The Impact of Narcissistic CEOs Running Media Companies on Stock Markets: a Case Study on Elon Musk's Twitter Activity on the Performance of Tesla and Twitter[1*]

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Abstract: Does a CEO's narcissism influence the company's stock? Would it matter if it is a media company? The Efficient Market Hypothesis claims that it matters little given market efficiency, as narcissism has been priced in stock based on the Capital Asset Pricing Model. Existing literature is divided on whether CEO narcissism influences corporate efficiency. This paper refines assumptions on asset pricing by indicating when market inefficiency occurs through panel studies, which the Adaptative Market Hypothesis overlooks. A case study on Elon Musk suggests that the CEO's narcissism with media involvement creates temporary market inefficiency. This paper innovatively combines an event study of Elon Musk's Twitter activities on Tesla and Twitter with a panel analysis of 17 S&P 500 CEOs. The finding shows that younger and female CEOs, who derive narcissism supply and lead media companies, are more inclined to take risks on stock returns. This result suggests re-evaluating stock market efficiency to include CEO demographics and personality, which extends beyond traditional CAPM models.

1   Introduction

CEOs' Narcissism is defined as an excessive interest in self-aggrandizing, craving for infinite power and success, and desire for public admiration (Zakolyukina et al. 2021). Does involvement in the media industry fuel a CEO's narcissism? How would stock investors react when billionaires express irrational and self-centered speeches? Do stock prices always react the same to these speeches? These questions are important for researchers to improve their understanding of the financial markets.

Twitter activities of Elon Musk—the new owner of Twitter, now rebranded as "X"---seem to provide some answers. On November 15, 2023, Elon Musk endorsed an antisemitic conspiracy post, which claimed that "Jewish communities have been pushing…hatred against whites…", by saying "You have said the actual truth" (CNN Business). Although Musk soon apologized for his endorsement, his erratic speech has cost X a $75 million loss for more advertisers quitting the X platform. It also leads to market concerns about Elon Musk's unpredictable speeches on controversial topics.

Despite his insensitive comments regarding politics, Elon Musk established his media exposure to seek more attention in the global financial market. Musk's desire for upvotes was often detrimental to his company's profits. For instance, Musk tweeted, "considering taking Tesla private at $420" (2018), which resulted in the U.S. Securities and Exchange Commission criticizing Musk with a fraud charge and penalizing $40 million. Elon Musk's

possible manipulation of financial markets via Twitter indicates his significant media influence, which projects onto the decision-making of individual investors. Therefore, this paper proposes and aims to answer two questions:

1. **Is Elon Musk unique among CEOs in terms of financial decision-making?**
2. **Does a CEO's narcissism, influence the company's stock performance, especially in the media industry?**

Understanding these two research questions is important. On one hand**,** they help researchers understand how a CEO's role functions in the stock market. On the other hand, they may provide some insights into a decades-long debate on asset pricing behaviors. More generally, the result of this paper helps explain in empirical terms how financial markets respond to the impact of a CEO's narcissism.

From a theoretical perspective, while Robert Shiller argued that the spikes in asset prices serve as century-long bubbles (UBS Nobel Perspectives 2019), Eugene Fama disagreed that the upsurge and declines in asset prices, triggered by exogenous events, should last only "one day" (Chicago Booth Review 2016). In addition, Fama's (1970) Efficient Market Hypothesis[2] claims that "asset prices are fully accountable for all known information". Under the framework of EMH, exogenous events, such as Musk's narcissistic tweets, have been efficiently "priced in" and reflected in his company's stock returns, which can be calculated using the Capital Asset Pricing Model.

Reconciling the ongoing discussion, Andrew Lo proposes an extension of the original EMH, named the Adaptative Market Hypothesis[3]. AMH is an extension of the classical EMH theory, where markets are described as mostly efficient but sometimes inefficient. The market information, priced in assets, depends on the investors' environments and the characteristics of the market participants (Lo 2019). Besides, AMH states that consumers are self-interested, naturally make mistakes, and adapt from their previous mistakes. For instance, some investors might act irrationally on purchasing Tesla stocks after Elon Musk praised it, before switching back to the rational observer mode a few moments later. The Tesla market then corrected itself from the temporary inefficiency and adjusted the stock price.

From an empirical perspective, several studies have been conducted on the relationship between narcissistic CEOs and firm's performances. Why investigate a CEO's

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[2] To save space, the Efficient Market Hypothesis will be abbreviated as EMH in this section.
[3] To save space, the Adaptative Market Hypothesis will be abbreviated as AMH in this section.

role and influence? A CEO's influence is unique and its role is irreplaceable to that of other senior executives. Over the past 60 years, CEOs have had a growing influence over firms' performances in the financial markets. It is reflected by an increase in the absolute market reaction to the sudden deaths of CEOs by 0.08 percentage points per year (Quigley, Crossland, and Campbell 2017). Meanwhile, some CEOs make irrational decisions within the media and entertainment industries (Demsetz and Lehn 1985). For example, Elon Musk often triggered lawsuits and profit losses for inappropriate speeches on Twitter; Walt Disney was reluctant to show old Disney films on Television, which could have generated much more profits for his company. It becomes crucial to understand the logic behind a CEO's irrational decision-making that does not maximize profit, especially in the media industry.

Despite existing theories on asset prices and empirical results on the negative financial influence of narcissistic CEOs, academia hasn't concluded much on market inefficiency in stock prices. AMH does not specify when and where market inefficiencies occur. Therefore, this paper aims to refine asset pricing assumptions by indicating when patterns of market inefficiency occur. In addition, although every existing empirical research has found that CEOs' narcissism negatively affects firm corporate performance, the debate on CEOs' priority in decision-making is ongoing. Some findings argue that narcissistic CEOs preferred higher compensation (Ham, Seybert, and Wang 2017), while other findings suggest that narcissistic CEOs valued higher prominence in public over compensation (Aabo, Jacobsen, and Stendys 2022).

The paper's case study on Elon Musk helps complement empirical evidence from what AMH and empirical studies have not yet provided. Among modern American CEOs, Elon Musk is the most special one: he runs technology-based businesses, such as Tesla, and a media-entertainment-based business—Twitter. Although both types of businesses needed him to engage on social media for branding, Elon Musk's rational business strategies on Tesla contrasted sharply with his irrational comments about Twitter. Unlike running Tesla, Elon Musk often posted his personal opinions about running Twitter, where he tweeted away two-thirds of Twitter's value since his purchase (Savov 2024). What caused such a difference in operational outcomes for Elon Musk?

The only difference between running Tesla and Twitter is whether these two companies are involved in the media industry. Therefore, media presence is a key factor that induces non-profit-maximizing behaviors in the narcissist Elon Musk. In other words, the stock market becomes inefficient in the media industry, due to rapidly changing information in the media industry.

My findings suggest that Elon Musk is not an outlier among CEOs. The trend of narcissism is common among 17 SP500 CEOs across multiple industries. In addition, I found that neither the CEO's narcissism nor the media industry presented a statistically significant price effect on stock returns. Nonetheless, results show that younger and female CEOs, supplied by narcissism and media exposure, are more inclined to take risks, reflected in stock volatility. CEO's narcissism, on the other hand, is mostly supplied by larger stock ownership, older age, and being female.

This paper follows the structure: section 2 describes the data and its basic trends, section 3 explains the data's descriptive patterns, section 4 explains the Economic logic behind hypotheses, section 5 consists of the results of the event study on Elon Musk (5.1) and the panel study on 17 SP500 CEOs (5.2), and section 6 presents the limitation of this paper and conclusion.

2 Information in the Stock Market through Media Influence

Information is pivotal in influencing investors' decisions and subsequent market outcomes in the rapidly changing financial markets. This section provides an additional literature review on the relationship between information given by CEOs such as Elon Musk via Twitter and the decision-making among common investors in the stock markets.

Elon Musk, along with other billionaires, are public celebrities who possess a significant impact on investors. Previous literature has discovered that these prominent figures possess a celebrity effect and can change consumer choices (McCracken 1989). In addition, Elon Musk's identity as a successful technological innovator makes him credible on technology-based topics, such as running a social media platform or building vehicles. The Austrian model suggests that Elon Musk can be characterized as non-deliberative, with a natural 'gift' for identifying opportunities for investors. Moreover, Researchers have also found that the investment decisions of investors are largely affected by the way they comprehend information from trusted individuals (Djafarova and Rushworth 2017). Therefore, Elon Musk's endorsements or statements of any products can significantly influence stock market dynamics.

Instant global communication makes Twitter an ideal medium to spread financial news rather than the conventional flow of media information from newspapers. Twitter links

every financial community around the world together. Elon Musk could directly communicate his opinions to 528.3 million Twitter users without any additional cost of spreading information, such as making a statement in a Wall Street Journal column. Therefore, the advantage of using Twitter as a medium of communication is that Elon Musk could immediately convey his sentiment on stock markets. In this context, the concept of information cascades becomes relevant.

An information cascade occurs when individuals, regardless of their existing knowledge, mimic the actions of others (Hirshleifer and Becker 1995). For instance, there may be an information cascade among Tesla stock buyers when Elon Musk greatly endorsed Tesla's new model on Twitter. Without deliberation, some investors may blindly follow Musk's sentiment and only to regain rationality afterward. On an empirical level, researchers have found that Elon Musk's Tweets can indeed temporarily induce more considerable spikes in terms of price and trading volume of his companies' stocks (Ante 2023). This finding resonates with the AMH as it suggests that the less efficient assets are more likely to experience a bigger influence on Elon Musk's Twitter activities. To examine the market efficiency between Tesla and Twitter's stock, a case study on Elon Musk will be explained in the following sections.

3   Data and Its Basic Trends

The data for this paper consists of four components: Elon Musk's relevant tweets, Daily Google Search Trends, and a panel dataset containing stock prices and demographic information about 17 SP500 firms. They are all compiled by myself. There have not been any public datasets available for research on narcissism and stock prices. Thus, my panel dataset is well-suited for analyzing the connection between a CEO's personality and the corporate performance of a company.

The panel dataset contains daily stock prices of 17 S&P 500 firms from January 2022 to October 2023. It contains 7,124 observations to ensure a normal distribution of data. This dataset is representative since it collects data from companies in various industries: the media and entertainment industry, the healthcare industry, the automobile industry, etc.

Dependent variables are each firm's excess stock returns and daily stock volatility. Together, they capture each company's financial performance and risk from the investor's perspective (Leahy and Whited 1996). In addition, Hirshleifer (2012) found that confident

CEOs tend to project higher stock volatility than non-confident CEOs. Therefore, stock volatility is one of the two dependent variables considered for this research.

Aligned with previous studies, I included key independent variables of CEOs that are either company control variables or CEO's narcissism supply variables from previous studies. They are percentage stock ownership, CEO duality, gender, tenure, and age (Aabo, Hoejland, and Pedersen 2020; Ham, Seybert, and Wang 2017; Zhang et al. 2021). Besides the above 6 variables, 2 variables are also influential. The larger the size of the company and the greater the amount of CEO compensation, the more sufficient the supply for narcissism becomes (Aabo, Hoejland, and Pedersen 2020). Compensation is the most explicit criterion examining a CEO's worth among other CEOs. Therefore, it is a major narcissism supply for CEOs from an intra-firm perspective. Researchers have found that under a sufficient supply of narcissism, CEOs have less individual influence over the firm's corporate performance. With a limited supply of narcissism, narcissistic CEOs may become more risk-taking due to their cravings to create greater personal fame in the company.

The main measure of narcissism is the variable named Naricssim FSP, which counts for the number of First-person Singular Pronouns divided by the total number of words in thousands. FSP consists of the words "I", "me", "mine", "my", and "myself" that CEOs use during each quarterly earnings report's question and answer session. Aligned with previous literature, I extracted 119 transcripts of each CEO's interview answers to analysts from a financial platform beebee.ai.com. Spontaneous responses are the only components considered due to their authentic reflection of CEOs' narcissistic personalities. I collected transcripts for CEOs from 17 S&P500 companies in every quarter to deal with the seasonality effects. To account for the constant nature of narcissism caused by resistance to change (Campbell and Foster 2007), I calculated a single value for each Narcissism FSP indicator per quarter.

Elon Musk's tweets were downloaded from an open data platform from Kaggle.com, which contains over 10,000 tweets since 2012. I systematically extracted 310 tweets containing keywords such as *Twitter* and *Tesla*. Then, I accessed Elon Musk's Twitter account via twitter.com/elonmusk, to manually select all relevant tweets. This truncates the sample to 48 tweets.

Furthermore, since the narrative of the financial market dynamic is largely dependent on a CEO's media coverage, the author also downloaded daily Google Search Trends for the terms "Tesla", "Twitter", and names of SP 500 CEOs—for example, "Elon Musk"-- to explore the general public's interest in these items over time. Changes in Google Search Trends imply the waxes and wanes of media prominence of these prominent figures.

4. Descriptive Patterns

4.1 Abnormal Return and Google Search Trend Around an Event

Figure 1 and Figure 2 display the average log abnormal return from one day before and after a Tesla-related tweet and a Twitter-related tweet by Elon Musk. The group "high-narcissism" indicates an average log abnormal return of Elon Musk's highly narcissistic tweets, while the group "low-narcissism" indicates an average log abnormal return of Elon Musk's tweets with little narcissism present. Between the two groups, abnormal returns around every tweet event indicate a universal difference before and after Musk's tweets.

Among tweets on Tesla, narcissistic tweets present a slight improvement of less than 0.5 percent in a one-day window. Tweets with little narcissism present, present a -6.6 percent negative influence on the abnormal return of Tesla stock. Among tweets on Twitter, narcissistic tweets present a slight improvement of around 1.4 percent within a one-day window. Tweets with little narcissism present show a -0.5 percent negative influence on the abnormal return of Tesla stock. While the prices of Tesla and Twitter responded to Musk's highly narcissistic posts positively, the market seems to be more responsive to Musk's narcissistic tweets in terms of Twitter. This finding aligns with how narcissism and the media industry spark abnormality in stock returns.

In addition to stock price analysis, the Google search trends for Elon Musk compile an Economic narrative on a CEO's media prominence and corporate performance together. For example, on December 14th, 2021, Tesla announced the implementation of Dogecoin as a payment option. As shown in Figure 3, Musk tweeted again about Tesla on January 14th as a follow-up announcement to boost the popularity of Tesla's sales. Musk previously tweeted about Dogecoin because he desired personal fame and popularity of his Tesla merchandise rather than actual wealth accumulation. Moreover, the Google Search trends on Elon Musk's fame align with that of Tesla and Twitter, respectively. This shows that there is no time difference between the rising attention Twitter or Tesla obtains and the prominence Elon Musk obtains. Elon Musk and his brands likely rely on each other for media fame. Imagine Elon Musk tweets an infamous tweet regarding his companies, which boosts media attention to his products and himself. This is a cyclical cycle that is likely to worsen his company's performance in the long run.

Given its importance, I collected a daily Google search trend index for all 17 CEOs in the panel study and named it CEO_media_fame, as a variable estimating the role media prominence plays in corporate performance.

4.2 Text Mining on Elon Musk's Tweets

Text mining results on Elon Musk's tweets have shown a difference in Elon Musk's tone between Twitter and Tesla. When tweeting about Tesla's operation, Musk used professional language only, such as "congratulations", "thanks", and "team". However, when tweeting about Twitter's operation, Musk became significantly more biased.

According to Figure 4, the most frequent phrases are "free speech". "Woke mind virus" was also among Musk's top choices, appearing 11 times between 2022 and 2023. Musk was extremely politically involved in Twitter's operation. For example, he repeatedly mentioned supporting the freedom of speech and source of truth on Twitter before purchasing Twitter in 2022. Moreover, the number of tweets with highly narcissistic content on Twitter takes almost 50 percent of all Twitter-related tweets, whereas none of the Tesla-related tweets is categorized as narcissistic. Therefore, it is likely that Musk led Tesla as a CEO following profit-maximizing intentions. He tweeted to encourage his audience to purchase Tesla merchandise. However, for Twitter, Musk desired less on its financial gain but more on its public prominence. For detailed contents of Elon Musk's tweets on Tesla and Twitter, please refer to Table 11.1 and Table 11.2.

4.3 Descriptive Statistics on the CEO Panel Dataset

The descriptive statistics of my dataset for the panel study on 17 SP500 CEOs are shown in Table 1. Dependent variables are the company's stock volatility and the firm's excess return. The average daily stock volatility across 17 companies is around 2.55 percent, which is aligned with Hirshleifer's descriptive statistics on CEOs. The standard deviation is 2.1 percent, which is larger than Hirshleifer's statistics due to a smaller file size. The firm's excess return has an average of 1.19 percent with a standard deviation of 0.62 percent, indicating a larger variance.

Among 17 companies, 7 companies belong to the media and entertainment industry and 10 companies belong to various non-media related industries. They are the technology industry, the healthcare industry, the automobile manufacturing industry, and the consumer

retail industry. For detailed information regarding to names of CEOs and their companies, please refer to Table 2.

The main independent variables are percentage stock ownership, CEO duality, gender, tenure, age, and narcissism FSP. Among CEOs, the average percentage of stock ownership is 2.47 percent, the average age is 57.17, and the average tenure of 7.88 years, which approaches Chen's finding (Chen et al. 2023). The variance of stock ownership is large, at 5.91 percent, suggesting a wide gap between ownership among CEOs. In addition, 58.82 percent of CEOs do not serve as the Chairperson of the Board of Directors, meaning that a majority of CEOs in the panel study do not hold strong structural power within the company.

Given a disproportionate gender ratio among SP500 CEOs, to ensure a sufficient representation of female CEOs, I chose 7 female CEOs, from each selected industry, in the panel dataset.

Interestingly, the level of narcissism among CEOs differs significantly. The independent variable narcissismfsp, which accounts for the number of first-person singular pronouns per 1000 words that appeared in a CEO's spontaneous response, has a maximum of 19.12 times and a minimum of 0.245 times. Some CEOs, such as Reed Hastings, only used first-person plural pronouns, whereas others such as Mark Zuckerberg, frequently used first-person singular pronouns throughout his responses, sometimes more often than Elon Musk.

The correlation between main dependent variables and major independent variables is shown in Table 3. Table 3 indicates that both the firm's daily stock volatility and daily excess return are significantly correlated with components of the CAPM model, the market's excess return at a 5 percentage level. However, the stock volatility is more significantly correlated with a majority of CEO demographic variables, except for the firm's board size and the CEO's education level. The firm's excess return, on the other hand, significantly correlated with very few numbers of the CEO's demographic variables. Among them, only the dummy variable Founder is significantly correlated with the firm's excess return at a 5 percent level.

Although the descriptive statistics provides some general information regarding to key variables used in this paper, it is nonetheless insufficient for answering my research questions. First, regressions are needed to examine the different correlation results between two dependent variables—a firm's daily stock volatility and a firm's daily excess return. In particular, regressions need to address whether the pattern of daily excess return aligns more closely with the Efficient Market Hypothesis, compared to the stock volatility. Second, the drastic variation in narcissism levels, especially among media CEOs, is unable to settle

whether a narcissistic media CEO is more influential over corporate performances than a non-narcissistic CEO. Therefore, it is necessary to investigate further into regression outcomes on the relationship between CEO narcissism, supply for narcissism, and two dependent variables measuring corporate performances.

5 Economic Logic of Hypotheses

How would market inefficiencies reflect on stock returns and stock volatility through media? What might I expect the CEOs' demographics and the companies' structure to influence corporate performances? Previous research on CEOs' social media activities and narcissism helps indicate conditions of market inefficiencies.

The higher level of media activity is negatively associated with corporate performance, reflected in stock volatility and stock excess return. According to the latest 1,500 case studies conducted at the University of Hong Kong, when a CEO's tweets are non-work related or when a CEO attains "online celebrity status", firm values tend to decline (Chen et al, 2023). This finding echoes Elon Musk's insensitive tweets and the consequent loss of profit. If Elon Musk tweets too much political content regarding freedom of speech on Twitter in the short term, the market will view his hype as Economic noise. The more noise present in a stock, the more rapid shifts in investor sentiment and market reactions. Consequently, the media-induced noise increases the uncertainty in a stock's valuation, which results in higher volatility in particular.

The higher percentage of CEO's stock ownership and CEO's duality are positively associated with corporate performance. This is because larger ownership shows matched interests between shareholders and the CEO. In addition, the corporate power structure becomes more centralized towards the CEO if the CEO also serves as the Chairperson of the Board. However, the higher the centration of company ownership and executive power a CEO obtains, the less effective corporate governance will result. Therefore, it leads to a riskier stock valuation, especially higher volatility.

Although women are perceived to be more risk-averse than men, such a feature does not reflect CEO attributes. A CEO's gender has an uncertain effect on corporate performance, based on previous works. In addition, the gender effect may also vary from industry to industry, leading to more uncertainty in predicting the sign of the variable gender.

The longer the tenure and the older in age, a CEO is related to executive experience and more stable leadership within the corporate governance. Therefore, it may not have any significant effects on stock excess return but is negatively correlated with stock volatility.

Lastly, a higher degree of CEO narcissism is correlated with more irrational decision-making and risk-taking. Thus, it results in higher stock volatility and may also result in a higher stock excess return in terms of magnitude.

Given the above reasoning, there are two following hypotheses:

1. **Elon Musk is not an outlier among SP500 CEOs. A high level of media activity and involvement is not rare.**
2. **A media company, run by a narcissistic CEO, is more likely to project temporary market inefficiency on stock pricing. It then negatively impacts the company's stock performance.**

6 Empirical Results

How are CEO demographics, CEO's media involvement, and supply of narcissism associated with corporate performance? I found that Elon Musk's narcissism is more priced in Twitter's stock returns than Tesla's, though statistically insignificant. Although the CEO's narcissism and media involvement do not project a statistically significant influence over stock returns, they do enlarge stock volatility. Moreover, female CEOs and CEOs involved in the media industry are more risk-taking, which also increases stock volatility. Finally, a CEO's narcissism is supplied by larger stock ownership, older age, and being a woman.

This section is structured as follows. The first section (6.1) explains the methodologies used in data analysis in detail. The second section (6.2) displays regression results from a case study analysis of Musk's tweet events on Tesla and Twitter. The third section (6.3) displays regression results from the panel study of 17 S&P500 CEOs, from both media and non-media industries. The fourth section (6.4) explains limitations of regression designs and the economic significance of my findings.

6.1 Methodologies for Data Analysis

The case study on Elon Musk uses the event study methodology to analyze the impact of his tweets on Twitter and Tesla stocks. Elon Musk's controversial tweets are treated as unexpected events for their randomness. Event study methodology is the most suitable

methodology for this paper because it is a well-established approach to testing market efficiency when facing unexpected events.

The left-hand-side dependent variable in the case study on Elon Musk is Tesla and Twitter's daily excess returns. Let $ExcessR_{it}$ represent them. t stands for a particular period, while i stands for a stock. Let market excess stand for $MarketE_{it}$. There are $n = 48$ tweet events to analyze.

The process of deriving the excess return for two assets takes several steps to complete. The purpose of transforming closing prices into formatted excess returns is I try to make the time series data stationary. The model in this paper computes the excess returns over a day. The first step is to calculate the daily expected return for Tesla and Twitter. Based on the CAPM model, the expected return consists of the following components:

$$ER_{it} = R_f + \beta_i \times (R_m - R_f) \qquad (1)$$

β_i is the daily beta measuring Tesla and Twitter stock volatility. I referred them to Reuters. R_f stands for the annual risk-free rate, which is the yield of a U.S. 10-year treasury bond. Given the annual risk-free rate, I can then calculate for daily risk-free rate to account for the daily expected return.

$$DailyR_f = (1 + 0.0355)^{1/252} - 1 \qquad (2)$$

Second, For each Elon Musk tweet event, the excess return is calculated by subtracting the expected return from the actual return during a one-day event window. The formula for daily excess return is given as follows:

$$ExcessR_{it} = R_{it} - ER_{it} \qquad (3)$$

Third, the regression formula for the case study is given as follows. β_3 and β_2 should capture the difference between tweets with high narcissism content and no tweets:

$$ExcessR_{it} = \beta_0 + \beta_1 MarketE_{it} + \beta_2 High\ Narcissism_{it} + \beta_3 Event\ Flag + \delta \quad (4)$$

Besides the case study on Elon Musk's tweets, the panel study on the relationship between the corporate performances of 17 S&P500 companies and their CEOs uses multivariate regression analysis. My regressions are established based on the two models below.

$$ExcessR_i = \beta_0 + \beta_1 MarketE_{it} + \beta_2 Narcissism_{it} + \beta_{3-9} CEO\ controls +$$
$$\beta_{10-13} Company\ controls + (interactions\ with\ Narcissim_{it}) \quad (5)$$

Given regression modes, the results from the case study on Elon Musk and the panel study on 17 CEOs will be presented in the following two sections (6.2) and (6.3).

6.2   Results from the Case Study on Elon Musk

To investigate whether Elon Musk's tweets have price effects on Tesla and Twitter's stock, event studies on 48 tweets are examined in this section. Regression results of (4) are presented in Figure 4.1 and Figure 4.2.

Figure 4.1 shows a simple model that regresses Tesla and Twitter's excess return with the market's excess return and a narcissism indicator of tweet contents. Only the market excess is significant on Tesla's stock excess returns at 1 percentage level. This may indicate that the Efficient Market Hypothesis functions better in a non-media company. Although the narcissism coefficients are statistically insignificant on Tesla and Twitter, it does indicate contrasts between the two firms. Highly narcissistic tweets decrease Tesla's stock excess return by 1.73 percentage points, whereas increase Twitter's stock excess return by 1.03 percentage points. It shows that the market is positively responsive towards Elon Musk's narcissism in media regarding Twitter's operation. The investor's response is also larger in magnitude. The result from Table 4.1 aligns with Figure 4 on the average abnormal returns for Tesla and Twitter around a tweet event.

Performing robustness checks, regressions from Table 4.1 do not pass the test. Therefore, I transformed the event study dataset from wide to longitudinal, and re-run regressions by adding two new variables: the log of company volume and the event flag. Table 4.2 presents the result. Although the R squared value increases from Table 4.1, none of the explanatory variables except the market excess are statistically significant. It again

confirms the validity of the Efficient Market Hypothesis. However, both the event flag and narcissism indicator variable have negative coefficients. It aligns with Chen's finding in 2023, where the more tweets a CEO posts, the worse corporate performance a company will present.

Though findings from Elon Musk's case study do match with previous literature, a research question is not yet answered. Is Elon Musk unique among S&P500 CEOs? Is a high level of media activity and involvement generally rare among S&P500 CEOs?

6.3   Results from the Panel Study on 17 CEOs

The panel study analysis conducted on the CEO dataset addresses unanswered questions. Table 5 presents 3 general regressions on a firm's excess return by adding more explanatory variables in each model. Similar to the previous event study analysis on Elon Musk, the market excess return still plays a significant role in estimating excess returns. Besides, in model 2 and model 3, being the founder is significantly correlated with around 10 percent more excess returns compared to CEOs who are not founders. In Model 3, a 1 percentage increase in stock ownership is associated with a decrease of 0.47 percent in the firm's excess returns. These coefficients indicate that being the founder helps with stocks' performance but having more stock ownership does not help with corporate performance.

Table 6 presents results by separately regressing on media and non-media firm's excess returns. Although coefficients of market excess return are all positive among 4 models, the market excess return increases a firm's excess return by 557 percent more on media firms than nonmedia firms. This indicates that media firms are much more sensitive to market-wide movements, possibly due to their reliance on advertising revenue, consumer discretionary spending, or other factors that make them more volatile in response to market changes. Therefore, Twitter is a unique case. In addition, the CEO is the founder increases a media firm's excess return by 11 percent whereas decreases a non-media firm's excess return by 330 percent. This implies that founder-led media firms tend to outperform in terms of returns, possibly due to founders' intrinsic understanding of the industry, their commitment, or visionary approaches.

The most surprising finding from Table 6 is that if a CEO owns 1 percent more stock ownership, then it increases his or her non-media firm's excess return by 1630 percent. The stock ownership does not have price effects on media firms. This may imply that in

non-media industries, a non-dominant CEO drives better corporate performance in terms of excess returns.

CEO's narcissism and its supply factors in companies do not seem to correlate much with the company's excess return. The R squared value is also below the 1.5 percentage level for Tables 5 to 7. However, the CEO's narcissism and its supply factors are more influential over corporate risk, reflected in stock volatility. Models from Tables 8 to 9 also have more explanatory power than models from previous tables, at a constant level of 15 percent.

Table 8 represents general regression outcomes on stock volatility. Every variable coefficient is statistically significant at either a 5 percent or 1 percent level. Among supply factors of CEO narcissism, many do increase corporate risk, reflected in stock volatility. CEOs working in smaller firms, with smaller board sizes, and having less stock ownership are associated with more corporate risk. CEOs with US nationality increase corporate risk by 0.73 percent in model 1 of Table 8. Furthermore, companies run by younger CEOs exhibit approximately 2.6 percent greater corporate risk for each year of an age gap when compared to firms run by older CEOs. Moreover, gaining a longer tenure and earning less compensation also contributes to a larger stock volatility. These findings match with previous research (Aabo, Hoejland, and Pedersen 2020).

Surprisingly, companies run by female CEOs have 1 percentage larger corporate risk than those run by male CEOs. A possible explanation is that although women are perceived as generally risk-averse, female CEOs work more competitively to gain their executive positions due to glass ceiling discrimination. Therefore, female CEOs may become more risk-taking than male CEOs.

Most importantly, corporate performance differs between the media and non-media industries. Media companies present 1.4 percent more corporate risk than non-media companies. This new finding again confirms with findings from Table 6. Media prominence of CEOs, on the other hand, is not significantly influential on corporate risk from both Table 8 and 9.

To address the counterintuitive finding where firms run by more narcissistic CEOs are associated with slightly less corporate risk at 0.0616 percent per annum. I interacted narcissism indicator with four key independent variables: gender, media, stock ownership, and company size. Models 1 and 2 from Table 9 show that higher levels of narcissism in CEOs, particularly among women, are associated with a trivial increase in corporate risk by 0.11 percent, significant at a 1% level. This finding, though not matched in magnitude, aligns

with previous research (Aabo, 2019). Besides this finding, other coefficients from Table 9, accounting for interaction terms, align with findings from Table 8.

What supplies the CEO's narcissism? Results from Table 10 reveal the following company and CEO demographic factors that increase CEO's narcissistic language expressions: being female, working in a small company, having older age, receiving more compensation, being a founder, getting larger stock ownership, leading a media firm, and having a smaller board of directors. From model 3 of Table 10, the most influential factor among supply factors is higher stock ownership, which increases the number of first-person singular pronouns by 151.8 per thousand words. Examining interaction effects on stock ownership in particular, I found that female CEOs with a percentage more ownership are associated with 181.05 more words, compared to male CEOs. Moreover, American CEOs and CEOs without dual roles on the board, having a percentage more ownership, are associated with 184.24 and 104.95 words of narcissistic expressions. The rest of the supply factors are all statistically significant at a 1% level and support previous findings in this section.

Upon examining the three-way relationship between CEO narcissism, supply of narcissism, and corporate performance, I can now confirm two hypotheses from section 5. First, shown in Figure 7, Elon Musk is not an outlier on the narcissism spectrum among 17 studied CEOs. Media involvement and activity is commonly seen among S&P 500 CEOs. Some of them, such as Mark Zuckerberg and Lachlan Murdoch from the panel study, are as narcissistic as Elon Musk in terms of language expressions. Second, a media company, led by a narcissist, is more likely to have worse corporate performance and display more market inefficiency on stock. In addition, without sufficiently supplied with narcissism in the company, narcissistic CEOs are more likely to become risk-taking. Thus, the firm's stock volatility increases.

6.4   Limitations

Though sufficient in research outcomes, this paper still has some limitations worthy of discussion. First, the stock price I collected only has a daily granularity. The minute-to-minute or hourly granularity is not available for free download. The library's data service was also unavailable for downloading data with shorter intervals until mid-April. Therefore, this research can only analyze daily stock data. Second, there are only 17 CEOs represented in my dataset, which is much less than the previous literature. It is due to a

vacancy of public datasets on CEO's narcissism and supply of narcissism. I had to manually select 17 companies from the media and non-media industry and collect each CEO's information. The process made it difficult to collect hundreds of S&P 500 CEOs in a few months. In the future, I will continue this research in graduate school. I plan to collect hourly and minute-to-minute data over the same period and on the same stocks, to examine if there are any statistical differences in coefficients. Moreover, with more time, I can then compile more CEO information into my dataset.

7   Conclusion

Elon Musk's controversial Twitter posts and corresponding market reactions raise questions about whether a media CEO's narcissism would trigger market inefficiencies. Upon conducting a case study on Elon Musk's tweets and the panel dataset on 17 CEOs, I obtained more information about the three-way relationship. The results indicate that the CEO's narcissism and the supply of narcissism are associated with corporate performance, especially in a media company. From the case study on Elon Musk, only the Twitter stock reacts positively to Elon Musk's narcissistic tweets. This suggests that narcissistic leadership might be perceived as visionary for investors. CEO's narcissism does not have any significant effect on non-media companies. In addition, from the panel study of 17 CEOs, the economic advantage of founder-led companies is more profound. The result also shows that increased stock ownership of CEOs does not necessarily lead to improved corporate performance. Therefore, investors and management must consider the executive power structure within a company.

On a broader scale, this research presents that factors related to CEOs, not typically associated with the CAPM model, are also vital in stock pricing and especially in corporate risk. More importantly, this paper provides empirical evidence of when market inefficiencies happen under the Adaptative Market Hypothesis—when media and CEO's narcissism meet. Although correlation does not equate to causation, these statistically significant findings are still worthy of further investigation. In the future, the researchers should re-evaluate stock market efficiency by including the CEO's personality, such as narcissism, and the company environment that supplies narcissism.

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Appendix

Figure 1: Differentiating average log abnormal returns around a Twitter-related tweet with the presence of high narcissism versus little narcissism
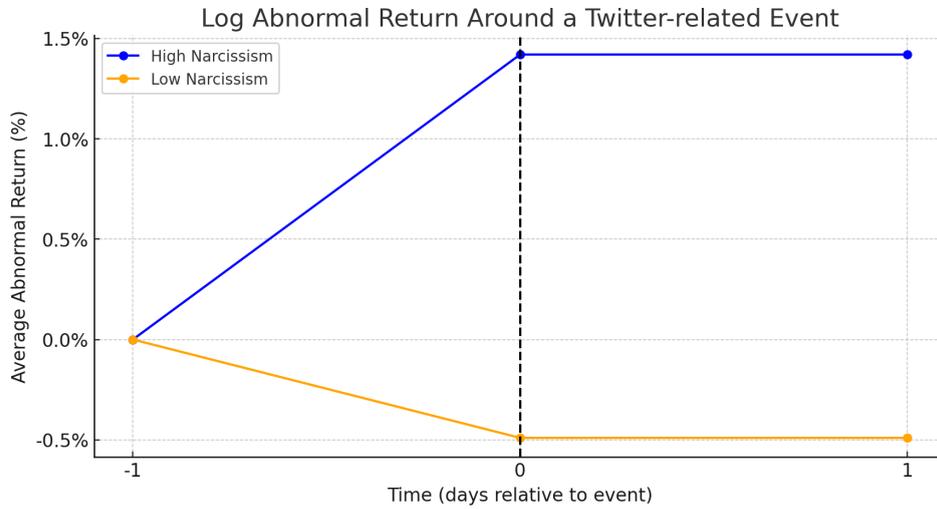
Source: this image is plotted from abnormal returns calculated from the compiled Elon Musk case study dataset.

Figure 2: Differentiating average log abnormal returns around a Tesla-related tweet with the presence of high-narcissism contents versus little narcissism
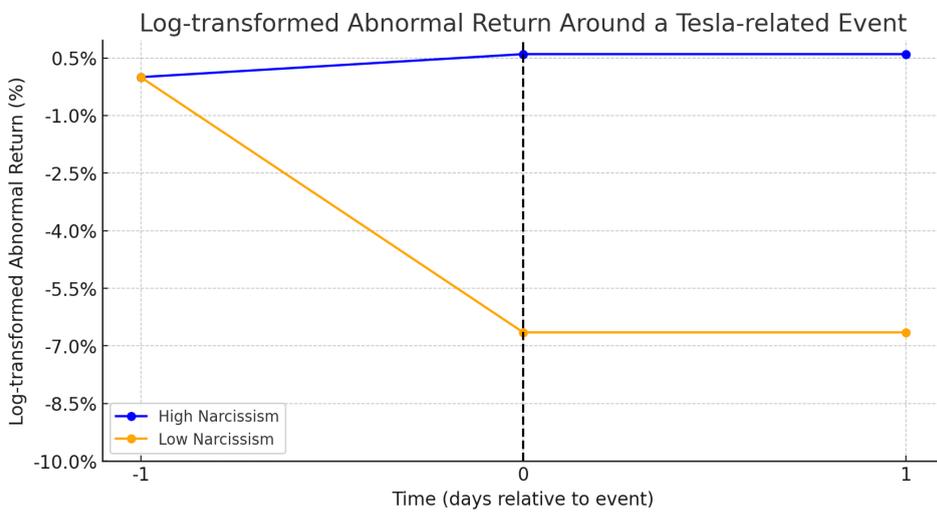
Source: this image is plotted from abnormal returns calculated from the compiled Elon Musk case study dataset.

Figure 3: The Google search prominence on Tesla and Elon Musk around January tweet events
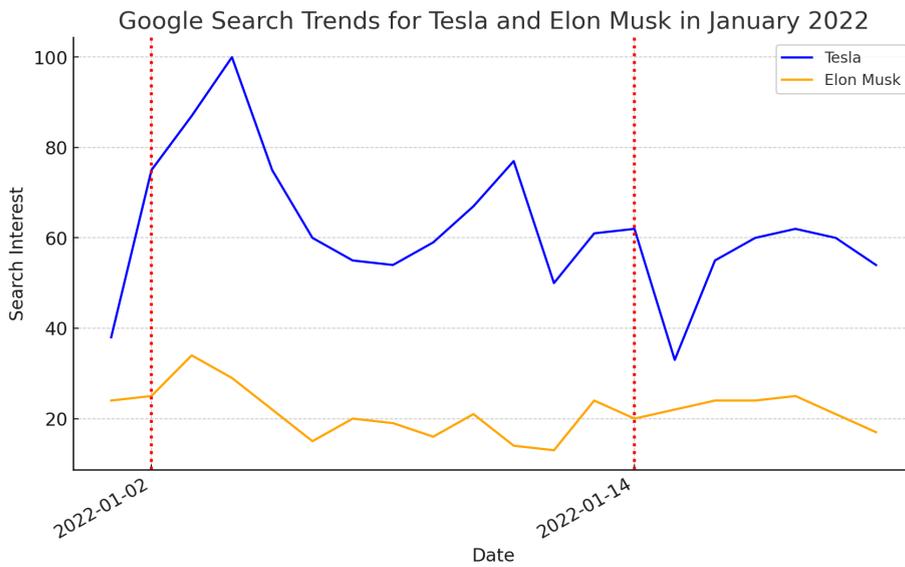
Source: this image is plotted by the author from the Google search index/trend dataset.

Figure 4: Elon Musk's Twitter Wordcloud, 2021 to 2023

Source: figure 4 is downloaded from Kaggle.com

Figure 5: Word cloud centered on "Tesla", mostly linked with professional language
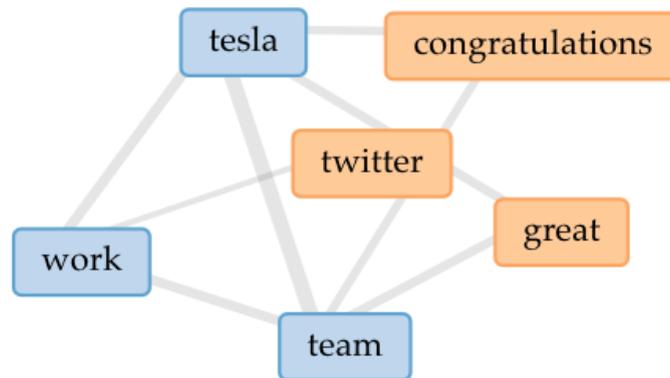
Figure 6: Word cloud centered on "Twitter", mostly linked with emotional language
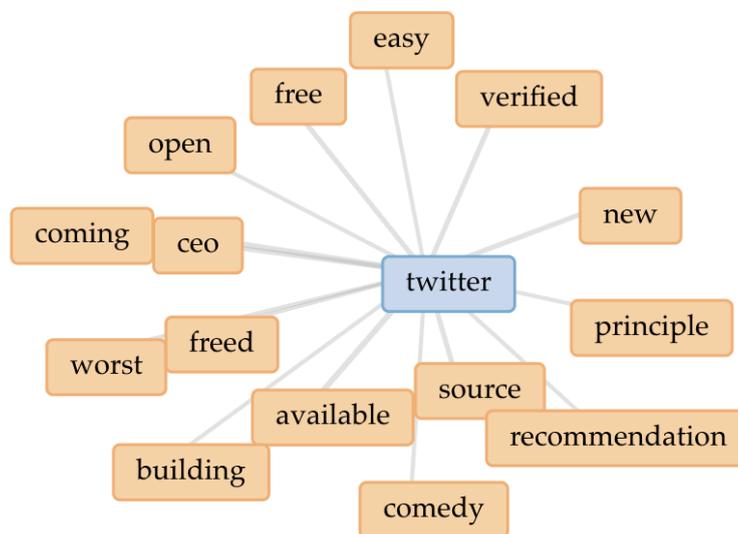
Figure 7: A spectrum of narcissism levels among prominent CEOs
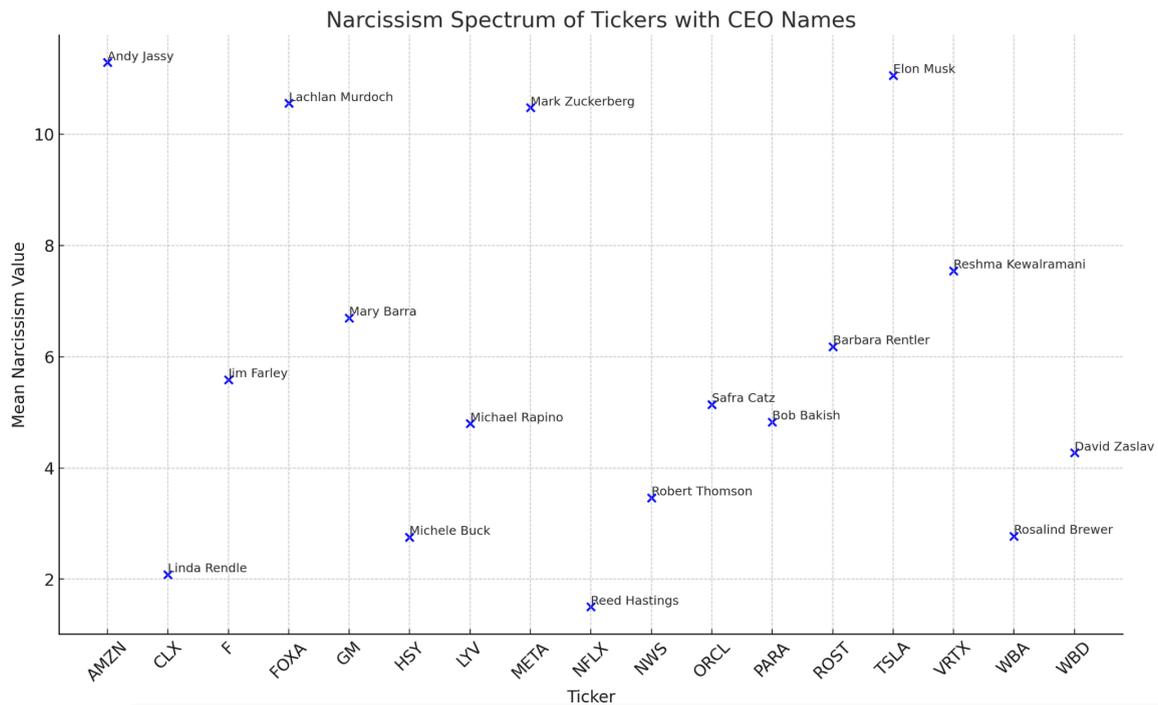
Source: visualized based on the narcissism indicator variable "narcissism" by each CEO from the panel dataset

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Volatility	6,781	.0255262	.0218156	.005768	.840903
Firm_excess	7,121	.0119177	.6165661	-.8338853	44.84765
Media	7,123	.4117647	.4921875	0	1
Boardsize	7,123	11.29328	2.163571	7	15
Company_size (million $)	7,123	3719988	5780465	13970	2.30e+07
Narcissim_FSP	7,123	5.942643	3.74948	.244828	19.12446
Age	7,123	57.17647	7.44629	39	66
Gender	7,123	.5882353	.4921875	0	1
stock_ownership%	7,123	2.473061	5.911115	0	22.493
CEO_media_fame	7,123	3.36333	8.222456	0	100
Founder	7,123	.1764706	.3812468	0	1
CEO_tenure	7,123	7.878012	5.617511	1.92	19.67
CEO_duality	7,123	.4117647	.4921875	0	1
CEO_educ	7,123	4.470869	.7761816	3	6
CEO_total_comp	7,123	28819.09	35150.77	0	139005.6
US_nationality	7,123	.7058824	.4556771	0	1

Note: This table reports descriptive statistics of independent and dependent variables.

Source: Derived from the compiled panel CEO dataset.

Table 2: CEOs in the Panel Study

CEO Name	Company	Ticker	Industry
Reed Hastings	Netflix	NFLX	Media/Entertainment
David Zaslav	Warner Brothers	WBD	Media/Entertainment
Lachlan Murdoch	Fox Corp	FOXA	Media/Entertainment
Robert Thomson	News Corp	NWS	Media/Entertainment
Michael Rapino	Live Nation Entertainment	LYV	Media/Entertainment
Bob Bakish	Paramount	PARA	Media/Entertainment
Mark Zuckerberg	Meta Platforms	META	Media/Entertainment
Andy Jassy	Amazon	AMZN	Information Technology
Safra Catz	Oracle Corporation	ORCL	Information Technology
Rosalind Brewer	Walgreens	WBA	Healthcare
Reshma Kewalramani	Vertex Pharmaceuticals	VRTX	Healthcare
Mary Barra	General Motors	GM	Automobile Manufacture
Jim Farley	Ford	F	Automobile Manufacture
Elon Musk	Tesla	TSLA	Automobile Manufacture
Barbara Rentler	Ross Stores	ROST	Consumer Retail
Michele Buck	The Hershey Company	HSY	Consumer Retail
Linda Rendle	The Clorox Company	CLX	Consumer Retail

Note: This table reports the names of 17 CEOs and their companies in the panel study.

Source: Derived from the compiled panel CEO dataset.

Table 3: Pairwise correlation of corporate performance, narcissism, and supply of narcissism variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) Firm_excess	1.000																	
(2) Market_excess	0.109***	1.000																
(3) Daily _volatility	0.029**	0.039***	1.000															
(4) log_stock_volume	-0.005	-0.004	0.295***	1.000														
(5) FSP_thousands	-0.003	0.008	0.037***	0.416***	1.000													
(6) log_firm_size	0.013	0.000	0.111***	0.233***	-0.050***	1.000												
(7) log_CEOage	-0.007	0.000	-0.027**	-0.043***	-0.334***	-0.173***	1.000											
(8) CEO_gender	0.013	-0.001	0.256***	0.421***	0.268***	-0.189***	-0.052***	1.000										
(9) Stock_ownership%	0.007	0.003	0.208***	0.507***	0.464***	0.469***	-0.463***	0.331***	1.000									
(10) Media	0.013	0.001	0.162***	-0.120***	-0.054***	-0.161***	-0.034***	0.700***	0.002	1.000								
(11) Founder	0.032***	0.000	0.247***	0.411***	0.215***	0.548***	-0.378***	0.387***	0.778***	0.240***	1.000							
(12) CEO_tenure	0.001	0.002	0.071***	-0.042***	0.312***	0.402***	-0.321***	0.148***	0.591***	0.194***	0.414***	1.000						
(13) Boardsize	0.008	-0.003	0.016	0.254***	-0.270***	0.193***	0.216***	-0.329***	-0.338***	-0.335***	-0.134***	-0.348***	1.000					
(14) CEO_duality	0.016	0.001	0.058***	0.087***	0.244***	0.313***	-0.126***	-0.029**	0.416***	0.029**	0.553***	0.404***	-0.224***	1.000				
(15) CEO_educ_level	0.001	0.000	-0.009	-0.004	-0.228***	-0.329***	0.453***	-0.108***	-0.370***	-0.045***	-0.281***	-0.595***	0.442***	-0.354***	1.000			
(16) log_CEO_comp	0.004	0.003	0.086***	-0.139***	-0.244***	0.190***	0.083***	0.222***	0.130***	0.526***	0.221***	0.367***	0.037***	0.123***	-0.041***	1.000		
(17) CEO_US_nationality	0.010	0.000	0.162***	0.496***	-0.062***	0.407***	-0.042***	-0.015	0.218***	-0.247***	0.299***	-0.187***	0.326***	0.278***	-0.108***	-0.225***	1.000	
(18) CEO_fame	-0.005	-0.002	0.057***	0.256***	0.129***	0.004	-0.022*	0.066***	0.250***	-0.134***	0.117***	-0.012	-0.058***	0.090***	0.014	-0.116***	0.186***	1.000

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source: Derived from the compiled panel CEO dataset.

Table 4.1: Event study results of the influence of Musk's tweets on excess returns of Tesla and Twitter (Wide format. Excess return calculated as a decimal, not as a percentage)

	(1)	(2)
	Tesla_excess_return	Twitter_excess_return
market_excess	1.212**	0.0168
	(2.79)	(0.06)
high_narcissim	-0.0173	0.0103
	(-1.60)	(1.51)
_cons	0.00336	-0.00365
	(0.54)	(-0.93)
N	48	48

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.2: Event study results of the influence of Musk's tweets on excess returns of Tesla and Twitter (Long format. Excess return calculated as a decimal, not as a percentage)

	(1)	(2)
	firm_excess_return	firm_excess_return
market_excess	1.219***	1.257***
	(0.123)	(0.124)
log_volume	0.000476	0.000383
	(0.00809)	(0.00811)
Flag		-0.00627
		(0.00493)
high_narcissim		-0.0209
		(0.0136)
_cons	-0.0102	-0.00713
	(0.180)	(0.180)
N	628	628
adj. R^2	0.134	0.139

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's calculations from the compiled Elon Musk dataset.

Table 5: Main regression results on CEO narcissism and excess returns (Excess return calculated as a decimal, not as a percentage)

	(1) firm_excess	(2) firm_excess	(3) firm_excess
market_excess	5.152***	5.058***	5.063***
	(0.582)	(0.548)	(0.548)
log_vol	-0.0320**	-0.0206*	-0.00465
	(0.0138)	(0.0107)	(0.00533)
narcissimfsp	0.00261		
	(0.00333)		
log_size	0.00273		
	(0.00685)		
log_age	0.0664	0.000760	
	(0.102)	(0.0688)	
gender	0.0806*	0.0605*	
	(0.0479)	(0.0332)	
ptc_stkown	0.00465	-0.00186	-0.00425**
	(0.00863)	(0.00462)	(0.00207)
media	-0.0473	-0.0398	
	(0.0532)	(0.0322)	
founder	0.0722	0.103**	0.111***
	(0.0644)	(0.0414)	(0.0303)
ceotenure	-0.00372	-0.00118	
	(0.00401)	(0.00274)	
boardsize	0.00998	0.00752	
	(0.0107)	(0.00677)	
ceoduality	0.0107		
	(0.0301)		
ceoeduc	-0.00288	-0.00207	
	(0.0213)	(0.0161)	
log_comp	-0.00162		
	(0.0135)		
usnationality	0.00171		
	(0.0303)		
CEO_fame	0.0000954		
	(0.00107)		
_cons	0.0886	0.234	0.0764
	(0.338)	(0.252)	(0.0825)
N	6702	7121	7121
adj. R^2	0.012	0.013	0.013

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's calculations from the compiled panel CEO dataset.

Table 6: Regression results on CEO narcissism and excess returns among media and non-media CEOs (Excess return calculated as a decimal, not as a percentage)

	(1) mediafirm_excess	(2) mediafirm_excess	(3) nonmediafirm_excess	(4) nonmediafirm_excess
market_excess	8.334***	8.334***	2.766***	2.766***
	(1.269)	(1.269)	(0.273)	(0.273)
narcissimfsp	-0.000884	-0.000571	-0.00177	-0.00174
	(0.00703)	(0.00549)	(0.00169)	(0.00161)
log_size	-0.000693	-0.000613	-0.00659	-0.00644*
	(0.00823)	(0.00815)	(0.00412)	(0.00337)
log_age	-0.0258		0.00240	
	(0.361)		(0.0364)	
stockownership	-0.478	-0.401	16.30*	16.40*
	(1.271)	(0.673)	(8.889)	(8.751)
founder	0.111*	0.110*	-3.305*	-3.327*
	(0.0623)	(0.0606)	(1.814)	(1.783)
_cons	0.118	0.00985	0.0856	0.0929*
	(1.516)	(0.110)	(0.122)	(0.0502)
N	2933	2933	4188	4188
adj. R^2	0.014	0.015	0.024	0.025

Standard errors in parentheses

Significance levels: * p<0.10, ** p<0.05, *** p<0.01

Source: Author's calculations from the compiled panel CEO dataset.

Table 7: Regression results on CEO narcissism and excess returns accounting for interaction effects (Excess return calculated as a decimal, not as a percentage)

	(1) firm_excess	(2) firm_excess	(3) firm_excess	(4) firm_excess
market_excess	5.053***	5.056***	5.050***	5.054***
	(0.548)	(0.548)	(0.548)	(0.548)
log_vol	-0.0237**	-0.0157*	-0.0254**	-0.0241**
	(0.0108)	(0.00927)	(0.0113)	(0.00995)
narcissimfsp	0.00391	-0.00122	0.00328	0.00360
	(0.00993)	(0.00414)	(0.00417)	(0.00281)
c.narcissimfsp#c.log_size	-0.000132			
	(0.000763)			
log_size		-0.000802	0.00220	0.00318
		(0.00536)	(0.00578)	(0.00581)
gender	0.0574		0.0620	0.0668*
	(0.0354)		(0.0400)	(0.0365)
ptc_stkown	-0.00134	-0.00306	-0.00141	
	(0.00443)	(0.00431)	(0.00444)	
founder	0.105***	0.114***	0.0960**	0.110***
	(0.0406)	(0.0428)	(0.0451)	(0.0363)
ceoeduc	-0.00425	0.000630	-0.00445	-0.000000713
	(0.0145)	(0.0152)	(0.0177)	(0.0138)
ceotenure	-0.00174	-0.000794	-0.00229	-0.00167
	(0.00266)	(0.00282)	(0.00297)	(0.00219)
CEO_fame	-0.00000999	-0.0000421	0.0000344	0.000105
	(0.000950)	(0.000951)	(0.000952)	(0.000950)
boardsize	0.00979	0.00672	0.00943	0.00732
	(0.00722)	(0.00669)	(0.00726)	(0.00595)
media	-0.0344	-0.0138	-0.0264	-0.0432
	(0.0327)	(0.0279)	(0.0602)	(0.0307)
c.narcissimfsp#c.gender		0.00456		
		(0.00438)		
c.narcissimfsp#c.media			-0.00122	
			(0.00539)	
c.narcissimfsp#c.ptc_stkown				-0.000307
				(0.000269)
_cons	0.261*	0.180	0.258	0.223
	(0.149)	(0.149)	(0.162)	(0.142)
N	7121	7121	7121	7121
adj. R^2	0.013	0.013	0.013	0.013

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's calculations from the compiled panel CEO dataset.

Table 8: Main regression results on CEO narcissism and stock volatility

	(1) volatility	(2) volatility
market_excess	0.0669***	0.0669***
	(0.0194)	(0.0194)
log_vol	0.00840***	0.00816***
	(0.000465)	(0.000459)
narcissimfsp	-0.000616***	-0.000618***
	(0.000110)	(0.000109)
log_size	-0.000642***	
	(0.000225)	
log_age	-0.0259***	-0.0279***
	(0.00343)	(0.00335)
gender	-0.0104***	-0.00806***
	(0.00157)	(0.00135)
ptc_stkown	-0.00333***	-0.00333***
	(0.000295)	(0.000295)
media	0.0140***	0.0133***
	(0.00175)	(0.00174)
founder	0.0191***	0.0166***
	(0.00215)	(0.00191)
ceotenure	0.00171***	0.00164***
	(0.000134)	(0.000131)
ceoduality	-0.00576***	-0.00466***
	(0.000997)	(0.000904)
ceoeduc	0.00408***	0.00445***
	(0.000701)	(0.000686)
log_comp	-0.000878**	-0.00102**
	(0.000446)	(0.000443)
usnationality	0.00733***	0.00628***
	(0.00101)	(0.000950)
boardsize	-0.00167***	-0.00167***
	(0.000356)	(0.000357)
CEO_fame	-0.0000594*	
	(0.0000345)	
_cons	0.00600	0.00894
	(0.0112)	(0.0112)
N	6382	6382
adj. R^2	0.149	0.148

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's calculations from the compiled panel CEO dataset.

Table 9: Regression results on CEO narcissism and stock volatility accounting for interaction effects

	(1) volatility	(2) volatility	(3) volatility	(4) volatility
market_excess	0.0670***	0.0672***	0.0669***	0.0671***
	(0.0195)	(0.0195)	(0.0195)	(0.0195)
log_vol	0.00708***	0.00627***	0.00745***	0.00740***
	(0.000427)	(0.000371)	(0.000449)	(0.000450)
narcissimfsp	0.000445	0.0000828	-0.000450***	-0.000438***
	(0.000491)	(0.000152)	(0.000149)	(0.000129)
c.narcissimfsp#c.log_size	-0.0000707**			
	(0.0000349)			
log_size		-0.000297	-0.000868***	-0.000910***
		(0.000195)	(0.000228)	(0.000221)
log_age	-0.0175***	-0.0201***	-0.0181***	-0.0170***
	(0.00330)	(0.00318)	(0.00319)	(0.00319)
gender	-0.0107***		-0.0122***	-0.0124***
	(0.00155)		(0.00155)	(0.00155)
ptc_stkown	-0.00260***	-0.00202***	-0.00274***	-0.00255***
	(0.000290)	(0.000264)	(0.000314)	(0.000360)
usnationality	0.00475***	0.00415***	0.00515***	0.00556***
	(0.00106)	(0.000922)	(0.000955)	(0.000980)
ceoduality	-0.00490***	-0.00258***	-0.00513***	-0.00569***
	(0.00110)	(0.000877)	(0.00107)	(0.00102)
founder	0.0134***	0.00908***	0.0155***	0.0165***
	(0.00195)	(0.00185)	(0.00234)	(0.00210)
ceotenure	0.00121***	0.000900***	0.00125***	0.00127***
	(0.000115)	(0.000102)	(0.000128)	(0.000114)
log_comp	-0.00184***	-0.00169***	-0.00159***	-0.00161***
	(0.000428)	(0.000425)	(0.000447)	(0.000429)
CEO_fame	-0.0000474	-0.0000368	-0.0000558	-0.0000556
	(0.0000346)	(0.0000346)	(0.0000346)	(0.0000346)
boardsize	-0.0000215	-0.0000880	-0.000254	-0.000249
	(0.000251)	(0.000255)	(0.000259)	(0.000257)
media	0.0192***	0.0148***	0.0198***	0.0190***
	(0.00153)	(0.00128)	(0.00183)	(0.00152)
c.narcissimfsp#c.gender		-0.00103***		
		(0.000152)		
c.narcissimfsp#c.media			-0.000157	
			(0.000209)	
c.narcissimfsp#c.ptc_stkown				-0.0000256
				(0.0000199)
_cons	-0.00496	0.0192*	0.00389	0.000762
	(0.0126)	(0.0112)	(0.0113)	(0.0113)
N	6382	6382	6382	6382
adj. R^2	0.143	0.142	0.144	0.144

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's calculations from the compiled panel CEO dataset.

Table 10: Regression results in the supply of narcissism among CEOs

	(1) narcissimfsp	(2) narcissimfsp	(3) narcissimfsp
firm_excess	0.0417		
	(0.0445)		
log_vol	1.318***	1.328***	0.187***
	(0.0477)	(0.0477)	(0.0572)
age	-0.153***	-0.147***	0.119***
	(0.00670)	(0.00662)	(0.0133)
gender	2.412***	2.036***	-6.135***
	(0.187)	(0.173)	(0.372)
log_comp	-0.570***	-0.796***	1.116***
	(0.0646)	(0.0485)	(0.0893)
ceo_totalcomp	-0.00000964***		
	(0.00000184)		
log_size	0.0677**	0.0172	-0.535***
	(0.0267)	(0.0249)	(0.0821)
ptc_stkown	0.134***	0.154***	151.8***
	(0.0310)	(0.0308)	(9.052)
founder	-4.213***	-4.053***	56.33***
	(0.232)	(0.231)	(2.640)
ceotenure	0.180***	0.160***	-0.815***
	(0.0150)	(0.0145)	(0.0452)
boardsize	-0.281***	-0.300***	3.103***
	(0.0390)	(0.0389)	(0.116)
ceoduality	3.097***	3.133***	9.002***
	(0.103)	(0.103)	(0.524)
ceoeduc	1.003***	0.901***	-3.896***
	(0.0782)	(0.0757)	(0.198)
usnationality	-2.865***	-2.699***	-13.10***
	(0.111)	(0.106)	(0.618)
CEO_fame	-0.00882**	-0.0111***	-0.0111***
	(0.00393)	(0.00392)	(0.00384)
media	-1.786***	-1.559***	12.15***
	(0.198)	(0.194)	(0.470)
c.ptc_stkown#c.gender			-29.25***
			(2.135)
c.ptc_stkown#c.usnationality			45.54***
			(2.302)
c.ptc_stkown#c.CEO_fame			0.0558***
			(0.00567)
c.ptc_stkown#c.ceotenure			2.308***
			(0.103)
c.ptc_stkown#c.boardsize			-10.72***
			(0.596)
c.ptc_stkown#c.ceoduality			-55.85***
			(2.495)
c.ptc_stkown#c.log_comp			-4.256***
			(0.214)
_cons	-3.118***	-0.216	-14.51***
	(0.883)	(0.691)	(1.135)
N	6702	6704	6704
adj. R^2	0.583	0.581	0.661

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's calculations from the compiled panel CEO dataset.

Table 11.1: Elon Musk's tweet events regarding Twitter's operation

Dates	Tweets Text
05/18/2023	Twitter Blue Verified subscribers can now upload 2-hour videos (8GB)!
05/12/2023	I am excited to welcome Linda Yaccarino as the new CEO of Twitter! @LindaYacc will focus primarily on business operations, while I focus on product design; and new technology. Looking forward to working with Linda to transform this platform into X, the everything app.
05/11/2023	Excited to announce that I've hired a new CEO for X/Twitter. She will be starting in ~6 weeks! My role will transition to being exec chair; and CTO, overseeing product, software; and sysops.
04/13/2023	For the next 12 months, Twitter will keep none of the money. You will receive whatever money we receive so that 70 percent for subscriptions on iOS and Android (they charge 30 percent) and ~92 percent on the web (could be better, depending on the payment processor). After the first year, iOS and Android fees drop to 15 percent and we will add a small amount on top of that, depending on volume. We will also help promote your work. Our goal is to maximize creator prosperity. At any point, you can leave our platform and take your work with you. Easy in, easy out.
04/01/2023	Twitter will be updating its recommendation algorithm based on user suggestions every 24 to 48 hours
03/31/2023	Twitter recommendation source code now available to all on GitHub https://t.co/9ozsyZANwa
03/24/2023	Twitter Verified is now available worldwide!
03/18/2023	Twitter will open source all code used to recommend tweets on March 31st
02/15/2023	The new CEO of Twitter is amazing https://t.co/yBqWFUDIQH
01/21/2023	In the coming months, Twitter will translate; and recommend amazing tweets from people in other countries; cultures

01/20/2023	Twitter is arguably already the least wrong source of truth on the Internet, but we still have a long way to go. Enabling @CommunityNotes to operate at a very large scale and providing maximum transparency about how Twitter works are fundamental to building trust.
01/20/2023	The Twitter app update is now available on the App Store
12/19/2022	Should I step down as head of Twitter? I will abide by the results of this poll.
11/20/2022	Twitter is ALIVE
11/15/2022	Twitter is All the News
11/08/2022	Twitter is the worst! But also the best.
10/31/2022	If I had a dollar for every time someone asked me if Trump is coming back on this platform, Twitter would be minting money!
10/29/2022	Comedy is now legal on Twitter
10/28/2022	the bird is freed
10/26/2022	Entering Twitter HQ – let that sink in! (attached a video showing him carrying a sink around)
10/26/2022	A beautiful thing about Twitter is how it empowers citizen journalism, people can disseminate news without an establishment bias
10/13/2022	Please buy my perfume, so I can buy Twitter
10/05/2022	Buying Twitter is an accelerant to creating X, the everything app
07/30/2022	Tesla + Twitter -gt; Twizzler
05/20/2022	To be clear, I spent;5 percent (but actually) of my time on the Twitter acquisition. It 'isn't rocket science! Yesterday was Giga Texas, today is Starbase. Tesla is on my mind 24/7. So may seem like below, but not true. https://t.co/CXfWiLD2f8
05/13/2022	The Twitter deal is temporarily on hold pending details supporting the calculation that spam/fake accounts do indeed represent less than 5 percent of users https://t.co/Y2t0QMuuyn
05/06/2022	If the Twitter acquisition is completed, the company will be super focused on hardcore software engineering, design, infosec; and server hardware https://t.co/m2HseK0TXl
05/04/2022	Twitter will always be free for casual users but may be a slight cost for commercial/government users
04/28/2022	Next, I'm buying Coca-Cola to put the cocaine back in

04/28/2022	For Twitter to deserve public trust, it must be politically neutral, which effectively means upsetting the far right and the far left equally
04/25/2022	I hope that even my worst critics remain on Twitter because that is what free speech means
04/21/2022	If our Twitter bid succeeds, we will defeat the spam bots or die trying!
03/26/2022	Given that Twitter serves as the de facto public town square, failing to adhere to free speech principles fundamentally undermines democracy. What should be done?
03/25/2022	Free speech is essential to a functioning democracy. Do you believe Twitter rigorously adheres to this principle? (vote)
03/24/2022	Twitter algorithm should be open source (vote)

Table 11.2: Elon Musk's tweet events regarding Tesla's operation

Dates	Tweets Text
06/03/2023	Congrats Tesla Plaid racing team!
06/01/2023	Congratulations to Giga Shanghai; and Tesla China SDS teams for their excellent work overcoming many obstacles over many years!! https://t.co/Q1QKajKR1l
05/10/2023	Congratulations Tesla Texas Team!!
03/26/2023	Big congratulations to the Tesla Germany team!!
03/02/2023	Detailed whitepaper with calculations; assumptions to be released by Tesla shortly
01/26/2023	Congrats Tesla California factory team on record production! https://t.co/1aF53hgWgM
01/12/2023	@SawyerMerritt @Tesla Great work by the Tesla Team!
12/22/2022	Congratulations Tesla Team!!
12/04/2022	Great work by the Twitter Spaces team!
12/02/2022	Tesla Semi Truck launch in 5 minutes!
11/27/2022	Tesla team just completed a 500-mile drive with a Tesla Semi weighing in at 81,000 lbs!
11/24/2022	Tesla Full Self-Driving Beta is now available to anyone in North America who requests it from the car screen, assuming you have bought this option. Congrats to the Tesla Autopilot/AI team on achieving a major milestone!
11/23/2022	World Cup traffic hit almost 20,000 tweets per second today! Great work by the Twitter team managing record usage.

11/19/2022	Tesla FSD 10.69.3.1 going to wide release now
08/21/2022	FSD Beta 10.69 started rolling out to Tesla owners last night. This build is a big step forward! 10.69.1 is probably the end of the week release. 1069.2 in a few weeks should be good enough to provide to all FSD Beta participants.
08/14/2022	Congrats Giga Shanghai on making the millionth car! Total Teslas made now over 3M. https://t.co/2Aee6slCuv
07/30/2022	Tesla + Twitter -gt; Twizzler
07/19/2022	Congrats to Tesla Fremont + Giga Nevada for making their 2 millionth car!
07/12/2022	Tesla, automatic cabin overheat protection should make a real difference with record heatwaves. Ability to adjust activation temperature coming with next software release.
07/08/2022	Super fired up for future product development with our awesome Tesla team! Such an honor to work with them.
05/20/2022	To be clear, I'm spending 5 percent (but actually) of my time on the Twitter acquisition. It aint rocket science! Yesterday was Giga Texas, today is Starbase. Tesla is on my mind 24/7. So may seem like below, but not true. https://t.co/CXfWiLD2f8
04/08/2022	Great work by the Tesla Texas Team!! Built; and delivered first Giga Texas production cars; threw a killer opening party
01/14/2022	Tesla merch buyable with Dogecoin
01/02/2022	Great work by the Tesla team worldwide!