014 (the data collection date) and the joined date scaled by 365. *LogGreenTweets* Log of one plus the number of tweets that contain green strategy related key words in the most recent 3000 Tweets. *LogFollowers* is log of one plus the number of Twitter followers. The data are collected in Nov 3, 2014. green is a firm's green score obtained from Newsweek 2012 rankings. *Controls* include firm size, market-to-book, leverage and return on assets. We further include industry fixed effects to accounting for industry specific impacts. We use the data for the quarter immediately before the firm joineded Twitter as control variables. In the regression with *LogGreenTweets* or *LogFollowers* as the dependent variable, we also include *TwitterAge* as a control variable as we expect *TwitterAge* to be positively associated with

[6] http://acct.wharton.upenn.edu/faculty/bushee/IIclass.html.

LogGreenTweets or *LogFollowers*. See Appendix B for the definition of each variable. Based on H1a, H1b, and H2a, we expect β_1 to be positive in all three regressions.

To test H2b and H2c, we estimate Model (2) to examine whether firms' green scores are associated with their individual investor ownership and transient institutional investor ownership:

$$\begin{aligned} Individual = {} & \beta_0 + \beta_1 Post + \beta_2 Green + \beta_3 Green \times Post + \beta_4 Size + \beta_5 MtoB \\ & + \beta_6 Leverage + \beta_7 ROA + IndustryFE + \varepsilon \end{aligned} \tag{2}$$

DepVar is *Individual* or *Transient*. *Post* is an indicator variable that takes a value of one after a firm adopts Twitter and zero otherwise. We include firm size, market-to-book, leverage, return on assets and industry fixed effects as controls. Our variable of interest is $Green \times Post$. Based on the hypotheses, we expect β_3 to be positive in the regressions. The definitions of all the variables can be found in Appendix B.

To test H3a and H3b, we re-estimate Model (2), and change the dependent variable to *Turnover* or *Volatility*. Again, based on the hypotheses, we expect β_3 to be positive. *Turnover* is trading volume scaled by number of shares outstanding for each firm-quarter and *Volatility* is standard deviation of daily stock returns for each firm-quarter.

5. Results

5.1 Comparison between Sample Firms and S&P 1500 Firms

We compare the industry distribution, firm size between our sample and S&P 1500 by firms' Twitter adoption year in Table 2. A comparison between Panel A and Panel B shows that the industry distribution of our sample and S&P 1500 is similar and manufacturing firms consist most of the sample. Panels C and D show that the firms in our sample are larger than S&P 1500 firms because our sample is obtained from Newsweek green rankings which include the largest

500 US public firms while S&P 1500 firms comprise of S&P 500, S&P MidCap 400, and S&P SmallCap 600. green Further, Panels C and D show that there is no significant difference in green scores and firm size for firms that adopted Twitter in different years. Overall, Table 2 indicates 2009 is the peak year that both our sample firms and S&P 1500 joined Twitter. green

5.2 Descriptive Statistics

Table 3 reports the summary statistics for the main variables used in our analyses. The mean of the green score is 53.71 with a standard deviation 10.40 for our sample. The firms have been on Twitter for 4.8 years by Nov 3, 2014, have 10.89 tweets about their environmental strategies and have 14,618 followers, on average. The mean of the size is 18 billion, consistent with the fact that *Newsweek* ranks the 500 largest US public firms. The distribution of other control variables is consistent with our expectations.

5.3 Main Findings

Table 4 reports the results of the OLS estimation from Equation (1), presenting the empirical results of how a firm's green score is associated with its timing of adopting Twitter or its disclosure of environmental strategies on Twitter. Column (1) shows the coefficient on green is positively significant, and the finding is consistent with our prediction that green firms are more likely to adopt Twitter early. One standard deviation increase in green score is associated with adopting around 5 months early. The coefficient on green in Column (2) is also positive, suggesting that, on average, firms with higher green scores are more likely to disclose their environmental actions on Twitter. Consistent with our expectation, *TwitterAge* as a control variable is positively associated with *LogGreenTweets*. Overall, the findings in Table 4 are consistent with the notion that firms take advantage of the new disclosure platform to advertise their green actions.

Panel A of Table 5 presents how a firm' green score is associated with its followers. We find a positive and significant coefficient on , suggesting that, overall, green firms draw more followers and are more popular on Twitter, controlling for size, industry, and other factors. H2a is supported. Panel B of Table 5 reports the evidence of change in investors' composition after green firms join Twitter. Columns (1), (3), and (5) show that there is no significant change in the percentage of in individual investor holdings and transient institutional investor holdings overall. Columns (2), (4), and (6) report the results of the OLS estimation from Equation (2). We find that the coefficient on $Green \times Post$ is positive and significant in all three regressions with *Individual*, *Transient* or the sum of the two as the dependent variable. The findings are consistent with H2b and H2c, suggesting green firms experience a significant increase in individual investors and transient institutional investors after adopting Twitter, consistent with the notion that corporates can serve as delegates to do good on their behalf and that transient institutions value more forthcoming disclosure practices.

Further, Table 6 presents evidence on the capital market consequences of green firms drawing more individual investors and transient institutional investors. Columns (1) and (3) provide evidence on the change in stock turnover and stock return volatilities after a firm joins Twitter, while Columns (2) and (4) are our focus and report the results of the OLS estimation from Equation (2). Columns (1) and (3) show that stock turnover does not change significantly and stock volatility drop on average after firms join Twitter. In Column (2), we find a positive and significant coefficient on $Green \times Post$, suggesting that firms with high green scores experience a greater increase in stock turnover. Similarly, we find a positive and significant coefficient on $Green \times Post$ in Column (4), consistent with our expectation that stock return volatilities will increase as a result of an increase in holdings by individual investors and transient institutional

investors. Overall, the findings suggest that firm disclosures of prosocial behavior on social media lead to higher stock turnover but generate unexpected costs to the firms, namely, an increase in stock return volatility, due to the unique profile of social media followers.

5.4 Additional Tests

5.4.1 Good Corporate Citizens or green Wash

The evidence in previous section suggests that firms take advantage of the new disclosure platform to advertise their green actions and we conjecture that such disclosures have the potential to create social image value. In this section, we examine whether firms with more disclosures are just more concerned with social image in general or they take advantage of such disclosures to disseminate a misleading picture of environmental friendliness. The answer is not clear ex ante. We try to gain a better understanding of firms' choice of disclosing green actions on Twitter by examining whether a firm' disclosure practices are consistent with another corporate behavior which is also considered to be associated with its social image – earnings management.

On the one hand, it is possible that a firm that is more concerned with its social image tend to less likely to manipulate earnings and are more likely to disclose their prosocial behaviors on Twitter (good corporate citizens explanation). Prior analytical research provides theoretical background of integrating ethical expectations of business into a rational economic and legal framework (e.g., e.g., Carroll 1979, Jones 1995). Supporting this view, Kim et al. (2012) find that socially responsible firms also behave in a responsible manner to constrain earnings management. On the other hand, it is also possible that disclosures on Twitter offer firms with low earnings quality a channel to create a misleading social image and disguise their earnings management behavior (green wash explanation). Hemingway and Maclagan (2004) manager 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 (Benabou and Tirole 2010).

Using earnings quality estimated from the model in Dechow and Dichev (2002) at the industry-year level, we examine the relation between earnings quality and number of green tweets. Table 7 shows that firms with higher earnings quality are associated with more green tweets, suggesting that firms meeting the expectations of financial reporting and social responsibilities consistently. The findings are consistent with the good corporate citizens explanation rather than the green wash explanation.

5.4.2 Alternative Explanation of Change in Volatility

To exclude the alternative explanation that the increase in volatility is the market response of an increase in green firms' risk-taking activities after the adoption of Twitter, we examine the change in firms' risk-taking activities after they joined Twitter. Following prior literature (e.g., Coles et al. 2006, Hayes et al. 2012), we use capital expenditure and research and development expenses to measure firms' risking taking behavior.[7] Consistent with our expectation, Table 8 shows that the coefficient on $Green \times Post$ is not significant, suggesting that firms with higher green scores do not increase risk-taking more than those with lower green scores. The results further support the idea that the increase in volatility for green firms after the adoption of Twitter is a result of change in investor base rather than a change in risk-taking activities.

[7] We use annual data rather than quarterly data for this test because capital expenditure is not available in the Compustat quarterly data and research and development is largely missing.

5.4.3 Change in Small Trades

To provide more evidence that advertising green strategies on social media changes the composition of a firm's investor base, we further examine the impact of green firms' Twitter adoption on trading patterns. The idea is that if green firms meet the demand of individual investors to delegate prosocial activities, we should observe an increase in small trades after a green firm joins Twitter. Following prior literature (e.g., De Franco et al. 2007), we define small trades as trades that take the form of less than or equal to 1,000 shares.[8] Table 9 shows that the coefficient on $Green \times Post$ is positive, consistent with the findings in previous sections that green firms experience a significant increase in individual investor trading after adopting Twitter.

6. Conclusion

Society's demands for individual and corporate social responsibility and corporate use of social media are two social phenomena that have received tremendous attention recently. Our study investigates how social media reveal individuals' demand for the disclosure of corporate prosocial behavior and whether the disclosures benefit the firms involved in such behavior (firms). We hypothesize and find that firms with higher green scores, on average, are more likely to join twitter early and have more tweets about their environmental strategies. We further document that firms' green scores are positively associated with the number of followers on Twitter and that green firms experience a greater increase in individual investor holdings after joining Twitter than do *non-* firms. As a consequence of increased holdings by individual investors and transient institutional investors, we find that green firms experience a greater increase in stock turnover and

[8] We redefine small trades as trades that take the form of less than 7,000 shares and the results still hold.

stock return volatilities than do *non green* firms after the adoption of Twitter, suggesting that disclosures of prosocial behavior on social media generate unexpected costs to the firms.

Our study makes contributions to several literatures. First, we add to the voluntary disclosure literature by documenting unintended consequences of disclosures on social media. Our findings suggest that improved disclosure is not always beneficial when disclosures are made on a specific platform such as social media on which the users are dominated by individuals. green Second, we contribute to the large economic literature by highlighting one potential tradeoff of disclosing corporate prosocial behavior on social media: enhancing image value vs. leading to unstable investor base. Our findings suggest while firms may receive the benefits of increased public attention and enhanced positive social image by disclosing their green practice (which may reduce the cost of capital), but such benefits come at a cost – an unstable investor base and the resulting increase in stock volatility.

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Appendix A Examples of green tweets

IBM

2014/7/29 18:0:39

We're providing sustainability scientists with free access to supercomputing resources http://t.co/uOD6azMdYt @wcgrid http://t.co/d361Ysj0fu

2014/6/6 17:33:41

How Green eMotion's @IBMcloud is helping make electric vehicle travel in Europe possible http://t.co/8gd2f50rI2 #MadeWithIBM RT @IBMResearch

Boeing

2014/6/5 16:15:21

Read how #Boeing is building a better planet: http://t.co/2ECCE9GuzO #environment

2014/4/21 16:9:34

Were committed to a sustainable future. Learn about our environmental leadership: green http://t.co/k1y9T8LLt2 @BizRoundtable #Boeing

Appendix B Variables definitions

Variable	Definitions
	Green score provided by *Newsweek* Green Rankings 2012: U.S. Companies.
Post	An indicator variable that takes a value of one after a firm adopts Twitter.
TwitterAge	The number of days between Nov 3, 2014 (the data collection date) and the joined date scaled by 365.
LogGreenTweets	Log of one plus the number of tweets that contain green strategy related key words in the most recent 3000 Tweets. The key words contain "ecosystem" green "ecology" green "ecological" "environment" "environmental" "green" "sustainable" "sustainability." The data are collected on November 12, 2014.
LogFollowers	Log of one plus the number of Twitter followers. The data are collected on November 3, 2014.
Turnover	Trading volume scaled by number of shares outstanding for each firm-quarter.
Volatility	Standard deviation of daily stock returns for each firm-quarter.
Individual	Percentage of shares held by individual investors for each firm-quarter, calculated as 1-%shares held by institutions based on 13-F.
Transient	Percentage of shares held by transient institutional investors for each firm-quarter (using the classification provided by Brian Bushee).
Indv_trans	*Individual+Transient*
Size	Log of lagged assets.
MtoB	Market value of total assets over book value for each firm-quarter.
Leverage	(Debt in Current Liabilities+ Long-Term Debt)/Common Equity for each firm-quarter.
ROA	Income before extraordinary items scaled by lagged assets for each firm-quarter.
EQ	Earnings quality measured using DD model.
CAPEX	Capital expenditures scaled by lagged assets.
RnD	Research and development expenses scaled lagged assets.
SmallSize	The number of small trades for each firm-quarter, where small trades are defined as trades that take the form of fewer than 1,000 shares.
SmallValue	The number of small trades for each firm-quarter, where small trades are defined as trades that take the form of fewer than 1,000 shares.

Table 1 Sample selection

500 biggest public US firms ranked by Newsweek	500
Less: firms that not on Twitter	(39)
Less: firms with missing Compustat variables required	(14)
Final sample:	447

This table presents our sample selection procedures.

Table 2 Comparison between sample firms and S&P 1500 firms

Panel A: Industry distribution by Twitter adoption year for sample firms

Industry	2007	2008	2009	2010	2011	2012	2013	2014	Total
Agriculture, Forestry, & Fishing	1	0	0	0	0	0	0	0	1
Construction	0	0	0	1	0	0	0	0	1
Finance, Insurance, & Real Estate	2	6	23	10	14	4	2	2	63
Manufacturing	4	26	73	27	29	12	8	2	181
Mining	0	1	8	2	3	1	1	0	16
Nonclassifiable Establishments	0	0	0	0	1	0	1	0	2
Retail Trade	2	11	28	5	6	0	1	1	54
Services	3	14	22	1	3	5	2	0	50
Transportation & Public Utilities	4	10	33	8	9	2	0	1	67
Wholesale Trade	1	1	2	2	3	3	0	0	12
Total	17	69	189	56	68	27	15	6	447

The panel presents industry distribution by Twitter adoption year for our sample firms.

Panel B: Industry distribution by Twitter adoption year for S&P 1500 firms

Industry	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Agriculture, Forestry, & Fishing	1	0	0	0	0	0	0	0	1
Construction	0	3	3	2	3	0	3	1	15
Finance, Insurance, & Real Estate	1	17	68	36	31	16	10	14	193
Manufacturing	5	56	162	63	65	42	22	8	423
Mining	0	1	12	8	9	3	3	2	38
Nonclassifiable Establishments	0	0	0	0	1	0	1	0	2
Retail Trade	2	17	53	11	10	2	3	2	100
Services	7	36	86	11	16	12	7	3	178
Transportation & Public Utilities	4	13	52	16	18	5	5	2	115
Wholesale Trade	1	2	8	7	7	5	1	0	31
Total	21	145	444	154	160	85	55	32	1096

The panel presents industry distribution by Twitter adoption year for S&P 1500 firms.

Panel C: Firm size and green score by Twitter adoption year for sample firms

Joinedyear	N	Size (mean)	Green (mean)
2007	17	9.79	57.44
2008	69	9.42	58.42
2009	189	9.49	53.92
2010	56	9.52	51.24
2011	68	9.81	50.46
2012	27	9.44	53.91
2013	15	9.99	50.09
2014	6	10.37	50.75
Total	447	9.57	53.71

The panel presents the mean of firm size and green score by Twitter adoption year for our sample.

Panel D: Firm size by Twitter adoption year for S&P 1500 firms

Joinedyear	N	Size (mean)
2007	21	9.01
2008	144	8.19
2009	436	8.04
2010	148	8.00
2011	155	8.27
2012	84	7.92
2013	55	8.09
2014	34	8.57
Total	1077	8.12

The panel presents the mean of firm size by Twitter adoption year for S&P 1500 firms.

Table 3 Descriptive statistics

Variable	N	mean	p25	Median	p75	sd
	447	53.71	47.20	53.40	60.60	10.40
TwitterAge	447	4.80	3.76	5.25	5.72	1.43
LogGreenTweets	447	2.38	1.39	2.40	3.33	1.40
LogFollowers	447	9.59	7.93	9.49	11.21	2.30
Turnover	13,146	0.63	0.34	0.50	0.75	0.47
Volatility	13,146	0.02	0.01	0.02	0.02	0.01
Individual	11,490	0.23	0.13	0.21	0.32	0.16
Transient	11,490	0.14	0.08	0.12	0.18	0.08
Indv_trans	11,490	0.37	0.28	0.36	0.45	0.14
Size	13,146	9.68	8.73	9.51	10.44	1.33
MtoB	13,146	1.76	1.13	1.42	2.01	0.97
Leverage	13,146	1.34	0.29	0.60	1.24	51.26
ROA	13,146	0.02	0.01	0.01	0.02	0.02

This panel contains summary statistics for the variables used in the analyses. For the control variables that are used in tests with varying sample sizes, the statistics for the largest sample across all tests are presented.

Table 4 Green firms' disclosure on Twitter

VARIABLES	(1) *TwitterAge*	(2) *LogGreenTweets*
	0.0378***	0.0273***
	(4.33)	(3.20)
Size	-0.1620**	0.1029
	(-2.08)	(1.40)
MtoB	0.0167	-0.0888
	(0.15)	(-0.91)
Leverage	-0.0426	0.0354
	(-1.11)	(1.26)
ROA	-4.2033**	-3.9019
	(-2.16)	(-1.55)
TwitterAge		0.2100***
		(4.77)
Constant	2.9434***	-1.7056
	(2.67)	(-1.48)
Observations	447	447
Adj R-sq	0.093	0.238
Industry FE	YES	YES

The table reports the relation between firms' Twitter usage and greenness. The dependent variable is *TwitterAge and LogGreenTweets*. The variable of interest is . See the appendix for variable definitions. ∗∗∗, ∗∗, and ∗ indicate significance at 1%, 5%, 10% levels, respectively (two-tailed tests).

Table 5 Twitter followers and investors

Panel A green firms and Twitter followers

VARIABLES	(1) *logFollowers*
	0.0357***
	(2.91)
Size	0.5417***
	(6.15)
MtoB	0.6203***
	(4.37)
Leverage	-0.0012
	(-0.03)
ROA	2.8235
	(1.06)
TwitterAge	0.6938***
	(10.28)
Constant	1.6225
	(0.89)
Observations	447
Adj R-sq	0.536
Industry FE	YES

The table reports the relation between firms' popularity on Twitter and greenness. The dependent variable is *logFollower*. The variable of interest is . See the appendix for variable definitions. ∗∗∗, ∗∗, and ∗ indicate significance at 1%, 5%, 10% levels, respectively (two-tailed tests).

Panel B Change in individual investors and transient institutional investor holdings

VARIABLES	(1) *Individual*	(2) *Individual*	(3) *Transient*	(4) *Transient*	(5) *Indv_trans*	(6) *Indv_trans*
Post	0.0049	-0.0607**	-0.0032	-0.0333	0.0030	-0.0926***
	(0.59)	(-2.06)	(-0.26)	(-1.52)	(0.22)	(-2.64)
Green		-0.0007		-0.0005		-0.0013
		(-0.80)		(-1.50)		(-1.51)
Green × Post		0.0012**		0.0006**		0.0018***
		(2.32)		(2.12)		(3.22)
Size	0.0398***	0.0402***	-0.0249***	-0.0243***	0.0157***	0.0168***
	(7.22)	(6.17)	(-11.30)	(-10.11)	(3.16)	(2.88)
MtoB	0.0105	0.0109	-0.0181***	-0.0176***	-0.0073	-0.0064
	(1.42)	(1.45)	(-4.67)	(-4.44)	(-1.07)	(-0.93)
Leverage	-0.0001***	-0.0001***	0.0000	0.0000	-0.0001***	-0.0001***
	(-3.40)	(-3.37)	(0.16)	(0.15)	(-2.74)	(-2.68)
ROA	0.4871*	0.4556*	0.1968	0.1845	0.7142**	0.6707**
	(1.78)	(1.65)	(1.37)	(1.29)	(2.55)	(2.38)
Constant	0.0334	0.0636	0.3960***	0.4105***	0.4169***	0.4617***
	(0.33)	(0.63)	(11.48)	(11.19)	(4.84)	(5.47)
Observations	11,490	11,490	11,490	11,490	11,490	11,490
Adj R-sq	0.270	0.271	0.197	0.199	0.169	0.173
Industry FE	YES	YES	YES	YES	YES	YES

The panel reports the change in green firms' investor base after the firm joined Twitter. The dependent variable is *Individual*, *Transient*, *Indv_trans*. The variable of interest is $Green \times Post$. See the appendix for variable definitions. Each firm-quarter is viewed as an observation. T-statistics are adjusted for firm-quarter clusters. ***, **, and * indicate significance at 1%, 5%, 10% levels, respectively (two-tailed tests).

Table 6 Stock turnover and volatility change

VARIABLES	(1) *Turnover*	(2) *Turnover*	(3) *Volatility*	(4) *Volatility*
Post	-0.0371	-0.2675**	-0.0038*	-0.0111***
	(-1.01)	(-2.04)	(-1.88)	(-2.73)
Green		-0.0027		-0.0001**
		(-0.98)		(-2.08)
Green×*Post*		0.0044**		0.0001***
		(2.05)		(2.82)
Size	-0.0659***	-0.0631***	-0.0018***	-0.0017***
	(-4.21)	(-3.63)	(-6.32)	(-5.40)
MtoB	-0.0443*	-0.0427*	-0.0012**	-0.0012**
	(-1.76)	(-1.73)	(-2.32)	(-2.24)
Leverage	-0.0001**	-0.0001**	-0.0000	-0.0000
	(-2.09)	(-2.08)	(-0.76)	(-0.73)
ROA	-3.9222***	-4.0503***	-0.1511***	-0.1551***
	(-3.85)	(-4.08)	(-2.67)	(-2.72)
Constant	1.1571***	1.2412***	0.0409***	0.0435***
	(5.12)	(5.15)	(7.37)	(7.00)
Observations	13,146	13,146	13,146	13,146
Adj R-sq	0.277	0.279	0.171	0.173
Industry FE	YES	YES	YES	YES

The table reports the change in green firms' liquidity after the firm joined Twitter. The dependent variable is *Turnover* and *Volatility* in Columns (1) and (2), and Columns (3) and (4), respectively. The variable of interest is *Green*×*Post*. See the appendix for variable definitions. Each firm-quarter is viewed as an observation. T-statistics are adjusted for firm-quarter clusters. ∗∗∗, ∗∗, and ∗ indicate significance at 1%, 5%, 10% levels, respectively (two-tailed tests).

Table 7 Social image concerns

VARIABLES	(1) log_disclosure
	0.0219**
	(2.18)
Abs_Accr	-7.8219*
	(-1.92)
Size	0.1060
	(0.97)
MtoB	-0.0229
	(-0.20)
Leverage	-0.0032
	(-0.10)
ROA	-3.9304
	(-1.16)
TwitterAge	0.2418***
	(4.02)
Sales Volatility	-0.0000
	(-0.02)
CF Volatility	-0.0001
	(-0.56)
Constant	-0.9071
	(-1.00)
Observations	362
Adj R-sq	0.237
Industry FE	YES

Table 8 Change in risk-taking activities

VARIABLES	(1) CAPEX	(2) CAPEX	(3) RnD	(4) RnD
Post	-0.0053***	0.0016	-0.0018	-0.0081
	(-3.39)	(0.24)	(-0.63)	(-0.74)
		0.0001		0.0016***
		(0.61)		(4.04)
$Green \times Post$		-0.0001		0.0001
		(-1.04)		(0.62)
Size	-0.0023**	-0.0024**	-0.0012	-0.0076***
	(-2.08)	(-2.05)	(-0.49)	(-2.60)
MtoB	0.0051***	0.0050***	0.0239***	0.0213***
	(2.62)	(2.60)	(3.71)	(3.08)
Leverage	-0.0006	-0.0005	-0.0011**	-0.0010**
	(-1.15)	(-1.14)	(-2.25)	(-2.13)
ROA	0.0685***	0.0691***	-0.1455	-0.1422
	(3.12)	(3.16)	(-1.37)	(-1.35)
Constant	0.0449***	0.0415***	0.0016	-0.0141
	(3.02)	(2.71)	(0.05)	(-0.43)
Observations	3,606	3,606	2,016	2,016
Adj R-sq	0.503	0.503	0.358	0.401
Industry FE	YES	YES	YES	YES

The table reports the change in green firms' risk-taking activities after the firm joined Twitter. The dependent variable is *CAPEX* and *RnD* in Columns (1) and (2), and Columns (3) and (4), respectively. The variable of interest is $Green \times Post$. See the appendix for variable definitions. Each firm-year is viewed as an observation. T-statistics are adjusted for firm-quarter clusters. $***$, $**$, and $*$ indicate significance at 1%, 5%, 10% levels, respectively (two-tailed tests).

Table 9 Change in Small Trades

VARIABLES	(1) *SmallSize*	(2) *SmallSize*	(3) *SmallValue*	(4) *SmallValue*
Post	0.0529***	0.0117	0.0528***	0.0109
	(3.20)	(0.45)	(3.20)	(0.42)
		-0.0028***		-0.0028***
		(-4.83)		(-4.84)
Green × *Post*		0.0008**		0.0008**
		(2.04)		(2.08)
Size	-0.0325***	-0.0243***	-0.0326***	-0.0243***
	(-7.35)	(-5.71)	(-7.37)	(-5.71)
MtoB	-0.0107**	-0.0064	-0.0108**	-0.0065
	(-2.28)	(-1.43)	(-2.29)	(-1.44)
Leverage	-0.0005	-0.0006	-0.0005	-0.0005
	(-0.47)	(-0.46)	(-0.42)	(-0.41)
ROA	0.7215***	0.7046***	0.7200***	0.7029***
	(3.35)	(3.41)	(3.33)	(3.39)
Constant	1.0562***	1.0831***	1.0689***	1.0962***
	(8.22)	(9.97)	(7.88)	(9.50)
Observations	12,784	12,784	12,784	12,784
Adj. R-sq	0.194	0.216	0.193	0.216
Industry FE	YES	YES	YES	YES