The relationship between negative social media sentiments, environmental and social disclosure and firm revenue

Authors and affiliations

Full name: Samuel Jebaraj Benjamin*
Affiliation: He is a Senior Lecturer at the School of Accounting, Finance and Economics, University of Waikato, Hillcrest, Hamilton 3216 New Zealand.
Tel: +6478379578
E-mail: samuel.benjamin@waikato.ac.nz

Full name: Jayalakshmy Ramachandran
Affiliation: She is an Associate Professor at the Nottingham University Business School, University of Nottingham Malaysia, Jalan Broga, 43500 Semenyih, Selangor, Malaysia.
Tel: +60389248779
E-mail: Jayalakshmy.Rama@nottingham.edu.my

Full name: Pallab Kumar Biswas
Affiliation: He is a Senior Lecturer at the Department of Accountancy & Finance, School of Business of the University of Otago, Cyde Street, Dunedin 9016 New Zealand.
Tel: +6434798108
E-mail: pallab.biswas@otago.ac.nz

*Main and corresponding author

Abstract

This paper investigates the link between negative social media sentiments with environmental and social disclosures and its relationship with firm revenue. Based on a sample of Fortune 500 firms from the year 2010 to 2017 we find that negative social media sentiments cause firms to increase their environmental and social disclosure. When we further explore the firm-specific settings under which the expected relation between negative social media sentiments with environmental and social disclosures might vary, the observed main finding remains unchanged in firms that are large in size, low in advertising spending, high in the number of employees, high in leverage and low in profitability. Finally, our results that point to a positive relationship between negative social media sentiments future revenue is dominated in firms with high environmental disclosure score.

Keywords: social media sentiments, environnemental and social disclosure, revenue, reputation

JEL classification*:* M14, O30, M10, M41

Introduction

These days, there is little doubt that customer and public sentiments expressed in social media platforms such as Facebook, Twitter, Instagram, TikTok, Reddit, Tumblr are noteworthy trends that have profound implications for corporations, creating a new world of possibilities and challenges for all aspects of a business (Shaw, 2018; Aral et al. 2013). Social media has now emerged as an important avenue for corporations to understand and respond to customers and public sentiments towards it, build business relationships, generate revenue, and manage their reputation (Etter et al. 2019; Sonnier et al. 2011; Luo, 2009; 2007). The last decade, in

particular, has witnessed a phenomenal increase in social media users, where the numbers have surpassed 4.20 billion in 2021 (Digital 2021: Global Overview Report: https://datareportal.com/reports/digital-2021-global-overview-report).

The last decade has accordingly experienced a rise in studies that explore the various implications and outcomes of social media sentiments on corporations. Researchers have highlighted the power of social media sentiments (hereafter SMS) in influencing firm value, performance, and revenue (Benjamin et al. 2021; Nguyen et al. 2020; Bartov et al. 2018; Sonnier et al. 2011; Luo, 2007; Chevalier and Mayzlin 2006). Specifically, the academic research and trade press suggests that it is more important to investigate negative SMS than positive SMS. Negative SMS is more influential in driving financial markets (Agrawal et al. 2018), damaging corporate reputations (Luo et al. 2013) and causing greater financial damage (Luo, 2009; Chevalier and Mayzlin 2006) than the corresponding benefits brought upon by the latter. Accordingly, firms may want to respond to negative SMS appropriately in order to manage the risk to their reputation, restore customers' and stakeholders' confidence and boost their financial performance. In this regard, while prior studies provide information on the hostile effects of negative social media sentiments, there is no concrete evidence that show how firms respond when faced with negative SMS.

On a parallel note, corporations are nowadays increasingly making CSR a priority and integrate social and environmental issues as an integral part of corporate strategy (Radhouane et al. 2018; Leiva 2016; Choi et al. 2010).[1] CSR initiatives nurture customers' trust in the corporation and its products, help corporations maintain favorable relationship with customers, and is an essential element in building and maintaining favorable corporate reputation and financial performance (Castaldo et al., 2009; Sen and Bhattacharya, 2001). Moreover, CSR information is helpful in increasing corporate reputation (Drempetic et. al. 2020). Interestingly,

[1] In this paper, we use the term 'CSR and sustainability with environmental and disclosures or reporting interchangeably, similar to Lu et al. (2014) and Fatemi et al. (2018).

there is no known study on the impact of social media sentiments on environmental and social disclosures. This may indicate a new phenomenon, and we address this gap by attempting to answer whether firms respond to negative social SMS by increasing environmental and social disclosures. While a recent study by Benjamin et al. (2021) finds that CSR influences the relationship between SMS and firm value, no prior evidence exists on the direct association of SMS with environmental and social disclosures. As argued earlier, because negative SMS causes reputational damage, while environmental and social disclosures increase corporate reputation, it is plausible to posit that firms experiencing negative SMS may respond by enhancing their environmental and social disclosures. The purpose of this article is neither to criticize nor commend firms' practices or course of action but rather to explore their strategy or response and consequence to derive insights for managers and stakeholders.

Next, we explore the settings (firm-specific factors, e.g., size, advertising spending intensity, employees, leverage, and profitability) under which the expected relation between negative SMS with environmental and social disclosures might vary. Past studies on CSR disclosures have often examined the influence of firm-specific factors to assess their confounding effects. Larger firms with more resources tend to provide more CSR disclosures (Drempetic et. al. 2020). Similarly, firms with superior financial performance/high profitability might provide more environmental and social disclosures (Tagesson et al. 2009; Belkaoui and Karpik 1989). Firms' leverage has also been reported to influence environmental and social disclosures (Mishra and Modi, 2012; Reverte 2009). Similarly, firms' employees, as a key stakeholder, are greatly driven by their employers' commitment to CSR issues and contribute to CSR initiatives (Yoo et. al. 2019; Simpson and Aprim, 2018). Likewise, firms advertising spending intensity is argued to have a bearing on their environmental and social disclosures (Meng et al. 2019). Therefore, we expect implications of negative SMS on environmental and

social disclosures to vary between the low and high subsamples of these firm-specific factors identified above.

Finally, this research examines whether firms' strategy of responding to negative SMS by increasing their environmental and social disclosures results in future financial benefits. Whilst it is reasonable to expect the reputational damage caused by negative SMS to be offset by the improvement in reputation brought on by increased environmental and social disclosures, another important motivation for firms to respond in this manner could be the eventual financial outcome it expects to gain. Firms' response to negative SMS in the form of increased environmental and social disclosures could be expected to improve customers and stakeholders' trust and support of these firms' product and services and ultimately result in higher revenues. The Triple Bottom Line framework calls for the examination of corporations' financial, social and environmental impact rather than solely focusing on the financial impact (Rambaud and Richard, 2015; Elkington, 2013; 1997). In reality, some evidence from prior studies and practice suggests that, regardless of what a firm does to disclosure its corporate social responsibility, the strategy is often related to market and financial benefits (Meng et al. 2019). The provision of environmental and social disclosures is argued to be a strategic investment to promote the reputation of the firm and one that will make corporations to anticipate future financial gains (Drempetic et al. 2020; Wang et al. 2016). Therefore, we expect effect of negative SMS on future revenue differ between firms with high and low environmental and social disclosure.

Drawing upon a sample of Fortune 500 firms from 2010 to 2017, our results show that in the face of negative SMS, firms increase their one-year ahead environmental and social disclosures. We also find that this observed result is conditional on a number of firm-specific factors. Specifically, the positive and significant association between negative SMS with environmental and social disclosures remains unchanged in firms that are large in size, low in

advertising spending, high in number of employees, high in leverage and low in profitability. Next, we show that the impact of negative SMS on future revenue is dominated by the environmental disclosure dimension, i.e., future revenue is higher as a result of negative SMS in firms with high environmental disclosures. Our results are supported by a series of robust estimations.

Our study makes several contributions to the CSR, social media sentiments and corporate reputation literature. To our knowledge, this is the first study to formally assess firms' environmental and social disclosure as a response to negative social media sentiments. We identify that when firms are faced with reputational decline from negative SMS, they respond to this by a reputation-increasing strategy, i.e., by increasing their environmental and social disclosure. Prior studies have documented the prominence of CSR as a business strategy that enhances customer and other stakeholders' perceptions and support (Radhouane et al. 2018; Castaldo et al. 2009; Bendixen and Abratt 2007; Lewis, 2003; McWilliams and Siegel 2001; Sen and Bhattacharya 2001). Recent research documents the role of social media sentiments as a useful measure of corporate reputation (Caviggioli et al. 2020) and the prominence of CSR as a representation of corporate reputation (Leiva et al. 2016). In this regard, our study sheds further light on how environmental and social disclosure, and negative social media sentiments, are both connected. In this regard, we demonstrate how firms enhance their environmental and social disclosure in response to negative social media sentiments to offset the reputational decline. Second, the extant literature indicates that changes in reputation is also a leading indicator of future financial fortunes (Davies and Miles, 1998), and when CSR disclosure is synonymous with increases in corporate reputation, corporations anticipate better financial performance (Drempetic et al. 2020; Wang et al. 2016). In this regard, our study shows that the strategy by corporations to increase their environmental disclosure as a response to negative social media sentiments creates a positive benefit that results in higher future

revenue. We also contribute to the literature on the relevance of social media sentiments to corporations by documenting the importance of negative social media sentiments to environmental and social disclosure. Prior literature has primarily focused on the unfavorable effects of negative social media sentiments (Luo et al. 2013; Luo 2007; 2009). Our study extends this line of inquiry as we focus our effort on understanding how firms' respond when they receive negative SMS. Our study offers fresh insights and important implications for managers and stakeholders.

The rest of the paper is organized in four more sections. The next section outlines the related literature and hypotheses, and this is followed by the discussion of the methodology and data. "Results" section presents the results, followed by the conclusion with a note on its limitations and future research opportunities in the "Conclusion" section.

Related Literature and Hypotheses

The concept of social media is the top agenda for many corporations today (Kaplan and Haenlein 2010). Social media platforms make it easier than even before for customers and stakeholders of firms to communicate and express themselves seamlessly through platforms such as YouTube, Twitter, and Facebook (Aral et al. 2013). Social media has also increasingly turn out to be the favorite medium of choice by the public to share opinions and information (Bartov et al. 2018). First and foremost, the importance of SMS can be understood through the philosophy of 'Wisdom of Crowds', which asserts that the average prediction of the crowd is more accurate than that of experts (Surowiecki, 2004). Sentiments expressed in social media (positive or negative sentiments) allows social media analytics providers and corporations to tap into the wisdom of the crowd in order to understand its implications, respond appropriately and gauge future performance prospects of a firm (Benjamin et al. 2021; Nguyen et al. 2020; Luo et al. 2013; Gu et al. 2012; McAlister et al. 2012; Luo 2009; Chen and Xie 2008).

Harnessing the ‘Wisdom of Crowds’ has many advantages as it is becoming a popular mechanism to obtain external knowledge, often regarded to be more accurate and typically less biased (Martinez and Walton, 2014). One of the important reasons behind researchers’ interest in social interaction is that they drive behavior (Godes et al. 2005). To date, the majority of studies center on analyzing customers' and stakeholders’ SMS on firms’ financial outcomes such as stock returns, firm value and earnings (e.g., Benjamin et al. 2021; Nguyen et al. 2020; Luo 2007, 2009). However not enough attention has been paid in investigating how firms react to online issues stemming from sentiments expressed in social media by customers and the public. Besides, prior studies highlight the need to focus on negative SMS over positive SMS and in light of former’s importance and implications to corporations (Agrawal et al. 2018; Luo et al. 2013; 2007).

Corporations’ reaction to negative SMS in the form of environmental and social disclosures is arguably driven by the need to preserve their reputation. Corporate reputation can be defined as “a perceptual representation of a firm’s past actions and future prospects that describes the firm’s overall appeal to all of its key constituents” or a “snapshot that reconciles the multiple images of a company held by all its constituencies”, Fombrun (1996, p72). On one hand, negative SMS causes firms reputational damage (Luo et al. 2013; Luo 2007). Sentiments expressed on social media that are computed and classified into negative or positive sentiments using data mining algorithms and machine learning techniques is employed in recent studies as a proxy of corporate reputation (Caviggioli et al. 2020). On the other hand, CSR activities are directly related to greater competitiveness of the firm such as enhancing a firm’s corporate reputation and, enhancing consumers’ attitude towards it (Dremptic et. al. 2020; Lewis, 2003; Sen and Bhattacharya 2001). CSR is in fact found to be one of the most widely used proxy of corporate reputation (Leiva et al. 2016). CSR creates a reputation that a firm is reliable and honest, and customers usually assume that the products or services of a reliable and honest firm

will be of high quality (McWilliams and Siegel 2001). A firm's reputation for socially responsible behavior is said to be an important factor in determining customers' loyalty to the firm (Martin et al. 2009). Moreover, CSR activities not only enhances firm' reputation to its customers but also to a wide range of stakeholders such as employees, suppliers and other stakeholders in general (Bendixen and Abratt 2007; Lewis 2003). An interesting question that has hereto fore been unexplored is whether the negative SMS from customers and stakeholders about a firm in general (that causes reputational damage) causes it, in return to increase its environmental and social disclosures to offset the reputational damage and eventually benefit from this strategy financially. In this regard, prior studies further acknowledge that firms' environmental and social disclosures reflect and set out to influence the broader social, political and economic context. Hence, it is important to extend our understanding of why firms disclose what they do (Adam 2008).

Changes in reputation are seen as being a leading indicator for the firm of a future change in financial fortunes (Davies and Miles 1998). Favorable corporate reputation stimulates sales, increases customer support and loyalty and generates a competitive advantage (Fombrun and Shanley 1990). If firms' response to negative SMS by increasing their environmental and social disclosures is favorable to their corporate reputation, it is plausible to expect these firms to benefit from it financially. The eventual financial gain from the strategy of increasing their environmental and social disclosures in the face of negative SMS could be another important motivation for these firms to embark on this strategy. The Triple Bottom Line framework talks about the fundamental three pillars, i.e., financial, social and environmental that firms should pursue equally. However, some studies find firms to prioritize the financial element as the primary or underlying consideration among the three pillars (Rambaud and Richard 2015; Robins 2006). Specifically, the strategy of disclosing CSR information has often been related to market benefits (Meng et al. 2019). The provision of CSR

information is argued to be important for organizations to enhance their legitimacy and financial gains (Schaltegger and Hörisch 2017). With regards to financial gains, prior studies also view CSR information as a strategic investment that promotes the reputation of the firm and one that will result in better future financial performance (Drempetic et al. 2020; Wang et al. 2016). Prior empirical evidence reveals that CSR disclosure enhances a firm's reputation, improves market value, bolsters customer confidence, and reduces cost of capital (Drempetic et al. 2020; Schadewitz and Niskala 2010). In sum, it is logical to conjecture that firms' strategy of responding to negative SMS by increasing environmental and social disclosures not only addresses their reputational decline, but results in net benefit that increase their future revenue.

Social media is easily accessible and facilitate anyone to publish information and opinions (Lee et al. 2015). As opposed to being a one-to-one or one-to-few, online communications or word of mouth in social media tend to be one-to-many or many-to many, facilitating information exchange and the dissemination of user-generated content that includes potential, actual or former customers (Godes et al. 2005; Hennig-Thurau et al. 2004). Social media is where people conduct a significant part of their lives, is largely about information sharing which is thought of as a form of online word of mouth or sentiment (Appel et al. 2020). Studies have found that approximately 20% of all social media content is about organizations (Jansen et al. 2009). In today's corporate scenario where "online reputation is your reputation" (Fertik and Thomson, 2010, p.16), understanding social media sentiments or word of mouth is increasingly important for corporations that are concerned with reputation management (Jansen et al. 2009).

Negative SMS or negative word of mouth is a display of complaints responses, expressions of dissatisfactions or expression of unhappiness or displeasure with the product, service or actions of a firm (Luo 2009; 2007). Typical negative SMS are identified through words like "angry" and "I hate it" (Nguyen et al. 2020) and are affective reactions to

individual's perceptual input, which then forms the basis of judgment about firms by wider stakeholder group (Haidt 2001). Prior studies portray effects of negative word of mouth in social media on stock returns and financial markets (Luo et al. 2013; Luo 2007; 2009). Essentially, negative comments on social media leads to damage of a firm's reputation (Luo et al. 2013). Actual corporate examples of how negative SMS causes serious reputational damages are abundant, e.g., McDonald's humiliation in 2012 after receiving massive amount negative SMS from customers sharing negative experiences and United Airlines' reputation damage in 2017 caused by negative online comments after the airline threw off a passenger violently off the place (Etter et al. 2019). Therefore, it is imperative for firms to respond to negative SMS appropriately to manage their reputation risk. As argued in the preceding section, environmental and social disclosures or CSR disclosures enhances firms' reputation. In this regard, it is then reasonable to assume that firms encountering negative SMS will be motivated to safeguard their reputation through higher ENV and SOC disclosures. Hence, we propose the following hypotheses:

H1a: Negative SMS increases environmental and social disclosure

Firms' environmental and social disclosures could be dependent on firm specific factors such as firm size, profitability, leverage, advertisement spending intensity and employees. Prior studies report that larger firms tend to provide increased environmental and social disclosures as they have more resources and make a greater impact on society. (Reverte 2009; Hackston & Milne 1996). Although our sample comprises of Fortune 500 firms which are considered to be generally large, the size of the largest firms based on total assets are on average, more than fifty times than the size of the smallest firms in this sample (https://fortune.com/fortune500/). However other studies report no relationship or mixed results when examining the influence of firm size on environmental and social disclosures (Neu et al. 1998; Roberts 1992). Likewise,

corporate profitability could influence firms' environmental and social disclosure. Firms with superior profitability could provide more environmental and social disclosure as they are exposed to political pressure and public scrutiny (Ng and Koh 1994) and have the necessary means to provide such disclosures (Tagesson et al. 2009; Campbell 2007). However, firms with low profitability might provide more CSR disclosure to distract the attention of financial stakeholders from the financial results (Reverte 2009). Some studies also find no support that profitability influences environmental and social disclosure (Cowen et al. 1987).

Similarly, firms' leverage levels could have a bearing on their environmental and social disclosure. Lenders are increasingly giving higher attention to firms' environmental and social disclosure and the latter favorably affect firms' credit ratings (Feng and Wu 2021; OECD 2020). Firms with high leverage could provide more environmental and social disclosure to deter negative reactions from lenders and possibly reduce their cost of capital and (Reverte 2009; Hannifa and Cooke 2005). However other studies argue that firms with high (low) leverage might not (might) provide enhanced disclosures due to their high (low) indebtedness that reduces (increases) the funds to available to carry out CSR activities (Barnea and Rubin 2010; Brammer and Pavelin 2006). Equally, employees could influence the extent of firms' environmental and social disclosure. Employees being key stakeholders of firms, are increasingly giving greater importance to environmental and social causes of their employers (Yoo et. al. 2019; Simpson and Aprim 2018). CSR is shown to meet the justice needs of employees (Aguilera et al. 2007). Employees further feel motivated with their employers' CSR efforts, and this leads to increased productivity and retention (Dona 2020; Meier and Cassar 2018). By the same token, firms' advertisement spending intensity could have a bearing on their environmental and social disclosure. Advertising and CSR disclosure both create awareness of products and services provided by a firm, boost customer confidence and loyalty, impress other stakeholders and bring about reputational advantage (Guo et. al. 2020; Meng et

al. 2019; Miles & Covin, 2000). In sum, the above arguments suggest that the effects of negative SMS on environmental and social disclosures could vary between low and high subsamples of these firm-specific factors identified above. More formally:

H1b: *The impact of negative SMS on environmental and social disclosure is conditional on firm specific factors such as size, advertising intensity, employees, leverage, and profitability*

As explained earlier, changes in reputation are seen as being a leading indicator for the firm of a future change in financial fortunes. Prior literature also shows that negative SMS brings about decline in sales and causes damages to firms' reputation (Chiosa and Anastasiei 2017; Sonnier et al. 2011; Bambauer-Sachse and Mangold 2011). If firms' response to negative SMS by increasing their environmental and social disclosures is favorable to them, it is plausible to expect these firms to benefit from it financially. The eventual financial gain from the strategy of increasing their environmental and social disclosures in the face of negative SMS could be another important motivation for these firms to embark on this strategy. The provision of CSR information is argued to be important for organizations to enhance their legitimacy and financial gains (Schaltegger and Hörisch 2017). Given the arguments above, it is therefore plausible to conjecture that firms' strategy of responding to negative SMS by increasing environmental and social disclosures not only offsets their reputational decline, but also results in net gains that increase their future revenue. More formally:

H2: The effect of negative SMS on future revenue differs between firms with high and low environmental and social disclosure

Data and sample selections

The sample of this study is derived from the Fortune 500 firms from the year 2010 to 2017. The social media data is retrieved from Infegy Atlas social media database. Infegy Atlas

is a US firm that employs data mining technique to comb billions of conversations data from multiple social media platforms, news sites, review sites blogs and forums, including Facebook, Twitter, Instagram, Reddit, Tumblr, TikTok and Pinterest. Infegy utilizes data mining algorithms to search, categorize, group, and relate social media conversations and uses natural language processing techniques to perform sentiment analysis. Infegy database is becoming popular in academic studies and some of the recent studies that used Infegy are Benjamin et al. (2021) and Nguyen et al. (2020). Firms' environmental and social disclosure scores and board-level governance variables are retrieved from Bloomberg professional services database. Firm-level financial data are sourced from the Compustat database. The initial sample of this paper was 4,000 firm-year observations but after removing financial firms and observations with incomplete financial, environmental, social or corporate governance data, the final sample totaled 2,296 firm-year observations.

Negative SMS, Environmental and Social Disclosure and Sales

The social media sentiments data is derived and computed by Infegy using automated machine learning and Artificial Intelligence based on the Natural Language Understanding (NLU) technique, Plutchik's wheel of emotion framework (Plutchik 1980) and Lexicon analysis.[2] In this process, these sentiments are broadly classified into negative and positive or into specific types of emotions such as *ANGER*.[3] Particularly, Infegy undertakes the following steps: (i) mining of social media data using Python technology, (ii) cleaning of data to remove non-functional words such as spaces, URLs, etc., to get to the root of the words, (iii) identifying social media sentiments such as positive and negative sentiments using lexicon analysis and

[2] For more information about Infegy, see https://infegy.com/infegy-atlas, accessed January 5, 2022.

[3] *ANGER* is a specific type of negative sentiments that is used in the 'further robustness tests' below.

(iv)[4] further identifying and refining more complex word patterns into positive and negative sentiments using of natural language processing techniques.[5] For example, words or phrases expressed in social media such "mad" and "I despise it" are negative SMS (Nguyen et al. 2020). In this study, the main social media sentiment variable of interest is negative SMS. Negative SMS (*NEGATIVE*) is measured as the ratio of the number of negative SMS to total number of negative and positive SMS expressed in social media about a firm.

The environmental disclosure score (*ENV)* and social disclosure scores (*SOC*) are developed by the Bloomberg professional services and are a measure of how complete and transparent a firm's reporting is on environmental and social topics (Eccles et al. 2014; Xie et al. 2019). Bloomberg constructs its annual environmental and social disclosure score by gathering information from various sources, namely, annual reports, websites, corporate social responsibility (CSR) or sustainability reports, and other public sources, as well as through direct contact with the firm, that include email exchanges, phone interviews, survey responses, and face-to-face meetings (Benjamin et al. 2019; Fatemi et al. 2018). The data points used to calculate the environmental and social disclosure scores are based on the Global Reporting Initiative (GRI) framework and capture standardized cross-sector and industry-specific metrics where each score is also tailored to be industry relevant, so that each firm is evaluated only in terms of the data that is relevant to its industry sector (Benlemlih et al. 2018). *ENV* is a weighted score of fifty-nine environmental data points. Likewise, *SOC* is a weighted score of twenty-six social data points. The score for both *ENV* and *SOC* ranges from zero (for firms that do not report any data) to 100 (for firms that disclose every data point). Bloomberg also penalizes a

[4] For example, the following sentences contain the word "I like my Chevy" and "That looks like a Chevy". The former embodies an emotion, while the latter does not. Infegy applies data mining techniques where the terms are clustered and association rules are applied to ascertain the patterns.

[5] Infegy uses natural language processing to identify simple negation worlds. For example, the terms "not angry" and "not excited" contains the words "angry" and "excited," but their sentiment is not one of anger or excited or broadly, a negative sentiment. Similarly, more complex word patterns such as "It is unthinkable to have fun using this product" includes the term "fun," but it is not a fun or positive sentiment. In contrast, the statement "It is unthinkable not to have fun using this product" is a "fun" or positive sentiment but encompass a negation ("not" and "fun" in the same sentence). Infegy employs the Bayesian topic modelling to discern similarities and differences in complex paragraphs.

firm for missing information (Chauhan and Kumar, 2018). Bloomberg's environmental and social disclosure scores are widely used in the recent literature (e.g., Benjamin et al. 2021; 2020, 2019; Fatemi et al. 2018; Chauhan and Kumar, 2018).

Sales represent the total revenue of a firm in a particular year. *SALES* is measured as the natural logarithm of the firm's total revenue.

Control variables

Following prior-related literature (Benjamin et al. 2021; Nguyen et al. 2020; Schmidt et al. 2020; Liao et al. 2015; Brammer and Pavelin 2006), we control for a number of variables that can affect the individual firm's environmental and social disclosure and sales. These variables are female directors (*PCT WOMEN*), independent directors (*BODIND*), CEO duality on the board (*DUALITY*), board size (*BOARDSIZE*), employees (*EMP*), firm size (*FIRM SIZE*), leverage (*LEV*), profitability (*ROA*) and advertising spending intensity (*ADV INTEN*). Table 9 in Appendix provides the variable definitions for our control variables.

Model Specification

The structural model to test our first set of hypotheses (H1a and H1b) are as follows:

$$ENV\ or\ SOC_{i,t+1} = \beta_0 + \boldsymbol{\beta_1 NEGATIVE_{i,t}} + \beta_i X_{i,t} + \varepsilon_{i,t} \quad \text{Eq. (1)}$$

And the structural model to test second hypothesis (H2) are as follows:

$$SALES_{i,t+1} = \beta_0 + \boldsymbol{\beta_1 NEGATIVE_{i,t}} + \beta_i X_{i,t} + \varepsilon_{i,t} \quad \text{if } ENV\ or\ SOC_{i,t+1} \text{ is } Low$$

Eq. (2a)

$$SALES_{i,t+1} = \beta_0 + \boldsymbol{\beta_1 NEGATIVE_{i,t}} + \beta_i X_{i,t} + \varepsilon_{i,t} \quad \text{if } ENV\ or\ SOC_{i,t+1} \text{ is } High$$

Eq. (2b)

where *Low ENV* and *SOC* represent firms with the values of *ENV* and *SOC* below the median sample value, respectively. *High ENV* and *SOC* represent firms with the values of *ENV* and *SOC* above the median sample value, respectively. *NEGATIVE* represent SMS; *SALES* represents sales or revenue; *X* is a common set of control variables; and $\varepsilon_{i,t}$ is the error term. Eq. (1) and Eq. (2) and is estimated based on the robust pooled ordinary least squares (OLS) regression. The two-digit Global Industry Classification Standard (GICS) codes and years are used as dummy indicators for industry effects and year effects, respectively in all our regressions.

Empirical results

Descriptive statistics

Table 1 shows the descriptive statistics and correlations for the variables employed in this study. The mean of environmental disclosure score (*ENV*) and social disclosure score *(SOC)* over the whole period is 28.023 and 28.689, respectively. Negative SMS (*NEGATIVE*), the number of main explanatory variable of interest in this study, has a mean of 28.720. *SALES* has a mean of 9.239 and media of 9.181.

---Insert Table 1 about here---

Correlation analysis

Table 2 presents the pair-wise correlation matrix for all the variables. The correlation between negative SMS and environmental and social disclosure are positive and significant. Results show that multicollinearity is unlikely to be a major concern, no pairs of independent variables show correlations of above the critical value of 0.8, hence suggesting no evidence of multicollinearity. Next, we present the multivariate analyses' results.

---Insert Table 2 about here---

Multivariate analysis

Table 3 shows the results of analyses to test Hypotheses 1 which predicts that negative SMS will cause firms to enhance their environmental and social disclosures, respectively. To tests these hypotheses, we regress one-year lead values of *ENV* and *SOC* on *NEGATIVE* and a set of control variables discussed in the previous section. The coefficient of *NEGATIVE* in column (1) is positive and significant at the 1% level, providing strong support for Hypothesis 1a. The coefficient of *NEGATIVE* suggests that ceteris paribus, a one standard deviation increase in *NEGATIVE* causes a 0.04 (0.087*11.510/28.023) increase in the one-year ahead *ENV* at the mean. The coefficient of *NEGATIVE* in Column (2) is similarly positive and significant at the 1% level in explaining the one-year ahead value of *SOC*, further supporting Hypothesis 1. The coefficient estimate of *NEGATIVE* indicates that, ceteris paribus, a one standard deviation increases in *NEGATIVE* causes a 0.03 (0.084*11.510/28.689) increase in the one-year ahead *SOC* at the mean. Overall, these findings are consistent with the notion that when firms receive significant amount of negative social media sentiments, they intensity their environmental and social disclosures in response. Additionally, we document several positive and significant relationships between environmental and social disclosure and the control variables, namely *PCTWOMEN*, *BODIND*, *BOARDSIZE*, *FIRM SIZE*, *ROA* and *ADV INTEN*.

---Insert Table 3 about here---

The results for the sub-sample analysis for Hypotheses 1b that examines the influence of firm-specific factors (firm size, advertising intensity, and employees) on the relationships between negative SMS on environmental and social disclosure, respectively are shown in Table

4. The subsamples are split based on high vs. low; for each firm-specific factor, firms with the respective values below the median are classified as '*Low*' and conversely, firms with values above the median are classified as '*High*'. Columns (1) – (4) show the subsample analysis for the influence of firm size. The coefficients of *NEGATIVE* are positively significant at the 5% (Column (2)) and 1% (Column (4)) levels in explaining one-year ahead *ENV* and *SOC*, respectively, in large firms (*Size High*) only. The corresponding coefficients for small firms (*Size Low*) in Columns (1) and (3) are positive but insignificant. Our results for the influence of firm size on the effects of negative SMS on environmental and social disclosure suggests that larger firms with more resources make a greater impact to the society, as opposed to relatively smaller sized firms and more concerned with the reputational impacts of negative SMS and are hence, inclined to enhance their reputation by increasing their environmental and social disclosures accordingly.

Columns (5) – (8) presents the results for the influence of advertising intensity on the association between negative SMS with environmental and social disclosure. In firms with low advertising spending intensity (*Adv Low*), *NEGATIVE* shows a positive and significant associations with *ENV* (Column (5)) and *SOC* (Column (7)) at the 5% and 1% levels, respectively. The corresponding coefficients of *NEGATIVE* in firms with high advertising intensity (*Adv High*) in Columns (6) and (8) are insignificant. Taken together, the results suggest that the need to respond to negative SMS by increasing environmental and social disclosures is important in firms with low advertising spending intensity because of the lack of reputational advantage brought upon by high advertising spending in such firms. In firms with high advertising spending, it seems like the reputational advantage that comes with high advertising spending intensity negate the need to further enhance corporate reputation by responding with higher environmental and social disclosures in the face of negative SMS. In Columns (9) – (12) of Table 4, we focus on the influence of employees on the effects of

negative SMS on environmental and social disclosure. In firms with high number of employees (*Emp High*) (Columns (10) and (12)), the coefficients of *NEGATIVE* load positively and significantly at the 1% levels on *ENV* and *SOC*, respectively. The corresponding coefficient of *NEGATIVE* does not exhibit any significant effect on *SOC* in firms with low number of employees (*Emp Low*) but exert a significant effect on *ENV* for the corresponding group. This finding nevertheless provides moderate evidence that firms are driven to strongly respond to negative SMS by increasing their environmental and social when they have high number of employees.

---Insert Table 5 about here---

In Table 5, we continue our examination of the influence of firm-specific factors on the link between negative SMS with environmental and social disclosure by looking at leverage and profitability. Columns (1) – (4) report the results for the influence on leverage. The coefficient of *NEGATIVE* is positively significant at the 1% level (Column (4)) in explaining one-year ahead *SOC*, in firms with high leverage (*Lev High*). The corresponding results for *ENV* in firms high leverage (*Lev High*) in Column (2) is positive but surprisingly insignificant. Likewise, the corresponding coefficients for low-leverage firms (*Lev Low*) in Column (1) for *ENV* is marginally significant at the 10% level and insignificant in Column (3) for *SOC*. Our results for the influence of leverage on the effects of negative SMS on social disclosure suggests that, due to increased appetite of lenders for social disclosure and the favorable outcomes it brings, firms with high leverage seem to be more concerned with negative SMS and are more inclined to increase their social disclosure as a result. The result for the influence of profitability on the social media sentiments-environmental and social disclosure nexus are presented in Columns (5) – (8) of Table 5. We find that coefficients of *NEGATIVE* on *ENV* (Column (5)) and *SOC* (Column (7)) are positive and statistically significant at the 5% levels in firms with low profitability (*Roa Low*). The equivalent coefficients of negative SMS in firms

with high profitability (*Roa High*) are positive but insignificant. Taken together, the results suggest that the need to respond to negative SMS by increasing environmental and social disclosures is important only in firms with low profitability possibly because of the additional motivation to distract stakeholders' attention from the poor financial performance.

---Insert Table 6 about here---

Lastly, we examine the implications arising from firms' response to negative SMS by increasing environmental and social disclosure; specifically, whether it improves their ultimate bottom line, i.e., financial goal. In order to do this, create two sub-samples based on each of *ENV* and *SOC*: firm-year observations with *Low* and *High ENV* and *SOC* and we examine the implications of $NEGATIVE_t$ on future revenue ($SALES_{t+1}$). The results are presented in Table 6. First, we present the baseline regression of negative SMS on future revenue for entire sample in Column (1), i.e., before dividing the sample into the *Low* and *High ENV* and *SOC* subsamples. The results show that overall, $NEGATIVE_t$ does not exhibit any significant association with $SALES_{t+1}$. In Columns (2) – (5) of Table 6, we present the results of our Hypothesis 2, where we partition the sample into subsample of firms with *Low* and *High ENV* and *SOC*. The results show that the coefficients of $NEGATIVE_t$ on $SALES_{t+1}$ are insignificant in Columns (2) and (4) in firms with *Low ENV* and *SOC*, respectively. The results for *High ENV* and *SOC* are reported in Columns (3) and (5), respectively. It is notable that the relationship between $NEGATIVE_t$ and $SALES_{t+1}$ becomes positive and significant at the 1% level in firms with *High ENV* but insignificant in firms with *High SOC*. The higher R^2 of 0.843 in Column 3 (*High ENV*) compared to the R^2 of 0.522 in Column (2) (*Low ENV*) further highlights the increased explanatory power of $NEGATIVE_t$ in explaining $SALES_{t+1}$ in firms with *High ENV*. This indicates that the effect of negative SMS on future revenue is dominated by the environmental disclosure dimension. These findings could suggest that the environmental dimension is perceived by customers and the public as having more important

implications than the social dimension for firm performance and this seems to also resonate in general with other related studies (e.g., Friede *et al.*, 2015). This finding shed important light on the fact that firms experience increases in their one-year ahead revenue when they increase their one-year ahead environmental disclosures as a result of negative SMS in the current year. Overall, this lends credence to our conjecture that, firms' CSR or efforts to provide more environmental and social disclosures in the face of negative SMS not only offsets the reputational decline, but also brings about a net improvement to their corporate reputation which results in financial benefit in the form of increased revenue.

Additional robustness tests

In this section, we conduct two additional tests for the purpose of robustness of our main findings. First, we address endogeneity concerns by employing the two-stage least squares (2SLS) regression analysis and the results are presented in Table 7. Our identification of the instrumental variables, i.e., the yearly industry average of *NEGATIVE* (excluding the focal firm), denoted as *IND AVG NEGATIVE*, and the one-year lagged value of *NEGATIVE*, denoted as *LAG NEGATIVE*, is based on prior literature (Benjamin et al., 2021, 2020, 2019; Al-Hadi *et al*., 2017; Cui *et al*., 2018) that employed the industry average and one-year lagged values of the explanatory variable as the instruments. In the first-stage of the 2SLS (Column (1)), we regress *NEGATIVE* on the instrument variable (IV); *LAG NEGATIVE* and *IND AVG NEGATIVE* and other control variables, and estimate the fitted value of negative SMS, denoted as *PRED NEGATIVE*. The first-stage fitted value of *PRED_NEGATIVE* is then used in the second-stage of the 2SLS regressions. In Table 7, the first-stage regressions IV, *LAG NEGATIVE* and *IND_AVG_NEGATIVE* are positively associated at the 1% levels with *NEGATIVE* in Columns (1) and (3). In the second-stage regression in Columns (2) and (4), the coefficients of *PRED NEGATIVE* are significant and positive at the 1% level in explaining

ENV and *SOC*, respectively. In sum, the findings of the 2SLS regressions approach remain robust with our main findings which shows that negative SMS is positively associated with environmental and social disclosure.

---Insert Table 7 about here---

In the second part, we gauge the robustness of our main finding by replacing *NEGATIVE* with *ANGER*, which represent a specific type of negative SMS.[6] Specifically, the results in Column (1) and (2) of Table 8 show that *ANGER* is positively and significantly associated with *ENV* and *SOC*. This robustness analysis indicates that our main findings remain unchanged and reinforces our argument that when increase their environmental and social disclosure when faced they receive more negative SMS.

---Insert Table 8 about here---

Conclusion

The rise of social media and its impact on corporations' activities and outcomes are undeniable. Realizing the importance of understanding this emerging phenomenon, we sample a comprehensive sample of Fortune 500 firms from the year 2010 to 2017 in this study. We first examine firms' reaction to negative SMS and find that negative SMS is positively related to one-year ahead environmental and social disclosures. Our results suggests that this is possibly due to reputational damage that negative SMS bring about and firms react to this by increasing something that improve their reputation, i.e., environmental and social disclosure. Next, we examine the influence of firm-specific factors on this relationship and find that firms' reaction to negative SMS by increasing environmental and social disclosures is important in

[6] *ANGER* is measured as ratio of the number of emotions that express anger in social media to total number of emotions that express anger and joy in social media about a firm.

firms which are large in size, low in advertising spending intensity, high in number of employees, high in leverage and low in profitability. Finally, we examine the implication for firms when they increase their environmental and social disclosures as a result of negative SMS and find that this leads to increased future revenue. This partially confirms our conjecture and show that firms' strategy to increase their environmental disclosure in the face of negative SMS is not only favorable to their reputation but also results in financial benefits in the form of increased future revenue. Our finding remains robust to a number of alternative estimation approaches. These findings offer fresh insights that are relevant to managers who are interested in the importance of social media and its implications on firms' responses and outcomes. Our study also serves as guidance to shareholders and stakeholders in understanding firms' strategies in dealing with social media sentiments, its links to their environmental and social disclosure and future revenue.

The paper offers some directions for future research. Future studies could be conducted across various time periods and from a global context to broaden our comprehension on the links between social media sentiments, environmental and social disclosure and firm revenue. Future studies could also broaden this evolving literature and investigate the importance of social media on other contemporary issues such as firm risk, stock crash risk and capital structure. Future studies could also examine the influence of the specific sub-dimensions within environmental and social disclosure such as resource use, environmental innovation, human rights and community and unveil their importance to social media sentiments-environmental and social disclosure-future revenue nexus.

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Table 1. Descriptive Statistics

Variable	N	Mean	SD	P25	P50	P75	Min	Max
ENV	2219	28.023	18.493	11.628	27.132	41.861	0.775	84.297
SOC	2575	28.689	15.961	17.544	24.561	39.063	3.125	79.688
NEGATIVE	2596	28.720	11.510	20.721	27.609	35.354	0.000	100.000
SALES	2972	9.239	1.139	8.667	9.181	9.860	6.552	12.156
PCT WOMEN	2596	0.182	0.094	0.111	0.182	0.235	0.000	0.500
BODIND	2596	0.821	0.108	0.769	0.846	0.909	0.000	1.000
CEO DUALITY	2596	0.522	0.500	0.000	1.000	1.000	0.000	1.000
BOARDSIZE	2596	2.373	0.184	2.303	2.398	2.485	1.386	2.890
EMP	2596	10.287	1.320	9.488	10.292	11.123	0.000	14.648
FIRM SIZE	2596	9.684	1.139	8.860	9.627	10.456	5.956	13.529
LEV	2596	0.299	0.174	0.174	0.281	0.405	0.000	0.847
ROA	2596	0.061	0.060	0.028	0.056	0.090	-0.212	0.227
ADV INTEN	2596	0.014	0.028	0.000	0.000	0.015	0.000	0.176

P25 and P75 = 25th and 75th percentile of the variables, respectively. Std.dev. denotes standard deviation. Definitions of all variables are presented in Table 9 in the Appendix section.

Table 2. Correlations Table

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*
(1) ENV_{t+1}	1.00												
(2) SOC_{t+1}	0.71***	1.00											
(3) $NEGATIVE_t$	0.15***	0.13***	1.00										
(4) $SALES_{t+1}$	0.25***	0.26***	0.20***	1.00									
(5) $PCT\ WOMEN_t$	0.26***	0.29***	-0.03*	0.26***	1.00								
(6) $BODIND_t$	0.25***	0.27***	0.17***	0.15***	0.27***	1.00							
(7) $CEO\ DUALITY_t$	0.10***	0.06***	0.04***	0.13***	0.06***	0.20***	1.00						
(8) $BOARDSIZE_t$	0.33***	0.31***	0.11***	0.34***	0.21***	0.18***	0.06***	1.00					
(9) EMP_t	0.19***	0.15***	0.05**	0.62***	0.27***	0.10***	0.12***	0.26***	1.00				
(10) $FIRM\ SIZE_t$	0.39***	0.39***	0.27***	0.78***	0.25***	0.21***	0.14***	0.45***	0.47***	1.00			
(11) LEV_t	-0.03	0.03	-0.01	-0.11***	-0.07***	-0.13	-0.01	0.04**	-0.09***	0.06***	1.00		
(12) ROA_t	0.07***	0.03*	-0.02	0.12***	0.07***	0.09	0.01	0.03**	0.13***	-0.01	-0.29***	1.00	
(13) $ADV\ INTEN_t$	0.07***	0.02	-0.02**	-0.013	0.15***	-0.14***	-0.04**	0.09***	0.05**	0.01	-0.03	0.13***	1.00

***,**,* indicate statistical significance at the 1%, 5%, and 10% level, respectively. Definitions of all variables are presented in Table 9 in the Appendix section.

Table 3. The effects of negative social media sentiments on environmental and social disclosure

Dependent variable	ENV_{t+1}	SOC_{t+1}
	(1)	(2)
$NEGATIVE_t$	0.087***	0.084***
	(0.03)	(0.03)
$PCT\ WOMEN_t$	27.973***	16.014***
	(3.86)	(3.13)
$BODIND_t$	24.012***	19.357***
	(3.91)	(2.44)
$CEO\ DUALITY_t$	0.643	-0.526
	(0.70)	(0.54)
$BOARDSIZE_t$	19.069***	11.225***
	(1.98)	(1.54)
EMP_t	0.463	0.670**
	(0.30)	(0.26)
$FIRM\ SIZE_t$	5.129***	2.911***
	(0.39)	(0.33)
LEV_t	-4.241**	-1.647
	(2.09)	(1.52)
ROA_t	30.084***	13.924***
	(7.07)	(4.97)
$ADV\ INTEN_t$	52.123***	36.953***
	(15.68)	(10.74)
Constant	-95.080***	-63.263***
	(5.82)	(3.83)
Year Dummies	Yes	Yes
Industry Dummies	Yes	Yes
R^2	0.331	0.314
F-stat	58.430	52.638
Observations	2299	2596

This table presents a series of OLS regressions for the relationship between negative social media sentiments with environmental and social disclosures. It provides the coefficient estimates and *t*-statistics based on standard errors, below. ***,**,* indicate statistical significance at the 1%, 5%, and 10% level, respectively. Definitions of all variables are presented in Table 9 in the Appendix section.

Table 4. Negative social media sentiments-environmental and social disclosure link; influence of firm size, advertising intensity and employees

Dependent variable	ENV_{t+1}		SOC_{t+1}		ENV_{t+1}		SOC_{t+1}		ENV_{t+1}		SOC_{t+1}	
	Size Low	*Size High*	*Size Low*	*Size High*	*Adv Low*	*Adv High*	*Adv Low*	*Adv High*	*Emp Low*	*Emp High*	*Emp Low*	*Emp High*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$NEGATIVE_t$	0.032	0.126***	0.030	0.144***	0.103**	0.022	0.155***	-0.015	0.076	0.138***	0.115***	0.098***
	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.03)	(0.05)	(0.04)	(0.04)	(0.03)
$PCT\ WOMEN_t$	17.823***	28.270***	17.302***	13.683***	50.299***	6.530	30.860***	3.682	34.245***	23.666***	19.255***	11.443***
	(6.23)	(5.14)	(4.59)	(4.32)	(5.53)	(5.42)	(4.70)	(4.23)	(6.53)	(5.07)	(4.91)	(4.13)
$BODIND_t$	23.160***	21.272***	17.630***	21.076***	12.919**	30.873***	11.281***	22.557***	31.322***	16.944***	20.956***	15.008***
	(5.65)	(5.55)	(3.35)	(3.69)	(5.92)	(4.66)	(3.74)	(3.06)	(6.78)	(4.65)	(3.61)	(3.42)
$CEO\ DUALITY_t$	0.693	0.536	-0.552	-0.600	0.326	1.919**	-0.800	0.422	-2.125*	2.683***	-0.515	-0.223
	(1.10)	(0.90)	(0.79)	(0.75)	(0.99)	(0.94)	(0.80)	(0.72)	(1.17)	(0.86)	(0.87)	(0.70)
$BOARDSIZE_t$	18.742***	18.894***	9.427***	10.542***	23.091***	16.135***	9.553***	12.247***	22.744***	15.356***	10.572***	12.147***
	(2.91)	(2.70)	(2.06)	(2.31)	(3.01)	(2.64)	(2.36)	(2.03)	(3.03)	(2.66)	(2.28)	(2.06)
EMP_t	0.174	1.048***	1.143**	0.519	0.387	1.537***	1.261***	0.698*	0.781*	-0.055	1.603***	-0.675
	(0.58)	(0.35)	(0.45)	(0.34)	(0.41)	(0.48)	(0.31)	(0.41)	(0.46)	(0.64)	(0.34)	(0.54)
$FIRM\ SIZE_t$	5.549***	3.994***	4.212***	2.317***	4.852***	4.174***	3.207***	2.121***	6.807***	5.602***	4.381***	3.299***
	(1.06)	(0.62)	(0.79)	(0.52)	(0.58)	(0.57)	(0.49)	(0.46)	(0.70)	(0.52)	(0.59)	(0.44)
LEV_t	1.744	-8.739***	-3.384	0.191	-9.448***	-3.808	-5.891**	0.163	-8.879***	0.052	-1.611	-1.247
	(2.96)	(2.85)	(2.11)	(2.15)	(3.39)	(2.66)	(2.45)	(1.87)	(3.21)	(2.76)	(2.35)	(1.97)
ROA_t	8.542	55.879***	4.454	24.701***	9.550	34.775***	14.402	9.204*	-16.966*	66.357***	-3.510	32.379***
	(9.81)	(9.99)	(7.03)	(7.12)	(12.76)	(7.85)	(9.78)	(5.49)	(9.98)	(8.35)	(7.71)	(5.80)
$ADV\ INTEN_t$	63.387***	49.462**	28.877**	45.197***	0.000	39.983**	0.000	27.010**	-43.649**	115.269***	14.077	68.232***
	(22.80)	(22.87)	(13.32)	(17.31)	(.)	(17.79)	(.)	(11.67)	(19.47)	(20.35)	(12.69)	(16.95)
Constant	-109.119***	-111.323***	-81.162***	-47.734***	-89.882***	-99.056***	-45.677***	-41.091***	-141.306***	-77.352***	-91.550***	-21.166***
	(11.08)	(7.20)	(7.98)	(7.66)	(7.94)	(7.39)	(6.76)	(5.72)	(9.73)	(8.17)	(7.27)	(6.84)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.218	0.287	0.252	0.258	0.330	0.379	0.319	0.358	0.342	0.362	0.382	0.298
F-stat	18.378	32.381	25.483	26.414	36.698	32.393	32.973	31.422	31.896	37.451	36.949	28.427
Observations	879	1420	1107	1489	1251	1048	1389	1207	970	1329	1164	1432

This table presents the estimation results of the relationship between negative social media sentiments with environmental and social disclosure amongst firms with high versus low size, advertizing intensity and employees. It provides the coefficient estimates and *t*-statistics based on standard errors, below. ***,**,* indicate statistical significance at the 1%, 5%, and 10% level, respectively. Definitions of all variables are presented in Table 9 in the Appendix section

Table 5. Negative social media sentiments-environmental and social disclosure link; influence of leverage and profitability

Dependent variable	ENV_{t+1}		SOC_{t+1}		ENV_{t+1}		SOC_{t+1}	
	Lev Low	*Lev High*	*Lev Low*	*Lev High*	*Roa Low*	*Roa High*	*Roa Low*	*Roa High*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$NEGATIVE_t$	0.092*	0.049	0.007	0.135***	0.092**	0.033	0.095**	0.054
	(0.05)	(0.05)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)
$PCT\ WOMEN_t$	30.591***	25.792***	9.306**	22.398***	29.043***	20.427***	16.453***	12.565***
	(5.57)	(5.97)	(4.42)	(4.50)	(5.32)	(5.77)	(4.46)	(4.41)
$BODIND_t$	25.983***	14.939***	23.656***	12.016***	3.785	40.180***	9.186**	27.464***
	(5.62)	(5.40)	(3.85)	(3.16)	(6.40)	(4.19)	(3.90)	(3.02)
$CEO\ DUALITY_t$	0.221	0.744	-0.696	-0.810	0.436	1.818*	-0.562	-0.262
	(1.00)	(0.98)	(0.77)	(0.76)	(1.01)	(0.93)	(0.79)	(0.75)
$BOARDSIZE_t$	19.726***	20.153***	13.604***	7.220***	24.601***	13.228***	11.322***	9.885***
	(2.73)	(3.03)	(2.04)	(2.40)	(3.00)	(2.56)	(2.42)	(2.04)
EMP_t	-1.115**	1.293***	-0.072	1.211***	0.504	0.524	1.180***	0.414
	(0.56)	(0.35)	(0.47)	(0.32)	(0.47)	(0.37)	(0.39)	(0.33)
$FIRM\ SIZE_t$	6.367***	4.252***	3.209***	3.372***	4.826***	5.751***	3.336***	2.918***
	(0.57)	(0.57)	(0.48)	(0.47)	(0.60)	(0.49)	(0.52)	(0.44)
LEV_t	5.786	-14.657***	5.406	-9.762***	-12.194***	-0.764	-3.807	-0.759
	(6.73)	(3.76)	(4.91)	(2.83)	(3.04)	(2.86)	(2.36)	(2.09)
ROA_t	43.055***	24.346**	22.375***	9.129	-52.847***	65.589***	-16.285	25.021***
	(10.26)	(10.05)	(7.19)	(6.98)	(13.83)	(10.83)	(10.42)	(8.52)
$ADV\ INTEN_t$	19.161	83.457***	27.042**	54.900***	-3.446	59.590***	21.803	30.797**
	(19.70)	(27.61)	(13.39)	(19.24)	(25.74)	(20.26)	(17.59)	(13.99)
Constant	-86.236***	-85.577***	-35.857***	-41.099***	-110.415***	-114.806***	-49.188***	-49.528***
	(7.58)	(8.07)	(6.01)	(5.86)	(7.27)	(6.64)	(6.50)	(9.52)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.340	0.343	0.321	0.350	0.341	0.384	0.327	0.331
F-stat	33.001	34.751	47.561	34.854	33.828	43.314	29.144	35.810
Observations	1168	1131	1315	1281	1074	1225	1209	1387

This table presents the estimation results of the relationship between negative social media sentiments with environmental and social disclosure amongst firms with high versus low leverage and profitability. It provides the coefficient estimates and *t*-statistics based on standard errors, below. ***,**,* indicate statistical significance at the 1%, 5%, and 10% level, respectively. Definitions of all variables are presented in Table 9 in the Appendix section.

Table 6. Negative social media sentiments, environmental and social disclosure, and revenue

Dependent variable	$SALES_{t+1}$				
	Overall	*ENV Low*	*ENV High*	*SOC Low*	*SOC High*
	(1)	(2)	(3)	(4)	(5)
$NEGATIVE_t$	0.000	-0.003*	0.003***	0.000	0.001
	(0.52)	(-1.79)	(2.89)	(0.29)	(0.95)
$PCT\ WOMEN_t$	0.459***	0.263	0.470***	0.299	0.365***
	(3.53)	(1.38)	(3.02)	(1.48)	(2.51)
$BODIND_t$	-0.346***	-0.14796	-0.339**	-0.19406	-0.11464
	(-3.02)	(-1.05)	(-2.37)	(-1.34)	(-0.8)
$CEO\ DUALITY_t$	0.0313	0.091***	-0.01902	0.090**	-0.02203
	(1.52)	(2.5)	(-0.83)	(2.51)	(-0.95)
$BOARDSIZE_t$	-0.07668	0.104425	-0.314***	0.003	-0.254***
	(-1.24)	(1.11)	(-4.09)	(0.04)	(-3.49)
EMP_t	0.214***	0.079***	0.359***	0.078***	0.334***
	(8.36)	(3.09)	(24.64)	(2.82)	(23.03)
$FIRM\ SIZE_t$	0.627***	0.581***	0.572***	0.616***	0.584***
	(31.7)	(18.77)	(36.53)	(20.34)	(37.33)
LEV_t	-0.623***	-0.548***	-0.710***	-0.667***	-0.622***
	(-9.02)	(-4.86)	(-9.78)	(-5.82)	(-8.6)
ROA_t	0.848***	0.49742	1.039***	0.644*	0.955***
	(3.98)	(1.33)	(4.85)	(1.68)	(4.66)
$ADV\ INTEN_t$	-4.049***	-3.257***	-3.718***	-3.329***	-3.497***
	(-10.51)	(-6.82)	(-8.0)	(-6.91)	(-7.69)
Constant	1.539***	2.558***	1.050***	1.976***	0.989***
	(8.74)	(8.37)	(4.96)	(6.3)	(4.83)
Year Dummies	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.761	0.522	0.843	0.553	0.843
F-stat	339.8	39.84	463.89	41.78	397.2
Observations	2638	1057	1581	1100	1538

This table presents the estimation results of the interaction between negative social media sentiment with environmental and social disclosure on future sales. It provides the coefficient estimates and *t*-statistics based on standard errors, below. ***,**,* indicate statistical significance at the 1%, 5%, and 10% level, respectively. Definitions of all variables are presented in Table 9 in the Appendix section.

Table 7. Two-Stage Least-Squares (2SLS) Results

Dependent variable	$NEGATIVE_t$	ENV_{t+1}	$NEGATIVE_t$	SOC_{t+1}
	First-Stage	Second-Stage	First-Stage	Second-Stage
	(1)	(2)	(3)	(4)
$LAG\_NEGATIVE_t$	0.890***		0.879***	
	(9.16)		(9.36)	
$IND\_AVG\_NEGATIVE_t$	0.540***		0.553***	
	(22.87)		(23.74)	
$PRED\_NEGATIVE_t$		0.166***		0.156***
		(3.04)		(3.56)
$PCT\ WOMEN_t$	-3.575*	28.130***	-4.235**	17.436***
	(-1.67)	(7.12)	(-2.05)	(5.42)
$BODIND_t$	2.748	24.651***	0.638	18.975***
	(1.30)	(5.90)	(0.28)	(7.10)
$CEO\ DUALITY_t$	0.093	0.736	0.178	-0.561
	(0.23)	(1.02)	(0.43)	(-0.99)
$BOARDSIZE_t$	-1.441	19.759***	-0.690	11.252***
	(-1.32)	(9.64)	(-0.60)	(7.02)
EMP_t	0.357*	0.442	0.361**	0.610**
	(1.92)	(1.43)	(2.00)	(2.19)
$FIRM\ SIZE_t$	1.088***	5.201***	0.967***	2.854***
	(4.70)	(12.75)	(4.29)	(8.02)
LEV_t	0.863	-4.588**	0.519	-1.305
	(0.74)	(-2.13)	(0.46)	(-0.83)
ROA_t	-1.670	26.990***	-1.229	9.378*
	(-0.50)	(3.75)	(-0.40)	(1.84)
$ADV\ INTEN_t$	2.512	44.420***	4.177	36.574***
	(0.33)	(2.72)	(0.47)	(3.20)
Constant	-28.014***	-99.618***	-26.614***	-42.281***
	(-6.58)	(-19.19)	(-6.60)	(-10.14)
Year Dummies	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes
Underidentification test	361.545***		394.578***	
Weak Identification Test	304.738		328.995	
Hansen *J*-stat	0.705		0.052	
R^2		0.345		0.309
F-stat		61.330		48.340
Observations	2057	2057	2301	2301

This table presents the estimation results of our instrumental variable (2SLS) specification. In Columns (1) and (3) the industry-mean of *NEGATIVE* (denoted as *NEGATIVE*) and the one year-lagged values of *NEGATIVE* (denoted as *LAG_ NEGATIVE*) serve as excluded instruments to generate *PRED_ NEGATIVE* that is used in Columns (2) and (4). Definitions of all variables are presented in Table 1. It provides the coefficient estimates and *t*-statistics based on standard errors, below. ***,**,* represents significance at the 1%, 5% and 10% level, respectively. Definitions of all variables are presented in Table 9 in the Appendix section.

Table 8. Robustness of the effects of negative social media sentiments on environmental and social disclosure

Dependent variable	ENV_{t+1}	SOC_{t+1}
	(1)	(2)
$ANGER_t$	0.055*	0.107***
	(0.03)	(0.02)
$PCT\ WOMEN_t$	27.747***	16.221***
	(3.86)	(3.13)
$BODIND_t$	24.498***	19.567***
	(3.93)	(2.46)
$CEO\ DUALITY_t$	0.671	-0.593
	(0.70)	(0.54)
$BOARDSIZE_t$	19.014***	11.196***
	(1.98)	(1.55)
EMP_t	0.507*	0.721***
	(0.30)	(0.26)
$FIRM\ SIZE_t$	5.223***	2.856***
	(0.39)	(0.33)
LEV_t	-4.351**	-2.025
	(2.11)	(1.53)
ROA_t	29.690***	13.436***
	(7.10)	(4.97)
$ADV\ INTEN_t$	54.158***	39.974***
	(15.80)	(10.81)
Constant	-117.709***	-49.335***
	(4.97)	(4.62)
Year Dummies	Yes	Yes
Industry Dummies	Yes	Yes
R^2	0.330	0.317
F-stat	58.199	54.311
Observations	2294	2589

This table presents a series of OLS regressions for the relationship between negative social media sentiments with environmental and social disclosures. It provides the coefficient estimates and robust standard errors, below. ***,**,* indicate statistical significance at the 1%, 5%, and 10% level, respectively. Definitions of all variables are presented in Table 9 in the Appendix section.

Appendix

Table 9. Variable definitions

Variable Name	Label	Description
Environmental disclosure score	*ENV*	Environmental disclosure score developed by the Bloomberg professional services and is a measure of how complete and transparent a firm's reporting is on environmental topics and based on a weighted score of fifty-nine environmental data points. The score ranges from zero to 100.
Social disclosure score	*SOC*	Social disclosure score developed by the Bloomberg professional services and is a measure of how complete and transparent a firm's reporting is on environmental topics and based on a weighted score of twenty-six social data points. The score ranges from zero to 100.
Negative Social Media Sentiments	*NEGATIVE*	Ratio of the number of negative SMS to total number of negative and positive SMS expressed in social media
Anger Social Media Sentiments	*ANGER*	Ratio of the number of emotions that express anger to total number of emotions that express anger and joy in social media
Female Directors	*PCT WOMEN*	Percentage of female directors on the board
Independent Directors	*BODIND*	Percentage of independent directors on the board
CEO Duality	*CEO DUALITY*	A binary variable that takes the value of '1' if the firm's CEO is also the Chairperson of the board and '0' if otherwise
Employees	*EMP*	Natural logarithm of the total number of employees
Sales	*SALES*	Natural logarithm of total sales or revenue
Firm size	*FIRM SIZE*	Natural logarithm of total assets
Leverage	*LEV*	Total debt divided by total assets
Firm Profitability	*ROA*	Net income before extraordinary items divided by total assets
Advertising Spending Intensity	*ADV INTEN*	Advertising expense divided by total assets at the beginning of the year