SOCIAL MEDIA, TRADING VOLUME, VOLATILITY AND STOCK PRICES

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Abstract

This study investigates the impact of social media events on the behavior of six mega-cap technology stocks. Analyzing both positive and negative events, we find that negative events correlate with higher VIX Betas and trading volumes, while positive events are linked to higher stock prices. These effects vary across individual stocks, and unexpected associations emerge, such as increased trading volume for certain positive events. Our findings offer insights into the intricate interplay between social media events and market dynamics, highlighting the nuanced influences on volatility, trading volume, and stock prices for specific stocks. This study contributes to our understanding of the complex relationship between social media and financial markets, emphasizing the importance of considering stock-specific dynamics in investment strategies.

Keywords: *social media, mega-cap, technology stocks, volatility, trading volume, stock prices.*

1. Introduction

In this paper, we examine the effects of social media events (i.e. mass viewed social media posts on Reddit, Twitter, Instagram, etc.) on three different stock market variables from the beginning of 2022 to July, 2023. Specifically, we investigate how positive and negative social media events impact volatility (i.e. VIX beta value), trading volume, and stock prices for a sample of seven mega-cap technology stocks.

Today, social media plays a vital role in society. This statement holds in the stock market as well. Constantly, we see viral posts causing a substantial and rapid change in firms' stock prices. This phenomenon was shown in the 2011 paper titled "Sentiment Revealed in Social Media and Its Effect on the Stock Market" by Chen, De, Hu, and Hwang. They examine articles from the Wall Street Journal and Seeking Alpha, and their thorough analysis reveals that even after controlling for sentiment in traditional media, social media sentiment has a significant relationship with present and future stock returns. We also repeatedly see the pattern of firms taking advantage of the outreach social media brings through advertising on different platforms (i.e. Twitter, Instagram, Twitter, etc) to boost their shares.

For the research, we gather social media events from posts on the popular discussion platform Reddit. In addition, we gather data on three other variables (i.e. VIX beta value, trading volume, and stock prices). We focus on the seven mega-cap technology stocks in the U.S. The stocks in our sample are ADBE, AAPL, GOOGL, META, MSFT, NVDA, and TSLA. The dataset that we compile includes 1,199 posts by users on Reddit, spanning from January of 2022 until July of 2023. We classify these posts as positive or negative events based on the sentiment in each post. Then, we

test to see if positive/negative events have a significant relationship with volatility (i.e. VIX beta value), trading volume, and stock prices

Our investigation reveals that across all seven firms, positive (negative) social media events yield lower (higher) VIX beta values and trading volume. These findings are in line with expectations. However, our investigation reveals that the classification of the event (i.e. positive or negative) didn't have a significant effect on the stock price. This goes against our hypothesis in which we thought that positive (negative) events will translate to higher (lower) daily stock prices. Meanwhile, when the stocks are examined individually, the stocks don't necessarily follow the same trend as the group. Some stocks have no significant findings for variables that do have a significant relationship for the whole group. A few stocks even have a positive relationship between positive/negative social media events and the VIX beta value or the trading volume (for the whole group, there is a negative relationship).

Our research concludes that if an investor decides to create a portfolio consisting of technology stocks, they should expect the following results found in our analysis (i.e. negative correlation between the event and the two variables -VIX beta value and trading volume), at least for the firms in our study.

The paper continues in the following order. Section 2 reviews the relevant literature. Then, section 3 reviews the data and methodology. Section 4 discusses our findings and analysis. The paper concludes with section 5.

2. Literature review

Our analysis of the body of existing research suggests a clear preference for studying how social media mood affects various aspects of stock market behavior, especially when it comes to mega-cap tech stocks. The study's aim is to reveal the complex connections between social media news and its impacts on important stock characteristics like volatility, trading volume, and stock prices.

In their 2011 study, Chen, De, Hu, and Hwang (2011) explore the complex relationship between mood exhibited in traditional and social media and its effects on the stock market. Their investigation reveals a strong correlation between social media mood and both the present and the future performance of stocks. Even after taking into consideration the emotion conveyed in conventional media outlets, this association still holds true. They also analyze articles from credible publications like the Wall Street Journal and Seeking Alpha as part of their research, and show the growing importance of social media as a powerful conduit for conveying news that affects stock prices. Notably, the impact of social media opinion on publications that get more attention from market participants and on companies that appeal to individual investors is particularly strong. All of these studies highlight how social media is becoming an increasingly important tool for influencing consumer attitudes and behavior.

Zhang and Liu's (2021) analysis of the impact of social media on stock market dynamics provides a unique perspective. Their investigation focuses on how the market reacts to advice posted on Chinese official WeChat accounts (OWA). The study provides evidence in favor of the price pressure concept, including significantly positive abnormal returns and an increase in trading activity on the day of publication. This finding is crucial because it highlights how social media sites like WeChat can affect the volatility of the stock market and trading activity. Zhang and Liu (2021) also rigorously rule out other potential causes for market reactions, including media attention, second-hand analyst recommendations, firm-specific news releases, and prior aberrant returns. Our knowledge of the complex interactions among social media platforms, market attitudes, and stock market behavior, particularly in the tech sector, is enhanced by their study.

The research by Agarwal, Kumar, and Goel (2021) deepens our comprehension of how emotion on Twitter affects the performance of the Indian stock market. Their research reveals a

strong relationship between mood on Twitter and indexes for the financial industry. This association demonstrates how individual opinions and feelings regarding particular equities can be influenced by Twitter sentiment, potentially affecting market volatility. The research by Paniagua and Sapena (2014) emphasizes the significance of social media interactions even more. It demonstrates the beneficial impact of Twitter "followers" and "likes" on influencing a company's share price. The importance of social media interactions in influencing investor sentiment and perception, and eventually in causing changes in market dynamics, is shown by these combined findings.

Collectively, the research shows several approaches to using social media data to analyze attitudes and comprehend their impact on stock market behavior. By using sentiment analysis and machine learning algorithms, Dogan, Metin, Tek, Yumusak, and Oztoprak (2020) show that influential Twitter speculators and influencers affect stock prices of large firms. Using event history analysis, Chahine and Malhotra (2018) investigate how the market reacts when Fortune 500 corporations introduce Twitter platforms. Additionally, Lehrer, Xie, and Zhang (2021) improve the precision of well-known volatility indices by including social media sentiment into forecasting volatility. These results show how researchers have used a variety of techniques to model sentiments and comprehend how they affect market dynamics using social media data.

Jiao, Veiga, and Walther (2020) add another level of complexity by looking at how volatility and turnover are affected by news coverage in traditional and social media. Their results show that social media and news media have different effects on stock market behavior. In order to analyze and forecast financial market patterns, Jin, Fang, Chakraborty, Self, Chen, and Ramakrishnan (2017) integrate a variety of sources, such as social media, news, Google search volumes, and Twitter. This integration adds to this sophisticated understanding. Their findings highlight the need to use information from several sources to thoroughly examine and forecast stock market volatility.

3. Data and methodology

We use the popular internet forum, Reddit, to gather social media events. Since this paper aims to assist investors in stock selection, we solely use posts from the beginning of 2022 to the end of July of 2023. To be included in the sample, these posts must mention at least one of the seven firms in either a positive or negative manner. For reference, on July 4th of 2023, for Meta, there was a post that read, "Meta launches Instagram Threads in a direct challenge to Twitter". In this instance, this would be a positive event for the firm. Conversely, on September 29th of 2022, for Apple, there was a post that said, "Samsung Mocks Apple in Twitter Thread Over the Lack of Innovation in Latest iPhone 14 lineup" and included the original link to this tweet. This would be an instance of a negative social media event for the firm. In total, there are 891 positive events and 308 negative events in our sample period. The ratio of positive to negative events varies on a large-scale between firms. The firm with the largest ratio of positive to negative events in this study is Microsoft with 243 positive events and 26 negative events. Next is Google with 283 positive events and 33 negative events. Following Google, it is Apple with 110 positive events and 53 negative events. For Nvidia there are 59 positive events and 37 negative events. Tesla has 81 positive events and 62 negative events. Meta has 111 positive events and 95 negative ones. The following statistics are for the six mega-tech firms eligible to gather results individually as the dataset for the seventh stock (Adobe) isn't sufficient to form a conclusion.

The VIX beta values, trading volumes, and stock prices come from Yahoo Finance "Historical Prices & Data" page. On a spreadsheet, we list the values of these three variables on the day of the social media event, for all 1,199 events. We use these three variables to study how they differentiate when a positive social media related event takes place as opposed to a negative one.

4. Empirical results

Table 1 compares the VIX betas, trading volumes, and stock prices for the six mega-cap firms across the positive and negative social media events associated with these firms. In total, there were 1,199 social media events for these firms on Reddit, of which 891 were positive and 308 were negative.

Table 1. The VIX Beta, Trading Volume, and Stock Price for the Six Mega Cap Firms

	Positive			Negative			Mann-W.
Variables	**N**	**Mean**	**Std**	**N**	**Mean**	**Std**	**p-value**
VIX Beta	891	1.1226	0.2744	308	1.2646	0.3765	<0.0001
Trading Volume	891	48,921,113	41,539,056	308	74,036,462	53,151,573	<0.0001
Stock Price	891	193.71	82.26	308	179.86	65.91	0.1764

Source: Authors' own work

When we examine the VIX betas, we are seeing that the average value was 1.1226 when there was a positive social media event, while it was 1.2646 when there was a negative social media event. The VIX beta was significantly lower for these firms when there was a positive event ($p<0.0001$). The difference is significant at 0.01% level. As we expected, the positive (negative) events are associated with lower (higher) VIX beta values (i.e. positive events are associated with lower volatility).

When we examine the trading volumes, we are seeing that the average value was 4,892,113 shares when there was a positive social media event, while it was 74,036,462 shares when there was a negative social media event. The trading volume was significantly lower for these firms when there was a positive event ($p<0.0001$). The difference is significant at 0.01% level. As we expected, positive (negative) events are associated with lower (higher) trading volume.

When we examine the stock prices, we are seeing that the average stock price was $193.71 when there was a positive social media event, while it was $179.86 when there was a negative social media event. There is no statistically significant difference between the stock prices across positive and negative events ($p=0.1764$).

Do these findings for the whole sample translate into each stock? In other words, will we find similar results if each stock is individually examined or are these findings for the sample due to specific stocks only? Table 2 shows the results for the AAPL stock. In total, there were 163 social media events for AAPL on Reddit, of which 110 were positive and 53 were negative.

Table 2. The VIX Beta, Trading Volume, and Stock Price for Apple

	Positive			Negative			Mann-W.
Variables	**N**	**Mean**	**Std**	**N**	**Mean**	**Std**	**p-value**
VIX Beta	110	1.0993	0.1622	53	1.1206	0.1672	0.4311
Trading Volume	110	80,571,564	25,947,945	53	83,508,824	28,858,126	0.6124
Stock Price	110	159.57	15.89	53	152.93	15.16	0.0058

Source: Authors' own work

When we examine the VIX beta for AAPL, we are seeing that the average value was 1.0993 when there was a positive social media event, while it was 1.1206 when there was a negative social media event. The difference is not statistically significant ($p=0.4311$).

When we examine the trading volume, we are seeing that the average value was 80,571,564 shares when there was a positive social media event, while it was 83,508,824 shares when there was a negative social media event. The difference is not statistically significant (p=0.6124).

When we examine the stock price, we are seeing that the average stock price was $159.57 when there was a positive social media event, while it was $152.93 when there was a negative social media event. The difference is statistically significant at the 1% level (p=0.0058). Positive (negative) events are associated with higher (lower) prices for the AAPL stock.

Table 3 examines the GOOGL stock. In total, there were 316 social media events for GOOGL on Reddit, of which 283 were positive and 33 were negative.

Table 3. The VIX Beta, Trading Volume, and Stock Price for Google

	Positive			Negative			Mann-W.
Variables	**N**	**Mean**	**Std**	**N**	**Mean**	**Std**	**p-value**
VIX Beta	283	0.9562	0.1009	33	1.0273	0.1085	0.0011
Trading Volume	283	26,580,536	21,664,488	33	33,129,637	27,954,498	0.1885
Stock Price	283	113.61	13.58	33	108.16	12.71	0.0317

Source: Authors' own work

When we examine the VIX beta for GOOGL, we are seeing that the average value was 0.9562 when there was a positive social media event, while it was 1.0273 when there was a negative social media event. The difference is statistically significant at the 1% level (p=0.0011). The positive (negative) events are associated with lower (higher) VIX beta values (i.e. positive events are associated with lower volatility).

When we examine the trading volume, we are seeing that the average value was 26,580,536 shares when there was a positive social media event, while it was 33,129,637 shares when there was a negative social media event. The difference is not statistically significant (p=0.1885).

When we examine the stock price, we are seeing that the average stock price was $113.61 when there was a positive social media event, while it was $108.16 when there was a negative social media event. The difference is statistically significant at the 1% level (p=0.0058). Positive (negative) events are associated with higher (lower) prices for the GOOGL stock.

Table 4 examines the META stock. In total, there were 206 social media events for META on Reddit, of which 95 were positive and 111 were negative.

Table 4. The VIX Beta, Trading Volume, and Stock Price for Meta

	Positive			Negative			Mann-W.
Variables	**N**	**Mean**	**Std**	**N**	**Mean**	**Std**	**p-value**
VIX Beta	95	1.2411	0.3397	111	1.4979	0.4281	<0.0001
Trading Volume	95	58,633,418	27,557,152	111	41,008,402	48,446,540	0.0167
Stock Price	95	185.62	64.12	111	189.22	71.29	0.5328

Source: Authors' own work

When we examine the VIX beta for META, we are seeing that the average value was 1.2411 when there was a positive social media event, while it was 1.4979 when there was a negative social media event. The difference is statistically significant at the 0.01% level (p<0.0001). The positive (negative) events are associated with lower (higher) VIX beta values (i.e. positive events are associated with lower volatility).

When we examine the trading volume, we are seeing that the average value was 58,633,418 shares when there was a positive social media event, while it was 41,008,402 shares when there

was a negative social media event. Interestingly, the trading volume was significantly higher for META when there was a positive event (p=0.0167). The difference is significant at the 5% level.

When we examine the stock price, we are seeing that the average stock price was $185.62 when there was a positive social media event, while it was $189.22 when there was a negative social media event. The difference is not statistically significant (p=0.5328).

Table 5 examines the MSFT stock. In total, there were 269 social media events for MSFT on Reddit, of which 243 were positive and 26 were negative.

Table 5. The VIX Beta, Trading Volume, and Stock Price for Microsoft

	Positive			Negative			Mann-W.
Variables	**N**	**Mean**	**Std**	**N**	**Mean**	**Std**	**p-value**
VIX Beta	243	1.0046	0.0301	26	0.9554	0.0474	<0.0001
Trading Volume	243	32,644,237	12,392,980	26	34,177,107	14,480,381	0.5174
Stock Price	243	288.99	38.74	26	262.38	32.97	0.0005

Source: Authors' own work

When we examine the VIX beta for MSFT, we are seeing that the average value was 1.0046 when there was a positive social media event, while it was 0.9554 when there was a negative social media event. The difference is statistically significant at the 0.01% level (p<0.0001). Interestingly, the positive (negative) events are associated with higher (lower) VIX beta values for MSFT.

When we examine the trading volume, we are seeing that the average value was 32,644,237 shares when there was a positive social media event, while it was 34,177,107 shares when there was a negative social media event. The difference is not statistically significant (p=0.5174).

When we examine the stock price, we are seeing that the average stock price was $288.99 when there was a positive social media event, while it was $262.38 when there was a negative social media event. The difference is statistically significant at the 0.1% level (p=0.0005). The positive (negative) events are associated with higher (lower) prices for the MSFT stock.

Table 6 examines the NVDA stock. In total, there were 96 social media events for NVDA on Reddit, of which 37 were positive and 59 were negative.

Table 6. The VIX Beta, Trading Volume, and Stock Price for Nvidia

	Positive			Negative			Mann-W.
Variables	**N**	**Mean**	**Std**	**N**	**Mean**	**Std**	**p-value**
VIX Beta	37	1.4327	0.0828	59	1.4154	0.0941	0.6449
Trading Volume	37	63,848,578	24,629,679	59	65,516,927	23,683,063	0.5296
Stock Price	37	184.77	89.94	59	209.59	73.27	0.2971

Source: Authors' own work

When we examine the VIX beta for NVDA, we are seeing that the average value was 1.4327 when there was a positive social media event, while it was 1.4154 when there was a negative social media event. The difference is not statistically significant (p=0.6449).

When we examine the trading volume, we are seeing that the average value was 63,848,578 shares when there was a positive social media event, while it was 23,683,063 shares when there was a negative social media event. The difference is not statistically significant (p=0.5296).

When we examine the stock price, we are seeing that the average stock price was $184.77 when there was a positive social media event, while it was $209.59 when there was a negative social media event. The difference is not statistically significant (p=0.2971).

Table 7 examines the TSLA stock. In total, there were 143 social media events for TSLA on Reddit, of which 81 were positive and 62 were negative.

Table 7. The VIX Beta, Trading Volume, and Stock Price for Tesla

	Positive			Negative			Mann-W.
Variables	**N**	**Mean**	**Std**	**N**	**Mean**	**Std**	**p-value**
VIX Beta	81	1.3656	0.3739	62	1.5861	0.4257	0.0074
Trading Volume	81	133,744,525	55,288,121	62	136,370,047	53,490,920	0.7200
Stock Price	81	218.88	56.64	62	189.88	53.59	0.0023

Source: Authors' own work

When we examine the VIX beta for TSLA, we are seeing that the average value was 1.3656 when there was a positive social media event, while it was 1.5861 when there was a negative social media event. The difference is statistically significant at the 1% level (p=0.0074). The positive (negative) events are associated with lower (higher) VIX beta values (i.e. positive events are associated with lower volatility).

When we examine the trading volume, we are seeing that the average value was 133,744,525 shares when there was a positive social media event, while it was 136,370,047 shares when there was a negative social media event. The difference is not statistically significant (p=0.7200).

When we examine the stock price, we are seeing that the average stock price was $218.88 when there was a positive social media event, while it was $189.88 when there was a negative social media event. The difference is statistically significant at the 1% level (p=0.0023). The positive (negative) events are associated with higher (lower) prices for the TSLA stock.

Table 8 summarizes our findings for these six stocks. In the overall sample, as expected, we find that there was a negative relation between the social media events and the VIX betas (i.e. volatility), and between the social media events and the trading volumes. There was not significant relation between the events and the stock prices.

Table 8. Summary of Results

	Vix beta		Volume		Price	
Variables	**Sign**	**Expected?**	**Sign**	**Expected?**	**Sign**	**Expected?**
All	negative	yes	negative	yes		
AAPL					positive	yes
GOOGL	negative	yes			positive	yes
META	negative	yes	positive	no		
MSFT	positive	no			positive	yes
NVDA						
TSLA	negative	yes			positive	yes

Source: Authors' own work

For AAPL, GOOGL, MSFT, and TSLA, as expected, positive events were associated with higher stock prices. For GOOGL, META, and TSLA, as expected, positive events were associated with lower VIX betas (i.e. volatility). The two unexpected findings that we have are the positive association for META's trading volume, and the positive association for MSFT's VIX beta.

Overall, we believe that our results are strong. If an investor forms a portfolio with these six stocks, they should expect higher volatility and higher trading volumes when there are negative social media events related to these firms. If an investor specifically invests in some of these stocks, he/she should consider our individual stock findings. The AAPL, GOOGL, MSFT, and TSLA stock prices are positively related to positive news. Regarding the volatilities which especially affects

stock option values, the volatilities of the GOOGL, META, and TSLA stocks go up when there are negative social media events related to these firms.

5. Conclusion

In the scope of this study, our investigation delves into the intricate realm of social media events and their impact on key indicators of market behavior for six mega-cap technology stocks. Specifically, we attempt to see whether variations in stock volatility, trading volume, and prices are linked to the occurrence of positive and negative social media events, encompassing the widespread dissemination of information across various news platforms.

Our research is underpinned by a dataset constructed from two primary sources: the vibrant discussion platform Reddit and diverse news outlets. The focal point centers on discerning the effects of social media events and viral content on seven prominent technology companies: Adobe, Apple, Google, Meta, Microsoft, Nvidia, and Tesla. With a meticulous approach, we curate a dataset of 1,199 Reddit posts and news articles spanning from January 2022 to July 2023. Each entry is subjected to stringent criteria, requiring explicit references to the designated technology stocks and a discernible display of positive or negative sentiments. Our analytical focus extends to the assessment of the VIX Beta Value, stock prices, and trading volumes, affording us the opportunity to probe their associations with market volatility within the context of social media events. Through this meticulous exploration, our aim is to unravel the nuanced impact of these factors on the behavior of the selected mega-cap technology stocks.

Our empirical examination into the effects of social media events on the volatility of these six mega-cap stocks has yielded revealing insights. Consistent with our expectations, we find discernible patterns in the relationship between these events and the key market indicators. Specifically, positive social media events correlate with lower VIX Beta values, indicating reduced volatility, while negative social media events are associated with higher VIX Beta values, signifying heightened market fluctuations. Moreover, our findings underscore the nuanced interplay between social media events and trading volumes. Positive events correspond to lower trading volumes, while negative events coincide with elevated trading activity.

While these findings offer a comprehensive snapshot of the overall sample, the analysis is further enriched by individual examinations of each stock. We find that AAPL, GOOGL, and TSLA exhibit anticipated patterns, with positive events linked to higher stock prices and negative events linked to lower VIX Beta values. However, the presence of unexpected associations for certain stocks, such as the positive relationship between META's trading volume and social media events, underscores the dynamic nature of these interactions. Our detailed scrutiny of each stock underscores the importance of considering stock-specific dynamics in investment strategies and decisions.

Overall, our study contributes to a broader understanding of the intricate interplay between social media events and market dynamics, particularly within the context of mega-cap technology stocks. As we navigate the complexities of social media's influence on financial markets, these insights offer valuable guidance for investors and policymakers alike. Furthermore, this study underscores the potential of nonparametric tests as a robust alternative to traditional regression models, offering a pathway to uncover nuanced relationships between social media events and key market indicators. Future research endeavors could explore additional dimensions of this intricate relationship and extend the analysis to encompass a wider range of stocks or industries, further deepening our understanding of the mechanisms driving market behavior.

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