

THE IMPACT OF ELON MUSK'S TWEETS ON THE STOCK PRICE OF TWITTER

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Abstract

The increasing use of social media by all individuals and the rumours posted via the Internet are an important source of market information that carries both opportunities and risks. On one side it can bring high financial risks, which can often lead to movements in the massive changes of stock prices (Z. Hua, 2022). On the other side, according to Biancotti & Ciocca (Biancotti, 2021), information sharing and discussions on internet platforms, like Twitter, can improve market transparency and efficiency.

Elon Musk, considered one of the richest individuals in the world, has a social network of over 110 million followers on Twitter, a social media platform that he often uses to pass along his views and opinions on various topics such as his new buy out of Twitter (Lennart, January 2023). His influence on this platform cannot be described in words as he has a pivotal public role in persuading and is an influencer for everyone. According to The Guardian, acquiring Twitter by Musk means that “the world’s richest man has bought his favourite megaphone” (R., 2022).

The paper will include an event study that has adopted average abnormal returns and cumulative abnormal returns and has found a significant impact of his tweets (for an assumed risk of 5%), by using intraday data from the trustworthy data provider (Alpha Vantage), for a period of 661 minutes, ranging from -630 minutes to +30 minutes, with the 0th minute being the time of his tweet (t=0).

Key words: event study, tweets, stock price, average abnormal return.

Introduction

Social media has been a great influence in the life of investors, helping them in the decision-making process, and moreover having a great input in real-time news and information sharing. Twitter is known as one of the most used social media platforms from where investors tend to get information in their decision-making process, being up to date with earning announcements, market-moving events or breaking news that allows them to react quickly on the stock market (Naiqian Wu, 2022).

In this context, our research paper aims to study the effect of Elon Musk’s tweets on the stock price of Twitter in the period that he was in the process of obtaining Twitter, by answering to the following research question:

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What is the impact of Elon Musk's tweets about Twitter acquisition on the stock price of Twitter?

Measuring the effect of an economic event on the value of a firm is often discussed in the economic world. Therefore, to determine the outcome of an event we can easily use the event study method. By using all available information, such as financial market data, we can determine the impact of a specific event on the value of a firm (Hayes, 2022). According to MacKinlay (1997) in accounting and finance research, the event study has many applications. Event studies have been applied to mergers and acquisitions, earnings announcements, issues of new debt or equity, and announcements of macroeconomic variables such as the trade deficit.

Using the event study methodology, this paper aims to assess the impact on the stock price of Twitter of Elon Musk's tweets about Twitter, during the process of acquiring the company.

The paper is structured as follows: first section includes a concise overview of the literature review, the second section presents more information about the data that we used in the analysis and how we collected it, the third section incorporates the methodology of our paper, showing each step that we took in our analysis, and in the end we will see the result that we got and what conclusions we reached subsequently to the analysis.

1. Review of the scientific literature

This paper reviews the theoretical and empirical literature review on the impact of Elon Musk's tweets on the stock price of Twitter, the tweets representing exogenous factors.

Even if social media is most known and used for entertainment, studies show that it also has a great impact on the financial world. As mentioned in the paper: "Social media posts and stock returns: The Trump factor", "a 2019 survey conducted by Brunswick Group shows that in the previous year 88% of the investors made decisions based on digital sources and also in the same year, a different survey conducted for 277 institutional investors across North America, Europe, and Asia shows that investors are more likely to consult digital media than finance-specific trade publications as expected" (Carl Ajjoub, 2022). Furthermore, we find multiple studies that analyse the impact of an event on the stock price or market performance of a company, studies such as: Effect of Twitter Tweets on the Short-Term Stock Prices After Donald Trump's Presidency (Antony Tom, A. Vijayakrishnan, G., 2018), Measuring the Impact of Elon Musk's Tweets on the Stock Market (Metta, S., Madhavan, N., 2022) and The Influence of Company Tweets on Its Stock Performance (Osatuyi, B. & Yoosefi, B.).

Considering these, our paper contributes to the literature with the analysis of the effect of Elon Musk's tweets on the stock price of Twitter, using relevant tweets starting from April 4, 2022, until October 26, 2022.

Similar studies have been conducted looking to see the impact of Elon Musk's tweets on the stock prices of the companies he tweets about. One study found that Musk's tweets about Tesla had a statistically significant impact on the company's stock price. The study found that positive tweets from Musk were associated with an increase in the stock price, while negative tweets were associated with a decrease in the stock price (Pyeong Kang Kim, 2021).

Another study shows that Elon Musk's tweets about cryptocurrencies, such as Bitcoin and Dogecoin, had a significant impact on the prices of those assets. The study

found that Musk's tweets were often followed by large price movements, implying that his tweets had the ability to influence investors (Lennart, January 2023).

Therefore, these studies suggest that Elon Musk's tweets can have a significant impact on the stock prices of the companies he tweets about. Considering this, we might find in our analysis the same connection between our dependent (stock price of Twitter) and independent (Elon Musk's Tweets) variables.

In this context, we formulate the following research hypotheses:

H0: Elon Musk's tweets had a significant impact on the stock price of Twitter in the period that he was in the process of obtaining the company.

H1: Elon Musk's tweets didn't have a significant impact on the stock price of Twitter in the period that he was in the process of obtaining the company.

2. Methodology research

2.1. Data

The data used in this event study was obtained from two sources. The main source was the article: „Elon Musk's Twitter takeover saga: a timeline of tweets” from the Financial Times, from which 14 relevant tweets from Elon Musk were collected. (Times, 2022). This paper is a news report that covers the events surrounding Elon Musk's tweets related to the potential takeover of Twitter. It provides a timeline of tweets from Musk and reports on the reactions from the public and from Twitter's management. While the article provides a historical context for the tweets that were included in the event study, it does not provide any data or analysis.

The 14 tweets from Elon Musk were collected from the Financial Times article and were chosen based on their relevance to the topic of this study, which is the impact of Elon Musk's tweets on the stock price of Twitter. In Table 1 from the appendix, we listed in chronological order chosen tweets and a brief explanation of the circumstances behind them.

The second source was the intraday stock price data for Twitter, which was obtained from the data provider Alpha Vantage. The study period for the analysis of the tweets and stock prices was from the date of the first relevant tweet to the date of the last relevant tweet.

The intraday stock price data for Twitter was obtained from Alpha Vantage, which provided the data in the form of a time series. Alpha Vantage provides APIs that allow us to access a wide range of financial data, including stock price data. By using the API with Python, we can easily retrieve the intraday stock price data for Twitter in a programmatic way. The data used in this event study included intraday data on stock prices for both Twitter and market proxy (in this event study, we used VOO, an ETF that tracks the S&P 500 index).

2.2. Methodology

We used a standard event study methodology, which is a statistical technique to assess the impact of a specific event on the assets' returns. The tweets of Elon Musk, in this case, are events and the asset is the stock of Tweeter.

We started by defying the estimation window and the event window. The estimation window is the period in which we estimated expected return and volatility. Usually, the estimation window is right before the event window. In this event study, we defined the estimation window as 600 minutes before the event window.

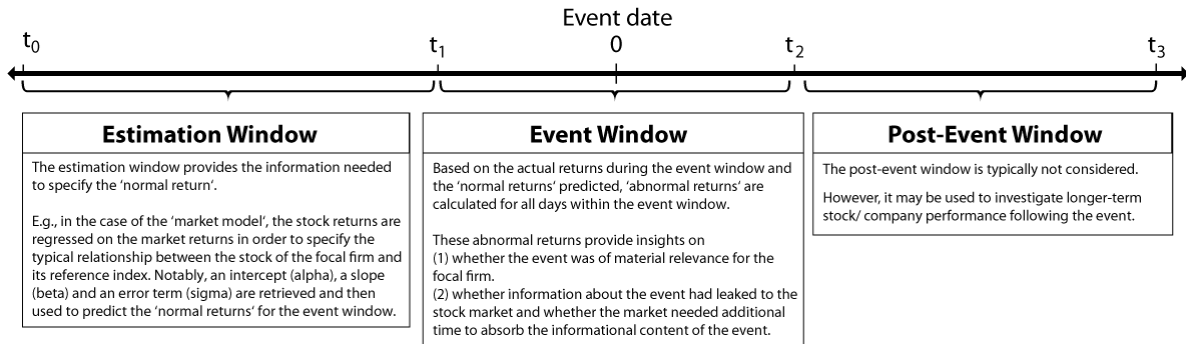


Figure no. 1. Estimation, event, and post-event window

Source: (Benninga, 2008)

To estimate the expected returns of Twitter's stock, we used a simple linear regression. The model is: expected return = $\alpha + \beta \times$ return of the market (VOO), and returns are discrete daily returns: (open price – closing price) / closing price. The parameters for this model were estimated using data from the estimation window.

The event window is the period in which the actual returns of the asset are observed and analysed. In this study, the event window is 61 minutes (30 minutes before the release of the tweet, $t=0$ – release of the tweet, and 30 minutes after the release of the tweet).

For each tweet, the abnormal return (1) is calculated as the difference between the actual return during the event window and the expected return. The cumulative abnormal return (CAR) (2) is then calculated as the sum of the abnormal returns during the study period.

$$AR_{it} = r_{it} - (\alpha + \beta r_{Mt}) \quad (1)$$

Where:

r_{it} – actual abnormal return in event window day t

$\alpha + \beta r_{Mt}$ – return predicted by the stock's α , β , and market return

$$CAR_t = \sum_{j=1}^t AR_{T1+j} \quad (2)$$

Where:

$\sum_{j=1}^t AR_{T1+j}$ – sum of all abnormal returns from the beginning of the event window $T1$ until day T in the event window

The test statistic for the abnormal return (AR) is calculated by dividing the AR by the standard error of the regression prediction. By assuming that the regression residuals are normally distributed, if the absolute value of the test statistic exceeds 1.96 (Benninga, 2008) it is considered statistically significant at the 95% level, indicating a less than 5% probability that the observed abnormal return was due to random chance rather than being statistically significant.

The event study methodology used in this study allows us to estimate the impact of Elon Musk's tweets on the stock price of Twitter by comparing the actual returns during the event window to the expected returns estimated using data from the estimation window. The statistical significance of any differences in returns is then determined using the t-test.

To conclude our analysis, we gathered the abnormal returns for each of the 14 tweets and computed the average abnormal return (3) and cumulative average abnormal return (4) in the event window, which goes from -30 minutes to +30 minutes after the event.

$$AAR_t = 1/N \sum_{i=1}^N AR_{i,t} \quad (3)$$

$$CAAR_t = 1/N \sum_{i=1}^N CAR_i \quad (4)$$

To do so, first, we split the tweets with the positive and negative effects, by looking at their average return after the event minute t=0.

After this, we used a statistical test for both categories of tweets (by dividing the appropriate cross-sectional error, formulae below (5), for the specific type of return) (Benninga, 2008).

$$\text{Cross-Sectional Error} = \sqrt{\frac{\text{Sum}^2 \text{ of standard error for positive (negative) tweets}}{\text{Number of positive (negative) tweets}}} \quad (5)$$

Thus, our hypotheses are the following: H0: CAAR = 0 and H1: CAAR ≠ 0, with 5% assumed risk.

3. Results and interpretations

The results of our analysis are found in Figure 2.

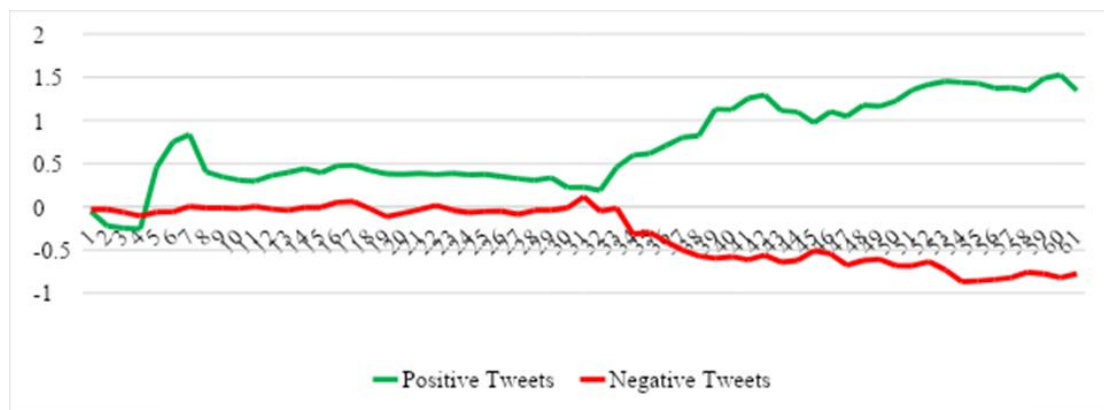


Figure no. 2. Cumulative Average Abnormal Returns

Source: Computed by the authors

As shown in the graph, we see that on average, after Elon Musk posts a tweet, the stock price of the company tends to change, proven by the significance test results given by the previous formula.

We understand from the graph that Elon's tweets which were interpreted by the market as positive news had a greater impact on Twitter's price than negative ones. This probably can be explained by the fact that investors were optimistic about the company's

future, being driven by positive market sentiment that is known to have a significant impact on the price movements of assets. One other interesting aspect is that the graph shows that positive tweets influenced the price prior to Elon Musk posting the tweets. This might be explained by multiple factors, such as insider information or news that already had been released on the market before Musk's posts.

After the tweet is posted (minute 31 in graph 2), the stock price moves drastically, showing that on average, Elon Musk's posts influence the market.

Looking individually at each tweet, we see that the biggest positive cumulative abnormal return (CAR) was observed for tweet 12, which had a CAR of 6.51%. This tweet stated, "Buying Twitter is an accelerant to creating X, the everything app". This tweet may have had the biggest positive impact on the stock price of Twitter because it suggests that Elon Musk is still interested in buying Twitter, which could be seen as a positive development by investors.

Also, the biggest negative CAR was observed for the 5th tweet, with a CAR of -2.91% ("Yesss!!!"). There are multiple reasons that can explain this great negative impact. Taking into consideration that the tweet refers to Twitter finally accepting Musk's takeover, we assume that investors were presenting concerns about this acquisition regarding its current business model, competitive position, and operations, and how all of these would be affected soon; additionally, they may be afraid about the funding and financing of such a large acquisition.

Conclusions

Finally, our analysis showed that Elon Musk's tweets had a great impact on the stock price of Twitter in the period that he was in the process of obtaining the company. As a result, we can conclude that stock prices are the result of the actions and perceptions of investors, which can be influenced by important figures actively posting on social media platforms.

Furthermore, we can say that monitoring the tweets of Elon Musk or other key figures in a particular industry can show valuable information about market sentiment and can help investors to make better decisions.

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Appendix
Table no. 1. Table of Elon Musk's Tweets

Event	Date	Time	Tweets	Description
1	4-Apr-22	12:04	"Oh hi lol"	"In a filing to the US financial regulator, Musk is revealed as Twitter's largest shareholder"
2	9-Apr-22	9:32	"Most of these "top" accounts tweet rarely and post very little content. Is Twitter dying?"	"Musk decides against joining Twitter's board, in a move that fuelled speculation he would mount a hostile takeover. Agrawal says Twitter remains open to Musk's "input"."
3	14-Apr-22	7:32	"I made an offer"	"Musk launches hostile bid for Twitter at \$44bn valuation, says he is "not sure" it will succeed"
4	21-Apr-22	14:53	"If our twitter bid succeeds, we will defeat the spam bots or die trying!"	"Musk unveils \$46.5bn financing package to fund Twitter bid, placing him personally on the hook for \$33.5bn, according to Financial Times analysis, unless he can secure additional outside backing"
5	25-Apr-22	15:43	"Yesss!!!"	"Twitter accepts Musk's \$44bn takeover offer. Co-founder and former chief executive Jack Dorsey publicly backs Musk's bid, calling him the "singular solution" to the site's problems"
6	29-Apr-22	21:23	"No further TSLA sales planned after today"	"Musk boosts his cash position ahead of Twitter deal by selling off \$8.5bn in Tesla stock, saying no further sales were planned"
7	5-May-22	11:14	"If Twitter acquisition completes, company will be super focused on hardcore software engineering, design, infosec & server hardware"	"Larry Ellison, Finance and Sequoia all chip in with financing for Musk's bid. Binance chief executive Changpeng Zhao tells the FT his company's support is essentially a "blank cheque". "
8	13-May-22	5:44	"Twitter deal temporarily on hold pending details supporting calculation that spam/fake accounts do indeed represent less than 5%"	"Musk claims Twitter deal "on hold" because of spam bots and calls on Agrawal to "prove" metrics on spam and bot accounts"

			of users”	
9	17-May-22	3:23	“20% fake/spam accounts, while 4 times what Twitter claims, could be *much* higher. My offer was based on Twitter’s SEC filings being accurate. Yesterday, Twitter’s CEO publicly refused to show proof of <5%. This deal cannot move forward until he does.”	“Musk claims Twitter deal “on hold” because of spam bots and calls on Agrawal to “prove” metrics on spam and bot accounts”
10	9-Aug-22	22:53	“Yes. In the (hopefully unlikely) event that Twitter forces this deal to close *and* some equity partners don’t come through, it is important to avoid an emergency sale of Tesla stock.”	“Musk sells another \$7.5bn in Tesla stock, taking advantage of a recent rebound in its share price. He says the sale is necessary to cover the “hopefully unlikely” event that he needs additional funding should the Twitter deal be forced to go ahead”
11	23-Aug-22	11:52	“ *emoji “	“Former Twitter security boss Peiter “Mudge” Zatko turns whistleblower, alleging deception on bots and security, boosting Musk’s case”
12	4-Oct-22	18:39	“Buying Twitter is an accelerant to creating X, the everything app”	“In a stunning about-face, Musk sends a letter to Twitter saying the original \$44bn deal is still on — provided he can still drum up the necessary financing and on the condition the litigation is halted. He says ownership of Twitter will form the basis of his vision for a new “everything app”. “
13	7-Oct-22	1:21	“Very intense 7 days indeed”	“Judge puts legal action on hold, giving Musk and Twitter until the end of October to close the deal.”
14	26-Oct-22	14:45	“Entering Twitter HQ – let that sink in!”	“Musk visits Twitter’s San Francisco headquarters carrying a sink and changes his Twitter profile to “Chief Twit”, suggesting he will run the company until he appoints new leadership”

Source: (Times, 2022)