Norges Handelshøyskole

FIN11 Trading and Market Microstructure

FIN11 Term paper

Predefined Information

Start date:	2021-11-02 09:00 AM	**Term:**	2021 12
End date:	2021-12-13 02:15 PM	**Assessment type:**	Norwegian 6-point scale (A-F)
Examination type:	Term paper (70%)		
Flow code:	191 FIN11 1 O3 2021 12		
Internal assessor:	(Anonymised)		

Participant

Candidate No.:	1041

Information from participant

The address from which I take this exam is: *:	Lindenbergweg 1, 61440 Oberursel, Germany

I am aware of what constitutes cheating and the consequences of cheating on an exam. I hereby declare that I will NOT cheat on this exam. *: Yes

Group

Group name:	(Anonymised)
Group number:	7
Other members:	1003, 1031

NORWEGIAN SCHOOL OF ECONOMICS

GME's short squeeze

- How David challenged Goliath and won

FIN11-H21

Candidate numbers:
1003, 1031, 1041



Contents

1 Introduction **2**

2 Theory background **3**
2.1 Short selling . . . 3
2.2 What is a short-squeeze? . . . 3
2.2.1 Volkswagen's short squeeze . . . 3

3 Before and after the squeeze **5**
3.1 r/wallstreetbets vs. hedge funds . . . 5
3.1.1 The redditors' position . . . 5
3.1.2 Robinhood halts trading . . . 6
3.2 Legal implications . . . 6
3.2.1 The hearing . . . 7
3.2.2 Results for Robinhood . . . 7
3.2.3 Results for Keith Gill . . . 8

4 Winners and losers **9**
4.1 Gains of r/WSB's traders . . . 9
4.1.1 u/DeepF******Value . . . 10
4.2 The losing side . . . 11
4.2.1 A deep dive into Melvin Capital's bet . . . 12

5 Has GME affected the market? **17**
5.1 Methodology . . . 17
5.2 Construction of Peer Groups . . . 17
5.3 Findings . . . 18
5.4 Conclusions . . . 20

6 Conclusion **21**

1 Introduction

On the 28th of January 2021, Gamestop's stock price reached an all time peak of 483 dollars per share, almost 3000% up from the 17 dollars per share it traded just 20 days before. As this happened, institutional investors crumbled upon millions of new investors who flooded the market and forced an apparently doomed stock to bounce back. For this to happen, one of the biggest short squeeze in financial markets' history unfolded before the eyes of astonished hedge fund manager, investment bankers and retail investors.

In this paper we'll go through GME's short squeeze analysing it from various points of view. We'll start with a brief introduction to basic concept needed to better understand the event, such as short selling basics and short squeeze past examples. Later, the event will be presented and discussed under its legal implication. Later, we'll carry out a scenario analysis to better understand how close were the big investor from the catastrophe. Finally, an empirical study on if and to what degree GME's huge spike in trading volume affected the U.S. stock market as a whole.

2 Theory background

To better understand the events we are about to describe it's crucial to have a brief knowledge of some concepts, namely short selling mechanics and its complications, as well as its failure, in the form of a short squeeze.

2.1 Short selling

Short selling is, in the simplest terms, to bet that the price of a security will go down in the future. To short sell a stock, a trader will borrow the security and sell it at a certain price, in the hope that its price will drop in the future. If this occurs, the trader can buy back the stock at a decreased price and give it back to the owner, profiting on the difference (Harris, 2011). The trader will however pay for a borrow interest rate, which is the price of the service offered by the owner of the stock. This interest rate can make the operation expensive, if the demand for short selling that stock is high: these stocks are classified as "hard to borrow".

To be able to sell a stock short, however, a margin account is needed. A margin account is an account that allows the use of borrowed money to operate in the market, and use the purchased stocks as a collateral, plus a maintenance margin that can range from 25% to 50%, depending on the broker (*FINRA, 2016*).

On the downside, the price of the stock can go up. If the position is not closed and the stock is not bought back, the losses are potentially limitless.

2.2 What is a short-squeeze?

When a security is targeted by many buyers, the price of the stock is driven up, and a short squeeze may happen. When this happens, the traders in short positions have two options. If they have enough buying power, they can double down their short position, forcing the price back down. On the other hand, the trader can back down and close its position on a loss. If the trader has doubled down in the attempt to force the price down and this has not happened, he is most likely forced to close its position on a bigger loss. To close its position, however, the trader has to buy back the shares he shorted for the price available. If the amount of shorted shares is of considerable size, it can further drive the price up, further enhancing the losses. This causes the stock chart to present a huge spike that most likely will decrease after the majority of the traders will close their position, since most people will be willing to sell the stock at the top of the squeeze.

The effect of the short squeeze is further enhanced depending on the amount of people trading in the stock, both in the long and in the short side. A good indicator to see whether a stock is prone towards a possible short squeeze is given by its short interest, which is the number of shares that have been sold short without being covered out of the total shares outstanding (*Investopedia*). When the short interest is high, it means that a lot of investors are betting on the demise of the firm. Therefore, a sudden rise in interest in the stock combined with the repurchase of stocks in order to cover a short position, make it possible for a huge spike in price.

2.2.1 Volkswagen's short squeeze

In the past, we have had numerous instances of short squeezes. Volkswagen' short squeeze in particular, is remembered as one of the biggest bloodbaths in financial market history. In 2007,

Porsche announced that it was starting a purchase plan for Volkswagen' shares, in order to take control of the firm. This initially had the effect of boosting VOW' share price. As a consequence, many hedge funds and institutional investors saw the firm as overvalued, and many short positions were opened. In 2008, Porsche increased its ownership in VOW, resulting in the control of 31% of the firm. The 26th of October 2008, Porsche revealed to the public the amount of shares owned in Volkswagen, which amounted to around 42%, plus another 32% in cash settled options, resulting in a total ownership of around 74% (*Reuters, 2008*). The second major shareholder, Lower Saxony, owned around 20% of the firm, and everyone knew that they were not going to sell any of that. As a result, the public float was 6%. However, the short interest was 12%, which meant that there were more shares shorted than actually available in the market. As a result, every short seller was trying to cover its position, which resulted in a huge spike in demand with a very small supply for the shares. In the span of a day, VOW's ordinary shares jumped from around $210 to 1000$ (*NewYorkTimes, 2008*) , making Volkswagen the biggest company in the world by market capitalization for a few hours.

3 Before and after the squeeze

3.1 r/wallstreetbets vs. hedge funds

The GameStop short squeeze caused a lot of commotion among many hedge funds who bet against the stock. Melvin Capital, an investment firm headquartered in New York City, suffering the biggest loss. Prior to the GameStop short squeeze, Melvin Capital was managing $12.5 billion in assets. In August of 2020, Melvin was owning put options for 3.4 million shares of GameStop. Put options increase in value as the stock decreases in value. By December, they increased their position to 6 million shares.

3.1.1 The redditors' position

The forum r/wallstreetbets, noticed the bet Melvin Capital made and the large short interest in GME and the word spread quickly. In particular, user u/Senior_Hedgehog made a post on the forum about "*The biggest short squeeze of your entire life*" back in April 2020. Later in October of the same year, user u/CommonTwist posted another thread called "*GME short interest - a summary*" on GMEs' short interest[1]. On the same month, user u/Stonksflyingup posted a clip taken from the tv show Chernobyl with the title "*GME Squeeze and the Demise of Melvin Capital*", depicting Melvin Capital as a nuclear reactor exploding as a result of GameStop's increase in stock value.



Figure 1: Short interest in GME as reported by *SEC filings*.

Mostly, these users received insults from the subreddit. The biggest push for the traders was given by another user, u/DeepF******Value, later known as the financial advisor Keith Gill, which had posted his *progresses* on the GME investment dated back to 08/09/2019. His first *post* was not successful in the forum, however he kept updating his profits on the investment, month after month. From October 2020 to his last update, on April 2021, his posts racked up millions of upvotes, and they were most definitely one of the main driver to the increase of price of GME throughout the month of Jenuary 2021. Another big push was given by Elon Musk, who the 26th of Jenuary 2021

[1]

tweeted from his official account "Gamestonk!! https://t.co/RZtkDzAewJ", with a link connected to r/wallstreetbets. The subreddit found themselves successful as just in the month of January 2021 Melvin Capital "lost 53% of the $12.5bn it was managing" (*Ranmorefunds.com*).

3.1.2 Robinhood halts trading

The hedge funds suffered huge losses during the squeeze, up to 5 billion USD from 4th to 27th of January 2021, per *Investopedia.com*, and more than 19 billion USD from the 4th to the 29th of January 2021, per *Fortune.com*. Some, however, bled more than others: Ken Griffin, founder of Citadel LLC and Steve Cohen (Point72) invested a combined total of $2.75 billion into Melvin Capital as an attempt to help the investment firm rise from their losses. Citadel Securities is one of the biggest market maker in the world, accounting by itself for 27% of US equities volume of listed and OTC products, and execute approximately 37% of all U.S.-listed retail volume (*citadelsecurities.com*). A market maker quotes the two sides of the market, which means that it makes the prices of bid and ask, and profits from the spread (*Harris, 2011*). It also happens that one of the clients that Citadel executes trades for is Robinhood Markets Inc., the platform that most r/wallstreetbets users traded with, and this was also extremely profitable for the broker: its Q1 revenues in 2021 were of 331 million USD, of which 43% thanks to Citadel Securities (see *tokenist.com*). Since Citadel pays for the order flows from Robinhood, reddit traders called for conspiracy when Robinhood made the decision to halt trading on their platform for GME stock, accusing the market maker of market manipulation. Users thought that Citadel was bailing-out Melvin Capital through a money injection and at the same time halting the trading of GME by not marketing orders from Robinhood users, in order not to make the situation worse for Melvin Capital, since this time it was also Citadel's money. r/wallstreetbets users filed a lawsuit on January 28th 2021 stating that Robinhood "deprived retail investors of the ability to invest in the open-market" (*cnet.com*).

3.2 Legal implications

By February of 2021, Robinhood announced they were facing at least 46 putative class action lawsuits along with three individual lawsuits following Robinhood's prevention to trade Gamestop stock on their platform (see *businessofbusiness.com*). The SEC and the U.S. Congress were monitoring the Gamestop situation during the ascent of the stock and a congressional hearing was announced on January 28th by the House Financial Service Committees. Among the political figures that commented the situation, the U.S. democratic party's representative Alexandria Ocasio-Cortez that expressed her disappointing on the halt of RobinHood with a *tweet* stating that "This is unacceptable [...]. As a member of the Financial Services Cmte, I'd support a hearing if necessary", to which U.S. republican party's representative Ted Cruz *retweeted* responing "Fully agree". Another U.S. Representative of the democratic party, Ro Khanna, strongly condemned the behaviour of the hedge funds "*We're done letting hedge fund billionaires treat the stock market like their personal playground*". Senator Sherrod Brown ultimately summed-up the situation with an article on his website titled "*WALL STREET ONLY CARES ABOUT RULES WHEN HEDGE FUNDS GET HURT*".

3.2.1 The hearing

The hearing occurred on February 18th 2021, and the Financial Services Committee had the goals of:

- Determine the legality of Robinhood's decision to stop trading of the Gamestop and other meme stocks.
- Whether Robinhood was encouraging customers to take unnecessary risks.
- Whether it is the lack of regulation or the market structure that caused the events to transpire.

A total of six people were called to testify (*c-span.org*): Keith Gill (u/DeepF******Value); Ken Griffin, founder of Citadel; Gabe Plotkin, founder of Melvin Capital; Steve Huffman, Reddit's CEO; Jennifer Schulp, an expert in financial markets; and Vlad Tenev, Robinhood's CEO. Tenev received the majority of the questions and received a lot of backlash and was also critiqued by Representative Brad Sherman, who stated that "*You are doing a great job of wasting my time*" as Tenev responded with excessively long answers. The congressional hearing followed many reactions by political figures to implement stronger regulation by the U.S. Securities and Exchange Commission . Protests occurred outside of the Robinhood headquarters and the Securities and Exchange Commission headquarters as a way to retaliate against the decisions of Robinhood and the lack of regulations by the SEC (*foxbusiness.com*). As more lawsuits unfolded, Robinhood was put under much discrimination as users demanded back the money they lost, and investors demanded regulations to be put into place to prevent such drastic short-squeezes among retail investors.

3.2.2 Results for Robinhood

On June 30th, 2021, a settlement was reached by the Financial Industry Regulatory Authority (FINRA) for Robinhood to pay $70 million in fines and payments to aggravated customers (*finra.org*). The FINRA argued that Robinhood misleads customers and causes confusion among the platform with an absence in managing the technology properly. Users who participated in Robinhood's options trading lost out on a lot of money as margin trading was enabled on their app, even when they did not give permission for the app to do so. Margin trading increases risk as the trader is borrowing money from a broker to buy stocks, and the trader must pay back the broker later. Brokers usually give the option to allow margin trading, whereas Robinhood's platform had this option enabled automatically. Issues such as this led to unfortunate events: 20-year-old Alex Kearns, killed himself after Robinhood wrongfully displayed a loss of $730,000 after he participated in options trading while margin trading was enabled, a specification he was not aware of (*cbsnews.com*). He even tried to contact customer support, but by the time they responded, attempting to tell him that he did not need to owe money, it was too late. Many retail traders also complained about the lack of customer service, a point brought up in the settlement by FINRA. Following Kearns death, Robinhood has made investments in customer support including in-app features and tripling the amount of customer support workers according to their website.

3.2.3 Results for Keith Gill

Another issue found with the Gamestop short-squeeze, was whether it was legal that Reddit user and financial advisor Keith Gill (who is a CFA chartholder) was allowed to give financial advice online about GME stock. Jacob Frenkel, former SEC enforcement attorney, states that the main issue is if people were providing wrongful information “for the purpose of inducing others to buy stock” (*Reuters*). As long as Gill was providing truthful advice, he was acting in accordance with the law:"if he is making false statements. . . that’s a different situation" says Nicolas Morgan, a partner at the defense firm Paul Hastings. Gill puts disclaimers on his investing YouTube video stating that no individual investment advice is given by him, along with statements recommending to find a financial professional if someone is seeking personal advice. A class-action lawsuit has been filed against Keith Gill and his previous employer, MassMutual, for neglecting to supervise Gill and his online financial advice. He has been charged for violating federal securities laws in Massachusetts. MassMutual is paying a $4 million fine as a result of the conduct of Keith Gill. MassMutual agreed to pay the fine, along with an independent compliance review (*wealthmanagement.com*). The legality of the actions of Robinhood, along with the actions of the retail traders is largely debated. Lawsuits are still being pursued, whether all traders will be compensated for their losses due to the broker’s negligence is still uncertain.

4 Winners and losers

As the short squeeze unfolded, and as in every kind of trading operation, there were both winners and losers. In this war between David and Goliath, the small fish came out on top and the retail investors achieved (often life changing) gains. On the other end, Wall Street's institutional investors saw themselves forced to close their reported position at a loss. In this paragraph we provide insights on the main protagonists of this unprecedented event.

4.1 Gains of r/WSB's traders

Multiple users in the subreddit r/wallstreetbet saw their brokerage accounts skyrocket in the 4th week of January, posting million dollars' positions and return on investments well over 1000%. Some, such as u/psytokine_storm, managed to control their nerves and close their position at the right time, avoiding panic selling.

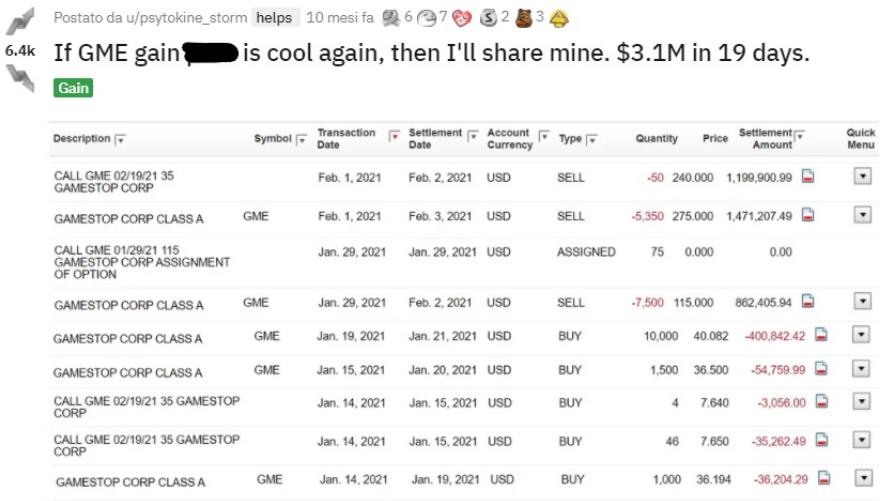


Figure 2: u/psytokine_storm's post on *r/wallstreetbets*

Other users, such as *u/Infinite-coffEe* and u/lantern_fan, stuck with their investment well past the short squeeze, mostly in the hope that the short squeeze was still to come and the hedge funds had not covered their position yet (which is, buying back the shorted shares of GME). The latter user in particular kept updating his position throughout the week, reaching peaks of 17 million USD and lows of 15 million USD.

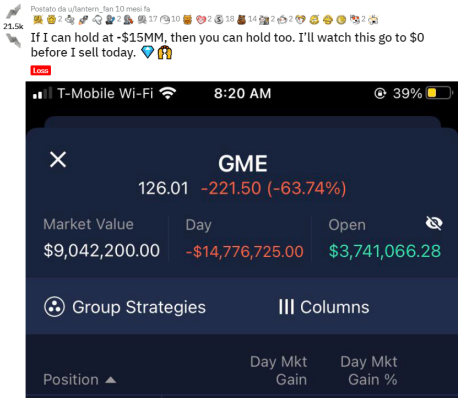


Figure 3: u/lantern_fan's position as of 28/01, posted on *r/wallstreetbets*.

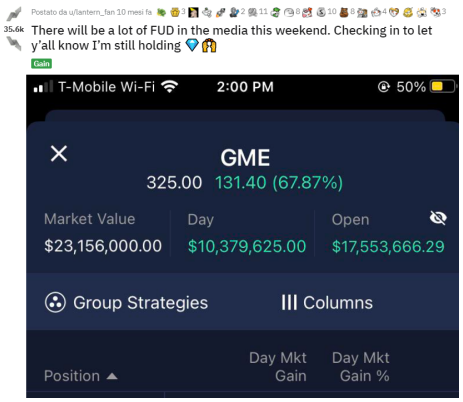


Figure 4: u/lantern_fan's position as of 29/01, posted on *r/wallstreetbets*.

Their position has been built up mostly throughout the purchase of GME shares. This was key in order to achieve the short squeeze. Even though r/WSB owned a modest chunk of the total shares outstanding, they were not intentioned to sell them (from here the famous words "diamond hands", meaning a strong hold onto the shares), and since the stock's short interest was over 100% (more on this in the next section), not selling the shares helped the price drive up even more.

On the other hand, in order to profit the most out of the squeeze, many traders purchased call options as well. A call option is a financial derivative that allows one to hedge against risk or, in this circumstance, to essentially bet that the price of a security will decrease (put) or increase (call). Using a stock replacement strategy, a trader is able to purchase a call option with a Δ[2] of 1 (or close to), so that it moves 1:1 with the underlying asset. This provides lower costs overall on the operation and therefore bigger profits.

4.1.1 u/DeepF******Value

Keith Gill, as stated before, is likely the match that made r/wallstreetbets light GME on fire. He was onto the stock for more than two year at the moment of the squeeze, and at its peak, his profits were reached as high as 33 million USD, as Figure 5 testifies.

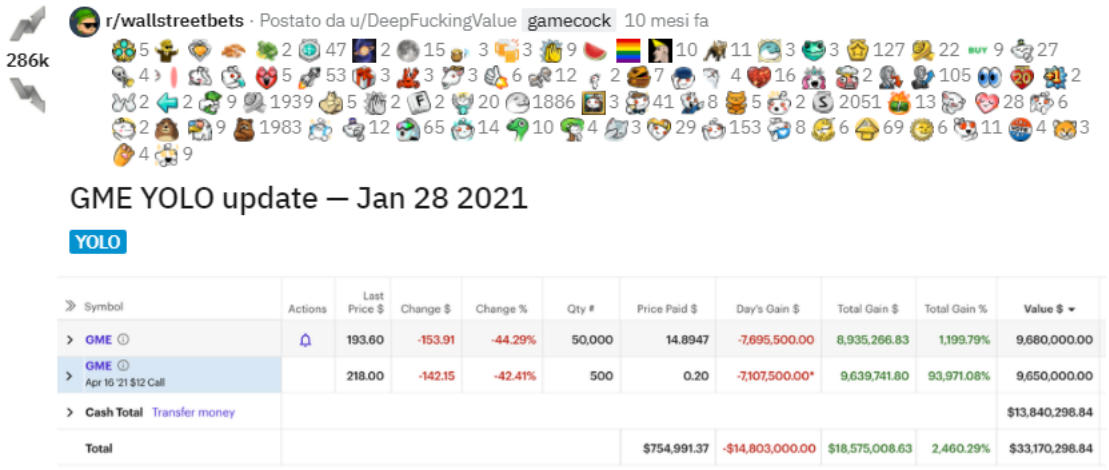


Figure 5: Keith Gill's post on the 28th of January 2021, via *reddit*.

[2]Delta is the amount an option price is expected to move based on a $1 change in the underlying stock (*Optionsplaybook.com*).

However, he kept his shares and call options through the peak and never closed his position, either for the ideology behind the subreddit trade (to go up against the powerful hedge funds), or most likely to avoid to be accused of a pump and dump scheme[3] in future hearings. Moreover, during the hearing of the 18th of February he was asked whether he'd buy more GME at the current price (which was around 45$ per share), and he responded affirmatively. 4 days later, he purchased more GME shares, doubling his investment from 50.000 shares to 100.000 shares (*businessinsider.com*). Moreover, in his final update, dated 16th of April 2021, as seen in Figure 6, he showed that he exercised his call option and bought more shares in addition. As a result, he lowered his AVG buy price, making his position just as profitable as it was during the peak of the short squeeze, at around 33 million USD.

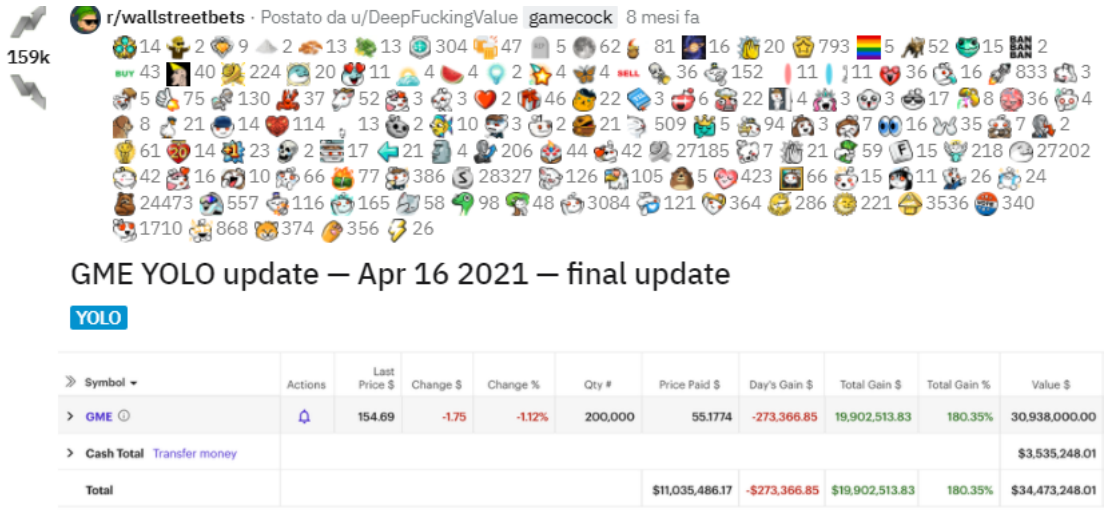


Figure 6: Keith Gill's post on the 16th of April 2021, via *reddit*.

4.2 The losing side

In the Street the music was different for the big hedge funds that had a short position on GME as well as other stocks with a big short interest. As reported by Markets Insider, short sellers found themselves in huge losses, up to 10 billion USD on the 27th of January alone. The 29th, when the stock soared to $340+, investment firms in a short position in GME and other stocks were on track for a daily loss of 19 billion USD. Among big names, Steve Cohen's Point72 had lost around 2.85 billion on these operations; D1 Capital, a 20 billion USD investment firm, lost 20% of its capital; Andrew Left, financial analyst and editor for Citron Research, was famously short on GME and forced to close at a 100% loss. Lastly, Melvin Capital, a 12.5 billion USD hedge fund run by Gabriel Plotkin lost 53% of its capital on its short positions.

For *Reuters*, as of the 28th January, short sellers were sitting on estimated losses of 70.87 billion USD, counting more than 5.000 firms sold short.

Most of these institutional investors managed to close their position in time to avoid the worst, and over time their capital has been partially restored. However, it is not an understatement to say that some of them were days away from disaster. Here we'll undertake a deeper dive into the major "antagonist" of the Gamestop saga, Gabriel Plotkin's Melvin Capital.

[3] A trader or a group of traders that promotes a stock to the public in order to pump up its price, for it only to be dumped when the price is high enough, front running the other investors.

This hedge fund was famously betting on GME's bankruptcy since its inception in 2014. Their position was built up both shorting GME's common shares and purchasing put options throughout this span of time. As a result, Melvin Capital was the biggest single loser in the GME's saga as well as being the only hedge fund that needed external help to stay afloat: the 25th January 2021 Ken Griffin's Citadel and Steve Cohen's Point72 invested together 2.75 billion USD into Melvin Capital, which was enough for it to hold its losses at around 6.6 billion USD. This "investment" was seen by the media as a bail-out, without which Melvin Capital would have collapsed.

The next section aims to find out whether this scenario was possible.

4.2.1 A deep dive into Melvin Capital's bet

The hedge fund's capital at the beginning of the year totalled 12.5 billion USD. At the end of January, the reported losses were 53% of their capital, or around 6.6 billions USD (*WallStreetJournal*). To determine the losses related to the short position, we should know the amount of shares shorted by the hedge fund.

$$(\#\text{ of shares}) \cdot (\text{AVG loss/share}) = \text{Total Loss} \tag{1}$$

$$\#\text{ of shares} = \frac{\text{Total Loss}}{\text{AVG loss/share}} \tag{2}$$

Where AVG loss/share = (January AVG price) − (AVG short price)

Date	Open	High	Low	Close	Adj Close	Volume
2021-01-04	19.000000	19.100000	17.150000	17.250000	17.250000	10022500
2021-01-05	17.350000	18.080000	17.230000	17.370001	17.370001	4961500
2021-01-06	17.340000	18.980000	17.330000	18.360001	18.360001	6056200
2021-01-07	18.469999	19.450001	18.020000	18.080000	18.080000	6129300
2021-01-08	18.180000	18.299999	17.080000	17.690001	17.690001	6482000
2021-01-11	19.410000	20.650000	19.010000	19.940001	19.940001	14908000
2021-01-12	19.959999	20.400000	19.320000	19.950001	19.950001	7060700
2021-01-13	20.420000	38.650002	20.030001	31.400000	31.400000	144501700
2021-01-14	38.090000	43.060001	33.049999	39.910000	39.910000	93717400
2021-01-15	38.490002	40.750000	34.009998	35.500000	35.500000	46866400
2021-01-19	41.549999	45.520000	36.639999	39.360001	39.360001	74721900
2021-01-20	37.369999	41.189999	36.060001	39.119999	39.119999	33471800
2021-01-21	39.230000	44.750000	37.000000	43.029999	43.029999	56216900
2021-01-22	42.590000	76.760002	42.320000	65.010002	65.010002	197157900
2021-01-25	96.730003	159.179993	61.130001	76.790001	76.790001	177874000
2021-01-26	88.559998	150.000000	80.199997	147.979996	147.979996	178588000
2021-01-27	354.829987	380.000000	249.000000	347.510010	347.510010	93396700
2021-01-28	265.000000	483.000000	112.250000	193.600006	193.600006	58815800

Table 1: January AVG closing price, *Yahoo Finance*

The AVG price for this span of time is $65.98/share.

To calculate the AVG price at which Melvin Capital short GME at since 2014, we will make

an assumption. Being Melvin Capital private, they are not bound to disclose their short position in their 13F[4] filings. They are, however, forced to disclose their position regarding option trading: we will assume that each time the hedge fund purchased put options from 2014 to 2020, it also shorted a proportional amount of GME's common shares.

Date	Put Pos.	% of Total Pos.	GME low price
31/12/2014	350000	5.8	33.71
12/31/2015	400000	0.83	28.03
31/03/2016	300000	-1.6	31.67
30/09/2016	400000	1.6	27.25
31/12/2016	1500000	18	25.22
31/03/2017	1064700	-7.25	22.37
30/06/2017	1955800	14.85	21.39
30/09/2017	465900	-24	20.52
31/12/2017	1001600	8.92	17.94
31/03/2018	1173100	2.85	12.20
30/06/2018	1328100	2.58	14.51
30/09/2018	1325700	-0.04	15.19
31/12/2018	1378400	0.87	12.31
31/03/2019	3250000	31.19	10.15
30/06/2019	1800000	-24.16	5.44
30/09/2019	4000000	36	5.40
31/12/2019	4000000	0	5.99
31/03/2020	2800000	-20	3.5
30/06/2020	3400000	10	4.2
30/09/2020	5400000	33	10.06
31/12/2020	6000000	10	18.80

Table 2: Put position of Melvin Capital on GME since 2014 and relative price of the stock at the time, *13f.info*

For instance, given a total short position of x at 31/12/2020, we will assume that Melvin Capital shorted 5.8 of x on 31/12/2014, and we will assume that it closed -1.6 of x position on 31/03/2016 and so on. We then proceed to calculate the weighted average of the purchases, with the sum of the weights being 100(%).

$$\frac{(5.8)(33.71) + (0.83)(28.03) + (-1.6)(31.67) + ... + (10)(18.8)}{100} = \$14.42/\text{share} \tag{3}$$

We will be conservative and assume that about less than half, or 3 billion USD of losses were caused directly from GME's shares:

$$\#\text{ of shares} = \frac{3.000.000.000}{65.98 - 14.42} = 58.184.639 \tag{4}$$

[4]The Securities and Exchange Commission's (SEC) Form 13F is a quarterly report that is required to be filed by all institutional investment managers with at least $100 million in assets under management. It discloses their equity holdings and can provide insights into what the smart money is doing in the market, *Investopedia.com*

With a float[5] of only 61.76 mln shares, this seems unreasonable. However, we have to keep in mind that the short interest for the GME stock throughout the month of January (and up to the very end of the short squeeze) reached 140% (see *Bloomberg*, *Reuters*): there were more shares shorted than shares outstanding for the public, meaning that the same share had been shorted more than once.

Melvin Capital's margin account. To short a stock, a margin account is needed, which allows the investor to borrow the stock and sell it, using money as collateral. The amount of money in the margin account is given by:

$$\text{Short Sale Value} + \text{Initial Margin Requirement} = \text{Total Margin Account} \tag{5}$$

The *Initial Margin Requirement* is set as a minimum of 25% of the *Short Sale Value* for firms quoted on NYSE and NASDAQ, even though most of the brokerage firms will impose much higher requirements (up to 40-50%). To be conservative once again, however, we will assume it to be set at 25%. As a result, the margin account for the shares shorted as of 31/12/20 is:

$$(58184639 \cdot \$14.51) \cdot 1.25 = \$1.055.323.889 \tag{6}$$

As GME starts its rally in January, Melvin Capital receives its margin call, to which it decides to post the margin required: this is reasonable to assume since the short interest rate will not fall on the stock up until the very last days of January. On the 22/01/21, Melvin Capital receives another margin call, following the closing price of GME at $65.01:

$$(58184639 \cdot \$65.01) \cdot 1.25 - \$1.055.323.889 = \$3.672.905.337 \tag{7}$$

Originally, to this margin call, Melvin Capital gets in touch with Citadel and Point72 to receive additional funds and starting the buyback, which happens the 25/01/21 at 15.00 (see *WallStreetJournal*), just before the end of the trading day, when Melvin Capital receives another margin call:

$$(58184639 \cdot \$76.79) \cdot 1.25 - \$1.055.323.889 = \$4.529.674.147 \tag{8}$$

At this point, Melvin has received the 2.75 billion USD money injection and starts to buy the shares back. If this does not happen, however, the 26/01/21, just on day after, it receives one last margin call:

$$(58184639 \cdot \$147.98) \cdot 1.25 - \$1.055.323.889 = \$9.707.379.710 \tag{9}$$

This may seem unreasonable, considering that, if Melvin Capital does not cover its position, one may think that the short squeeze does not happen, since the buy back of the shares from the hedge fund was a huge driver of the surge in price of GME. However, as filed by the *SEC Report* on the GME saga, the number of individual investors trading in GME was much bigger than the number of institutional investors, as we can see in Figure 7.

[5]Number of shares available for trading for the public.

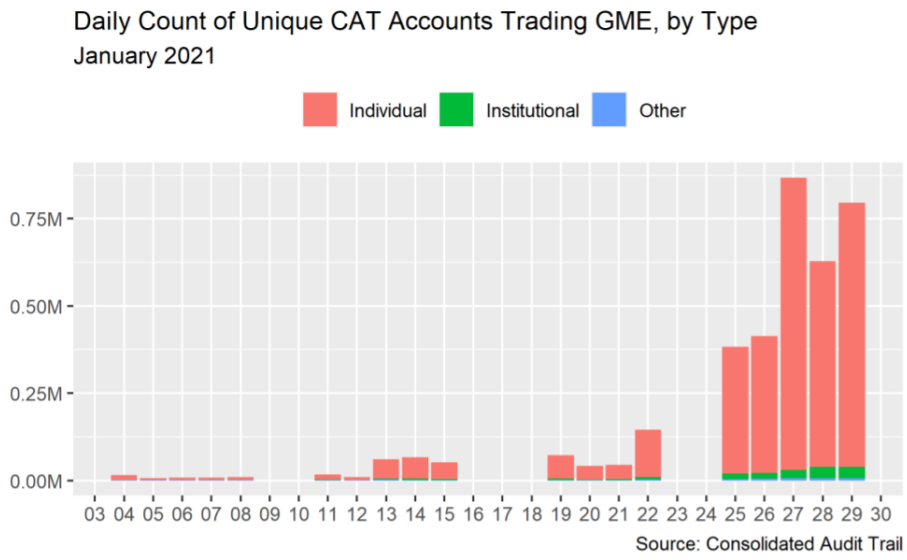


Figure 7: Number of individual vs. institutional investors trading in GME in January, *SEC Report*

Moreover, the same SEC Report explains that short sellers' buy volume was a small fraction of overall buy volume, and "it was the positive sentiment, not the buying-to-cover, that sustained the weeks-long price appreciation of GameStop stock.", as Figure 8 shows.

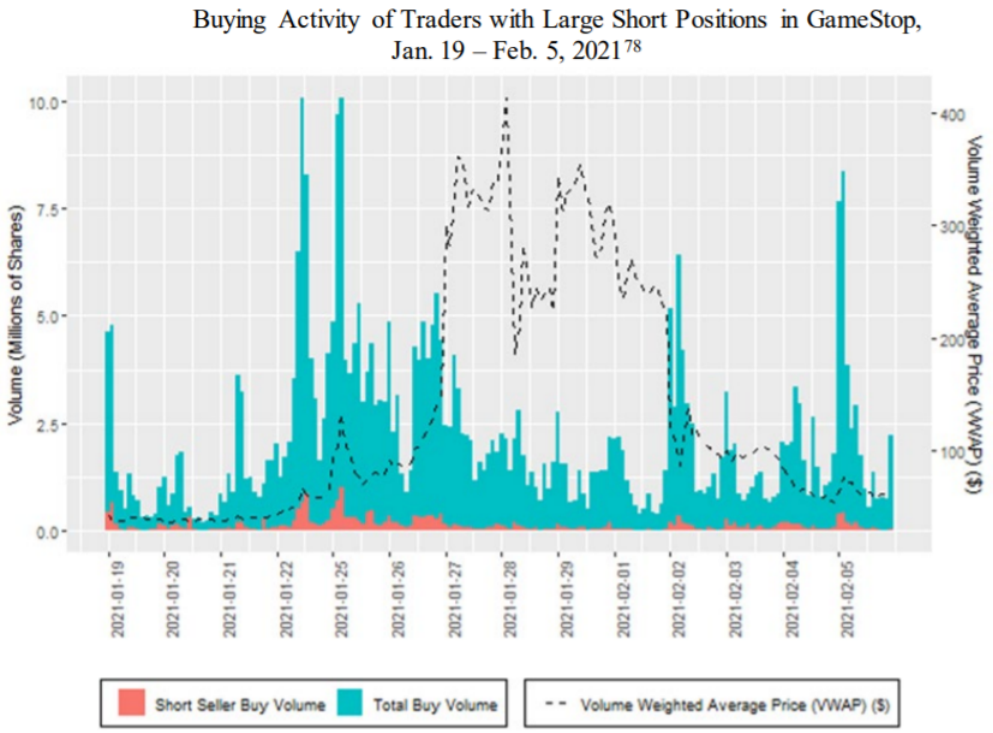


Figure 8: Short Seller buy volume vs Total buy volume, *SEC Report*

As the stock doubles in value in just a day, Melvin starts its buy back procedures, but it is likely too late. To this, is to be added the losing position on the put options, valued $113 mln as of 31/12/2020, as reported on the *13F filing*.

Moreover, on the stocks shorted, Melvin Capital is paying a huge borrow rate, per *iborrowdesk*: on average for the whole month of January, the borrow rate for GME is of 30.41%, which means:

$$\frac{(58.184.639) \cdot (30.41\%) \cdot (\$65.98)}{360} = 3.242.907\$/\text{day} \tag{10}$$

or around $87.558.505 on interest rate throughout the month of January.

Lastly, it is to be noted that the hedge fund had a short position in many more stocks that saw a surge in price during January. *Insistutional Investor* reports that in addition to selling all of its GME put options during Q1, it also sold put options of 17 other stocks in the same period.

5 Has GME affected the market?

In this section we will analyze whether the short squeeze of GME and the rallying of traders on Reddit had any effects on the overall volatility of the market. We have split this question into three. First, did the events in early 2021 have any effect on GMEs closest peers? Second, did the GME short squeeze affect volatility of the broader market? And third, did the GME short squeeze affect the volatility of other stocks that were hijacked by reddit-traders?

5.1 Methodology

For the calculations, we compared the daily intraday volatility of GME and the relevant control group. We calculated the volatility according to an approach by *Chan and Lien (2003)*. Usually, the historic volatility is calculated as the standard deviation of the logarithmic returns. These returns consist of the opening and closing prices of a stock *(Cabrera, 2012)*. By only using opening and closing prices, however, the volatility within one day is not properly depicted. Therefore, Chan and Lien propose several alternatives, which incorporate the daily high- and low-prices in the calculation of the intraday volatility. Out of the four different approaches, we selected the fourth one as this is the only formula that accounts for drift in the data mean. Drift means that the mean is not constant over time, which is a sensible assumption for real world financial data as it is usually assumed that there is a specific trend over time. Taking this into account, the formula for the calculation of the intraday volatility is the following:

$$V_{RS,t} = [ln(H_t) - ln(O_t)] \cdot [ln(H_t) - ln(C_t)] + [ln(L_t) - ln(O_t)] \cdot [ln(L_t) - ln(C_t)] \qquad (11)$$

Where H_t, L_t, O_t and C_t are the high, low, opening and closing prices at time t respectively.

Where Ht, Lt, Ot, and Ct are the high, low, opening, and closing prices at time t respectively. With this formula we calculated the intraday volatility for each day over the observation period from the 2. December 2020 to the 2. December 2021. In addition, we also isolated one month around the day with the highest volatility of GME. This was the month from the 11. January 2021 to the 11. February 2021. This allowed us to take a closer look into the precise time frame in which the short squeeze mainly took place. For the analysis we compared the mean volatility and the maximum volatilities of the different groups over the whole year as well as over the month with GMEs highest volatility. Furthermore, we regressed the volatility of GME on the respective peer group to check whether the volatility of GMEs stock is a meaningful explanatory variable for volatility in the peer group. Again this was done twice, for the whole year as well as for the month with GMEs highest volatility.

5.2 Construction of Peer Groups

We analyzed different peer groups to assess whether the GME short squeeze had an impact on other parts of the market as well. The first group was a selection of industry peers. Namely there are Best Buy (BBY), JB Hi-Fi (JB), and Ceconomy (CEC). They are all specialized in the retail of consumer electronics and home entertainment. Best buy is mainly active in northern America but also has some exposure to Europe and China. JB Hi-Fi is active in Australia and Ceconomy's main area of operation is Europe with a strong focus on the DACH region.

Second, we compared GMEs volatility to a broader market. Therefore, we used the Dow Jones U.S. Specialty Retailers Index, which is also used by GME in their 10-K filing with the SEC as a reference for GMEs performance *(SEC filings)*. Compared to the small peer group for the first comparison, the Dow Jones U.S. Specialty Retailers Index provides a broader perspective on the market as it includes retailers from other sectors as well.

The third group are other stocks that were discussed in Reddit forums alongside GME. This sample includes the stocks of AMC, Blackberry, Nokia, Bed Bath Beyond, Beyond Meat, and Koss Corporation. All of them experienced a significant price increase over a very short time frame in the examination period. The spikes in the prices varied over the different stocks. GME, AMC, and Koss all spiked over 1000%+. Blackberry and Bed, Bath Beyond had their highs between 150% and 200% up from the beginning of the observation while Nokia and Beyond meat met their respective highs below 50%.

5.3 Findings

Looking at the industry peers, GMEs mean and maximum volatility are a lot larger than the mean and maximum of the peer group for both observation periods. Another interesting observation is that the mean volatility doesn't differ much between the two periods, whereas the mean volatility of GME is around 7 times higher in the monthly period. For the two regressions we observe that only the one for the monthly period is significant at a five percent significance level. For both the regression coefficient is very small, which indicates that any influence is very small at best. However, for the monthly period the R^2 and adjusted R^2 are relatively high at 30.09% and 26.76% respectively. Therefore, according to our regression model GMEs volatility explains almost a third of the volatility in the peer group.

	GME	BBY	JB	CEC	Peers Mean
Mean Vrs	0.01674598	0.00030596	0	0.00025173	0.0001859
Max Vrs	1.01700782	0.00716598	0	0.00714407	0.00477002

Coefficient	P-value	R square	Adj R square
0.000373234	0.086254259	0.011679428	0.007741896

Table 3: Volatility comparison full year, industry comparison.

	GME	BBY	JB	CEC	peer mean
mean Vrs	0.11815087	0.00037869	0	0.00026805	0.00021558
max Vrs	1.01700782	0.00103618	0	0.00168054	0.00090557

Coefficient	P-value	R square	Adj R square
0.000364443	0.006726066	0.300865615	0.267573502

Table 4: Volatility comparison max month (11.01.20 - 11.02.20), industry comparison

For the comparison between GME and the Dow Jones U.S. Specialty Retailers Index there is a similar picture as for the industry peers. In both observation periods GMEs mean and maximum volatility are much higher than the volatility of the index. Again, the difference between the different observation periods is much larger for GME. As for the two regressions, both coefficients are quite small again. However, this time booth coefficients are statistically significant at the five percent level. The R^2 and adjusted R^2 for the two regressions vary a lot. For the whole year

the volatility of GME explains just two percent of the index's volatility. For the monthly period however, GME explains around a quarter of the volatility in the index.

	GME	Market
Mean Vrs	0.01674598	0.0000921
Max Vrs	1.01700782	0.001036214

Regression	Results
Coefficient	0.00024446
P-value	0.00720739
R square	0.02841287
Adj R square	0.02454201

Table 5: Volatility comparison full year, market comparison.

	GME	Market
Mean Vrs	0.11815087	0.000115011
Max Vrs	1.01700782	0.000268804

Regression	Results
Coefficient	0.00017522
P-value	0.00976438
R square	0.27777229
Adj R square	0.24338049

Table 6: Volatility comparison max month (11.01.20 - 11.02.20), market comparison.

When comparing GME to the group of other stocks that were targeted by traders on Reddit, there are some notable differences to the two earlier comparisons. First, the mean and maximum volatilities of GME and the peers demonstrate less disparity. This holds true for both observation periods. Furthermore, the changes between the different periods are similar for GME and its peers. Notably, the maximum intraday volatilities over the whole year are found in the same monthly period as for GME for all stocks except for Beyond Meat. Regarding the regressions, the coefficients are much higher than for the other two comparisons with 0.25 for both periods, indicating that a change in GMEs volatility has a notable effect on the peer group's volatility. Furthermore, the two models are highly significant with p-values well below 0.01. The R^2 and adjusted R^2 are also considerably higher for this model with 0.64 for the whole year and around 0.60 for the monthly period. In addition, the differences between the R^2 and adjusted R^2 are very low which indicates that the volatility of GMEs' stock is a good predictor of the volatility in the peer group.

	GME	AMC	BB	NOK	BBBY	BYND	KOSS
mean Vrs	0.016745979	0.01072353	0.00303657	0.00147257	0.0033164	0.00099545	0.0160431
max Vrs	1.01700782	0.37940966	0.09538318	0.27806251	0.14081296	0.0076508	1.16596458

Coefficient	P-value	R square	Adj R square
0.247010047	2.09237E-57	0.638632836	0.637193126

Table 7: Volatility comparison full year, reddit peers.

	GME	AMC	BB	NOK	BBBY	BYND	KOSS
mean Vrs	0.118150865	0.05136864	0.01350259	0.01370998	0.0162738	0.00197149	0.10371567
max Vrs	1.01700782	0.37940966	0.09538318	0.27806251	0.14081296	0.00629003	1.16596458

Coefficient	P-value	R square	Adj R square
0.251835596	9.20556E-06	0.616096781	0.597815675

Table 8: Volatility comparison max month (11.01.20 - 11.02.20), reddit peers.

5.4 Conclusions

In conclusion, it appears that the volatility of GME best predicts the volatility of the peer group of Reddit stocks. For the other two comparisons there are some limitations in the form of low coefficients and low explanatory power in the form of low R2 and adjusted R2. Therefore, our calculations do not deliver strong and unambiguous evidence that the increased volatility in GME had a contagious effect on the industry peers or the broader market. Especially the comparison of GME to the industry peers also suffers from a very limited peer group size. As there are few listed retailers with a similar specialization the peer group is quite small to begin with. Furthermore, the stock of JB Hi-Fi is very illiquid with very small trading volumes and as a result also quite limited volatility.

However, the volatility of GME and other stocks targeted by reddit users seem to be closely correlated. Yet, there are some limitations to this comparison as well. First, as our regression doesn't control for any other variables, we cannot say with certainty that the volatility of GME was the driver for volatility in the peer groups. Especially in the past year the stock market was subject to a lot of volatility due to the ever-changing pandemic situation. Another possible limitation could be the missing causation for the correlation of volatility in GME and other stocks on Reddit. Another explanation for the correlation could be that the coordination between private traders on Reddit just gained momentum in early 2021 and drove the prices of the stocks simultaneously.

6 Conclusion

The GME' short squeeze caused a lot of turmoil among traders of all types. However, it allowed retail investors to come out on top with returns on their investments being over 1000%, all because of the popular subreddit r/wallstreetbets. While those retail traders, who bought in early and closed their positions at the right time, thrived, larger investors and hedge funds lost out on an estimated 70 billion dollars (according to estimates of Reuters). The entire squeeze was argued in court on the legality of the actions of the retail traders and Robinhood with a settlement for Robinhood to $70 million due to their prevention of trade for smaller traders.

We also found some evidence that the volatility caused by the GME short squeezed spread over to different parts of the market. However, the evidence is very weak as there are some significant limitations to our findings. We cannot say with certainty that it was the main driver for the volatility in the studied peer groups as the pandemic caused has caused a lot of changes in the market. It can also be said that the volatility of GME correlates with the volatility of other Reddit stocks. Whether this is also a causal relationship is not entirely clear from our model. The squeeze continues to be talked about and traders from all backgrounds still debate whether the market should be more regulated because of those trades in January of 2021. The ability of retail traders to create such a reaction in the trading world is unprecedented and projects how the limits to trading are endless.

References

[1] Chan, L., Lien, D. (2003). International Review of Financial Analysis, 12(1), 35-47. *Using high, low, open, and closing prices to estimate the effects of cash settlement on futures prices*. *https://doi.org/10.1016/S1057-5219(02)00125-4*.

[2] Cabrera, F. (Producer). (2012, 04.12.2021). Calculating Historical Volatility (HV) with Example.

[3] Peche, S. (2021). Ranmorefunds.com. *The WSJ reports that Melvin Capital, the $12.5bn hedge fund at the centre of this GME debacle, lost 53% in Jan. http://ranmorefunds.com/the-wsj-reports-that-melvin-capital-the-12-5bn-hedge-fund-at-the-centre-of-this-gme-debacle-lost-53-in-jan/*.

[4] Michael, R. (2021). Form 10-K Gamestop Corp. Annual report [Section 13 and 15(d), not S-K Item 405]. *https://sec.report/Document/0001326380-21-000032/*.

[5] Schroeder, P.; Prentice, C. (2021). Reuters. *Analysis: GameStop saga expected to revive scrutiny of hedge fund industry*. *https://www.reuters.com/business/gamestop-saga-expected-revive-scrutiny-hedge-fund-industry-2021-02-02/*

[6] The Option Playbook. (2021). *Meet the Greeks*. *https://www.optionsplaybook.com/options-introduction/option-greeks/*.

[7] Mitchell, C. (2021). Investopedia. *Short Interest Definition and Uses*. *https://www.investopedia.com/terms/s/shortinterest.asp*.

[8] Yahoo Finance. (2021). *GME > Historical Data > 01/01/21 to 28/01/21*. *https://finance.yahoo.com/quote/GME/history?period1=1609459200period2=1611792000interval=1dfilter=historyfrequency=1dincludeAdjustedClose=true*.

[9] Gonzalez, O.; Priest, D. (2021). cnet.com. *Robinhood backlash: What you should know about the GameStop stock controversy*. https://www.cnet.com/personal-finance/investing/robinhood-backlash-what-you-should-know-about-the-gamestop-stock-controversy/.

[10] Hayes, A. (2021). Investopedia. *What is the SEC Form 13F?*. *https://www.investopedia.com/terms/f/form-13f.asp*.

[11] Greifield, K.; Lipschultz, B. (2021). Bloomberg. *GameStop Short-Sellers Reload Bets After $6 Billion Loss*. *https://www.bloomberg.com/news/articles/2021-01-25/gamestop-short-sellers-reload-bearish-bets-after-6-billion-loss*.

[12] *Melvin Capital's 13F Holding History for GME*. *https://13f.info/manager/0001628110/cusip/36467W109*.

[13] Chung, J. (2021). The Wall Street Journal. *Citadel, Point72 to Invest $2.75 Billion Into Melvin Capital Management. https://www.wsj.com/articles/citadel-point72-to-invest-2-75-billion-into-melvin-capital-management-11611604340*.

[14] Davies, M. (2021). Reuters. *Short interest in GameStop declined to 15% vs 141% at peak - S3*. *https://www.reuters.com/article/us-retail-trading-gamestop-short-idUSKBN2BG28H*.

[15] SEC Staff. (2021). SEC.gov. *Staff Report on Equity and Options Market Structure Conditions in Early 2021*. *https://www.sec.gov/files/staff-report-equity-options-market-struction-conditions-early-2021.pdf*.

[16] Celarier, M. (2021). InstitutionalInvestor. *Melvin Capital Closed Out All of Its Public Short Positions in the First Quarter*. *https://www.institutionalinvestor.com/article/b1rwp47tt0sj0w/Melvin-Capital-Closed-Out-All-of-Its-Public-Short-Positions-in-the-First-Quarter*.

[17] iborrowdesk.com. (2021). *GME's borrow rate on shorted stocks*. *https://iborrowdesk.com/report/GME*.

[18] Chung, J. (2021). The Wall Street Journal. *Melvin Capital Lost 53% in January, Hurt by GameStop and Other Bets*. *https://www.wsj.com/articles/melvin-capital-lost-53-in-january-hurt-by-gamestop-and-other-bets-11612103117*.

[19] Harris, L. (2011). *Trading and exchanges: Market microstructures for Practitioners*. Oxford University Press.

[20] De Luce, I. (2021). businessofbusiness.com. *Robinhood is facing 49 — that's right, 49 — lawsuits over Gamestonks*. *https://www.businessofbusiness.com/articles/Robinhood-lawsuits-gamestop-stonk-meme-stock/*.

[21] Brown, S. (2021). brown.senate.gov. *WALL STREET ONLY CARES ABOUT RULES WHEN HEDGE FUNDS GET HURT*. *https://www.brown.senate.gov/newsroom/press/release/brown-wall-street-hedge-funds*.

[22] c-span.org. (2021). *Robinhood CEO, Reddit Co-Founder Others Testify on GameStop Stock*. *https://www.c-span.org/event/?508545/robinhood-ceo-reddit-cofounder-testify-gamestop-stock*.

[23] Manfredi, L. (2021). foxbusiness.com. *Protesters gather at Robinhood HQ, SEC, NYSE*. *https://www.foxbusiness.com/markets/protesters-gather-at-robinhood-hq-nyse-in-response-to-restricted-stock-trades*.

[24] Ong, M.; Pellecchia, R.; Plemmer Williams, A.; DeSouza, A. (2021). finra.org. *FINRA Orders Record Financial Penalties Against Robinhood Financial LLC*. *https://www.finra.org/media-center/newsreleases/2021/finra-orders-record-financial-penalties-against-robinhood-financial*.

[25] Dokoupil, T.;, Kaplan, M.; Finn, M.; McDonald, C.; Kamin, J.; Kaplan, R. (2021). cbsnews.com. *Alex Kearns died thinking he owed hundreds of thousands for stock market losses on Robinhood. His parents have sued over*

his suicide. *https://www.cbsnews.com/news/alex-kearns-robinhood-trader-suicide-wrongful-death-suit/*.

[26] Donachie, P. (2021). wealthmanagement.com. *MassMutual to Pay $4M for Failing to Identify Keith Gill's Social Persona*. *https://www.wealthmanagement.com/regulation-compliance/massmutual-pay-4m-failing-identify-keith-gill-s-social-persona*.

[27] Fox, M. (2021). businessinsider.com. *Famed Reddit trader Keith Gill has piled more money into his GameStop investment*. *https://markets.businessinsider.com/news/stocks/reddit-trader-keith-gill-roaring-kitty-buys-more-gamestop-stock-2021-2*.

[28] Rao, S. (2021). Reuters. *Losses on short positions in U.S. firms top $70 billion - Ortex data*. https://www.reuters.com/article/us-retail-trading-shortbets-idUSKBN29X1SW*https://www.reuters.com/article/us-retail-trading-shortbets-idUSKBN29X1SW*.

[29] FINRA. (2016). *4210. Margin Requirements*. *https://www.finra.org/rules-guidance/rulebooks/finra-rules/4210*.

[30] Mitchell, C. (2021). Investopedia. *Short Interest Definition and Uses*. *https://www.investopedia.com/terms/s/shortinterest.asp*.

[31] Reuters staff. (2008). Reuters. *TIMELINE: Porsche approach to VW*. *https://www.reuters.com/article/us-vw-porsche-chronology-idUSTRE49Q52H20081027*.

[32] Norris, F. (2008). New York Times. *A Clever Move by Porsche on VW's Stock*. *https://www.nytimes.com/2008/10/31/business/worldbusiness/31norris.html*.