Tweets from the Top: CEO Overconfidence and Twitter Behavior

Shradha Bindal
University of Kansas
shradha@ku.edu

T. Colin Campbell
University of Cincinnati
campbtt@ucmail.uc.edu

Chad Dulle
University of Cincinnati
dullecd@ucmail.uc.edu

September 5, 2024

Abstract

We analyze firms' and CEOs' tweeting behavior from 2008 to 2021 and find that firms managed by overconfident CEOs tweet more frequently across a variety of topics, use more embellishment, "hedge" less in their statements, and use greater self-reference than firms with non-overconfident CEOs. These effects are stronger around substantive firm events that require public filings and generate abnormally high engagement. Around M&A deal announcements, abnormal deviations from an overconfident CEO's 'expected' tweeting are viewed by the market as a negative signal of deal quality. Our findings suggest that overconfident CEOs appear to encourage greater public interaction with stakeholders, and the content of those interactions have the hallmarks of the firm attempting to influence public perception.

Keywords: CEO overconfidence, disclosure, Twitter, mergers

1. Introduction

Social media has become a relevant source of information dissemination and strategic disclosure. In the last decade, empirical research on social media has gained momentum, with researchers studying the impact of social media interactions among different stakeholders. Blankespoor, Miller, and White (2014) find that firms' use of Twitter to disseminate press releases reduces information asymmetry. Furthermore, firm executives use social media to either shape the narrative or update investors' priors. Elliott, Grant, and Hodge (2018) find that executives are able to gain investor trust if they tweet negative earnings news from their personal accounts. Jung, Naughton, Tahoun, and Wang (2018) find that executives use Twitter for strategic information dissemination and are less likely to release bad news about quarterly earnings through Twitter.

Evidence also suggests a predictive or even influential effect of social media on firm performance. Gu and Kurov (2020) find that Twitter sentiment predicts the next day's return, while Bartov, Faurel, and Mohanram (2018) find that investor opinions predict earnings announcement returns. Ang, Su, Tang, and Wu (2021) find that negative investor posts predict merger withdrawals among value-destroying acquisitions in China. Cookson, Niessner, and Schiller (2023) use StockTwits data to find that negative social media sentiment predicts merger withdrawal. Utilizing an experiment, Grant, Hodge, and Sinha (2018) find that social media CEO bragging is associated with low shareholder investment in the firm. Put simply, social media presents the firm with an opportunity to more freely and rapidly gather and disseminate information among firm stakeholders, with meaningful effects for the firm. As such, it is increasingly important to understand the firm- and executive-level factors that drive the strategic use of social media by the firm.

We examine this in the context of a particular CEO characteristic, overconfidence, that has been shown to have a pervasive impact on firm-level policies and decision-making, and is likely to be relevant for both the disclosure and collection/use of information. Prior literature has shown that overconfident CEOs overvalue their personal information and subsequently their firm, leading to the belief that the market undervalues their firm. As a result, they use internal funds for investment (Malmendier and Tate, 2005), are more likely to manipulate earnings to increase market value (Schrand and Zechman, 2012), report less conservatively (Ahmed and Duellman, 2013), hide bad news in less readable reports (Kim et al., 2016), and try to send costly signals to improve market valuations (Boulton and Campbell, 2016). Overconfident CEOs are also likely to underinvest in information (Goel and Thakor, 2008) and filter out/ignore negative feedback (Taylor and Brown, 1988; Taylor and Gollwitzer, 1995). Three natural questions arise in the context of social media: are overconfident CEOs more likely to attempt to shape public perception through the firm's use of social media? Are they successful? And are overconfident CEOs influenced by the feedback they receive?

We use Twitter (renamed X) as a measure of social media-based public relations because it is immediate, direct, and has a near-zero setup cost. Twitter provides a public and instantaneous channel through which the firm can attempt to shape public (and therefore, market) perception. The importance of Twitter as a medium to distribute relevant information to investors is also recognized by the SEC.[1] Recent literature has found that firms use Twitter as a medium to disseminate information and/or to shape the narrative. Nekrasov et al. (2021) find that firms use visuals when their earnings are good to draw investor attention. Given Twitter's popularity, widespread use, and some evidence of firms and CEOs' use of the platform to communicate with investors, we believe that it is an apt setting to explore our research questions. We find that both

[1] https://archive.nytimes.com/dealbook.nytimes.com/2013/04/02/s-e-c-clears-social-media-for-corporate-announcements/

firm and CEO Twitter activity is positively related to CEO overconfidence, particularly around important events such as M&A deal announcements, the sentiment of the tweets as well as the engagement generated with stakeholders differ with CEO overconfidence. We also find that Twitter activity and engagement can significantly impact the likelihood of M&A deal completion, consistent with CEOs using public stakeholder interaction to "shape the narrative" around the deal.

One empirical strategy relies on collecting and analyzing tweets by firms and CEOs. We collect Twitter 'handle' and usage details for all S&P 1500 firms and their CEOs with available data from 2008 to 2021. This generates a sample of 4,170 CEOs across 2,096 firms, of which 1,240 firms (232 CEOs) posted approximately 26 million (345 thousand) tweets during our sample period. We classify the overconfidence level of all S&P 1500 firm CEOs with required option-holding data in Execucomp, using Malmendier and Tate's (2005) 'holder67' overconfidence measure and Campbell et al.'s (2011) process for calculating the measure using Execucomp data.

There are four key hypotheses we test. First, we analyze whether disclosure volume differs by CEO overconfidence. Overconfident CEOs overestimate their abilities and the degree of information asymmetry with the market, increasing their incentive to disclose information to raise the market's perception of the firm. For example, Chang et al. (2020) find that firms listed in Taiwan have more earnings calls on average when they are managed by overconfident CEOs. While there is no empirical evidence of a similar effect in social media usage or other public relations policies, there are a number of relevant anecdotes. For instance, on July 3rd, 2012, Netflix CEO Reed Hastings made a social media post that attracted extensive attention in the popular press, by analysts and the market, and by the Securities and Exchange Commission (SEC). Hastings 'casually' posted a congratulations to the content licensing team for Netflix achieving a streaming time of 1 billion hours for the first time in the previous month.[2] This drew near immediate popular press, investor, and analyst attention, as well as a 'Wells Notice' from the SEC. Ultimately, however, this helped lead to a change in SEC advice, suggesting that social media announcements would not violate rules, such as Reg. FD, provided that investors are informed that such disclosures could occur.[3] Interestingly, Hastings is classified as overconfident in our sample. Second, we analyze whether the tone of these disclosures vary between the two types of CEOs. Our ex-ante prior is that the CEO would use a more positive tone to convey a message to their followers and they would be surer of themselves and therefore, hedge less in the face of uncertainty. Finally, we test if these engagements have any impact on stakeholders' – particularly investors' – perception of the firm. If an overconfident CEO tries to shape the narrative of a particular investment decision (M&A in our analysis) and is successful in convincing the market, then we would expect a positive market perception of such investments. Specifically, we would expect a less negative stock price reaction to the deal announcement and a higher likelihood of faster deal completion.

We begin by examining whether firm Twitter activity differs between firms headed by OC and non-OC CEOs on average during the sample period. We find that firms with OC CEOs tweet approximately 10% more per year relative to the average firm, and up to 40% more on a univariate basis than a firm with a non-overconfident CEO. This effect is substantially larger around firm events; firms with OC CEOs have an abnormal increase in Twitter activity that is 88% larger than the average firm in the 3-day window around an 8-k filing date.

We next turn to the content of the tweets. We perform textual and content analysis of each tweet using three methods: (1) Loughran and MacDonald's (2011) Sentiment Dictionary (2)

[2] https://www.facebook.com/reed1960/posts/10150955446914584
[3] https://www.theverge.com/2013/4/2/4175630/sec-clears-reed-hastings-netflix-to-share-investor-information-on-facebook; https://www.sec.gov/news/press-release/2013-2013-51htm

Diction Textual-Analysis Software's sentiment analysis to examine sentiment,[4] and Latent Dirichlet Allocation (LDA) modelling to identify topic coverage/contents. From Loughran and MacDonald (2011), we focus on positive and negative sentiment, and strong and weak modal words (which could convey greater certainty and greater 'hedging' language, respectively). Overall, we find little evidence of a difference in positive or negative sentiment, or strong or weak modal words, between OC and non-OC CEOs. During event periods, we find a significant decrease in weak modal words when the firm has an OC CEO, suggesting that these firms "hedge" less in their language around important firm events. Thus, it appears that CEO overconfidence primary impacts the sentiment of tweets by using more certain/less hedging language, particularly around firm events.

From Diction, we focus on measures of "concreteness," "insistence," "complexity," "embellishment," and "self-reference." Of these, we find that tweets from firms with OC CEOs contain significantly greater complexity, embellishment, and self-reference, on average. We also find that both complexity and embellishment are higher around firm events for firms with OC CEOs. Taken together, these results suggest that OC CEOs impact the firm's public interaction with stakeholders, increasing the amount of interaction and conveying significant different sentiment, particularly around firm events.

We identify four broad categories for both firm and CEO tweet topics using LDA topic modeling: (1) Business-related, (2) Finance-related, (3) Politics-related, and (4) Other. We find that, in both the full sample and around firm events, firms led by overconfident CEOs tweet more across all topics, with the largest increases in Business-related and 'Other' tweets. Additionally, overconfident CEOs themselves tweet significantly more Finance-related content during firm

[4] This analysis is restricted only to firms that used Twitter during the year or event window.

events, with both firm and CEO accounts showing abnormal spikes in Finance-related tweets during these periods.

However, Twitter interactions may not be not particularly meaningful if they do not impact the public's—and more importantly, the market's—perception of the firm. We begin with a direct measure of public perception: the engagement that the firm receives on Twitter. Specifically, we examine the frequency of retweets, likes, quotes, and replies that the firm's tweets receive. We find that firms with OC CEOs experience significantly higher engagement through retweets, likes, and replies. Around firm events, firms with OC CEOs also experience an abnormal increase in retweets, likes, and quotes. Thus, OC CEO-helmed firms not only choose to engage more publicly with stakeholders, but this drives higher stakeholder engagement as well.

Finally, we explore if these OC CEOs can change the market's perception through their engagement. We explore this using M&A. We focus on mergers announced between 2008 and 2021 where both the acquirer and targets are based out of the U.S. We find 4,096 deals that satisfy our criteria. Of these deals, we have firm accounts for 2,444 of the deal-acquirers, with accounts for 343 deal-CEOs. We find a number of interesting results. First, we find that both firm and CEO Twitter activity is significantly higher in the 30 days prior to, in the days surrounding, and the 30 days after an M&A announcement when the CEO is overconfident. Second, we find that deviations from the expected level of Twitter activity, positive or negative, give a negative signal of deal quality to the market when the CEO is overconfident, leading to more negative deal announcement abnormal returns. Third, we find that CEO Twitter activity has a significant impact on deal completion. A one-standard deviation increase in CEO tweets in the 30 days post-announcement increases the probability of deal completion increases by approximately 2.5%. Finally, we find that deal completion is significantly more related to public feedback, as measured by likes on the

CEO's tweets in the 30 days following the announcement, when the CEO is overconfident. This suggests that overconfident CEOs both engage more to shape public perception, and respond more positively to public enthusiasm than do non-overconfident CEOs.

We make the following key contributions to literature. We contribute to the relatively new but rapidly growing literature on the use of social media platforms by firms to interact with their stakeholders. Twitter has become an important source of corporate disclosure, with Bloomberg Terminals now including tweets from firms and their executives.[5] Several papers have used Twitter data and found that firms and their executives use Twitter to develop trust with investors (Elliott et al, 2018), that a CEO's global reputation can improve global merger performance (Bui et al 2023), and that excessive CEO tweets could result in lower firm value (Chen et al, 2023). We differ significantly from other papers as we use the entire universe of firm and CEO tweets. Our paper is closest to Crowley et al (2022) in terms of the scale of the data. However, the focus of Crowley et al (2022) is on information content of executive CEOs relative to firm, our focus is on how overconfident CEOs and firms managed by these CEOs behave on social media.

Social media engagements are unique not only because an investor can learn about the firm, but the firm can learn how investors judge a firm's decision. This two-way interaction makes this data invaluable as it allows researchers to study if and how firms can use this to shape their policies. For instance, Cookson et al (2023) find that social media activity can alter a firm's decision to go ahead with an acquisition. Similarly, we first establish that firm behavior toward its investors differs depending on whether the CEO is overconfident. Then we test and find that CEOs use the feedback from Twitter to change their decision or interact with the investors in such a way to alter their perception.

[5] https://archive.nytimes.com/dealbook.nytimes.com/2013/04/04/twitter-arrives-on-wall-street-via-bloomberg.

We also contribute to the behavioral literature by showing that CEO characteristics affect not only financial policies but also disclosure practices. Previous research has established that overconfidence as a trait influences various firm-level policies: overconfident CEOs are more likely to undertake value-destroying M&As (Malmendier and Tate, 2008), engage in innovation (Hirshleifer et al., 2012), and report R&D expenses (Koh et al., 2023). We extend this literature by demonstrating that CEO overconfidence also influences their social media activity, shaping the firm's public relations strategy.

2. Data and Methods

2.1 Twitter Data and Sample

To construct our disclosure measures we hand collect the Twitter handles of S&P 1500 firms and their CEOs from 2008-2021. Next, we use the Twitter Developer's API to extract all tweets from these accounts from 2008 – 2021. This data includes complete tweet as well as engagement metrics (e.g. likes, replies, retweets, and quote tweets) and the meta-data associated with each tweet. We focus on original tweets, replies, retweets, and quote tweets but exclude advertising tweets.[6] Our starting Twitter sample includes 1,667 unique firm-level Twitter accounts with a total of about 33.4M tweets. For CEO Twitter accounts, we have 283 unique Twitter accounts and about 468K tweets. After merging this with Execucomp, CRSP, and Compustat data, and excluding observations with missing values, we have a sample of 4,170 CEO across 2,096 firms, of which 1,240 firms (232 CEOs) posted approximately 26 million (345 thousand) tweets during our sample period. Figures 1 and 2 illustrate the top 200 words used in firm and CEO tweets, respectively, as word clouds with larger words representing greater usage in tweets.

2.2. Measuring Overconfidence

[6] Some Twitter accounts leverage third part advertising services to tweet advertisements on behalf of the firm.

We proxy for CEO overconfidence using the option-moneyness-based measure introduced by Malmendier and Tate (2005) and adapted for use with widely available data by Campbell et al. (2011). The Hall and Murphy (2002) model shows that undiversified executives are no longer utility-maximizing when they hold options too far into the money. Because executives face undiversifiable firm-specific risk, those who fail to exercise deep in-the-money options are identified as overconfident. Malmendier and Tate (2005) argue that, based on the Hall and Murphy (2002) model and a constant relative risk aversion of three, a typical executive would rationally exercise their options at or before 67% moneyness. Thus, we classify an executive as overconfident if he/she continues to hold (i.e., not to exercise) an exercisable option that is at least 67% into the money (Holder67).

Following Campbell et al. (2011), we calculate average moneyness as the average realizable value per option scaled by the average exercise price. To obtain the average realizable value per option, we divide the total realizable value of exercisable options (Execucomp variable OPT_UNEX_EXER_EST_VAL) by the total number of exercisable options (Execucomp variable OPT_UNEX_EXER_NUM). We then subtract the average realizable value per option from the stock price at the end of the fiscal year (Execucomp variable PRCCF). We exclude un-exercisable options to avoid misclassifying an executive who holds high moneyness options but is unable to exchange them for cash.

To identify consistent overconfident behavior, we follow prior convention and classify only those executives who have displayed this behavior at least twice. Further, we exclude executives who hold a trivial dollar amount of options that are far into the money. Specifically, we restrict the classification to executives whose dollar value of exercisable options is at least 50% of total annual compensation. Lastly, Holder67 takes a value of one throughout the executive's tenure beginning with the first observation in which this behavior was observed.

Holder67 requires CEOs to hold a non-trivial dollar value of exercisable options in order to be classified reliably. As such, we construct two indicators to control for CEOs whose overconfidence is not reliably identifiable. The first (Unclassified) is equal to one if the CEO had trivial options in a particular year, and chose not to exercise any amount of those options. Trivial options is defined as the total dollar amount of exercisable options is less than half of total compensation (Execucomp variable TDC1). If the CEO had trivial options, but chose to exercise some amount of them rather than holding them deep into the money, we classify the CEO as not overconfident. The second (Never Classifiable) is equal to one if the CEO had trivial options and chose not to exercise them in every year they are in the sample.

2.3 Controls

We incorporate various firm-level and CEO-level covariates that could influence a firm's or CEO's Twitter activity. Firm size is defined as the natural log of total assets. Firm age is the natural log of one plus the total number of years the firm has been listed in the Compustat database. R&D Intensity is measured as the firm's research and development expense, divided by the beginning-of-year total assets. Missing R&D is replaced by zero. Advertising Intensity is the firm's advertising expense, divided by the beginning-of-year total assets. Missing values are replaced by zero. Return on assets (ROA) is calculated as the prior year's net income divided by the average total assets over the prior year. We also control for the firm's annual stock return over the prior year. Finally, we include CEO age and CEO tenure in all models. We note that the decision to have a Twitter account could be considered trivial, and deciding not to have an account may not differ substantially from the decision not to tweet. However, to account for the possibility that these decisions differ fundamentally, we also include as a control an indicator variable that takes a value of one if the firm (CEO) has a Twitter account during the time period in question.

3 Results

3.1 Firm Twitter Intensity

3.1.1 Non-Event Specific (Annual) Twitter Activity

We begin by examining firm and CEO Twitter usage as a function of the CEO's overconfidence on a univariate basis. We find that the average firm headed by a non-overconfident CEO tweet approximately 1070 times per year, while the average firm headed by an overconfident CEO tweets roughly 40% more, approximately 1525 times per year. Moreover, the difference is statistically significant, with a p-value of 0.003. We note, however, that the number of tweets is positively skewed, leading to the possibility that a small number of outliers could impact our results. As a second test, we take the natural log of one plus the number of tweets, and again compare these between firms with overconfident and non-overconfident CEOs. We continue to find that firms with overconfident CEOs tweet more on average, and the difference is even more statistically significant (p-value = 0.000). We next examine the personal Twitter activity across CEO types. While we find that overconfident CEOs tweet somewhat more frequently that non-overconfident CEOs, the difference is not statistically significant on a univariate basic. When we focus only on original tweets (excluding replies, quotes, etc.), we continue to find that firms with overconfident CEOs tweet significantly more than firms with non-overconfident CEOs. Additionally, we find that overconfident CEOs tweet significantly more than their non-overconfident counterparts from their personal accounts (7.90 vs. 5.15, p-value = 0.011). Of course, these tests do not control for time trends, unobserved time-invariant characteristics, or other factors that could impact firm or CEO twitter activity.

We next move to multivariate regression models. In our primary specifications, we regress the natural log of the firm's number of Tweets on Holder67 and a number of controls. First, we include two controls for CEOs that cannot be classified under the Holder67 measure. This allows us to examine the impact of CEO overconfidence more cleanly, without the results being impacted by CEOs that cannot be clearly classified as overconfident or not. Additionally, we control for firm size (as measured by natural log of total assets), age, previous year stock performance and ROA, investment in innovation (R&D), and advertising expenses. Finally, all models control for CEO age and tenure, which may be related to both overconfidence and willingness to adopt new public relations and/or social media policies. All models include firm and year fixed effects, and cluster standard errors at the firm level. We present the results for firm Twitter activity in Table 3. In Columns 1 through 3, we examine the impact of CEO overconfidence on the firm's total annual Twitter activity.

In Column 1, we find that CEO overconfidence has a positive and significant impact, leading to an approximate 6% increase in firm Twitter usage for the average firm (p-value = 0.018). While the creation of a Twitter account is somewhat trivial as it is free, it may also be of interest to examine whether this result is driven primarily by the firm's willingness to create a Twitter account or by a higher level of tweeting within the set of firms that have an account. To examine this, in Column 2, we additionally include an indicator for the firm having a Twitter account during the year in question. We continue to find that CEO overconfidence has a positive and significant impact on firm twitter activity, suggesting that CEO overconfidence does not simply increase the probability of the firm having a twitter account.

One possibility is that CEOs treat their personal Twitter account as a substitute for the firm's Twitter account. In Column 3, we additional control for (1) an indicator that takes a value of 1 if the CEO had a personal twitter account during the same year, and (2) to natural log of the CEO's number of tweets during the year. We find two interesting results. First, CEO overconfidence continues to have a positive and significant impact on firm-level twitter activity. Second, the CEO's twitter activity has a positive impact on firm twitter activity, suggesting that these may both reflect the CEO's attitude toward the use of social media. In Columns 4 and 5, we examine the likelihood that the firm had non-zero Twitter activity during the year, and the probability that the firm had a Twitter account, respectively. In each case, we find a positive but insignificant impact of CEO overconfidence. These results suggest that, on average, firms with overconfident CEOs use the public forum of Twitter to engage more with their stakeholders, and that this is primarily driven by increased Twitter activity for firms that have a Twitter account. [7]

Next, we turn our attention to CEO personal Twitter usage. We repeat the models from Table 3 with all dependent variables measured at the CEO level, and use CEO fixed effects and clustered errors. We present these results in Table 4. In Column 1, we find that CEO overconfidence has a positive and significant impact on CEO twitter activity, with an approximate 56% increase in CEO Twitter usage relative to the average CEO (p-value = 0.006). We continue to find a significant positive effect after controlling for the CEO having a Twitter account in Column 2. After controlling the firm's Twitter activity in Column 3, we continue to find a positive coefficient on CEO overconfidence, but it is marginally insignificant (p-value = 0.113). In Column 4, we find that overconfident CEOs are significantly more likely to have non-zero Twitter activity. In Column 5, we also find that overconfident CEOs are approximately 3% more likely to have a Twitter account (p-value = 0.012). Interestingly, we find that the likelihood of the CEO having an

[7] In untabulated tests, we examine the time-to-adoption for the firm's Twitter account, using one observation per firm. For this test, we exclude firms that had more than one CEO type between first entering the sample and adopting Twitter. We find that firms that had overconfident CEOs adopted Twitter significantly more quickly than non-overconfident CEOs.

account is negatively related to the firm having an account, suggesting that CEOs may view the firm's account as a substitute for their own, but not the other way around as noted above. Taken together, these results suggest that non-event-specific CEO and firm Twitter activity increases significantly with CEO overconfidence.

3.1.2 Twitter Activity Around Firm Events

We next examine whether the tweeting frequency correlation holds true around firm events. To define firm events, we use all firm 8-K (current report) filings, and examine the firm's Twitter activity in the 3-day (-1, +1) window surrounding each filing. To avoid contamination from multiple events, we exclude cases in which there are multiple filings within the same window. We then examine firm Twitter activity as a function of CEO overconfidence within the event windows. In Columns 1 through 3 of Table 5, we examine the natural log of total firm tweets within the 3-day window. We find a positive and significant impact of CEO overconfidence, regardless of whether we control for the firm's choice to have a Twitter account and/or the CEO's personal Twitter usage. For the average firm, having an overconfident CEO increases Twitter usage around firm events by approximately 8% (average p-value = 0.026).[8] In Columns 4 through 6, we examine CEO Twitter activity around firm events. In each model, we find that CEO overconfidence has a positive but insignificant impact on CEO Twitter activity.

3.1.3 Combined Twitter Activity

Lastly, we examine whether the combined Twitter activity of the firm and CEO increases with CEO overconfidence and present the results in Table 6. In Column 1, we examine the annual

[8] While this suggests that firms with overconfident CEOs tweet more around firm events, this could reflect the overall higher propensity to engage stakeholders on Twitter rather than an event-specific effect. To examine this, we calculate the firm's "abnormal" event tweets by subtracting the number of firm tweets for an average non-event 3-day period during the same year. In untabulated tests, we find that firms with overconfident CEOs tweet an abnormally high amount around firm events. Taken together, our results suggest that CEO overconfidence has a significant positive impact of the firm's public interaction with stakeholders, particularly around firm events.

combined Twitter activity. We find that CEO overconfidence has a positive and significant impact on the joint Twitter activity of the firm on an annual basis. Similarly, in Column 2, we examine the combined Twitter activity around firm events. We again find that CEO overconfidence has a positive and significant impact. Taken together, the results suggest that overconfident CEOs increase the Twitter activity of their personal and firm account, both in general and around firm events.

3.2 Tweet Engagement, Sentiment, and Topic Content

3.2.1 Engagement

Our results suggest that CEO overconfidence has a significant impact on Twitter activity. A natural question is whether overconfident CEOs use their personal account or firm account differently than their non-overconfident counterparts, generating higher levels of stakeholder engagement, conveying stronger sentiment, or focusing on different information disclosure. First, we examine the impact that CEO overconfidence has on the 'engagement' that the firm experiences from their tweets. Specifically, we examine the natural log of the number of likes, replies, and retweets that the CEO/firm experiences. Each of these provides a measure of "attention" that the firm is receiving from potential stakeholders. We also examine tweet "ratios," or the number of replies divided by the number of likes. This provides a simple measure of Twitter sentiment, as "likes" represent positive engagement, while the "ratio" is used to represent negative engagement as no "dislike" option exists (Minot, 2021). We analyze each engagement measure in two scales: (1) engagement per day, and (2) engagement per tweet.[9] The exception is "ratio," which we measure per tweet only. We only include observations for which the CEO/firm tweeted, and conduct the analysis for firms (CEOs) using the base model from Table 3 (Table 4), including all

[9] For these tests we use the natural log of one plus the total number of engagements (e.g. "likes") divided by the total number of tweets in a given CEO/firm-year after winsorizing at 99%.

controls and fixed effects. We present these analysis for both the full and firm-event samples in Table 7, without tabulating control coefficients for brevity.

We find a number of interesting that firms results. In Panel A, we find that firms with overconfident CEOs annually generate significantly more daily engagement through likes and retweets, but not replies. On the other hand, these firms do not generate more engagement per tweet, suggesting that this could be driven primarily by quantitatively rather than qualitatively different use of Twitter. Results are largely similar for the 8-k event sample in Panel B, where we find that firms with overconfident CEOs have higher daily retweets, but no other significantly different engagement. The results are much stronger when we examine the CEO's personal Twitter. In both Panels C (full sample) and D (event sample), we find that overconfident CEOs generate significantly more daily and per-tweet engagement, and this holds for nearly every measure of engagement.[10] Interestingly, it appears that overconfident CEOs tweets may be more divisive. In each sample, we find that overconfident CEOs generate more likes, but also higher "ratios," suggesting more potentially negative feedback as well.

3.2.2 Sentiment

We next analyze the sentiment expressed in the firms's/CEO's tweets. We consider multiple measures of sentiment from two distinct sources. First, we consider the positive, negative, strong modal (expressing greater certainty), and weak modal (hedging) words defined by Loughran and McDonald (2011) (LM). Second, we use five word categories from Diction Textual Analysis Software, the use of which we predict could be impacted by CEO overconfidence. These include self-reference, embellishment, complexity, concreteness, and insistence. We analyze each variable first using annual data, with the same model specification in earlier tables. We only include

[10] The one exception is that overconfident CEOs do not have significantly more daily retweets in the full sample, with a p-value of 0.199.

observations for which the firm tweeted, as we cannot analyze the sentiment of non-existent text. For brevity, we only present the coefficients of interest, for CEO overconfidence. We present the results of this analysis for firm tweets in Table 8.

In Panel A of Table 8, we analyze the LM sentiment measures, and find little evidence of a significant impact of CEO overconfidence for firm tweet sentiment. In Panel B, we examine the Diction measures. Here, we find that CEO overconfidence has a positive impact on self-reference, embellishment, and complexity. This suggests that, beyond tweeting more frequently, the content of tweets are significantly different when the firm has an overconfident CEO. We next repeat the sentiment tests, focusing only on the event windows around firm announcements, as described above. In Panel C, we again find little evidence that CEO overconfidence has as significant impact on LM sentiment. In Panel D, we find that CEO overconfidence increases the embellishment and complexity of the language in firm tweets during event windows.[11]

We next repeat these tests for CEO tweets, presenting the results in Table 9. For the full sample in Panel A, we again find little relation between CEO overconfidence and sentiment. On the other hand, we find a significant impact of CEO overconfidence on sentiment around firm events. In particular, we find that overconfident CEOs use significantly fewer negative and weak modal (hedging) words in their tweets around firm events (Panel C), as we would predict. We do not see a significant difference in the Diction measures for overconfident CEOs in general (Panel B) or around firm events (Panel D).

3.2.3 Topic Contents for Firm and CEO Tweets

We next examine the topic coverage of firm and CEO tweets in both the full sample and during 8-k filing event windows. We use Latent Dirichlet Allocation (LDA) modeling, a form of

[11] If we control for the firm's non-event sentiment, we find that this largely explains out results. In other words, firms with overconfident CEOs have higher embellishment and complexity, but this does not *change* around firm events. We do, however, find increased concreteness around events when the CEO is overconfident.

unsupervised machine learning Natural Language Processing (NLP), to identify the topics discussed in firm and CEO tweets as follows. We first preprocess the data to remove non-normal text such as URLs or user mentions as well as stop words, standardize terms and covert words to their base forms, and address issues with punctuation. We then follow Cao and Juan (2009) and use a coherence score algorithm to select the optimal number of topics, which yielded an optimal number of 25. We then use LDA modeling to classifies the words in each tweet into 25 categories, assigning a proportion score for each category to each tweet. We then aggregate the similar topic categories into four primary categories for firm tweets, and five primary categories for CEO tweets. For firm tweets, we classify the topics as: (1) Business-related, (2) Finance-related, (3) Politics-related, or (4) Other. For CEOs, we include the same four categories, but also allow for a distinct Technology-related category (which was not apparent in the firm LDA categories). We then classify tweets based on the category for which the tweet has the highest score. For more detail on the LDA analysis, individual categories, the associated words, and the aggregated categories, please see the Appendix and Table A1.

We then repeat the analysis from Column 3 in Table 3 (Table 4) to examine the impact of CEO overconfidence on firm (CEO) tweets within each broad content category, for both the full sample and 8-k event sample. We include the full set of control variables, but do not tabulate the coefficients for brevity. We report the results in Table 10. In Panel A, we analyze the impact that CEO overconfidence on firm tweet contents in the full sample. We find that CEO overconfidence increases the firm's tweeting activity significantly in each of the four categories, with the largest effect on "Business-related" and "Other" tweets. In Panel B, we repeat this analysis using the 8-k event sample, and find similar results: CEO overconfidence has a significantly positive effect on the firm's twitter activity related to each of the four topic categories. In Panels C and D, we repeat the analysis from Panels A and B, but focus on the CEO's personal tweeting. Similar to the results in Tables 4 and 5, overconfident CEOs do not appear to tweet more from their personal account, at least after controlling for both the firm and CEO having twitter accounts, and this is the case regardless of topic.

3.3 M&A Activity

To test whether the Twitter engagements are meaningful, we now shift our focus to a specific type of event: Mergers and Acquisitions. Because M&A deals are large, infrequent events when asymmetric information is high, CEOs have the incentive to 'shape the public narrative' around these events to try to influence their outcome. This may be particularly true for overconfident CEOs who are more likely to overvalue a deal and complete a 'bad' deal (Malmendier and Tate, 2008). As such, we examine whether firm and CEO Twitter behavior around M&A announcements changes with CEO overconfidence, and whether CEO overconfidence changes how CEOs perceive the public's view of the deal.

We focus on mergers between U.S. acquirers and targets that were announced between 2008 and 2021 and had a deal value of at least $1 million. We find 4,096 deals that satisfy our criteria. Using this set, we analyze the firm and CEO Twitter activity that takes place in the run-up to, around, and following the announcement of the deal. We then examine the impact of Twitter activity on the announcement cumulative abnormal returns (CARs) and the likelihood that the deal is completed.

We investigate whether firm and CEO Twitter activity around the deal announcement depends on CEO overconfidence using the same regressions model specifications as in earlier analyses, with additional controls. Specifically, we include controls for the deal value in millions of dollars, and an indicator that takes a value of one if the payment method included an equity component. We then analyze firm and CEO Twitter activity over three non-overlapping windows: (1) 30 days prior to 2 days prior to the announcement (-30, -2); (2) 1 day prior to 1 day after the announcement (-1, +1); and (3) 2 days after to 30 days after the announcement (+2, +30). We present the results in Table 11.

In Columns 1-3, we examine the firm's Twitter activity. In each window, we find that CEO overconfidence has a positive and significant effect on the firm's number of tweets. The largest per-day effect appears to be in the window immediately surrounding the deal announcement. In Columns 4-6, we examine the CEO's Twitter activity. Similar to the results for firm tweets, we find that overconfident CEOs tweet significantly more from their personal accounts in each window. Again, the largest per-day effect appears to be in the (-1, +1) window. Taken together, these results suggest that overconfident CEOs take a significantly stronger approach to publicly interacting with stakeholders around the deal announcement.

Next, we examine the impact that CEO Twitter activity has on the market's reaction to the deal announcement. Specifically, we estimate the cumulative abnormal returns (CARs) to the firm's stock for the (-1, +1) announcement window using a Fama-French-Carhart four-factor model estimated using daily returns over the year ending thirty-one days prior to the deal announcement. We then regress the deal announcement on the CEO's Twitter activity following the regressions specifications in Table 11, and present the results in Table 12. In Column 1, we examine the impact of the daily average number of CEO Tweets during the (-1, +1) announcement window on the announcement CARs. We find that CEO tweets have a negative impact on the announcement CARs. In Column 2, we replace the daily CEO tweets with abnormal CEO tweets, calculated as the CEO's daily average tweets minus the CEO's daily average tweets during the year ending thirty-one days prior to the deal announcement. We find that abnormal CEO tweets also have a significantly negative impact on the announcements CARs. In Column 3, we allow the impact of abnormal CEO tweets to differ for OC and non-OC CEOs. Specifically, we define OC (Non-OC) Abnormal CEO Tweets as the CEO's abnormal tweets if the CEO is overconfident (not overconfident), and zero otherwise. We find that both the abnormal twitter activity of overconfident and non-overconfident CEOs; however, the effect for overconfident CEOs is approximately three times the effect for non-overconfident CEOs.[12] In Columns 4-6, we repeat the tests from Columns 1-3, but additionally include the CEO's daily tweets for the (-30, -2) window prior to deal announcement. We find some evidence that abnormal daily twitter activity in the run-up to deal announcement has a positive impact on the announcement CARs, but this is only significant for non-overconfident CEOs.[13] Importantly, in untabulated tests, we find no evidence that the announcement CARs significantly influence CEO twitter activity, regardless of specification, helping to limit concerns related to reverse causality.

The results in Table 12 suggest that the CEO deviating from their normal twitter activity serves as a negative signal to the market. To further examine this, we next allow the impact of abnormal twitter activity to differ depending on whether the CEO's twitter activity was abnormal high or abnormally low. Our primary variables of interest are Positive OC Abnormal CEO Tweets (Negative OC Abnormal Tweets), defined as the CEO's abnormal daily tweets if the CEO is overconfident and tweeted above their normal amount (below their normal amount), and zero otherwise. For ease of interpretation, we multiply Negative OC (Non-OC) Abnormal Tweets by minus 1, such that an increase in the variable represents a larger drop in twitter activity versus the CEO's expected level. We then repeat the abnormal return analysis using the specifications in

[12] We also find that this difference is statistically significant with a p-value of less than 0.0001.
[13] In untabulated tests, we do not find a significant difference between the abnormal twitter activity of overconfident and non-overconfident CEOs. It appears that, on average, OC CEOs continue their higher twitter usage around the deal announcement, rather than increasing or decreasing it. However, we also find that abnormal changes in the twitter activity of OC CEOs is informative to the market.

Table 12, and present the results in Table 13.

This leads to a number of interesting results. First, we find that below-expected tweeting by an overconfident CEO in the run-up to the deal announcement (-30 to -2 window) has a negative impact on announcement CARs, while non-OC CEO abnormal tweeting during this time has no consistent significant effect. Second, we find that above- or below-expected tweeting by an overconfident CEO during the announcement window also has a negative effect on announcement CARs. This results is further supported when we examine daily abnormal twitter activity starting during the run-up to and ending one day after the deal's announcement (-30, +1). On the other hand, only above-expected tweeting by a non-overconfident CEO during the announcement window has a significant negative effect. In other words, *any* deviation from expected twitter activity by an overconfident CEO is viewed as a negative signal by the market, while only certain above-expected twitter activity is viewed as a (negative) signal when the CEO is not overconfident.[14]

Finally, to examine the possible effects of feedback on the CEO/Firm's decision making, we examine whether the firm or CEO's Twitter activity, or the public engagement it generates, impacts the likelihood that the merger is completed. We follow the regression specifications outlined above, but the dependent variable is an indicator that takes a value of one if the deal is completed. We present these results in Table 14. In Column 1, we first examine whether firm Twitter activity around the deal announcement has a significant impact on the likelihood of deal completion. We find no significant impact on the probability of deal completion. In Column 2, we examine the effect of CEO Twitter activity, and find that CEO tweets in the 30 days post-announcement have a significant positive impact on the likelihood of deal completion. In Column

[14] Although not reported in a table, we perform similar tests to examine the impact of firm twitter activity around the M&A deal announcement. We find no significant effect, regardless of specification, and controlling for the firm's twitter activity does not impact any of our reported results for CEO twitter activity.

3, we confirm these results after also control for firm Twitter activity. This is consistent with CEOs using Twitter to shape the narrative to increase public support for the deal, making completion more likely.

Finally, in Column 4, we examine whether deal completion depends on the engagement that the firm and/or CEO receive on their tweets. Moreover, because overconfident CEOs are likely to believe that the market will undervalue the deal, they may be more sensitive to public engagement surrounding the deal. We again find little evidence that firm Twitter activity or engagement metrics impact the likelihood of deal completion. However, we find that a number of engagement metrics for the CEO's tweets have a significant effect. In particular, we find that 'likes' of the CEO's tweets in the 30 days post-announcement have a significantly more positive impact on the likelihood of deal completion when the CEO is overconfident. This offers preliminary evidence that overconfident CEOs attempt to shape the narrative around the deals, and their decision to complete the deal is sensitive to their perceived ability to 'move the needle' with public perception.

4. Conclusion

Using Twitter data from 2008 to 2021, we find that firms helmed by overconfident (OC) CEOs tweet more frequently, use more embellishment, are more complex/less superficial, "hedge" less in their statements, and use greater self-reference than firms with non-overconfident CEOs. Moreover, firms with overconfident CEOs increase their Twitter activity even more around substantive firm events that require public filings, and this generates abnormally high engagement. Thus, overconfident CEOs appear to encourage greater public interaction with stakeholders, and the content of those interactions have the hallmarks of the firm attempting to positively influence public perception. Does this affect the *market's* perception and valuation of the firm and its activities in a meaningful way? We investigate this question focusing on firm M&A announcements. M&A activities are typically substantial firm events, are particularly subject to asymmetric information and uncertainty, and are known to generate worse market reactions and outcomes for firms headed by overconfident CEOs. We find that firm and CEO Twitter activity is significantly higher around M&A announcements when the CEO is overconfident, and that CEO Twitter activity in the 30 days post-announcement has a significant positive effect on deal completion. Finally, we find that deal completion is significantly more positively related to public feedback as measured by likes on the CEO's tweets in the 30 days post-announcement when the CEO is overconfident. This suggests that overconfident CEOs both engage more to shape public perception, and respond more positively to public enthusiasm than do non-overconfident CEOs.

References:

Ang, J.S., Hsu, C., Tang, D., and Wu, C. (2021), The Role of social media in Corporate Governance. The Accounting Review.

Bartov, E., Faurel, L., and Mohanram, P.S. (2018), Can Twitter Help Predict Firm-Level Earnings and Stock Returns? The Accounting Review, 93 (3), 25-57.

Blankespoor, E., Miller, Gregory S., and White, Hal D. (2014), The Role of Dissemination in Market Liquidity: Evidence from Firms' Use of Twitter. The Accounting Review, 89, 79-112.

Boulton T. J. and Campbell T. C. (2016), Managerial confidence and initial public offerings. Journal of Corporate Finance, 37, 375-392.

Bui D.G., Chen Y., Hasan I., Lin C. (2023), CEO Global Reputation and Cross-Border M&A: Evidence from CEO's Twitter Account. Working Paper.

Campbell T. C., Gallmeyer M., Johnson S.A., Rutherford J., Stanley B. W. (2011), CEO optimism and forced turnover. Journal of Financial Economics, 101 (3), 695-712.

Chang, Shu-Ling and Hwang, Long-Jainn and Li, Chun An, The Effect of Managerial Overconfidence on Conference Calls (2020). The International Journal of Business and Finance Research, v. 14 (1), p. 1-12, 2020, Available at SSRN: https://ssrn.com/abstract=3522524

Chen H., Hwang B., Liu B., Tang Y. (2023), Tweeting Away Firm Value: How investors evaluate CEOs' use of social media. Working Paper.

Cookson J.A., Niessner M. and Schiller C. (2023), Can social media Inform Corporate Decisions? Evidence from Merger Withdrawals. Working Paper.

Crowley R.M., Huang W. and Lu H. (2023), Executive Tweets. Working Paper.

Elliott B., Grant S., and Hodge F. (2019), Negative News and Investor Trust: The Role of $Firm and #CEO Twitter Use. 56(5), 1483-1519.

Grant, S.M., Hodge, F.D., & Sinha, R.K. (2018), How disclosure medium affects investor reactions to CEO bragging, modesty, and humblebragging. Accounting, Organizations and Society, 68-69, 118-134.

Gu, C. and Kurov, A. (2020), Informational role of social media: Evidence from Twitter sentiment. Journal of Banking & Finance, 121.

Hall B. J. and Murphy K. J. (2002), Stock Options for undiversified executives. Journal of Accounting and Economics, 33(1), 3-42.

Hirshleifer D., Low A. and Teoh S. H. (2012), Are Overconfident CEOs Better Innovators? The Journal of Finance, 67, 1457-1498.

Jung, M.J., Naughton, J.P., Tahoun, A., Wang, C. (2018), Do firms strategically disseminate? Evidence from corporate use of social media. 28, 225-252.

Koh P, Reeb D.M., Zhao W. (2018) CEO Confidence and Unreported R&D. Management Science, 64(12), 5725-5747.
https://doi.org/10.1111/j.1540-6261.2012.01753.x

Loughran T. and McDonald B. (2011), When Is a Liability Not a Liability? Textual Analysis, Dictionaries, and 10-Ks. The Journal of Finance, 66, 35-65.

Malmendier U. and Tate G. (2005), CEO Overconfidence and Corporate Investment. The Journal of Finance, 60, 2661-2700.

Malmendier U. and Tate G. (2008), Who makes acquisitions? CEO overconfidence and the market's reaction. Journal of Financial Economics, 89, 20-43.

Minot, Joshua R., et al. "Ratioing the President: An exploration of public engagement with Obama and Trump on Twitter." PloS one 16.4 (2021): e0248880.

Nekrasov A., Teoh S. and Wu S. (2022), Visuals and attention to earnings news on Twitter. Review of Accounting Studies, 27 (4), 1233-1275.

Schrand C. M. and Zechman S. L.C. (2012), Executive overconfidence and the slippery slope to financial misreporting. Journal of Accounting and Economics, 53 (1–2), 311-329.

Figure 1: Firm Tweet Word Cloud

This figure shows the top 200 words in tweets sent by Firm Twitter accounts. The size of the word is commensurate with the relative number of times it appears in the corpus of all words in all tweets sent by Firm Twitter accounts.

Figure 2: CEO Tweet Word Cloud

This figure shows the top 200 words in tweets sent by CEO Twitter accounts. The size of the word is commensurate with the relative number of times it appears in the corpus of all words in all tweets sent by CEO Twitter accounts.

Table 1: Summary Statistics

	Mean	Standard Deviation	25th	Median	75th
Tweet-related Variables					
Firm Total Tweets	1217.260	10490.444	0.000	0.000	373.000
Ln(Firm Tweets)	2.816	3.235	0.000	0.000	5.924
CEO Total Tweets	14.770	196.995	0.000	0.000	0.000
I(Firm Had Twitter)	0.472	0.499	0.000	0.000	1.000
I(CEO Had Twitter)	0.070	0.256	0.000	0.000	0.000
Ln(CEO Tweets)	0.226	1.019	0.000	0.000	0.000
Ln(Firm Positive)	0.009	0.012	0.000	0.000	0.019
Ln(Firm Negative)	0.004	0.007	0.000	0.000	0.007
Ln(Firm Strong Modal)	0.002	0.003	0.000	0.000	0.004
Ln(Firm Weak Modal)	0.001	0.002	0.000	0.000	0.002
Ln(Firm Self Reference)	1.175	1.834	0.000	0.000	2.197
Ln(Firm Embellishment)	0.169	0.215	0.000	0.000	0.322
Ln(Firm Complexity)	0.546	0.582	0.000	0.000	1.154
Ln(Firm Concreteness)	2.532	2.936	0.000	0.000	5.459
Ln(Firm Insistence)	4.849	5.641	0.000	0.000	10.585
Ln(Firm Retweets)	0.583	1.027	0.000	0.000	0.848
Ln(Firm Likes)	0.521	0.998	0.000	0.000	0.693
Ln(Firm Replies)	0.144	0.420	0.000	0.000	0.090
Ln(Firm Quotes)	0.070	0.315	0.000	0.000	0.003
CEO Characteristics					
Holder67	0.325	0.469	0.000	0.000	1.000
Unclassified	0.298	0.457	0.000	0.000	1.000
Never Classifiable	0.162	0.368	0.000	0.000	0.000
CEO Age	56.432	7.217	52.000	56.000	61.000
CEO Tenure	7.296	7.581	2.000	5.000	10.000
Firm Characteristics					
Size	21.514	1.695	20.350	21.458	22.681
Firm Age	3.091	0.726	2.639	3.178	3.738
R&D Intensity	0.038	0.080	0.000	0.001	0.041
Advertising Intensity	0.014	0.033	0.000	0.000	0.009
ROA	0.034	0.146	0.011	0.048	0.089
Stock Return	0.170	0.753	-0.164	0.074	0.326
N	22,344				

Table 2: Twitter Activity by CEO Overconfidence

Presented below are univariates tests comparing Twitter activity between Overconfident and Non-Overconfident CEOs. Twitter activity is measured (separately) at the firm and CEO level and compared using both the level and the natural log of the Twitter activity level to account for skewness in the distribution. p-values for 2-sided t-tests are provided.

All Tweets	Not Overconfident	Overconfident	Difference	P-Value
Firm Total Tweets	1069.70	1523.23	453.53	0.003
Ln(Firm Tweets)	2.57	3.32	0.75	0.000
CEO Total Tweets	14.65	15.01	0.36	0.899
Ln(CEO Tweets)	0.22	0.24	0.02	0.252

Original Tweets	Not Overconfident	Overconfident	Difference	P-Value
Firm Original Tweets	259.92	347.08	87.16	0.000
Ln(Firm Tweets)	2.41	2.73	0.31	0.000
CEO Original Tweets	5.15	7.90	2.75	0.011
Ln(CEO Tweets)	0.17	0.18	0.01	0.212

Table 3: Firm Twitter Activity

This table reports the results from analysis of the impact of CEO overconfidence on firm Twitter activity using firm-year panel from 2008 to 2021. The dependent variable is the natural log of the number of tweets per firm in a given year (models 1-3), whether a firm tweeted (model 4), and whether a firm had a twitter account (model 5). The key variable of interest is Holder67, which is equal to one if the CEO is overconfident (zero otherwise). Standard errors are clustered at the firm level. *p*-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively.

	(1) Full Year Tweet Count	(2) Full Year Tweet Count	(3) Full Year Tweet Count	(4) I(Tweeted)	(5) I(Had Twitter)
Holder67	0.171**	0.091**	0.087**	0.000	0.015
	(0.018)	(0.019)	(0.022)	(0.212)	(0.184)
Unclassified	0.078	0.050	0.043	0.000	0.005
	(0.203)	(0.139)	(0.193)	(0.494)	(0.587)
Never Classifiable	-0.122	-0.082	-0.084*	-0.000	-0.008
	(0.194)	(0.103)	(0.087)	(0.781)	(0.572)
Size	0.126**	0.043	0.041	-0.000	0.016*
	(0.027)	(0.145)	(0.157)	(0.388)	(0.088)
Firm Age	-0.386**	-0.090	-0.103	0.000	-0.064**
	(0.018)	(0.331)	(0.257)	(0.758)	(0.012)
R&D Intensity	0.346	0.797***	0.781***	-0.000	-0.102
	(0.494)	(0.001)	(0.000)	(0.719)	(0.293)
Advertising Intensity	-2.277	-1.344	-1.338	-0.000	-0.201
	(0.207)	(0.305)	(0.282)	(0.691)	(0.391)
Annual Return	0.004	-0.005	-0.005	0.000	0.002
	(0.786)	(0.628)	(0.570)	(0.922)	(0.501)
ROA	0.200	0.118	0.119	0.000	0.018
	(0.155)	(0.234)	(0.212)	(0.179)	(0.479)
CEO Age	0.011**	0.005	0.004	0.000	0.001
	(0.041)	(0.107)	(0.111)	(0.833)	(0.142)
CEO Tenure	-0.006	-0.000	0.000	0.000	-0.001
	(0.291)	(0.989)	(0.998)	(0.512)	(0.178)
I(Firm Had Twitter)		4.907***	4.885***	1.000***	
		(0.000)	(0.000)	(0.000)	
I(CEO Had Twitter)			0.257**	0.000	0.094***
			(0.021)	(0.901)	(0.001)
Ln(CEO Tweet)			0.129***	0.000***	0.001
			(0.000)	(0.006)	(0.805)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	22,245	22,245	22,192	22,192	22,192
Adjusted R^2	0.758	0.922	0.923	1.000	0.714

Table 4: CEO Twitter Activity

This table reports the results from analysis of the impact of CEO overconfidence on CEO Twitter activity using firm-year panel from 2008 to 2021. The dependent variable is the natural log of the number of tweets by the CEO in a given year (models 1-3), whether a firm tweeted (model 4), whether a firm had a twitter account (model 5). The key variable of interest is Holder67, which is equal to one if the CEO is overconfident (zero otherwise). Standard errors are clustered at the CEO level. *p*-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively.

	(1) Full Year Tweet Count	(2) Full Year Tweet Count	(3) Full Year Tweet Count	(4) I(Tweeted)	(5) I(Had Twitter)
Holder67	0.127***	0.046*	0.044	0.008*	0.027**
	(0.006)	(0.099)	(0.113)	(0.090)	(0.012)
Unclassified	0.045**	0.017	0.017	0.002	0.010*
	(0.046)	(0.224)	(0.244)	(0.390)	(0.080)
Size	0.011	-0.010	-0.010	-0.001	0.007
	(0.667)	(0.602)	(0.586)	(0.747)	(0.286)
Firm Age	0.125	0.090	0.091	0.008	0.014
	(0.132)	(0.113)	(0.106)	(0.419)	(0.507)
R&D Intensity	0.011	-0.045	-0.046	-0.009	0.021
	(0.939)	(0.621)	(0.611)	(0.645)	(0.584)
Advertising Intensity	0.096	-0.449	-0.426	-0.174	0.203
	(0.928)	(0.558)	(0.578)	(0.387)	(0.285)
Annual Return	0.008	0.008*	0.008*	0.001	-0.000
	(0.157)	(0.088)	(0.088)	(0.140)	(0.967)
ROA	-0.015	-0.017	-0.018	-0.004	-0.000
	(0.726)	(0.613)	(0.596)	(0.565)	(0.994)
CEO Age	0.086	-0.061	-0.058	-0.000	0.052
	(0.692)	(0.704)	(0.719)	(0.975)	(0.318)
CEO Tenure	0.483	0.186	0.191	0.012	0.107
	(0.443)	(0.526)	(0.518)	(0.635)	(0.369)
I(CEO Had Twitter)		2.852***	2.841***	0.803***	
		(0.000)	(0.000)	(0.000)	
I(Firm Had Twitter)			-0.054	-0.004	-0.021*
			(0.181)	(0.643)	(0.083)
Ln(Firm Tweet)			0.016**	0.002	0.010***
			(0.044)	(0.317)	(0.000)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
CEO Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	21,570	21,570	21,570	21,570	21,570
Adjusted R^2	0.742	0.846	0.846	0.880	0.797

Table 5: Firm And CEO Twitter Activity – Firm Events

This table reports the results from analysis of the impact of CEO overconfidence on firm and CEO Twitter activity in the 3-day (-1, +1) window around firm events that required an 8-K filing, from 2008 to 2021. In Columns 1-3, the dependent variable is the natural log of the number of tweets by the firm in the event window. In Columns 4-6, the dependent variable is the natural log of the number of tweets by the CEO in the event window. The key variable of interest is Holder67, which is equal to one if the CEO is overconfident (zero otherwise). Standard errors are clustered at the firm level. *p*-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively.

	Firm Activity			CEO Activity		
	(1)	(2)	(3)	(4)	(5)	(6)
	Event Tweet Count	Event Tweet Count	Event Tweet Count	Event Tweet Count	Event Tweet Count	Event Tweet Count
Holder67	0.098**	0.098**	0.093**	0.018	0.007	0.006
	(0.019)	(0.020)	(0.039)	(0.130)	(0.531)	(0.588)
Unclassified	0.045	0.046	0.035	0.012	0.012	0.012
	(0.258)	(0.244)	(0.375)	(0.196)	(0.183)	(0.197)
Never Classifiable	-0.052	-0.055	-0.048	0.024*	0.023	0.023
	(0.350)	(0.312)	(0.385)	(0.098)	(0.120)	(0.117)
Size	0.028	0.031	0.028	0.056	0.054	0.054
	(0.409)	(0.368)	(0.422)	(0.123)	(0.122)	(0.118)
Firm Age	-0.142	-0.156	-0.196*	-0.015	-0.025	-0.028
	(0.168)	(0.135)	(0.075)	(0.831)	(0.735)	(0.701)
R&D Intensity	0.278	0.400	0.352	0.059	-0.018	-0.011
	(0.266)	(0.108)	(0.127)	(0.822)	(0.941)	(0.963)
Advertising Intensity	-0.528	-0.655	-0.675	-0.021	-0.022	-0.023
	(0.623)	(0.540)	(0.532)	(0.396)	(0.360)	(0.338)
ROA	0.124	0.130*	0.133*	0.005	0.005	0.005
	(0.107)	(0.085)	(0.080)	(0.171)	(0.161)	(0.151)
Annual Return	-0.014	-0.015	0.133*	0.023	-0.079	-0.073
	(0.214)	(0.173)	(0.080)	(0.237)	(0.287)	(0.338)
CEO Age	-0.000	-0.000	-0.000	-0.047**	-0.019	-0.022
	(0.985)	(0.896)	(0.932)	(0.016)	(0.416)	(0.341)
CEO Tenure	0.004	0.005	0.005	-0.013	-0.012	-0.011
	(0.221)	(0.181)	(0.222)	(0.486)	(0.496)	(0.535)
I(Firm Had Twitter)		0.331***	0.344***			-0.013*
		(0.000)	(0.000)			(0.054)
I(CEO Had Twitter)			0.445***		0.282***	0.278***
			(0.000)		(0.000)	(0.000)
Ln(CEO Tweet)			0.160***			
			(0.000)			
Ln(Firm Tweet)						0.010***
						(0.000)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	126,447	126,447	126,190	126,188	126,188	126,188
Adjusted R^2	0.640	0.644	0.649	0.588	0.601	0.601

Table 6: Combined Twitter Activity

This table reports the results from analysis of the impact of CEO overconfidence on total annual and event-specific combined firm and CEO Twitter activity using firm-year panel from 2008 to 2021. The dependent variable is the natural log of number of tweets by the firm and CEO in a given year (model 1) and during the 3-day (-1, +1) event window for an 8-K filing (model 2). The key variable of interest is Holder67, which is equal to one if the CEO is overconfident (zero otherwise). Standard errors are clustered at the firm level. *p*-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively.

	(1) Total Annual Tweets	(2) Event Tweet Count
Holder67	0.091**	0.093**
	(0.017)	(0.038)
Unclassified	0.049	0.047
	(0.129)	(0.231)
Size	-0.065	-0.059
	(0.196)	(0.286)
Firm Age	0.036	0.035
	(0.218)	(0.313)
R&D Intensity	-0.094	-0.175
	(0.298)	(0.110)
Advertising Intensity	0.661***	0.260
	(0.003)	(0.288)
ROA	0.116	-0.641
	(0.234)	(0.550)
Annual Return	-0.001	0.140*
	(0.933)	(0.080)
CEO Age	0.003	-0.005
	(0.220)	(0.701)
CEO Tenure	0.001	-0.001
	(0.678)	(0.836)
I(CEO Had Twitter)	1.234***	0.005
	(0.000)	(0.172)
I(Firm Had Twitter)	4.827***	0.611***
	(0.000)	(0.000)
Year Fixed Effects	Yes	Yes
Firm Fixed Effects	Yes	Yes
Observations	22,192	126,190
Adjusted R^2	0.923	0.654

Table 7: Engagement

This table reports the results from analysis of the impact of CEO overconfidence on tweet engagement. The dependent variables are the natural logs of the number of likes, replies, and retweets that the firm's and CEO's tweets receive on Twitter. In Columns 1-3, the dependent variables are measured as the average engagement per day during the analysis period. In Columns 4-6, the dependent variables are measured as the average engagement per tweet. Lastly, in Column 7, we examine the natural log of the tweet 'ratio.' In each case, the empirical specification follows Column 1 of Table 3, plus an indicator for the CEO having a Twitter account (Panels A and B) and the firm having a Twitter account (Panels C and D), including the full set of control variables and fixed effects. This analysis is conducted only within the sample of firms that tweeted during the relevant period. Standard errors are clustered at the firm level for firm tweet models and at the CEO level for CEO tweet models. *p*-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively.

	Daily Engagement			Per Tweet Engagement			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Likes	Replies	Retweets	Likes	Replies	Retweets	Ratio
Panel A: Full Sample Firm Tweets							
Holder67	0.131**	0.066	0.124**	-0.021	-0.030	-0.007	-0.003
	(0.030)	(0.247)	(0.036)	(0.604)	(0.209)	(0.806)	(0.595)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	10,348	10,348	10,348	10,348	10,348	10,348	10,348
R2 Adj.	0.389	0.358	0.348	0.454	0.551	0.514	-0.306
Panel B: Event Sample Firm Tweets							
Holder67	0.053	0.006	0.088**	-0.013	-0.034	0.020	-0.005
	(0.246)	(0.843)	(0.010)	(0.775)	(0.201)	(0.511)	(0.223)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	53,861	53,861	53,861	53,861	53,861	53,861	53,861
R2 Adj.	0.345	0.375	0.338	0.384	0.419	0.371	-0.222
Panel C: Full Sample CEO Tweets							
Holder67	0.772**	0.410*	0.366	0.463***	0.171***	0.246***	0.068**
	(0.015)	(0.055)	(0.199)	(0.000)	(0.001)	(0.004)	(0.012)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CEO Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,096	1,096	1,096	1,096	1,096	1,096	1,096
R2 Adj.	0.774	0.737	0.735	0.733	0.802	0.741	0.551
Panel D: Event Sample CEO Tweets							
Holder67	0.667***	0.150**	0.407***	0.663***	0.154***	0.488***	0.010***
	(0.001)	(0.012)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CEO Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2481	2481	2481	2481	2481	2481	2481
R2 Adj.	0.474	0.917	0.415	0.565	1.159	0.468	-0.087

Table 8: Firm Sentiment

This table reports the results from analysis of the impact of CEO overconfidence on tweet sentiment. In Panel A, the dependent variables are positive sentiment (model 1), negative sentiment (model 2), strong modal words (model 3), and weak modal words (model 4), as defined by Loughran and McDonald (2011) (LM). In Panel B, the dependent variables are self-reference (model 1), embellishment (model 2), complexity (model 3), concreteness (model 4), and insistence (model 5) as classified by Diction Textual Analysis Software. Panel C (D) repeats the analysis in Panel A (B) around firm events. In each case, the empirical specification follows Column 1 of Table 3, including the full set of control variables as well as firm and year fixed effects. This analysis is conducted only within the sample of firms that tweeted during the period. Standard errors are clustered at the firm level. *p*-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively.

Panel A: LM Measures – Full Sample

	(1) Positive	(2) Negative	(3) Strong Modal	(4) Weak Modal
Holder67	0.000	-0.000	0.000	0.000
	(0.860)	(0.875)	(0.357)	(0.305)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	10,397	10,397	10,397	10,397
Adjusted R^2	0.267	0.440	0.241	0.313

Panel B: Diction Measures – Full Sample

	(1) Self-Reference	(2) Embellishment	(3) Complexity	(4) Concreteness	(5) Insistence
Holder67	0.138^{**}	0.012^{*}	0.007^{*}	0.047	0.061
	(0.043)	(0.085)	(0.053)	(0.411)	(0.566)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	10,397	10,397	10,397	10,397	10,397
Adjusted R^2	0.647	0.354	0.522	0.667	0.680

Panel C: LM Measures - Event

	(1) Positive	(2) Negative	(3) Strong Modal	(4) Weak Modal
Holder67	0.022	0.028	0.009	-0.007
	(0.667)	(0.614)	(0.855)	(0.881)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	53,806	53,806	53,806	53,806
Adjusted R^2	0.522	0.552	0.534	0.538

Panel D: Diction Measures - Event

	(1) Self-Reference	(2) Embellishment	(3) Complexity	(4) Concreteness	(5) Insistence
Holder67	-0.006	0.014^{*}	0.005^{*}	0.058	0.017
	(0.910)	(0.056)	(0.075)	(0.272)	(0.870)

Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	53,806	53,806	53,806	53,806	53,806
Adjusted R^2	0.461	0.150	0.114	0.508	0.569

Table 9: CEO Sentiment

This table reports the results from analysis of the impact of CEO overconfidence on tweet sentiment. In Panel A, the dependent variables are positive sentiment (model 1), negative sentiment (model 2), strong modal words (model 3), and weak modal words (model 4), as defined by Loughran and McDonald (2011) (LM). In Panel B, the dependent variables are self-reference (model 1), embellishment (model 2), complexity (model 3), concreteness (model 4), and insistence (model 5) as classified by Diction Textual Analysis Software. Panel C (D) repeats the analysis in Panel A (B) around firm events. In each case, the empirical specification follows Column 1 of Table 3, including the full set of control variables as well as CEO and year fixed effects. This analysis is conducted only within the sample of firms that tweeted during the period. Standard errors are clustered at the CEO level. *p*-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively.

Panel A: LM Measures – Full Sample

	(1) Positive	(2) Negative	(3) Strong Modal	(4) Weak Modal
Holder67	-0.002	0.001	0.002	0.001
	(0.625)	(0.270)	(0.263)	(0.176)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	1,244	1,244	1,244	1,244
Adjusted R^2	0.235	0.167	0.052	0.131

Panel B: Diction Measures – Full Sample

	(1) Self-Reference	(2) Embellishment	(3) Complexity	(4) Concreteness	(5) Insistence
Holder67	0.039	0.005	-0.005	0.078	0.143
	(0.895)	(0.902)	(0.865)	(0.817)	(0.824)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	1,189	1,189	1,189	1,189	1,189
Adjusted R^2	0.631	0.307	0.269	0.637	0.664

Panel C: LM Measures - Event

	(1) Positive	(2) Negative	(3) Strong Modal	(4) Weak Modal
Holder67	-0.073	-0.256**	-0.126	-0.114**
	(0.567)	(0.045)	(0.201)	(0.040)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	3,109	3,109	3,109	3,109
Adjusted R^2	0.359	0.368	0.312	0.246

Panel D: Diction Measures - Event

	(1) Self-Reference	(2) Embellishment	(3) Complexity	(4) Concreteness	(5) Insistence
Holder67	0.004	0.001	-0.003	-0.000	-0.011
	(0.240)	(0.896)	(0.847)	(0.974)	(0.358)

Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	2,993	2,993	2,993	2,993	2,993
Adjusted R^2	0.079	0.205	0.222	0.069	0.288

Table 10: Tweet Content Topics

This table reports the results from analysis of the impact of CEO overconfidence on firm and CEO Tweet content topics, as defined using the Latent Dirichlet Allocation (LDA) modelling described in Section 3.2.3. In each column, the dependent variable is the natural log of the number of tweets that are categorized into each group. The key variable of interest is Holder67, which is equal to one if the CEO is overconfident (zero otherwise). Panel A (Panel B) presents the results for the full sample (event sample) of Firm tweets; Panel C (Panel D) presents the results for the full sample (event sample) of CEO tweets. Technology is omitted as a category for firm tweets, as the LDA modeling did not identify a clearly technology-related category among firm tweets. All models follow the associated full specification (Column 3) in Tables 3 (for firm tweets) and 4 (for CEO tweets); control variable coefficients are omitted for brevity. Standard errors are clustered at the firm level. *p*-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively.

	(1) Ln(Business)	(2) Ln(Finance)	(3) Ln(Politics)	(4) Ln(Other)
Panel A: Full Sample Firm Tweets				
Holder67	0.131***	0.084**	0.081***	0.134***
	(0.002)	(0.019)	(0.006)	(0.005)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
N	21,965	21,965	21,965	21,965
R2 Adj.	0.313	0.324	0.329	0.304
Panel B: Event Sample Firm Tweets				
Holder67	0.072***	0.033***	0.014*	0.088***
	(0.000)	(0.004)	(0.066)	(0.001)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
N	105,167	105,167	105,167	105,167
R2 Adj.	0.354	0.437	0.260	0.274
Panel C: Full Sample CEO Tweets				
Holder67	0.009	0.029	0.005	0.023
	(0.224)	(0.186)	(0.634)	(0.293)
Year Fixed Effects	Yes	Yes	Yes	Yes
CEO Fixed Effects	Yes	Yes	Yes	Yes
N	21,965	21,965	21,965	21,965
R2 Adj.	-0.888	0.661	-2.864	0.670
Panel D: Event Sample CEO Tweets				
Holder67	0.002	0.002**	0.000	0.003
	(0.353)	(0.044)	(0.741)	(0.307)
Year Fixed Effects	Yes	Yes	Yes	Yes
CEO Fixed Effects	Yes	Yes	Yes	Yes
N	105,167	105,167	105,167	105,167
R2 Adj.	-0.329	-0.079	-0.094	-0.466

Table 11: M&A Twitter Activity

This table reports the results from analysis of the impact of CEO overconfidence on firm and CEO Twitter activity in the 3-day (-1, +1) window around firm events that required an 8-K filing, from 2008 to 2021. In Columns 1-3, the dependent variable is the natural log of the number of tweets by the firm in the 30 days (-30, -2) prior to, the 3 days (-1, +1) immediately surrounding, and the 30 days (+2, +30) following the deal's announcement, respectively. In Columns 4-6, the dependent variable is the natural log of the number of tweets by the CEO in the 30 days (-30, -2) prior to, the 3 days (-1, +1) immediately surrounding, and the 30 days (+2, +30) following the deal's announcement, respectively. The key variable of interest is Holder67, which is equal to one if the CEO is overconfident (zero otherwise). Standard errors are clustered at the firm level. *p*-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively.

	(1) Firm (-30, -2)	(2) Firm (-1, +1)	(3) Firm (+2, +30)	(4) CEO (-30, -2)	(5) CEO (-1, +1)	(6) CEO (+2, +30)
Holder67	0.239***	0.091**	0.276***	0.052**	0.031**	0.039*
	(0.006)	(0.017)	(0.001)	(0.031)	(0.034)	(0.090)
Unclassified	0.164**	0.062*	0.210***	0.061*	0.050**	0.058*
	(0.043)	(0.085)	(0.009)	(0.051)	(0.039)	(0.073)
Never Classifiable	0.077	0.029	0.042	0.143	0.051	0.082
	(0.548)	(0.602)	(0.741)	(0.102)	(0.342)	(0.320)
Size	-0.004	-0.009	-0.017	-0.030	-0.007	-0.029
	(0.956)	(0.779)	(0.810)	(0.235)	(0.634)	(0.233)
Firm Age	0.063	0.080	0.122	0.100	0.046	0.069
	(0.762)	(0.374)	(0.550)	(0.125)	(0.154)	(0.231)
R&D Intensity	0.282	0.269	0.715	-0.218	-0.041	-0.254
	(0.789)	(0.596)	(0.557)	(0.627)	(0.869)	(0.521)
Advertising Intensity	0.538	1.079	-1.045	1.155	1.174	1.150
	(0.838)	(0.536)	(0.713)	(0.557)	(0.362)	(0.513)
ROA	0.064	0.143	0.119	-0.059	-0.023	-0.071
	(0.832)	(0.271)	(0.690)	(0.421)	(0.648)	(0.379)
Annual Return	0.082**	0.034**	0.066*	0.013	0.007	0.011
	(0.021)	(0.042)	(0.052)	(0.233)	(0.249)	(0.253)
CEO Age	-0.008	-0.006*	-0.011	0.005**	0.002*	0.004*
	(0.257)	(0.057)	(0.126)	(0.039)	(0.059)	(0.090)
CEO Tenure	0.018**	0.010***	0.022***	-0.006**	-0.004**	-0.005*
	(0.027)	(0.004)	(0.004)	(0.016)	(0.034)	(0.059)
Deal Value	-0.000	0.000	-0.000	-0.000	-0.000	-0.000
	(0.952)	(0.798)	(0.295)	(0.455)	(0.861)	(0.769)
Equity Payment?	-0.009	0.001	-0.016	0.005	0.021	0.013
	(0.866)	(0.975)	(0.750)	(0.794)	(0.145)	(0.434)
I(Firm Had Twitter)	1.747***	0.408***	1.831***			
	(0.000)	(0.000)	(0.000)			
I(CEO Had Twitter)				1.396***	0.677***	1.484***
				(0.000)	(0.000)	(0.000)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,096	4,096	4,096	4,089	4,089	4,089
Adjusted R^2	0.790	0.680	0.797	0.675	0.586	0.692

Table 12: M&A Announcement CARs

This table reports the results from analysis of the impact of CEO tweeting by overconfidence level on Cumulative Abnormal Returns (CARs) in the 3-day (-1, +1) window around M&A Announcements, from 2008 to 2021. CARs are calculated using a Fama-French-Carhart four-factor model. In Columns 1, 2, 4, and 5, the impact of tweeting activity is examined for all CEOs. In Columns 3 and 6, the impact of CEO tweeting is examined separately for OC and Non-OC CEOs. Columns 1 and 4 examine overall tweets per day, while all other columns examine the impact of abnormal CEO tweets per day, as defined in the text. Standard errors are clustered at the firm level. *p*-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	CAR (-1, +1)	CAR (-1, +1)	CAR (-1, +1)	CAR (-1, +1)	CAR (-1, +1)	CAR (-1, +1)
CEO Daily Tweets (-1, +1)	-0.006**			-0.007***		
	(0.023)			(0.008)		
Abn. CEO Tweets (-1, +1)		-0.005***			-0.007***	
		(0.006)			(0.008)	
OC Abn. CEO Tweets (-1, +1)			-0.009***			-0.011***
			(0.000)			(0.000)
Non-OC Abn. CEO Tweets (-1, +1)			-0.003***			-0.005***
			(0.000)			(0.000)
CEO Daily Tweets (-30, -2)				0.009		
				(0.413)		
Abn. CEO Tweets (-30, -2)					0.020**	
					(0.036)	
OC Abn. CEO Tweets (-30, -2)						0.017
						(0.191)
Non-OC Abn. CEO Tweets (-30, -2)						0.032*
						(0.051)
Holder67	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.896)	(0.889)	(0.902)	(0.869)	(0.846)	(0.863)
I(Firm Had Twitter)	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008
	(0.171)	(0.176)	(0.180)	(0.182)	(0.181)	(0.190)
I(CEO Had Twitter)	-0.004	-0.005	-0.006	-0.006	-0.007	-0.008
	(0.559)	(0.450)	(0.425)	(0.448)	(0.326)	(0.268)
Full Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4076	4076	4076	4076	4076	4076
Adjusted R^2	0.151	0.151	0.151	0.151	0.151	0.151

Table 13: M&A Announcement CARs

This table reports the results from analysis of the impact of abnormal CEO tweeting by overconfidence level on Cumulative Abnormal Returns (CARs) in the 3-day (-1, +1) window around M&A Announcements, from 2008 to 2021. CARs are calculated using a Fama-French-Carhart four-factor model. The impact of abnormal daily tweets is allowed to differ for positive and negative abnormal tweeting and by CEO overconfidence. Negative abnormal tweets are multiplied by -1 for ease of interpretation. Standard errors are clustered at the firm level. *p*-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively.

	(1)	(2)	(3)	(4)	(5)
	CAR (-1, +1)	CAR (-1, +1)	CAR (-1, +1)	CAR (-1, +1)	CAR (-1, +1)
Positive OC Abn. CEO Tweets (-30, -2)	**-0.019**		**-0.005**		
	(0.327)		**(0.796)**		
Negative OC Abn. CEO Tweets (-30, -2)	**-0.019*****		**-0.026****		
	(0.008)		**(0.017)**		
Positive Non-OC Abn. CEO Tweets (-30, -2)	0.015		0.026		
	(0.417)		(0.165)		
Negative Non-OC Abn. CEO Tweets (-30, -2)	-0.017		-0.051		
	(0.538)		(0.185)		
Positive OC Abn. CEO Tweets (-1, +1)		**-0.013*****	**-0.013*****		
		(0.000)	**(0.000)**		
Negative OC Abn. CEO Tweets (-1, +1)		**-0.031*****	**-0.011**		
		(0.005)	**(0.504)**		
Positive Non-OC Abn. CEO Tweets (-1, +1)		-0.003***	-0.004***		
		(0.001)	(0.000)		
Negative Non-OC Abn. CEO Tweets (-1, +2)		0.047	0.055		
		(0.232)	(0.185)		
OC Abn. CEO Tweets (-30, +1)				**-0.007**	
				(0.274)	
Non-OC Abn. CEO Tweets (-30, +1)				-0.002	
				(0.823)	
Positive OC Abn. CEO Tweets (-30, +1)					**-0.037***
					(0.056)
Negative OC Abn. CEO Tweets (-30, +1)					**-0.024*****
					(0.007)
Positive Non-OC Abn. CEO Tweets (-30, +1)					-0.005
					(0.574)
Negative Non-OC Abn. CEO Tweets (-30, +1)					-0.030
					(0.300)
Full Controls	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	4076	4076	4076	4076	4076
Adjusted R^2	0.150	0.151	0.151	0.150	0.150

Table 14: Deal Completion

This table reports the results from analysis of the impact of firm and CEO Twitter activity on the likelihood that an announced M&A deal is completed, from 2008 to 2021.The dependent variable takes a value of one if the deal is completed, and zero otherwise. The key variables of interest in Columns 1-3 are the natural log of the firm and CEO tweets around the M&A deal announcement. In Column 4, additional variables of interest are the natural log of the twitter engagement metrics after the firm's announcement of the M&A deal, as well as interactions with CEO overconfidence (Holder67). All models include full controls as in Table 9. Standard errors are clustered at the firm level. *p*-values are in parentheses. *, ** and *** indicate statistical significance at 10%, 5% and 1% respectively.

	(1)	(2)	(3)	(4)
	Completed	Completed	Completed	Completed
Firm Tweets (-30, -2)	0.014		0.015	0.016
	(0.256)		(0.212)	(0.178)
Firm Tweets (-1, +1)	-0.002		-0.002	-0.003
	(0.860)		(0.889)	(0.832)
Firm Tweets (+2, +30)	-0.010		-0.011	-0.010
	(0.343)		(0.281)	(0.350)
CEO Tweets (-30, -2)		-0.008	-0.007	-0.020
		(0.816)	(0.836)	(0.589)
CEO Tweets (-1, +1)		-0.042	-0.044	-0.043
		(0.174)	(0.148)	(0.156)
CEO Tweets (+2, +30)		0.050*	0.053**	0.057*
		(0.060)	(0.049)	(0.081)
Holder67	0.015	0.015	0.015	0.010
	(0.410)	(0.402)	(0.412)	(0.610)
Firm Likes/Tweet (+2, +30)				0.014
				(0.527)
Firm Replies/Tweet (+2, +30)				-0.058
				(0.186)
Firm Retweets/Tweet (+2, +30)				-0.014
				(0.328)
Firm Quotes/Tweet (+2, +30)				-0.009
				(0.891)
Holder67*Firm Likes/Tweet (+2, +30)				-0.002
				(0.958)
Holder67*Firm Replies/Tweet (+2, +30)				0.036
				(0.580)
Holder67*Firm Retweets/Tweet (+2, +30)				0.007
				(0.792)
Holder67*Firm Quotes/Tweet (+2, +30)				-0.022
				(0.863)
CEO Likes/Tweet (+2, +30)				-0.099**
				(0.037)
CEO Replies/Tweet (+2, +30)				0.184**
				(0.044)
CEO Retweets/Tweet (+2, +30)				0.018
				(0.474)
CEO Quotes/Tweet (+2, +30)				0.275*
				(0.051)
Holder67*CEO Likes/Tweet (+2, +30)				0.135**
				(0.012)
Holder67*CEO Replies/Tweet (+2, +30)				-0.193*
				(0.081)
Holder67*CEO Retweets/Tweet (+2, +30)				-0.047
				(0.129)
Holder67*CEO Quotes/Tweet (+2, +30)				-0.334

				(0.102)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
N	4,096	4,096	4,096	4,096
Adjusted R^2	0.082	0.082	0.082	0.084

Appendix: LDA Topic Modeling

Latent Dirichlet Allocation (LDA) is a popular unsupervised machine learning Natural Language Processing (NLP) technique used for topic modeling in textual data. It helps discover hidden thematic structures within a large corpus by categorizing words into different topics. LDA assumes that each document (in this case, a CEO's/Firm's tweet or collection of tweets) is a mixture of topics, and each topic is a distribution of words. By analyzing the frequency and co-occurrence of words, LDA probabilistically assigns words to topics, allowing us to identify the underlying themes in the text.

One of the key advantages of LDA is its ability to uncover latent patterns in textual data, making it particularly useful for analyzing large-scale datasets like CEO/Firm Twitter activity. By applying LDA, we can identify the topic content of each tweet—for example, whether they focus on firm performance, industry trends, or personal matters—without needing predefined categories. This offers a data-driven way to understand how the content of their tweets relates to firm and CEO strategies for using social media to facilitate stakeholder communication. In this analysis, LDA helps provide a nuanced view of the topics CEOs engage with on Twitter, adding depth to the examination of how their public statements might affect market perceptions and firm outcomes.

For this analysis, we preprocess the Twitter data to ensure consistency and improve the model's accuracy. This involves first removing URLs, user mentions, and hashtags, standardizing financial terms (e.g., replacing specific figures like dollar amounts and percentages with generalized terms such as "dollar_figure_mention"), and handling punctuation. We also apply lemmatization to convert words to their base forms while retaining specific words related to finance or proper nouns (e.g., "cryptocurrency" and "artificial_intelligence") that could be relevant for the analysis.

The data was further refined by removing stopwords, numeric values, and short words that did not contribute to topic modeling. This preprocessing step is essential to ensure that LDA could effectively group the tweets into meaningful topics. Finally, after applying these preprocessing steps, tweets that were too short to be classified were dropped.

To ensure that the topics remain distinct yet semantically meaningful, maximizing LDA's effectiveness for this dataset, we followed Cao and Juan (2009) and used a coherence score algorithm to minimizes semantic distances between topics to enhance interpretability and optimize the number of topics. Based on the algorithm, 25 topics were suggested as optimal, marking an inflection point where further increases yielded diminishing improvements in coherence scores. After the LDA processing provides 25 topics, we manually assign each topic into one of five broader categories: Business, Finance, Technology, Politics, and Other. This classification was based on the most prominent words within each topic, which provided a clear indication of its thematic focus. Grouping the topics into these broader categories allows for a more structured analysis of the types of content that CEOs or firms emphasize in their Twitter communications.

For example, the Finance category includes topics characterized by words such as "dollar_figure_mention," "percent_figure_mention," and "earnings," reflecting discussions related to financial performance and metrics. The Business category encompasses topics with terms like "leadership," "customer," and "team," pointing to themes around management, company culture, and operational strategies. In the Technology category, prominent words include "cloud," "data," and "innovation," indicating a focus on technological advancements and digital transformation.

The Politics category contains words such as “president” and “vote,” highlighting tweets that address political issues or interactions with political figures. Lastly, the Other category covers a wide range of miscellaneous topics, including words like “family,” “happy,” and “game,” reflecting more personal, casual, or entertainment-related content.

In the LDA output, each document (in this case, each tweet) is assigned a set of 25 theta values, which represent the proportion of the tweet associated with each topic. These theta values are bounded between 0 and 1, and their sum across all 25 topics equals 1. In order to simplify the analysis and focus on broader thematic patterns, we consolidated these 25 theta values into the 5 broader categories. By summing the theta values for each topic within these broader categories, we can reduce the number of topic distributions from 25 to 5 for each tweet. As a result, the final theta values— theta_business, theta_finance, theta_technology, theta_politics, and theta_other— sum to 1 for each tweet, representing the proportion of each tweet that is focused on each of the five main categories. This approach provided a more interpretable way to analyze the thematic content of CEO and firm tweets.

In addition to this, we create indicator variables for each of the five categories. The indicator variable for a given category is set to 1 if the theta value for that category is the highest among all five, and 0 otherwise. This process assigns each tweet to one and only one category based on the maximum theta value. For example, if a tweet has the following theta values: theta_finance = 0.2, theta_business = 0.6, theta_technology = 0.1, theta_politics = 0, and theta_other = 0.1, the indicator variable for Business would be set to 1, while all other categories would have an indicator value equal to 0. Thus, each tweet is classified into one dominant topic category, making the thematic analysis clearer and more focused.

Table A1: LDA Topic Categories

Topic Label	LDA Category	Defining Words
Business	LDA category 4	Team; Proud; Leadership; Customer; Excite; Meet; Honor; Partner; Company; executive_officer; award; woman; forward; support; world; employee; community; top; board; visit
	LDA category 5	Customer; dollar_figure_mention; sell; network; pay; merger_acquisition; plan; consumer; price; deal; million; billion; buy; brand; phone; data; market; free; unlimited; offer
	LDA category 17	Leadership; People; Learn; Life; Business; Success; Employee; Change; Trust; Company; Culture; Tough; Lesson; Share; Build; Start; Book; Read; Practice; Team
	LDA category 22	Leadership; world; change; proud; woman; company; community; business; people; support; create; employee; future; build; equality; challenge; technology; global; continue; culture;
Finance	LDA category 14	percent_figure_mention; economy; company; market; increase; job; business; china; global; growth; cost; supply; low; rate; industry; technology; grow; covid; risk; report
	LDA category 24	dollar_figure_mention; percent_figure_mention; finance_term_mention; earnings; sell; share; stock; growth; price; buy; revenue; short; estimate; market; rate; street; invest; credit; vol; trade
Technology	LDA category 11	Data; Google; Story; Late; Test; Weekly; artificial intelligence; study; technology; human; learn; system; report; top; release; issue; fix; research; search; drive
	LDA category 18	Cloud; Customer; Data; Service; Network; Excite; Announce; Build; partner; technology; solution; team; platform; partnership; learn; app; enterprise; access; provide; business;
	LDA category 21	Customer; Technology; Business; Company; Future; Innovation; Leadership; executive_officer; industry; digital; change; talk; experience; world; share; market; team; excite; strategy; create

Politics	LDA category 3	Trump; vote; America; President; Bill; Biden; Law; People; House; Election; Leadership; Party; Senate; Call; Republican; Democrat; Support; Stand; Court; Country
	LDA category 12	People; Mask; Stop; life; city; test; wear; America; Covid; Death; Bad; Police; Leave; Kill; Trump; Home; Call; Happen; Travel; Fire
	LDA category 15	Job; Economy; America; Trump; Tax; Business; China; People; Government; Bad; Plan; Company; Deal; Trade; agree; money; pay; cut; policy; create
Other	LDA category 1	Family; honor; life; happy; proud; friend; celebrate; driver; America; woman; serve; world; Support; country; service; team; community; professional; remember; peace
	LDA category 2	dollar_figure_mention; support; million; family; donate; care; homeless; health; people; raise; child; save; fund; sell; community; home; free; book; house; hospital
	LDA category 6	Tomorrow; Start; Game; Forward; Ready; Watch; Talk; Tonight; Excite; Follow; Wait; Event; Call; executive_officer; miss; night; morning; win; keynote; conference
	LDA category 7	Happy; Birthday; Holiday; Enjoy; Friend; Family; Hope; Team; Meet; Weekend; Celebrate; Stay; Home; Fun; Nice; Glad; wait; head; season; awesome
	LDA category 8	Energy; launch; power; clean; space; world; solar; rocket; engine; land; home; mission; ocean; tree; water; future; plant; build; test; earth
	LDA category 9	Game; Team; Win; Play; Watch; Fan; Tonight; Night; Music; Awesome; World; Luck; Season; Player; Fun; Sport; Proud; meet; rock; event
	LDA category 10	People; Life; Change; Kid; World; School; Learn; Story; Idea; Real; Feel; Stuff; Free; Student; Cool; Hear; Talk; Read; Word; True
	LDA category 13	Wear; Collection; Polo; Store; Feature; Fall; Style; red; magenta; black; shop; cover; shirt; discover; spring; cool; color; classic; label; inspire
	LDA category 16	Post; facebook; photo; share; read; check; video; book; app; twitter; social; medium;

		blog; enjoy; follow; tune; late; stay; watch; email;
	LDA category 19	Car; drive; model; launch; fast; vehicle; electric; brand; start; test; satellite; customer; network; production; range; speed; build; battery; mile; buy
	LDA category 20	Email; executive_officer; question; tweet; twitter; read; answer; call; follow; hear; send; people; talk; mike; interview; issue; news; trump; story; president
	LDA category 23	Cruise; Carnival; beautiful; ship; morning; fun; line; world; ready; video; team; view; travel; visit; sea; sail; tour; meet; land; wait
	LDA category 25	Win; Game; award; vote; watch; team; super; winner; night; top; run; star; wow; play; movie; tonight; video; awesome; prize; chance