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A Note on GameStop, Short Squeezes, and Autodidactic Herding: An Evolution in Financial Literacy?

Abstract

This note explores a secondary effect of the GameStop short squeeze event and links the exalted focus of retail investors on meme stocks to financial literacy and autodidacticism. From an overview of stylized facts about the short squeeze of GameStop based on high frequency data, short interest, and key figures of related derivatives, it is shown that these financial concepts are reflected in keyword searches across multiple platforms. This self-education with regard to financial terms, keywords, and products and the understanding of basic market speculation mechanisms such as short sales plays a significant role for the influx of retail investors.

Keywords: Financial Literacy, Short Squeeze, GameStop, Reddit, Meme Stocks

JEL classification: G11 · G14 · G41

1. Introduction

This letter aims to explore a secondary effect of the recent price surges of GameStop and other meme stocks such as AMC, the excessive focus of retail investors on those firms, and the coverage of these events in popular media. While we could label the organized influx of retail investors into long positions of these shares and related derivatives a primary effect, which sees increasing interest in financial literature already (Chohan, 2021, Hasso et al., 2021, Long et al., 2021), this note systematically provides evidence that there is a secondary effect to be observed—autodidacticism with focus on financial strategies and derivatives. This secondary effect links the frenzy around GameStop to financial literacy and lays out several important issues that drive further research.

Fueled by newsboards and social media sites, mainly on Reddit and r/wallstreetbets—and later r/superstonk—retail investors focused on GameStop shares in a so-called short squeeze as GameStop was massively shorted, in particular by a number of large hedge funds. Retail investors unified globally to buy shares of GameStop in order to decrease the free-float needed to cover short positions end of January, effectively driving prices far beyond any reasonable fundamental value, while others—via no- or low-fee brokerage apps

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Some participants believed that the original subreddit in which GME and similar investments are discussed, r/wallstreetbets, had been flooded with false information to deliberately discourage from long positions in GME. The new subreddit was created on 15 March 2021 to counter this alleged belief manipulation.
and accounts—used derivatives to benefit from any possible squeeze-like price behavior.

The short squeeze of GME in January 2021 has quickly been picked up by scholars and several dimensions of this phenomenon been analyzed. In an extensive sentiment analysis, Long et al. (2021) show that there is a differentiated effect of posts on Reddit on intraday returns of GME. In a more generalized approach, Bradley et al. (2021) provides evidence that specific threads on Reddit, so-called due-diligence (DD) posts, sharply increase trading volume and provide positive returns in the short and medium run. It is inferred that participants in those DD threads are indeed skilled investors. Dim (2021) labels these investors nonprofessional social media investment analysts (SMAs) and finds strong herding tendencies among them. Hasso et al. (2021) find that the investor profile changed during the squeeze while small investors took both long and short positions with high trading activity and high risk affinity. This is in some contrast to the portrayed fight of retail investors against Wall Street in a simple buy-and-hold fashion. Vasileiou et al. (2021) show that there is a significant relationship between Google searches and GameStop returns. Pedersen (2021) divides investors into four categories where some focus is put on naive investors learning via social networks. The latter is of particular interest to this note.

Financial literacy is broadly defined as the understanding of a variety of financial concepts, including risk, inflation, and interest (Huston, 2010, French & McKillop, 2016). The understanding of concepts of (naked) short sales and financial derivatives is associated with this literacy. Socio-demographic characteristics affect financial literacy (Lusardy et al., 2010), in particular in young people (Huston, 2010), further promoting heterogeneity across society (Stolper & Walter, 2017). An encompassing bibliographic analysis of financial literacy is found in Gallego-Losada et al. (2021). This note links the interest in and self-education with regard to specific financial terms, market mechanisms, and the GameStop event. It is suggested that the large attraction of small investors also forces an educative component provided in social networks, for example in DD posts as analyzed in Bradley et al. (2021), and self-driven search queries in an autodidactic effort.

Section 2 provides some stylized facts on the extreme price and volatility movements. This section aids the understanding of what made this GameStop frenzy in January 2021 such an abnormal event which led to an unprecedented coverage in popular media. It also documents some key aspects of the narrative of the short squeeze such as short interest and fails to deliver which were repeatedly used in newsboards to justify an impending squeeze and to motivate a unified buy-and-hold strategy by retail investors. In Section 3, this note attempts to link these stylized facts of key figures of the GameStop squeeze event to financial literacy by providing evidence that there is an unparalleled increase in interest in definitions and explanations of financial terms and basics related to the functioning of a short squeeze as well as financial derivatives. Section 4 concludes this letter.
2. Some Stylized Facts on Prices, Trading Volumes, and Short Interest: An Example of Extremes

2.1. Data

From 13 October 2020 to 31 March 2021, high frequency data for GameStop shares are obtained from Bloomberg. This data consists of OHLC prices sampled on five-minute intervals. In addition, the number of transactions and the total number of traded shares are recorded for this frequency. The last prices per five-minute interval are used to calculate intraday returns which, in turn, are utilized to derive realized volatilities. Data sources and open access links are given in Table 1.

<table>
<thead>
<tr>
<th>Series</th>
<th>Frequency</th>
<th>Source</th>
<th>OA Link</th>
</tr>
</thead>
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<td>Intraday</td>
<td>Bloomberg</td>
<td>—</td>
</tr>
<tr>
<td>Open Interest Derivates</td>
<td>Daily</td>
<td>Bloomberg</td>
<td>—</td>
</tr>
<tr>
<td>Short Interest</td>
<td>Bi-Weekly</td>
<td>FINRA/Bloomberg</td>
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</tr>
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</tr>
<tr>
<td>Fails to Deliver</td>
<td>Daily</td>
<td>SEC</td>
<td><a href="https://www.sec.gov/data/foiadocsfailsdatahtm">https://www.sec.gov/data/foiadocsfailsdatahtm</a></td>
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<tr>
<td>Search Volume YouTube</td>
<td>Weekly</td>
<td>Google</td>
<td><a href="https://trends.google.com/trends">https://trends.google.com/trends</a></td>
</tr>
</tbody>
</table>

Table 1: Data series, frequencies, and sources of financial data and search volumes utilized in this note.

2.2. Prices and Volatility

The price development of GameStop shares is visualized in the upper plot of Figure 1 where open, high, low, and last prices per day are depicted. The extreme price movements on an intraday level starting in January 2021 are well visible. The day with the highest intraday price movements in the sample is 28 January 2021 with an intraday price range from \( p_{\text{low}} = $112.25 \) to \( p_{\text{high}} = $483.00 \).

The lower plot of Figure 1 visualizes the realized volatility of each day based on intraday returns. It becomes apparent that this volatility is abnormally high during the assumed squeeze. The magnitude of these intraday movements and resulting volatility is noteworthy as these extreme levels have rarely been observed in financial markets before. More importantly, phases of such elevated volatility affect pricing of derivatives, risk management, and might imply further market distortion with regard to delivery of outstanding shares. Several retail brokers restricted the ability to purchase shares and derivatives of GameStop and other related firms during these days as a consequence of this market behavior and clearing demands. It is yet to be clarified what exactly led to this restriction on retail level and the driving forces behind these decisions.

\[ n = 9099 \] observations over a period of \( N = 116 \) trading days.

Intraday returns are calculated as \( r_{t,j} = (\log P_{t,j} - \log P_{t,j-1}) \times 100 \) for \( j = 1, \ldots, K \) where \( K \) denotes the number of intraday returns on day \( t \) and \( P_{t,0} \) is the open price of the first five-minute interval each.
If 13 January 2021 is chosen—which marks the first day with an abnormal open-to-close return of 43.09%—to split the sample, the following basic descriptive statistics of realized volatility for these two market phases is obtained and given in Table 2. We find exceptionally high intraday volatility in the second phase and a structural change in the volatility behavior could be implied. The mean daily realized volatility, as measure of price variability, is $\overline{RV}_I = 35.20$ in the first phase—13 October 2020 to 12 January 2021—while in the second phase the mean realized volatility takes a value of $\overline{RV}_{II} = 625.31$ with a maximum on 28 January of $RV^{\text{max}} = 6212$. Hence, we observe an extreme increase in riskiness, if volatility is interpreted as such.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Max</th>
<th>Min</th>
<th>STD</th>
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</thead>
<tbody>
<tr>
<td>13 Oct '20 - 12 Jan '21</td>
<td>35.1992</td>
<td>26.6068</td>
<td>166.3035</td>
<td>8.3439</td>
<td>29.6323</td>
</tr>
<tr>
<td>13 Jan '20 - 31 Mar '21</td>
<td>625.3084</td>
<td>194.0689</td>
<td>6,212,1240</td>
<td>22.7150</td>
<td>1,073,5142</td>
</tr>
</tbody>
</table>

Table 2: Descriptive statistics of realized volatility $RV_t$ for two market phases, 13 October 2020 to 12 January 2021 and 13 January 2021 to 31 March 2021.

day. These returns are used to calculate the realized volatility of day $t$ as $RV_t = \sum_{j=1}^{K} r_{t,j}^2$.  
4Several hearings of the U.S. House Committee on Financial Services and The Committee on Banking Housing, and Urban Affairs have addressed the payment for order flow approach taken by some brokerage firms to explore its role during one-sided trading halts.
2.3. Trading Volumes

Trading volume in daily number of transactions and number of shares are calculated from intraday data and visualized in the top plot of Figure 2. It is again quite obvious that January marks an anomaly for GameStop as trading volumes spike, interestingly enough already in mid-January. The average transaction volume in number of shares per transaction per day is given in the bottom plot. A decline in this average transaction volume is depicted after a peak on 21 January which coincides with a peak in trading volume and number of transactions. The decline in average transaction volume in number of shares is likely due to the price increase. From the available aggregated data set, no inference on the trading behavior of retail investors can be made. There appears to be no significant difference in order volume throughout the day which aligns with the findings of Long et al. (2021) in terms of activity on newsboards.

![Figure 2](image)

Figure 2: *Top:* Total trading volume in number of shares and total number of transactions per day from 13 October 2020 to 31 March 2021. *Bottom:* Average transaction volume in number of shares per transaction for the same period.

2.4. Short Interest

A main driver of the frenzy around GameStop and related firms is the public information that large hedge funds have shorted the stock beyond the available free float. This

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5The short interest ratio (SIR) for GME stagnated around 120 – 130% in the months prior to the squeeze and peaked in January at 141%. These figures are calculated as the ratio of short position to average trading volume and can be interpreted as time needed to cover all short positions. With a substantial increase in trading volume in January, the SIR decreased rather quickly.
number of shares that have been sold short is reported twice per month by all brokerage firms to the FINRA. Short interest in GameStop is stable in the month preceding the extreme price movements end of January as shown in Figure 3. During the squeeze, short interest declines significantly to approximately one seventh of its initial and rather stable volume. Interestingly, a steep increase of factor 4 to 5 in open interest in Put options is observed at the same time, suggesting that there is a shift in volume to derivatives, while the open interest of Call options remains at similar levels. This yields a change in Put/Call open interest ratio from around 1 prior to the alleged squeeze to values around 3 to 5. The maximum of this ratio is observed on 1 February with 6.7669.

![Open Interest Put & Call Options in # contracts](image)

![Short Interest in # of Shares](image)

Figure 3: Short interest in GameStop (red) and open interest in Put and Call options with GameStop as underlying aggregated across all maturities (blue) from 13 October 2020 to 31 March 2021.

As the last noteworthy series, fail(s) to deliver (FTD) for GameStop are visualized in Figure 4. These numbers circulated in newsboards as evidence that the free float is drying up. From Figure 4 we find that GameStop shows elevated FTD numbers in December already, peaking end of January which aligns with the narrative of the short squeeze. Interestingly, after 28 January, FTD figures are at very low levels compared to the previous four months. The market value of FTD shares peaked on 28 January with a value of roughly 360M USD.

3. Effects on Financial Literacy

In what follows, the information dissemination on newsboards and the media coverage around the squeeze are connected with search queries based on Google Trends. We interpret these keyword searches for explanations on Google as well as for educational videos on YouTube as an approach to self-education of individuals, including but not limited to retail investors. Some of the general keywords, for example related to types of financial derivatives, are regularly searched for irrespectively of this squeeze event. Some sample

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6As per the SEC definition, shares are counted as FTD if they cannot be provided by the short seller within the standard three-day settlement period.
plots of the development of search volumes are given below. In general, it is focused on keywords that are excessively used in newsboards to explain or justify the squeeze. Keywords pertaining to this topic are “short squeeze,” “short interest” and “short sale,” for example. Other keywords are linked to investment vehicles, such as different option types.

Figure 5 visualizes the search volume for GameStop and its ticker symbol and clearly shows that the search volume peaks with the coverage in media and the price increase in late January. This translates to a general interest in this stock. The search volume for the phenomenon of a short squeeze peaks at identical times. It is noteworthy that there exist other prominent examples of short squeezes such as Volkswagen in 2008 and Tesla in early 2020. However, the search volume for short squeeze is so high in relative terms in the last week of January 2021 that the remainder of the scaled search volume score becomes negligible. This underlines that the phenomenon of a short squeeze gained much attention due to the GameStop squeeze and search volumes indicate that (Google) users herded into these keyword searches. Naturally, not every search query comes from an investor but it is still implied that this increase in search interest also promotes and fosters the understanding of the financial mechanics behind a squeeze. This aligns with the search volume on the video platform YouTube related to educational videos on the term short squeeze as given in Figure 6.

Searches related to financial derivatives, such as Call and Put options, also peak during the squeeze, as visualized in the lower plot of Figure 5. This is likely due to a high amount of explanations and investment advice on newsboards and how to use these derivatives to benefit from increasing prices. In particular the search volume on Call options and their functionality has its maximum in the last week of January. Explanatory videos on these derivatives also see an increase in traffic and searches on YouTube, as Figure 6 suggests.

Table 3 shows related search terms on Google and on YouTube to the keywords “short squeeze.” These related terms are additional searches a user ran. The connection between...
the functionality of a short squeeze and the GameStop event is evident. It also shows that other assets such as shares of AMC or precious metals such as Silver are focused on which coincides with squeezes or abnormal market behavior in these assets at the time of the GameStop squeeze.

<table>
<thead>
<tr>
<th>Related Keyword(s)</th>
<th>Score</th>
<th>Related Keyword(s)</th>
<th>Score</th>
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<td>stock short squeeze</td>
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<td>amc short squeeze</td>
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<td>what is short squeeze</td>
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</tr>
<tr>
<td>amc</td>
<td>39</td>
<td>short squeeze stocks</td>
<td>24</td>
</tr>
</tbody>
</table>

Table 3: Related search queries to the term short squeeze, ranked in relative score.
Quantifying the magnitude of the relationship of search volumes and share prices, a dynamic conditional correlation (DCC, [Engle, 2002]) model with a machine learning component for idiosyncratic volatility property identification (Klein, 2017) is applied. Figure 7 plots dynamic correlations between changes of an aggregated search volume of related queries and the highest intraday price (H). The correlation between search volume and price signaling remains at high levels from mid-January, capturing and underlining an attention and sentiment effect.

Figure 7: Smoothed dynamic correlation coefficients estimated with a modified DCC [Klein, 2017] between log returns of a search volume aggregate and intraday high (H) prices.

Overall, paired with the increased news and media coverage of the short squeeze of GameStop, a secondary effect of self-education with regard to financial terms related to this squeeze is identified from Google and YouTube search queries and related volumes. This secondary effect is of such magnitude that labeling it as autodidactic herding is indeed justified. It goes without question that the elevated interest in financial terminology positively affects financial literacy.

4. Concluding Remarks

It can be concluded that the GameStop squeeze shows signs of a perfect storm as several factors to trigger such an interest of retail investors aligned and amplified. Firstly, all information circulated on Reddit with regard to the squeeze is public. This also includes DD posts and reports of exceptional gains or losses by members of this community. In particular gains of early investors and regular posters in these boards might have triggered some fear-of-missing-out behavior. In addition, the small investor vs. large hedge funds mentality (Chohan, 2021)—or David vs. Goliath as Aharon et al. (2021) put it—attracts more retail investors to participate. Confirmation bias and sentiment (Long et al., 2021) in those newsboards as well as the deliberate spread of misinformation are likely to play an additional role in how the short squeeze panned out. However, it would be naive to believe that only small investors participated and significantly drove this squeeze.

[7] Specific subgroups/subreddits became temporarily private and only accessible to signed-up members during the squeeze.
Secondly, with the increasing availability and popularity of brokerage apps and providers on all platforms, including smartphones, trading stocks and derivatives has become remarkably easy and the barrier to entry to financial markets for small investors has virtually disappeared. An additional component is the increasing *gamification* of such investment apps. The influx of small investors is further amplified by the coverage of the frenzy in mainstream media as shown in download numbers and news heat indices.

Lastly, this note shows that self-education with regard to financial terms, keywords, and products and the understanding of basic market speculation mechanisms such as short sales plays a significant role in this frenzy. Despite the observed *memeification* of investments (and advice) on Reddit and other newsboards, it is shown that rare events like the present one positively affect financial literacy and financial affinity. This is of particular interest for further research as it is evident that social media platforms are able to cause market disruption and improve information dissemination for small investors. It is noted that the effects of these squeeze events on financial literacy cannot be fully identified or explained by keyword searches and a more encompassing analysis with some temporal distance and basic investment performance measures of relevant small investor groups is required.

Future research should be centered around the effects of social media and the ease-of-use of trading apps on financial literacy and performance beyond single events such as this rally. As small investors show an—at least temporarily—elevated awareness of short sale mechanisms, it is unclear how this affects business models of some hedge funds or future short squeeze opportunities of retail investors. It is also to be analyzed if the majority of small investors, despite signs of increased literacy, financially benefited from this squeeze. Lastly, as there is potential for market destabilizing herding effects and specifically their manipulation steering through social media, policy makers should address this frenzy in greatest detail.
References


