Did the Game Stop for Hedge Funds?

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Abstract

Can retail investors on social media platforms effectively target hedge fund short positions? We show that the disclosure of hedge fund short positions triggers activity on WallStreetBets, which in turn precipitates price increases for heavily shorted stocks. In line with a causal interpretation, the effect of social media activity on stock returns (i) emerges when short sales are publicly disclosed but not when they are settled, (ii) strengthens when social media posts reflect coordination attempts against hedge funds, and (iii) attenuates during trading restrictions imposed by Robinhood. The resultant price appreciations hurt hedge funds, which respond by shorting less aggressively, leading to prolonged overpricing.

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1. Introduction

Retail investors increasingly turn to social media for guidance on which stocks to buy and sell.[1] If social media sites offer unique, value-relevant insights, the prominence of retail investors[2] and their reliance on these platforms could enhance market efficiency. However, if social media mainly generates noise or serves as a vehicle for retail investors to coordinate for ideological or strategic purposes, it could destabilize financial markets and introduce new risks for institutional investors.

Our goal in this study is to evaluate the latter possibility and examine the corresponding implications for asset prices and market efficiency. In particular, our study asks three intertwined research questions: (i) Do retail investors increasingly coordinate on social media platforms for ideological or strategic reasons? (ii) If so, do retail investors, on balance, succeed in moving prices, and if so, how do these price movements affect institutional investors? (iii) Finally, how do institutional investors respond to this new development, and what are the broader implications for asset prices and market efficiency?

Our empirical design to tackle these questions draws inspiration from the GameStop short squeeze in January 2021. By the end of 2020, many institutional investors believed that GameStop, an American video game retailer, was overvalued and aggressively shorted the stock. These actions led retail investors on the social media site WallStreetBets (WSB) to speculate that they could use GameStop's high short interest to orchestrate a short squeeze and challenge Wall Street establishment. In January 2021, retail investors succeeded as their coordinated actions through WSB generated a dramatic rise in GameStop's price, leading to a classic short squeeze and substantial losses for many hedge funds.[3] Allen, Haas, Nowak, Pirovano, and Tengulov (2022) describe WSB-driven short squeezes in twelve other "meme" stocks during January and February 2021.

[1] "Social media is the most popular source of investment ideas for young investors, CNBC survey finds," CNBC, August 26, 2021.

[2] Retail trading in the US has grown significantly, now making up nearly a quarter of the equity trading volume ("Retail trading just hit an all-time high. Here's what stocks are the most popular," Forbes, February 3, 2023).

[3] "Melvin Capital, GameStop, and the road to disaster," The Financial Times, February 6, 2021.

To speak to our first research question—whether retail investors routinely coordinate on social media platforms—we draw from the GameStop event and examine the relationship between WSB activity and hedge funds' short positions across a broad set of stocks over an extended time period. If retail investors routinely coordinate on social media, we should observe spikes in WSB activity following the publication of high levels of short positions.

For each US stock on each day from January 2020 through March 2022, we measure WSB activity by assessing the number of posts, the number of comments, the number of unique posters, the use of emojis, and the prevalence of "meme stock" language. These five measures collectively capture the magnitude and intensity of WSB activity for a given stock on a given day.

To provide evidence that WSB activity and the publication of high levels of short positions are not spuriously correlated but, instead, causally tied, we exploit the following institutional feature. Short sellers must report their short positions to the Financial Industry Regulatory Authority (FINRA) twice a month: first, on the 15th of each month (or the preceding business day if the 15th is not a business day), and then again on the last business day of the month. We refer to these days as "settlement dates." FINRA compiles the short-interest data and discloses them to the public eight business days after the settlement dates. We refer to these days as "publication dates."

If WSB activity and short interest are simultaneously determined by fundamental news, we should observe a positive correlation between WSB activity and short interest around the settlement date. In contrast, if social media users react to the publication of short-interest data, we should observe a positive correlation between WSB activity and short interest only around the publication date.

Our evidence suggests that Reddit users do indeed coalesce and target hedge funds' short positions, as WSB activity increases only after the publication date. For instance, when it is revealed to the public that a stock is a high-short interest stock, the corresponding stock experiences an almost 60% increase in the number of WSB posts (t-statistic = 2.27). We observe no change in WSB activity around the settlement date. We also observe no significant change in WSB activity around the days the corresponding company appears in the Dow

Jones Newswires, suggesting that the spike in WSB activity is specific to news about short interest.

In additional tests, we leverage the regulatory feature, by which hedge funds must disclose their long positions in put options through Form 13F. We find that WSB activity on a stock increases noticeably when hedge funds publicly disclose that they own put options on that stock. We observe no change in WSB activity around the settlement of those put options. Again, these results are consistent with the hypothesis that retail investors target hedge funds' short positions and align with the general idea that retail investors routinely coordinate on social media platforms for ideological or strategic reasons.

To address our second question—whether retail investors succeed in moving prices, and if so, how these price movements affect institutional investors—we first examine whether the observed spikes in WSB activity are followed by noticeable stock price appreciations. We find that increases in WSB activity are followed by higher stock returns, but only if the corresponding stock's short interest is in the top one percentile ("top shorted stocks"). For this subset of stocks, a one-standard-deviation increase in the number of posts is followed by 2.25% higher next-day returns (t-statistic = 3.48).

Supporting a causal link between WSB activity and prices for these stocks, we observe that the positive returns emerge only when short positions become publicly disclosed and observable to retail investors, i.e., around short sale publication dates. We observe no positive returns around short sale settlement dates.

Further pointing to a causal relationship, we find that the association between WSB activity and stock prices strengthens substantially when the WSB posts contain terms indicative of coordination efforts (e.g., "shorts," "squeeze," or names of hedge funds with publicly disclosed put option positions in the corresponding stock). In addition, when Robinhood, a popular trading platform among retail investors, curtailed trading in various stocks to meet its capital obligations and clearinghouse deposit requirements, our effect disappears for the affected stocks, presumably as many retail investors could no longer follow through on their planned coordinated attacks against hedge funds.

How do these stock price movements affect institutional investors? Again, we utilize the regulatory feature that hedge funds need to disclose their put options holdings. This feature allows us to assess which hedge funds, at what time, have short positions in stocks with high levels of short interest. We find that hedge funds' monthly returns and Fung and Hsieh (2004) seven-factor adjusted returns negatively correlate with prior month's WSB activity on highly shorted stocks that the funds have short positions in. For instance, a one-standard-deviation increase in the monthly number of posts corresponds to a 0.43% decrease in fund returns and a 0.64% reduction in Fung and Hsieh seven-factor adjusted returns. Given the average assets under management of hedge funds in our sample ($270.61 million), these performance deteriorations translate into losses of between $1.16 million and $1.73 million a month. We find that hedge fund performance is unrelated to WSB activity on stocks that funds have short positions in, but that do not have high levels of short interest. These findings validate practitioners' concerns expressed in the popular press that it has become increasingly risky to take short positions in stocks that already are heavily shorted.

To address our third and final research question regarding hedge funds' response to this new development, we examine whether hedge funds changed their short positions after the first quarter of 2021. We consider the first quarter of 2021 as a possible inflection point because attacks on hedge funds became particularly salient in January 2021, when the price of GameStop surged and many hedge funds were squeezed.

We find that after the first quarter of 2021, hedge funds reduced both the dollar value and the number of shares in their publicly disclosed short positions on top shorted stocks. In particular, compared to the four quarters before the first quarter of 2021, hedge funds reduced the value of their publicly disclosed short positions in top shorted stocks by $345.44 million, or 56.78%. Meanwhile, hedge funds did not reduce their publicly disclosed short positions in non-top shorted stocks.

Retail investors' seemingly coordinated actions have at least two possible implications for market efficiency. First, if hedge funds are correct in taking short positions and retail investors are uninformed, retail investors' coordinated buying and the associated positive price pressure could move market prices above fundamental values. Our regression analysis shows

that stocks with high short interest and high WSB activity, subsequently, are more likely to announce negative earnings surprises, implying that hedge funds' negative assessments were generally correct and that retail investors' coordinated buying led to less efficient markets.

Increased retail investor coalescence could affect prices and market efficiency through a second, indirect channel. Our observed reduction in hedge funds' short positions post-GameStop suggests that hedge funds have become less aggressive in trading against overpricing. The less aggressive trading could result in prolonged overvaluations. In line with this view, our portfolio analysis suggests that top shorted stocks have become more overpriced relative to non-top shorted stocks after the GameStop event.

In our final analysis, we complement our observational data with a field survey conducted in April 2024. We survey 450 institutional investors from 15 countries about their views regarding retail investors' use of social media. Our survey pool is notable. 87% work for organizations managing over $100 million in assets, and 51% work for firms managing over $5 billion. 75% of the respondents have more than ten years of work experience as investment managers. The countries represented in the survey include Australia, Brazil, Canada, China, France, Germany, India, Italy, Japan, Mexico, Singapore, South Korea, Spain, the UK, and the USA.

First, we ask institutional investors to what extent they agree or disagree with the statement: "I or my team regularly monitor social media outlets/blogs/online forums to gain an understanding of what retail investors are saying about different stocks." Almost a third of our respondents agree with this statement.

Second, we inquire whether our institutional investors believe that the "meme stocks phenomenon is likely to continue or intensify over the next few years." Here, 43% agree.

Finally, we ask whether, over the past year, our institutional investors made portfolio changes "as a direct result of information gleaned from online forums." 18% of respondents agree with this statement. In other words, almost a fifth of institutional investors openly acknowledge that retail investors' social media activities had a direct impact on their investment decisions.

Overall, our survey corroborates our analyses based on observational data. Our survey, conducted more than three years after the GameStop short squeeze in January 2021, suggests that – in the eyes of institutions – the GameStop event was not a one-off occurrence. Instead, institutional investors believe that retail investors continue to coordinate. Our survey results also highlight that the effects of retail investor coordination are not confined to the US but represent a global phenomenon.

Our study adds to the growing literature on word-of-mouth effects in financial markets. With the advent of modern information technologies, an increasing share of people's interactions occurs on social media platforms. Early research on investment-oriented social media platforms shows that views and comments expressed on online platforms predict future returns and earnings surprises and, in that regard, provide a valuable resource to investors (Chen, De, Hu, and Hwang, 2014; Avery, Chevalier, and Zeckhauser, 2016; Jame, Johnston, Markov, and Wolfe, 2016). More recent work highlights the adverse effects of social media platforms, including the formation of echo chambers (Cookson, Engelberg, and Mullins, 2022) and the spread of fake news (Kogan, Moskowitz, and Niessner, 2023). Our study complements these perspectives by documenting increased retail investor coordination on a prominent social media platform and that such coordination can have adverse consequences for institutional investors and stock prices.

Our paper also relates to recent work by Hu, Jones, Li, Zhang, and Zhang (2023) who examine how WSB activity predicts retail investor flow, shorting flow, and stock returns. Our paper diverges through its focus on identification. By exploiting the time lag between settlement and publication dates and the disclosure of hedge funds' short positions through Form 13F, we provide causal evidence that retail investors target hedge funds' short positions on WSB and push up prices of stocks with high short interest. Unlike Hu et al., we also provide evidence how retail investor activity impacts institutional investors' performance and alters their future behavior.

2. Data and methodology

2.1. Social media and financial market data

Reddit is one of the most frequently visited social media platforms. From January 2024 through March 2024, it attracted more than 2.1 billion monthly visits. For comparison, during the same period, the website of the Wall Street Journal attracted 94 million monthly visits, while the SEC's website, which includes its Electronic Data Gathering, Analysis, and Retrieval system (EDGAR), attracted 7 million monthly visits.[4] Reddit consists of subcommunities known as subreddits, with WSB being one of its most prominent.

We scrape all WSB posts and comments from January 1, 2020 through March 31, 2022, using the Pushshift Application Programming Interface.[5] Our sample period includes the four quarters before and after 2021Q1, the quarter of the GameStop short squeeze.

In their posts, users frequently employ the term "$TICKER" to refer to a stock. We use this convention to assign posts to stocks. We exclude cases where a dollar sign is followed by a ticker for a stock that does not publicly trade during our sample period. We also exclude cases where a dollar sign is followed by common words, including THE, WSB, DD, ON, ALL, IN, FOR, and GO.[6]

Posts can include multiple tickers, complicating the assignment of WSB activity to a specific stock (Chen, De, Hu and Hwang, 2014). We therefore focus on single-ticker posts, which comprise 72.7% of all posts that contain at least one ticker. For a very small number of posts, the username of the poster is missing. We delete these posts.

To gauge WSB activity for stock i on day t, we construct several measures: the number of posts on day t referencing stock i, the number of unique posters of those posts, the number of comments on day t to posts referencing stock i, the number of emojis used in posts on day t referencing stock i, and the number of meme stock lingos used in these posts. Meme stock lingos include the following terms: Apes, BTFD, Diamond hands, FOMO, Hold the

[4] https://www.similarweb.com.

[5] https://files.pushshift.io/reddit/.

[6] DD is an acronym for "due diligence."

line, Paper hands, Stonks, Tendies, To the moon, and YOLO.[7]

We merge our WSB data with US stock return data from CRSP using ticker symbols.[8] We focus on stocks with CRSP share codes of 10 or 11 that trade on either the NYSE, NASDAQ, or AMEX. We restrict our sample to firms mentioned in WSB posts at least five times during our sample period. We supplement our stock return data with short-interest data from the Compustat Short Interest File, which provides mid-month and month-end short-interest data for stocks listed on the NYSE, NASDAQ, and AMEX. Our final sample comprises 378,770 posts and 9,699,133 comments on 950 stocks.

In our analysis, we differentiate between "top shorted stocks" and "non-top shorted stocks." Drawing from Asquith, Pathak, and Ritter (2005), we classify stocks as top shorted as of time t, if, at time t, they are in the top one percentile based on short interest. The average number of top shorted stocks at a given point in time is 27.41; 138 stocks are classified as top shorted at some point during our sample period.

2.2. Hedge fund data

Hedge funds' monthly net-of-fee returns and assets under management come from the Morningstar database. Since hedge funds are not required to list on commercial databases, hedge fund data are susceptible to self-selection biases. For example, hedge funds often backfill returns earned prior to their listing onto the databases. Because funds with a good track record are more likely to list on databases to attract capital, backfilled returns tend to be higher than non-backfilled returns (Liang, 2000; Fung and Hsieh, 2009; Bhardwaj, Gorton, and Rouwenhorst, 2014). To alleviate such backfill bias, we only consider the returns after the corresponding fund lists. Since Morningstar does not provide the listing dates, we rely on the Jorion and Schwarz (2019) algorithm to infer the listing dates.

We adjust hedge fund returns using the seven factors of Fung and Hsieh (2004).[9] Fung

[7] https://www.investopedia.com/meme-stock-5206762.

[8] We focus on US stocks as almost all discussions on WSB pertain to US stocks.

[9] The seven factors include the S&P 500 return minus the risk-free rate, the Russell 2000 return minus the S&P 500 return, the change in the constant maturity yield of the 10-year US Treasury bond appropriately adjusted for the duration, the change in the spread of Moody's BAA bond over the 10-year Treasury bond appropriately adjusted for duration, bond trend following factor, currency trend following factor, and

and Hsieh (2004) show that their factors can capture 84% of the variation in hedge fund index returns.

We obtain hedge funds' holdings data from Form 13F filings. Under the Securities Exchange Act of 1934, all institutional investors, including hedge fund management companies, with investment discretion over $100 million must disclose their quarter-end portfolio holdings to the SEC through Form 13F within 45 days of the quarter-end. The reported holdings include long positions in stocks as well as long positions in equity options.

We are particularly interested in hedge funds' long put option holdings, which we extract directly from the SEC's EDGAR system, as they are not included in standard commercial databases (Aragon, Martin, and Shi, 2019). The information we obtain includes the CUSIP, the fair value, and the number of shares associated with the options.

We identify hedge funds from the universe of 13F filers by matching the 13F data to our Morningstar sample via fund management company names. We are able to match our 13F data to 267 hedge fund firms that operate 1,506 hedge funds and hold put options on 1,719 unique stocks during our sample period. 70 hedge fund firms and 235 hedge funds report returns during our sample period.

2.3. Descriptive statistics

Panels A and B of Table 1 report summary statistics for various characteristics at the stock and hedge fund levels. Panel C of Table 1 compares stock characteristics between top shorted stocks and non-top shorted stocks.

Panel A shows that WSB activity for the average stock is low, with stocks averaging 0.34 posts and 9.52 comments per day. However, there is significant variation in WSB activity as the standard deviation in the number of posts and comments are 32.31 and 1,187.36, respectively. Panel C indicates that top shorted stocks attract significantly more WSB activity than non-top shorted stocks. Top shorted stocks average 5.63 posts and 248.51 comments per day, while non-top shorted stocks garner only 0.18 posts and 2.31 comments

commodity trend following factor.

per day.

Figure 1 shows that WSB activity increased substantially during 2021Q1. Compared to the four quarters preceding 2021Q1, the average number of posts per stock per day increased by 2,500%, from 0.08 posts to 2.10 posts. The increase in WSB activity for top shorted stocks is even more pronounced. Here, the number of posts per day surged by 13,000%, from 0.34 posts to 44.62 posts. After 2021Q1, WSB activity remains elevated, though not at the same level. The average number of daily posts in the four quarters following 2021Q1 is 1.45 posts, which still represents a 325% increase relative to the average number of posts in the period before 2021Q1.

3. Empirical results

3.1. Do retail investors on social media target hedge funds' short positions?

If retail investors, with the help of social media, target hedge funds' short positions, we should observe that WSB activity increases with short interest. To draw causal inferences, we do not simply correlate WSB activity with short interest. Instead, we exploit the following institutional feature: short sellers must report their positions to FINRA twice a month, once as of the settlement on the 15th (or the preceding business day if the 15th is not a business day) and again as of the last business day of the month. FINRA compiles the positions and publishes them on the 8th business day after the reporting date, creating a lag of more than eight calendar days between the reporting of short sales to FINRA (settlement date) and the dissemination of short-interest data to the public (publication date). If investors on WSB respond to short sellers, we should observe that WSB activity increases around the publication of short interest rather than the settlement of short sales. Conversely, if fundamental news triggers discussions on WSB and also causes institutions to short, we should observe a stronger relationship around the settlement date.[10]

[10] A large literature shows that negative news is much more likely to be shared and discussed (e.g., Berger (2014)).

We estimate the following regression equation:

$$\begin{aligned}\Delta WSB\ Activity_{it+1} = \alpha &+ \beta_1 High\ Short\ Interest_{it} \\ &+ \sum_i \beta_2^i Firm\ Dummy_i \\ &+ \sum_t \beta_3^t Settlement\ Cycle\ Dummy_t + \epsilon_{it}, \end{aligned} \tag{1}$$

where $\Delta WSB\ Activity$ represents the change in one of our five measures of WSB activity at the stock level: the number of posts ($\#Posts$), comments ($\#Comments$), unique posters ($\#Posters$), emojis ($\#Emojis$), and meme stock lingos ($\#Meme\ Lingos$).

We compare WSB activity on day $t + 1$ relative to the average WSB activity from days $t - 3$ through $t - 1$, where day t is either the publication date or the settlement date. There are situations where none of the posts on a particular stock from days $t - 3$ through $t - 1$ contain emojis or meme stock lingos, which prevents us from computing changes. In very few cases, there are also no comments on any of the posts from days $t - 3$ through $t - 1$. Consequently, the regressions based on $\#Comments$, $\#Emojis$, and $\#Lingos$ are estimated for a smaller number of observations.

Our key variable of interest is $High\ Short\ Interest$, which equals one if the stock is a top shorted stock as of the corresponding settlement cycle. $Firm\ Dummy$ and $Settlement\ Cycle\ Dummy$ represent firm- and settlement cycle fixed effects. Statistical inferences are based on White (1980) robust standard errors clustered by firm and settlement cycle to account for serial- and cross-correlation as well as heteroskedasticity.

Again, suppose retail investors target hedge funds' short positions. In that case, the coefficient estimates on $High\ Short\ Interest$ should be strongly positive when WSB activity is measured around the publication date. The estimates should be indistinguishable from zero when the change in WSB activity is measured around the settlement date.

This is exactly what we find. Panel A of Table 2 shows that when we consider changes in WSB activity around the publication date, the coefficient estimates for $High\ Short\ Interest$ are all positive irrespective of whether we consider changes based on $\#Posts$, $\#Comments$,

$\#Posters$, $\#Emojis$, or $\#Lingos$. In other words, WSB activity strongly increases when it is publicly disclosed that a stock is a top shorted stock. To illustrate the economic significance, the estimate in the first column reveals that when it is publicly revealed that a stock is a high short interest stock, the corresponding stock experiences an almost 60% increase in the number of WSB posts (t-statistic = 2.27).

In sharp contrast, the results in Panel B show no effect around the settlement date. Regardless of which WSB measure we employ, the coefficient estimates for $High\,Short\,Interest$ are all close to zero and statistically insignificant.

One alternative explanation for the observed spike in WSB chatter is that it reflects a general reaction to corporate news: Whenever information about a company is made public, discussions naturally arise on social media. The increase in WSB activity around the short interest publication date is therefore not special and does not imply that retail investors coordinate against hedge funds' short positions on social media. To evaluate this possibility, we examine whether WSB activity changes following the release of corporate news in the Dow Jones Newswires. The results, presented in Panel C, show little change in WSB activity around Dow Jones corporate news dates, suggesting that the increase in WSB activity is not a general response to corporate news. Instead, it is specific to the revelation of short positions.

We conduct various sensitivity analyses, all tabulated in the Online Appendix. Allen, Haas, Nowak, Pirovano, and Tengulov (2022) provide evidence that GameStop and twelve other meme stocks experienced short squeezes in January and February 2021. To examine whether our patterns extend beyond January and February 2021, we re-estimate regression equation (1) after removing January and February 2021 from our sample period. Second, we re-estimate our regression after excluding stocks with market equity below the NYSE market equity 30th percentile. Third, we focus on posts that reference the respective stocks in the title as opposed to those that reference the stock either in the title or in the body. Online Appendix Table A1 shows that our main findings carry through after applying all these adjustments. In fact, the estimates in Online Appendix Table A1 are very similar to those in Table 2.

In our next analysis, we utilize the regulatory requirement that hedge funds must disclose

their long positions in put option through Form 13F. We investigate whether the public disclosure of these positions triggers WSB activity in the corresponding stocks by estimating a regression equation similar to regression equation (1).

The dependent variables are now changes in WSB activity around the public disclosure of the short positions via put options (publication date). Unlike the level of short interest, put option positions are not all reported on the same day. 68% of the time, hedge funds wait with their disclosure until the deadline reporting date t; the deadline reporting date is 45 days after the corresponding quarter-end. In 97% of cases, hedge funds report their put option holdings within t - *2* and t. We therefore measure changes in WSB activity in two ways. First, we compare, as before, WSB activity on day t + *1* relative to the average WSB activity from days t - *3* to t - *1*, where t is the deadline reporting date. Second, we compare WSB activity on day t + *1* relative to the average WSB activity from days t - *5* to t - *3*. As a placebo test, we also compare WSB activity on the day after the corresponding quarter-end (settlement date) relative to the average WSB activity in the three days prior to the settlement date.

The key independent variable is *High HF Short Position*, which, similar to *High Short Interest*, equals one if the size of the publicly disclosed hedge fund short positions on the stock via put options (in terms of number of shares), scaled by the number of shares outstanding, resides in the top one percentile as of the corresponding settlement cycle.

The results reported in Panels A and B of Table 3 show that, irrespective of how we compute changes in WSB activity, WSB activity increases substantially when hedge funds publicly disclose that they have strong short positions in a stock via put options. The results in Panel C of Table 3 show that WSB activity does not change around the settlement date.

3.2. Do retail investors succeed when they target hedge funds' short positions?

The results in the previous subsection suggest that retail investors target hedge funds' short positions on WSB. Here, we assess whether these social media activities trigger investment decisions substantial enough to push up prices against hedge funds' short positions. We also

examine the implications of such movements for hedge fund performance.

3.2.1 WSB activity and stock returns

To test whether increased activities on WSB push up prices against hedge funds' short positions, we estimate the following regression equation on the full panel of 950 stocks from January 1, 2020 through March 31, 2022:

$$\begin{aligned} Return_{it+1} = \alpha &+ \beta_1 \ln(1 + WSB\ Activity_{it}) + \beta_2 High\ Short\ Interest_{it} \\ &+ \beta_3 \ln(1 + WSB\ Activity_{it}) * High\ Short\ Interest_{it} \\ &+ \beta_4 DowJones_{it} + \beta_5 Sentiment_{it} \\ &+ \beta_6 Analyst\ Rec\ Changes_{it} + \beta_7 Return_{it} \\ &+ \beta_8 Return_{it-5,t-1} + \beta_9 Return_{it-60,t-6} \\ &+ \beta_{10} \log(Size_{it}) + \textstyle\sum_i \beta_{11}^i Firm\ Dummy_i \\ &+ \displaystyle\sum_t \beta_{12}^t Time\ Dummy_t + \epsilon_{it}, \end{aligned} \tag{2}$$

Return is either the daily raw stock return or the daily Fama and French (2015) five-factor adjusted return, with factor loadings estimated over the prior 24 months. $WSB\ Activity$ represents one of our five measures for WSB activity, all at the stock level and as of day t: the number of posts ($\#Posts$), comments ($\#Comments$), unique posters ($\#Posters$), emojis ($\#Emojis$), and meme stock lingos ($\#Meme\ Lingos$). $High\ Short\ Interest$ is an indicator variable that takes the value of one if the stock is in the top one percentile based on its most recently disclosed short interest. *Dow Jones* is an indicator variable that takes the value of one if the stock is mentioned in the Dow Jones Newswire that day. *Sentiment* refers to the Dow Jones Newswire daily sentiment. $Analyst\ Rec\ Changes$ is the number of analyst recommendation upgrades minus the number of analyst recommendation downgrades on the stock that day. *Size* is the firm's market capitalization in US$ millions. $Firm\ Dummy$ and $Time\ Dummy$ represent firm- and year-month-day fixed effects. Statistical inferences are based on White (1980) robust standard errors clustered by firm and year-month-day to account for serial- and cross-correlation as well as heteroskedasticity.

The results in Table 4 show that increased WSB activity generally does not push up prices. The coefficient estimates of our measures of WSB activity are all insignificant. However, we find that WSB activity does strongly and positively predict returns among stocks with high levels of short interest. The coefficient estimates on the interaction terms between our measures of WSB activity and $HighShortInterest$ are all positive and statistically significant at the 1% level, irrespective of whether we consider raw returns or Fama and French (2015) five-factor adjusted returns. For instance, the coefficient estimate on the interaction between WSB activity based on the number of posts and $High\,Short\,Interest$ in Panel A of Table 4 indicates that a one-standard-deviation increase in $\#Posts$ relative to the mean precipitates a 2.25% increase in next-day raw returns (t-statistic = 3.48). These results suggest that WSB users succeed in pushing up stock prices when a stock is heavily shorted already.

The coefficient estimates on the control variables all align with expectations and the existing literature, suggesting that our regressions are well specified. In particular, stock returns positively correlate with sentiment (Tetlock, 2007), media mentions (Engelberg, Sasseville, and Williams, 2012), and analyst recommendation changes (Jegadeesh and Kim, 2010).

In additional tests, we conduct the same set of sensitivity analyses as before. First, we remove January and February 2021 from our sample period. Second, we re-estimate our regression after excluding stocks with market equity below the NYSE market equity 30th percentile. Third, we focus on posts that reference the respective stocks in the title as opposed to those that reference the stock either in the title or in the body. Online Appendix Table A2 shows that our results continue to hold. The estimates in Online Appendix Table A2 are not materially different from those in Table 4.

3.2.2 WSB activity and stock returns: additional analyses

To gauge whether it is retail investors' targeting of hedge fund short positions that causes the positive association between WSB activity and returns of stocks with high short interest, we conduct three additional tests.

In our first test, we compare the relationship between WSB activity and subsequent stock returns around the publication date to that around the settlement date. Our previous

analysis shows that WSB activity typically increases by day $t + 1$ when it is publicly disclosed on day t that a stock is highly shorted. Suppose the surge in WSB activity by day $t + 1$ is driven by retail investors who, after observing the short-interest data, try to coalesce and target stocks with high short interest. Suppose further that, by doing so, retail investors push up prices. In that case, we should see a strong positive association between WSB activity on day $t + 1$ and ensuing stock returns on day $t + 2$. We should observe no such pattern around the settlement date.

To test this prediction, we estimate a variant of regression equation (2). Our dependent variable is now the daily raw stock return or the daily Fama and French (2015) five-factor adjusted return as of day $t + 2$, where date t is either the publication date or the settlement date.[11] Our key independent variables are $WSB\,Activity$, the level of WSB activity as of day $t + 1$, and $High\,Short\,Interest$, an indicator variable that takes a value of one if the stock is in the top one percentile based on its most recently disclosed short interest. We replace the year-month-day fixed effects with settlement cycle fixed effects. Statistical inferences are now based on White (1980) robust standard errors clustered by firm and settlement cycle.

The results in Panels A and B of Table 5 show that WSB activity following the publication date strongly positively predicts raw and factor-adjusted returns among stocks with high levels of short interest. The estimates for the interaction term between WSB activity and $High\,Short\,Interest$ are all strongly positive. To provide a sense of the economic magnitude of our findings, the coefficient estimate on the interaction between WSB activity based on the number of posts and $High Short Interest$ in Panel A of Table 5 suggests that a one-standard-deviation increase in $\#Posts$ relative to the mean pushes up prices by 6.34% the next day (t-statistic = 6.01). In sharp contrast, Panels C and D of Table 5 show that the coefficient estimates on the interaction terms all become unreliable and statistically indistinguishable from zero when considering activity around the settlement date.

To further assess our interpretation that retail investor coordination on WSB and stock price increases are causally linked, we separate posts more likely to reflect coordination attempts. We then test whether the return effects primarily arise in the presence of such

[11] Factor loadings are again estimated over the prior 24 months.

posts.

To gauge the degree to which posts reflect ideological or strategic coordination attempts, we count the number of posts that include the terms "short seller" ($\#Short\,Seller$), "shorts" ($\#Shorts$), "squeeze" ($\#Squeeze$), and "Melvin" ($\#Melvin$). We consider the term "Melvin" because retail investors may refer to Melvin Capital, a prominent hedge fund that incurred significant losses from its short position in GameStop, to rally others against hedge funds and short sellers in general. We also count the number of posts that include the names of hedge funds that, as of the posting date, have short positions in the corresponding stock, as inferred by the funds' reported put option holdings ($\#HF\ Short$). Finally, we count the number of posts that include the names of hedge funds with large short positions in the stock ($\#HF\ Large\ Short$); a fund is considered to have a large short position if its put option position is in the top quintile for the corresponding reporting quarter.

We re-estimate regression equation (2) but now include interaction terms between our measures of WSB activity, $High\ Short\ Interest$, and our measures capturing the degree to which posts reflect retail investor coordination attempts.

Our findings, reported in Table 6, show that the coefficient estimates on the triple interaction terms are all positive and statistically significant at the 1% or 5% level. In other words, similar to our results comparing the association around the publication date to that around the settlement date, we find that the return effect strengthens in the presence of posts that likely reflect coordination attempts.

In related analyses, we examine how the tone of WSB posts predicts stock returns. We score the sentiment of each post using the Valence Aware Dictionary and sEntiment Reasoner (VADER), a sentiment classifier designed specifically for social media and previously employed in studies exploring the role of social media in finance (Hutto and Gilbert, 2014; Cookson, Lu, Mullins, and Niessner, 2024). Specifically, we combine the title and body of each post and apply the VADER algorithm to compute the fractions of positive and negative words. For each stock-day, we construct $WSB\ Tone$ as the average of the differences between the fraction of positive words and the fraction of negative words across all posts referencing the stock on a given day. We then re-estimate regression equation (2), replacing

$WSB\,Activity$ with $WSB\,Tone$. The results, presented in Online Appendix Table A3, show that the tone in WSB posts positively correlates with future returns, particularly for stocks with high short interest.

In our third attempt to establish causality, we exploit trading restrictions imposed by Robinhood, a trading platform favored by many retail investors, including those following WSB.

In January 2021, Robinhood raised margin requirements for the following securities: AAL, AMC, BB, BBBY, CTRM, EXPR, GME, KOSS, NAKD, NOK, SNDL, TR, and TRVG; Robinhood also restricted buy transactions by clients and automatically closed out some positions if clients were deemed at risk of not having the necessary collateral. According to Robinhood, these measures were taken to meet its capital obligations and clearinghouse deposit requirements. The trading restrictions caught many retail investors off guard and led to at least one class action suit alleging that Robinhood deprived investors of trading gains without legitimate reason.[12]

If retail investors who target hedge funds' short positions often trade through Robinhood, then the trading restrictions imposed by Robinhood should weaken the positive relationship between WSB activity and subsequent stock returns as retail investors were inhibited in their ability to follow through on their planned attacks. To test this prediction, we augment regression equation (2) with interactions between WSB Activity, *High Short Interest*, and *Restriction*. *Restriction* is an indicator variable that takes the value of one if Robinhood imposed trading restrictions on that stock that day.

The results reported in Table 7 align with our prediction. The coefficient estimates on the triple interaction terms are all negative and statistically significant at the 1% level.

Since hedge funds and other institutional investors do not trade on Robinhood, our results suggest that our observed return patterns are indeed driven by retail investors.

[12] "Robinhood restricts trading in GameStop, other names involved in frenzy," CNBC, 28 January 2021, and "Robinhood, other brokerages restrict trading on GameStop, AMC," Wall Street Journal, 28 January 2021.

3.2.3 WSB activity and hedge fund performance

What are the implications of the observed stock price movements for hedge funds with short positions in the corresponding stocks? To explore the possible effects, we estimate the following regression equation:

$$\begin{aligned} HF\ Performance_{it+1} = \alpha &+ \beta_1 \ln(1 + WSB\ Activity\ Top\ Shorted\ Stocks_{it}) \\ &+ \beta_2 \ln(1 + WSB\ Activity\ Non-Top\ Shorted\ Stocks_{it}) \\ &+ \beta_3 \ln(Size_{it}) \\ &+ \sum_j \beta_4^j Fund\ Dummy_i^j + \sum_n \beta_5^n Time\ Dummy_t^n + \epsilon_{it}, \end{aligned} \tag{3}$$

$HF\ Performance$ is either a fund's monthly return or its monthly seven-factor adjusted return from the Fung and Hsieh (2004) model, with factor loadings estimated over the prior 24 months.[13] $WSB\ Activity\ Top\ Shorted\ Stocks$ represents one of our five WSB activity measures aggregated over the previous month across all top shorted stocks in which the corresponding fund has short positions (as per the fund's reported put options holdings). $WSB Activity Non-Top Shorted Stocks$ is the analog for non-top shorted stocks. $Size$ is the fund's assets under management in US$ millions. $Fund Dummy$ and $Time Dummy$ represent fund- and year-month fixed effects. Statistical inferences are based on White (1980) robust standard errors that are clustered by hedge fund management company and year-month to account for serial- and cross-correlation as well as heteroskedasticity.

The results reported in Table 8 support the view that WSB activity in high-short-interest stocks negatively impacts next-month's performance of hedge funds with short positions in these stocks. The coefficient estimates for $WSB\ Activity\ Top\ Shorted\ Stocks$ are negative, economically meaningful, and statistically significant at the 5% or 10% level. To illustrate the economic significance, the coefficient estimates for $WSB Activity Top Shorted Stocks$ suggest that a one-standard-deviation increase relative to the mean in the monthly number of posts on top shorted stocks in which a fund has a short position leads to a 0.43% decrease in fund

[13] Our inferences do not change when we use factor loadings estimated over the past 36 months instead.

return and a 0.64% reduction in fund seven-factor alpha the following month. Given that the average hedge fund in our sample manages US$270.61 million (see Panel B in Table 1), this translates into losses of between US$1.16 million and US$1.73 million. The effects are even stronger when looking at the contemporaneous relation between WSB activity and hedge fund performances (results available upon request).[14] We do not observe a similar negative relationship between hedge fund performance and $WSB\ Activity\ Non-Top\ Shorted\ Stocks$.

Some hedge funds simultaneously hold long equity and long put positions, making them less vulnerable to WSB activity. In untabulated analyses, we find that the coefficient estimates for $WSB\ Activity\ Top\ Shorted\ Stocks$ are indeed no longer negative for these funds (results available upon request).

3.3. How do hedge funds respond to this new development and what are the implications for asset prices and market efficiency?

Increased retail investor coalescence could affect prices and market efficiency through two channels. First, if retail investors are uninformed or trade primarily for ideological or strategic reasons not rooted in fundamentals, their successful coalescence could push up prices above their fundamental values. Second, suppose that institutional investors are informed and, on average, correctly identify and target overpriced stocks. If retail investor coordination through social media heightens the risk of short selling, institutional investors may not short overpriced stocks as aggressively as before. The less aggressive arbitrage activity could lead to prolonged overpricing and less efficient markets.

To gauge the relevance of the first channel, we estimate a variant of regression equation (2). The dependent variable is now *Positive Earnings Surprise*, which takes the value of one if a firm announces a positive earnings surprise that day, and zero otherwise. Earnings surprise is the difference between the actual quarterly earnings-per-share and the average

[14]The results in Panel A of Table 5 imply that—when it is publicly disclosed on day t that a stock is highly shorted—a one-standard-deviation increase in $\#Posts$ on day $t + 1$ pushes up prices by 6.34% the next day. In additional tests, we find that, on average, prices continue to drift upwards for another month as there is persistence in both the disclosure that a stock is highly shorted and WSB activity. This persistence helps explain why we observe a negative relation between increases in WSB activity in month t and hedge fund performance in month $t + 1$.

quarterly earnings-per-share forecast across sell-side analysts in IBES.

Suppose "professional" market participants are incorrect in their negative assessment of a stock. That is, "professional" hedge funds are incorrect in taking short positions and "professional" analysts' consensus forecasts are too low. Suppose further that retail investors are correct in buying and pushing up the prices of these stocks. In that case, these stocks should subsequently announce positive earnings surprises. Conversely, if professional market participants are correct in their negative assessment and retail investors' coalescence is motivated by strategic and ideological considerations not rooted in fundamentals, these stocks should not more frequently announce positive earnings surprises.

The results in Table 9 suggest that stocks with high short interest that attract greater WSB activities more frequently disappoint. The estimates for the interaction terms are all strongly negative and statistically significant at the 1% or 5% level in three out of the five columns. These results suggest that professional investors are correct in their negative assessments. In fact, analysts' assessments are not negative enough. By coalescing and pushing up prices, retail investors therefore make markets less efficient.

To gauge the relevance of the second channel, we conduct the following analysis. A large body of literature notes that short sellers are informed and correctly identify overpriced securities. However, their shorting efforts are not substantial enough to correct prices immediately; instead, prices adjust gradually. Consequently, high short interest negatively predicts returns over the ensuing months (e.g., Asquith, Pathak, and Ritter, 2005; Diether, Lee, and Werner, 2009).

It is conceivable that since the GameStop episode, hedge funds have reduced their short positions in stocks with relatively high short interest given the perceived higher risk.

Consider a stock in the post-GameStop period with comparatively high short interest. Based on the above presumption, this stock would likely have attracted even greater short interest in the pre-GameStop period. More aggressive shorting would have corrected more of the overpricing immediately and, as a result, weakened the relationship between short interest and future returns.

The above thinking gives rise to the following hypothesis: If retail investor coordination has reduced the shorting efforts for *stocks with comparatively high short interest* in the post-GameStop period, these stocks should become even more overpriced and earn even lower future returns in the post-GameStop period. We should observe little change in future returns for *stocks with lower short interest*.

To test our presumption that hedge funds have curtailed their shorting activity in heavily shorted stocks since the GameStop short squeeze in January 2021, we evaluate the time-series in the dollar value of hedge funds' aggregate publicly disclosed short positions through their put options.

Figure 2 shows that hedge funds significantly reduced their publicly disclosed short positions in the four quarters following the GameStop short squeeze among top shorted stocks. Compared to the four quarters before 2021Q1, hedge funds reduced the dollar value of their short positions in top shorted stocks by US$345.44 million, or 56.78%. We do not observe a reduction in hedge funds' publicly disclosed short positions in non-top shorted stocks. This pattern is consistent with the idea that hedge funds have responded to the heightened risk of short selling created by retail investor coordination and curtailed their short positions in stocks that already have high levels of short interest.

To test the return implications, we form, on each short interest publication date t, a portfolio of top shorted stocks and a portfolio of non-top shorted stocks. Portfolios are value-weighted and held for one quarter. We skip day $t + 1$ to eliminate concerns about patterns induced by the bid-ask bounce in the CRSP data (Kaul and Nimalendran, 1990).

We then estimate three time-series regressions. The dependent variable is either the daily raw return of the portfolio over the risk-free rate or the daily Fama-French (2015) five-factor alpha. The independent variable, $Post - GameStop$, is an indicator, set to one for the post-GameStop period (after 2021Q1) and zero for the pre-GameStop period (before 2021Q1). The estimate on $Post-GameStop$ tells us how much more, on average, the portfolio underperforms in the post-GameStop period compared to the pre-GameStop period. We estimate the regressions separately for the portfolio of top shorted stocks and the portfolio of non-top shorted stocks. We predict that the coefficient estimate for $Post - GameStop$ be

markedly more negative for the portfolio of top shorted stocks.

The results in Table 10 align with this prediction. Top shorted stocks earn even lower future returns in the post-GameStop period than in the pre-GameStop period. In sharp contrast, there is minimal change in the performance of non-top shorted stocks. A Wald test comparing the $Post - GameStop$ estimate for top shorted stocks with that for non-top shorted stocks indicates a statistically significant difference.

Our time series is short, and our results should be interpreted with caution. Still, our results are consistent with the idea that hedge funds have begun to respond to increased retail investor coalescence by shorting less aggressively and that this has led to prolonged overpricing in the stock market.

4. Survey-based results

Overall, our analysis suggests that retail investor coordination on social media has begun to impact hedge funds' behavior and trading decisions.

One question regarding our observational data-based inference is whether the observed changes in short positions are driven by an unobserved event coinciding with the GameStop short squeeze. Another question is whether any impact on hedge fund behavior is temporary or represents a more lasting feature affecting funds and stocks across time and different markets.

This section presents complementary survey-based evidence to address these two questions. Specifically, we ask institutional investors directly how they view retail investors' activities on social media and whether these activities impact their investment decision making.

To reach institutional investors, we collaborate with CoreData Research, a market research firm that conducts investor surveys for large financial institutions. Our subject pool comprises 30 institutional investors from each of the following 15 countries for a total of 450 investors: Australia, Brazil, Canada, China, France, Germany, India, Italy, Japan, Mexico, Singapore, South Korea, Spain, the UK, and the USA. Our survey was conducted in March

and April 2024, three years after the GameStop short squeeze, yet before the return of Mr. Gill on social media in May 2024, which sparked another rally in GameStop and other meme stocks. The institutional investors in our survey work for mutual funds, pension funds, sovereign wealth funds, wealth management firms, financial adviser firms, family offices, endowment funds, foundations, or other investment firms. We require all survey participants to be actively involved in investment decisions regarding equity securities.

As shown in Table 11, 75% of our respondents have more than ten years of experience. 87% work for organizations managing over $100 million in assets; 51% work for firms managing over $5 billion.

We ask our institutional investors three questions regarding retail investors' social media activities:

To what extent do you agree or disagree with the following statements?

(S1) I or my team regularly monitor social media outlets/blogs/online forums to understand what retail investors are saying about different stocks, either through direct review or by receiving summarized data from a data vendor.

(S2) The meme stocks phenomenon (i.e., stocks gaining viral popularity due to heightened attention on social media/blogs/online forums) is likely to continue or intensify over the next few years.

(S3) In the last 12 months, we have made changes to our portfolio (e.g., sold, bought, or hedged a stock) as a direct result of information gleaned from online forums.

We report our findings in Table 11. Overall, 27.3% of all investors agree with statement (S1) that they regularly monitor the activities of retail investors on social media. This is particularly notable in the APAC region, where 29.4% agree, compared to 18.3% in North America. Furthermore, 42.9% of our survey respondents agree with statement (S2) that the "meme stocks phenomenon" is likely to continue or intensify over the next few years, with the highest agreement in Europe (48.0%) and APAC (47.2%). In other words, almost half of the institutional investors believe that retail investors continue to coalesce or will do so even more intensively in the future. Finally, 18.0% of all investors agree with statement (S3)

that they have made portfolio changes in direct response to monitoring online forums, with the strongest agreement in APAC (20.0%) and North America (20.0%).

Overall, our survey results corroborate our observational findings, demonstrating that a significant number of institutions take retail investor social media activities seriously, and that these activities can directly influence their investment decisions. This phenomenon extends beyond the US and permeates markets around the world. Furthermore, the results of our survey—conducted more than three years after the GameStop short squeeze—underscore that the rise of retail investor coordination and its effects on institutional investors are enduring trends. This conclusion aligns with recent statistics on retail investor trading. In 2021, US retail trading "*hit an all-time high*" (Forbes, February 3, 2023), accounting for a quarter of US equity trading volume.[15] By 2023, the weekly inflow of retail investors into US stocks set a new record, reaching $1.5 billion (The Business Times, 2024).[16]

5. Conclusion

Anecdotal accounts suggest that social media increasingly acts as a vehicle for retail investors to coordinate for strategic or ideological reasons. We systematically examine this possibility and its broader implications for financial markets by investigating (i) whether social media users on WSB target hedge funds' short positions, (ii) whether they are able to trigger price increases in heavily shorted stocks, and (iii) how hedge funds respond to the stock price movements induced by social media users.

We find that the disclosure of hedge fund short positions triggers WSB activity. The fact that this pattern emerges around the publication date for short-interest data and not around the settlement date suggests that high short interest and WSB activity are causally linked. Moreover, we show that WSB attention in a stock increases following the public disclosure of hedge funds' put options in the stock.

For heavily shorted stocks, WSB activity is associated with higher returns. Consistent

[15] "Retail trading just hit an all-time high. Here's what stocks are the most popular," Forbes, February 3, 2023.

[16] "A case for broadening retail access to private markets," The Business Times, May 14, 2024.

with a causal interpretation, increases in WSB activity lead to higher stock returns around the publication dates of short-interest data but not around the settlement dates. In addition, the relationship between WSB activity and stock prices is amplified when considering WSB posts more likely to reflect retail investor coordination attempts. Finally, the trading restrictions imposed by Robinhood in January 2021 attenuated the relationship between WSB attention and stock prices for stocks affected by the trading restrictions.

Hedge funds with short positions in high-short-interest stocks that attract WSB activity experience meaningful losses. Hedge funds appear to have responded to these developments by lowering their publicly disclosed short positions.

Overall, our results suggest that the GameStop short squeeze was not a one-off event. Using social media as a coordinating device, retail investors can now credibly challenge hedge funds and Wall Street establishment. Thus, while the game of short selling has certainly not stopped for hedge funds and institutional investors at large, it has fundamentally evolved to reflect the growing power of retail investors and social media.

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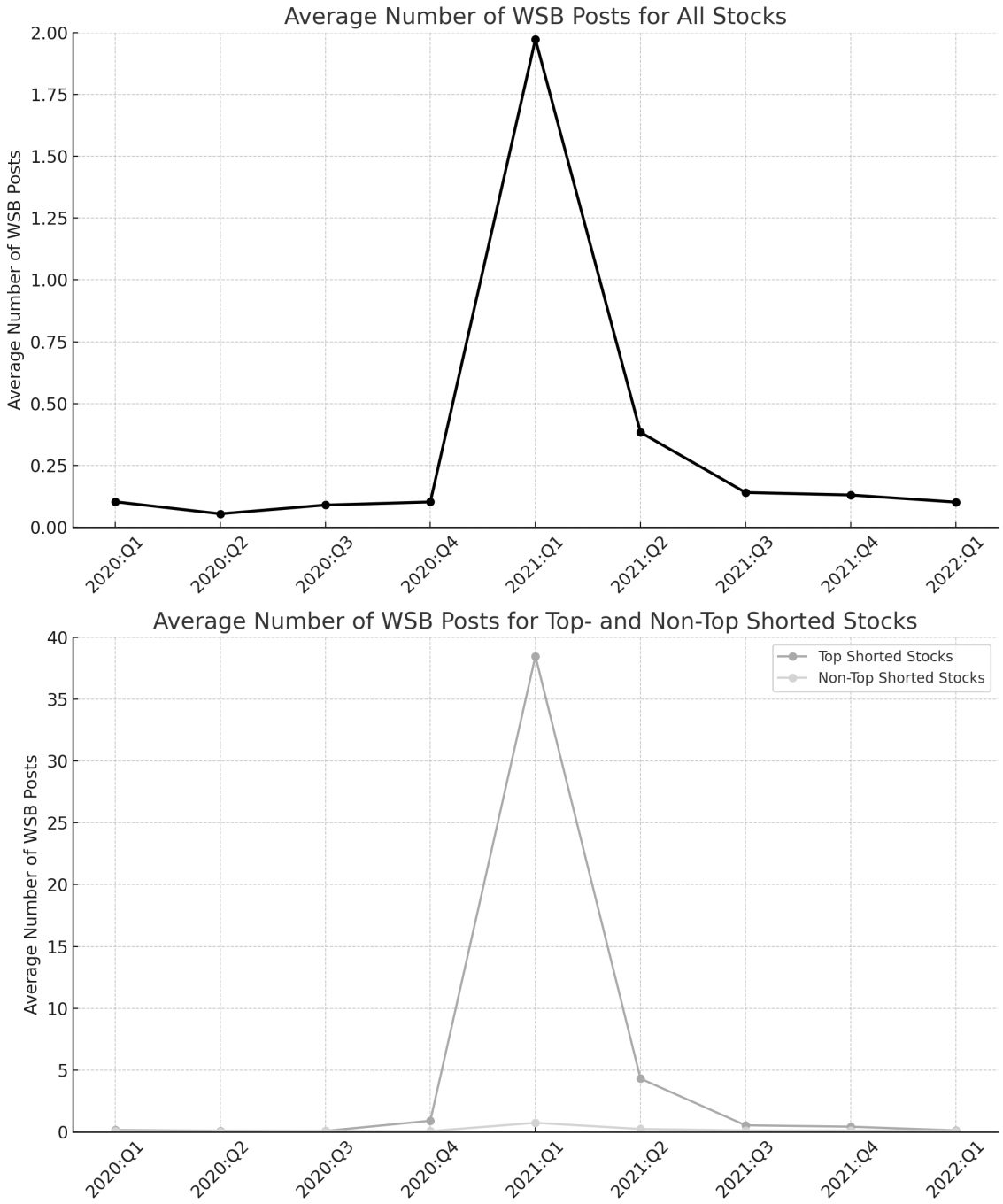

Figure 1: WSB activity over our sample period. This figure displays the average number of WSB posts per stock per day from January 1, 2020 through March 31, 2022 separately for all 950 stocks in our sample, for "top shorted stocks" and for "non-top shorted stocks." Drawing from Asquith, Pathak, and Ritter (2005), we classify stocks as top shorted if, at a particular point in time, they reside in the top one percentile based on short interest.

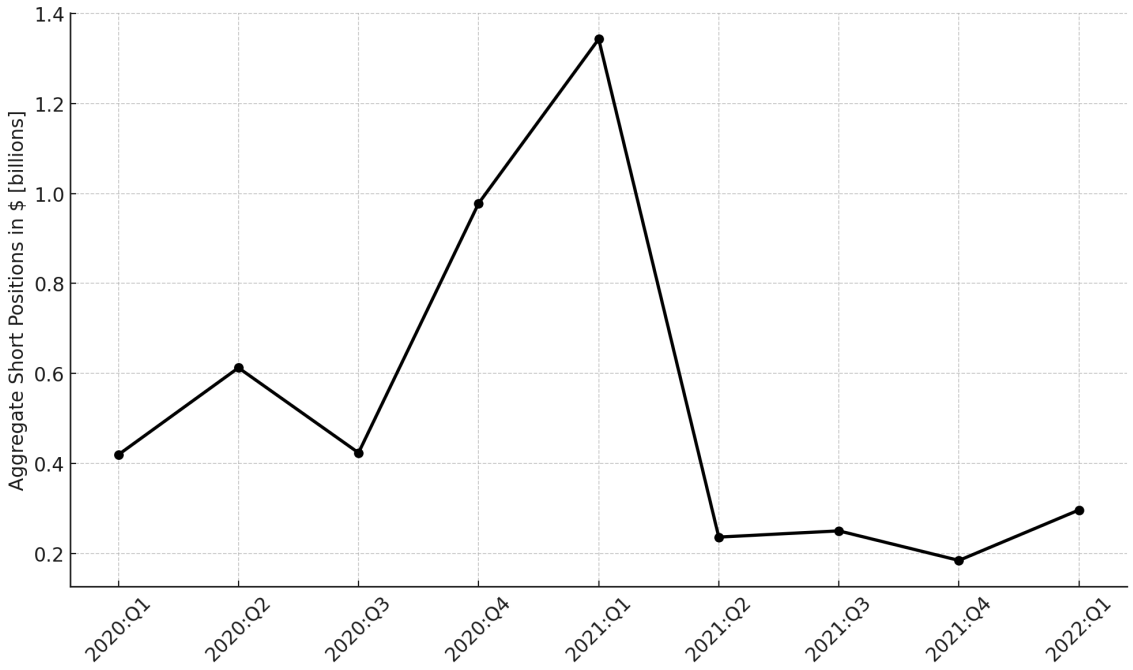

Figure 2: Hedge funds' aggregate publicly disclosed short positions before and after the first quarter of 2021. This figure displays the aggregate publicly disclosed short positions by hedge funds through long positions in put options in top shorted stocks in US$ billions from January 1, 2020 through March 31, 2022.

Table 1: **Descriptive statistics**
In this table, we present summary statistics for various variables at the stock and hedge fund levels. Our sample comprises 950 stocks from January 1, 2020 through March 31, 2022. The observations are at the stock/year-month-day level in Panels A and C and at the fund/year-month level in Panel B. In Panel C, we distinguish between "top shorted stocks" and "non-top shorted stocks." Drawing from Asquith, Pathak, and Ritter (2005), we classify stocks as top shorted if, at a particular point in time, they reside in the top one percentile based on short interest.

	Number of Observations	Mean	Std Dev	P_5	P_{25}	P_{50}	P_{75}	P_{95}
Panel A: Summary statistics for stock-level attributes								
Daily stock return (%)	463,999	0.14	6.40	-6.60	-2.02	-0.01	1.90	7.08
Daily Fama and French (2015) five-factor adjusted return (%)	449,557	0.08	6.37	-6.24	-1.78	-0.10	1.55	6.53
Short interest	463,999	0.06	0.07	0.01	0.02	0.04	0.09	0.19
Number of posts	463,999	0.34	32.31	0.00	0.00	0.00	0.00	0.00
Number of comments to posts	463,999	9.52	1187.36	0.00	0.00	0.00	0.00	0.00
Number of unique posters	463,999	0.29	28.78	0.00	0.00	0.00	0.00	0.00
Number of emojis used in posts	21,196	6.74	171.94	0.00	0.00	0.00	0.00	8.00
Number of meme stock lingos used in posts	21,196	0.98	14.04	0.00	0.00	0.00	0.00	2.00
Number of times the term "short seller" appears in posts	21,196	0.02	0.48	0.00	0.00	0.00	0.00	0.00
Number of times the term "shorts" appears in posts	21,196	0.14	2.69	0.00	0.00	0.00	0.00	0.00
Number of times the term "squeeze" appears in posts	21,196	0.32	4.50	0.00	0.00	0.00	0.00	1.00
Number of times the term "Melvin" appears in posts	21,196	0.06	2.28	0.00	0.00	0.00	0.00	0.00
Fraction of days a stock is mentioned in the Dow Jones Newswire	463,999	0.21	0.41	0.00	0.00	0.00	0.00	1.00
Dow Jones sentiment	99,442	0.63	6.05	-7.00	0.00	0.00	4.00	8.00
Number of analyst upgrades minus analyst downgrades on a stock on a particular day	463,999	-0.00	0.12	0.00	0.00	0.00	0.00	0.00
Size of hedge fund short positions through put options as a fraction of shares outstanding	463,999	0.36	0.85	0.00	0.00	0.04	0.39	1.62
Number of hedge funds with short positions through put options	463,999	4.25	5.98	0.00	0.00	1.00	7.00	16.00
Number of posts that mention hedge funds with short positions through put options	463,999	0.00	0.05	0.00	0.00	0.00	0.00	0.00
Market capitalization (US$bn)	463,999	30.56	131.85	0.02	0.18	1.65	12.49	147.64
Panel B: Summary statistics for hedge fund-level attributes								
Monthly hedge fund return (%)	2,034	0.67	3.81	-4.93	-0.92	0.67	2.30	6.11
Monthly Fung and Hsieh (2004) seven-factor adjusted return (%)	2,017	0.30	3.39	-4.24	-0.79	0.28	1.36	5.53
Assets under management (US$m)	2,034	270.61	760.68	0.03	4.13	50.00	158.12	1291.21

Table 1. Continued.

	Top-shorted stocks		Non top-shorted stocks			
	Mean	Std Dev	Mean	Std Dev	Difference	p-value
Panel C: Differences in attributes between top shorted and non-top shorted stocks						
Daily stock return (%)	0.20	7.42	0.14	6.36	-0.06	0.332
Daily Fama and French (2015) five-factor adjusted return (%)	0.18	7.17	0.07	6.35	-0.11*	0.090
Short interest	0.29	0.14	0.06	0.06	-0.24***	0.000
Number of posts	5.63	174.26	0.18	12.61	-5.45***	0.000
Number of comments to posts	248.51	6889.32	2.31	138.75	-246.20***	0.000
Number of unique posters	4.99	155.16	0.15	11.26	-4.84***	0.000
Number of emojis used in posts	50.67	560.25	2.92	68.44	-47.75***	0.000
Number of meme stock lingos used in posts	5.87	45.57	0.56	5.61	-5.31***	0.000
Number of times the term “short seller” appears in posts	0.18	1.56	0.01	0.20	-0.16***	0.000
Number of times the term “shorts” appears in posts	1.09	9.13	0.06	0.73	-1.03***	0.000
Number of times the term “squeeze” appears in posts	2.34	15.34	0.14	1.09	-2.20***	0.000
Number of times the term “Melvin” appears in posts	0.63	8.04	0.01	0.14	-0.63***	0.001
Fraction of days a stock is mentioned in the Dow Jones Newswire	0.20	0.40	0.21	0.41	0.02***	0.000
Dow Jones sentiment	-0.08	6.67	0.65	6.04	0.73***	0.000
Number of analyst upgrades on a stock on a particular day	-0.00	0.12	-0.00	0.12	0.00***	0.000
Size of hedge fund short positions through put options as a fraction of shares outstanding	1.90	2.86	0.31	0.66	-1.59***	0.000
Number of hedge funds with short positions through put options	4.66	4.50	4.24	6.02	-0.43***	0.000
Number of posts that mention hedge funds with short positions through put options	0.01	0.17	0.00	0.04	-0.01***	0.000
Market capitalization (US$bn)	1.94	3.39	31.42	133.73	29.49***	0.000

Table 2: **Changes in WSB activity after the disclosure of short interest data**
In this table, we present coefficient estimates from regressions of changes in WSB activity on an indicator of whether the corresponding stock is a highly shorted stock. The dependent variable represents the change in one of our five measures of WSB activity at the stock level: the number of posts (Column 1), comments (Column 2), unique posters (Column 3), emojis (Column 4), and meme stock lingos (Column 5). We compare WSB activity on day *t + 1* relative to the average WSB activity from days *t - 3* through *t - 1*, where day *t* is either the publication date (Panel A), the settlement date (Panel B) or any date the corresponding company is mentioned in the Dow Jones Newswires (Panel C). There are situations where none of the posts on a particular stock from days *t - 3* through *t - 1* come with comments or contain emojis or meme stock lingos, which prevents us from computing changes. Consequently, the regressions in Columns 2, 4, and 5 are estimated for a smaller number of observations. Our independent variable is *High Short Interest*, which equals one if the stock's short interest resides in the top one percentile as of the corresponding settlement cycle. We include firm and settlement cycle fixed effects. Statistical inferences are based on White (1980) robust standard errors clustered by firm and settlement cycle to account for serial- and cross-correlation as well as heteroskedasticity. The sample period is from January 1, 2020 to March 31, 2022. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

	WSB activity				
	#Posts	*#Comments*	*#Posters*	*#Emojis*	*#Lingos*
Independent variable	(1)	(2)	(3)	(4)	(5)
Panel A: Change in WSB activity around the publication date					
High Short Interest	0.575**	0.517*	0.655***	1.241***	0.583**
	(2.27)	(1.78)	(2.89)	(3.28)	(2.51)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Settlement Cycle Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.234	0.102	0.255	0.223	0.219
#Observations	2,181	1,826	2,181	787	750
Panel B: Change in WSB activity around the settlement date [Placebo 1]					
High Short Interest	0.072	-0.058	0.069	-0.039	-0.014
	(0.91)	(-0.54)	(1.01)	(-0.33)	(-0.18)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Settlement Cycle Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.098	0.043	0.105	-0.005	0.097
#Observations	2,665	2,234	2,665	1,133	991
Panel C: Change in WSB activity around Dow Jones news date [Placebo 2]					
High Short Interest	0.170	0.174	0.169**	-0.343	0.002
	(1.58)	(0.16)	(2.08)	(-1.20)	(0.02)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Settlement Cycle Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.142	0.033	0.161	0.110	0.092
#Observations	7,409	6,556	7,409	2,857	2,836

Table 3: **Changes in WSB activity after the disclosure of hedge funds' short positions via put options**

In this table, we present coefficient estimates from regressions of changes in WSB activity on an indicator of whether hedge funds have high short positions in the corresponding stock via put options. Hedge funds must publicly disclose their put option positions quarterly via Form 13F within 45 days of the corresponding quarter-end. 68% of the time, hedge funds wait with their disclosure until the deadline date t, which is 45 days after the corresponding quarter-end. In 97% of cases, hedge funds report their put option holdings within $t-2$ and t. The dependent variable represents the change in one of our five measures of WSB activity at the stock level: the number of posts (Column 1), comments (Column 2), unique posters (Column 3), emojis (Column 4), and meme stock lingos (Column 5). We measure changes in WSB activity in two ways. First, we compare, as in Table 2, WSB activity on day $t+1$ relative to the average WSB activity from days $t-3$ to $t-1$ (Panel A). Second, we compare WSB activity on day $t+1$ relative to the average WSB activity from days $t-5$ to $t-3$ (Panel B). As a placebo test, we also compare WSB activity on the day after the corresponding quarter-end (settlement date) relative to the average WSB activity in the three days prior to the settlement date (Panel C). Our independent variable of interest is *High HF Short Position*, which equals one if the size of publicly disclosed hedge fund short positions on the stock (in terms of number of shares), scaled by the number of shares outstanding, resides in the top one percentile as of the corresponding settlement cycle. We include firm and settlement cycle fixed effects. Statistical inferences are based on White (1980) robust standard errors clustered by firm and settlement cycle to account for serial- and cross-correlation as well as heteroskedasticity. The sample period is from January 1, 2020 to March 31, 2022. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

	WSB Activity				
	#Posts	*#Comments*	*#Posters*	*#Emojis*	*#Lingos*
Independent variable	(1)	(2)	(3)	(4)	(5)
Panel A: Change in WSB activity around the disclosure date, assuming a one-day 13F filing window					
High HF Short Position	0.889**	1.124**	0.803**	1.230**	0.539
	(3.08)	(2.62)	(2.52)	(3.11)	(0.82)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Settlement Cycle Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.433	0.346	0.441	0.686	0.506
#Observations	844	718	844	159	148
Panel B: Change in WSB activity around the disclosure date, assuming a three-day 13F filing window					
High HF Short Position	1.210***	2.491***	0.835*	0.147	0.594
	(4.97)	(4.12)	(2.09)	(0.66)	(1.27)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Settlement Cycle Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.146	0.044	0.162	0.519	0.105
#Observations	527	409	527	170	155
Panel C: Change in WSB activity around the settlement date [Placebo]					
High HF Short Position	-0.206	1.987	-0.119	-0.514	0.070
	(-0.47)	(1.76)	(-0.27)	(-0.78)	(0.46)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Settlement Cycle Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.352	0.284	0.339	0.422	0.580
#Observations	739	589	739	184	164

Table 4: **WSB activity and stock returns**
In this table, we present coefficient estimates from regressions of returns on measures of WSB activity and a high short-interest indicator. The dependent variable is either the daily raw stock return (Panel A) or the daily Fama and French (2015) five-factor adjusted return (Panel B) of a stock. Our key independent variables are $WSB\,Activity$ and $High\,Short\,Interest$. $WSB\,Activity$ represents one of our five measures for WSB activity, all at the stock level and as of day t: the number of posts (Column 1), comments (Column 2), unique posters (Column 3), emojis (Column 4), and meme stock lingos (Column 5). *High Short Interest* is an indicator variable that takes a value of one if the stock is in the top one percentile of stocks based on the most recently disclosed short interest. Firm controls include: $DowJones$, an indicator variable that takes a value of one if the stock is mentioned by any Dow Jones Newswire that day; $Sentiment$, the Dow Jones Newswire daily sentiment; $Analyst\,Rec\,Changes$, the number of analyst recommendation upgrades minus the number of recommendation downgrades on a stock on a day; and $Size$, the firm's market capitalization. We include firm and year-month-day fixed effects. Statistical inferences are based on White (1980) robust standard errors clustered by firm and year-month-day. The sample period is from January 1, 2020 to March 31, 2022. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

	WSB activity				
	#Posts	*#Comments*	*#Posters*	*#Emojis*	*#Lingos*
Independent variable	(1)	(2)	(3)	(4)	(5)
Panel A: Regressions based on raw stock returns (%)					
High Short Interest	-0.188*	-0.161	-0.183*	-0.140	-0.133
	(-1.73)	(-1.44)	(-1.69)	(-1.30)	(-1.25)
ln(1+*WSB Activity*)	0.163	0.067	0.190	0.128	0.349
	(1.00)	(1.39)	(1.02)	(0.56)	(1.24)
ln(1+*WSB Activity*)**High Short Interest*	0.697***	0.330***	0.716***	0.825***	1.208***
	(3.48)	(3.24)	(3.45)	(4.30)	(5.05)
Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.112	0.112	0.112	0.112	0.112
#Observations	463,999	463,999	463,999	463,999	463,999
Panel B: Regressions based on Fama and French (2015) five-factor adjusted returns (%)					
High Short Interest	-0.081	-0.058	-0.076	-0.029	-0.023
	(-0.69)	(-0.48)	(-0.65)	(-0.25)	(-0.19)
ln(1+*WSB Activity*)	0.247	0.092*	0.278	0.202	0.448
	(1.46)	(1.86)	(1.44)	(0.83)	(1.61)
ln(1+*WSB Activity*)**High Short Interest*	0.718***	0.368***	0.736***	0.785***	1.140***
	(5.91)	(5.08)	(6.07)	(6.46)	(7.94)
Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.018	0.018	0.018	0.018	0.018
#Observations	449,557	449,557	449,557	449,557	449,557

Table 5: **WSB activity and stock returns: Publication date versus settlement date**
In this table, we replicate the analysis tabulated in Table 4, but consider only the returns after the short interest publication versus the short interest settlement date. Our dependent variable is now the daily raw stock return (Panels A and C) or the daily Fama and French (2015) five-factor adjusted return (Panels B and D) as of day $t+2$, where date t is either the publication date (Panels A and B) or the settlement date (Panels C and D). Our key independent variables are *WSB Activity*, the level of WSB activity as of day $t+1$, and *High Short Interest*, an indicator variable that takes a value of one if the stock is in the top one percentile of stocks based on the most recently disclosed short interest. We replace the year-month-day fixed effects with settlement cycle fixed effects. Statistical inferences are now based on White (1980) robust standard errors clustered by firm and settlement cycle. The sample period is from January 1, 2020 to March 31, 2022. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

	WSB activity				
	#Posts	*#Comments*	*#Posters*	*#Emojis*	*#Lingos*
Independent variable	(1)	(2)	(3)	(4)	(5)
Panel A: Regressions based on raw stock returns (%) around the publication date					
High Short Interest	-0.143	0.013	-0.146	0.077	0.125
	(-0.39)	(0.04)	(-0.39)	(0.21)	(0.35)
ln(1+*WSB Activity*)	0.120	0.115	0.139	0.034	0.897*
	(0.54)	(1.29)	(0.58)	(0.15)	(1.74)
ln(1+*WSB Activity*)**High Short Interest*	1.963***	0.908***	2.076***	1.918***	2.375***
	(6.01)	(3.69)	(6.18)	(6.10)	(4.19)
Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Settlement Cycle Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.269	0.268	0.269	0.268	0.269
#Observations	84,284	84,284	84,284	84,284	84,284
Panel B: Regressions based on Fama and French (2015) five-factor adjusted returns (%) around the publication date					
High Short Interest	0.184	0.332	0.182	0.390	0.425
	(0.58)	(1.10)	(0.57)	(1.21)	(1.35)
ln(1+*WSB Activity*)	-0.234	-0.026	-0.238	-0.135	0.398
	(-1.14)	(-0.29)	(-1.07)	(-0.58)	(0.83)
ln(1+*WSB Activity*)**High Short Interest*	1.808***	0.800***	1.916***	1.671***	2.167***
	(6.77)	(3.81)	(6.97)	(5.83)	(4.63)
Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Settlement Cycle Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.009	0.008	0.009	0.009	0.009
#Observations	84,284	84,284	84,284	84,284	84,284

Table 5. Continued.

	WSB activity				
	#Posts	*#Comments*	*#Posters*	*#Emojis*	*#Lingos*
Independent variable	(1)	(2)	(3)	(4)	(5)
Panel C: Regressions based on raw stock returns (%) around the settlement date [Placebo]					
High Short Interest	-0.553*	-0.484	-0.548*	-0.505	-0.519*
	(-1.76)	(-1.69)	(-1.74)	(-1.66)	(-1.78)
ln(1+*WSB Activity*)	-0.087	-0.049	-0.098	-0.047	-0.246
	(-0.43)	(-0.48)	(-0.44)	(-0.18)	(-0.56)
ln(1+*WSB Activity*)**High Short Interest*	0.974	0.316	1.034	1.454	3.365
	(0.93)	(0.66)	(0.86)	(1.51)	(1.62)
Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Settlement Cycle Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.102	0.102	0.102	0.102	0.102
#Observations	51,112	51,112	51,112	51,112	51,112
Panel D: Regressions based on Fama and French (2015) five-factor adjusted returns (%) around the settlement date [Placebo]					
High Short Interest	-0.556*	-0.526*	-0.556*	-0.559*	-0.579**
	(-1.83)	(-1.83)	(-1.84)	(-1.92)	(-2.16)
ln(1+*WSB Activity*)	0.014	-0.003	0.029	-0.037	-0.058
	(0.06)	(-0.02)	(0.11)	(-0.15)	(-0.11)
ln(1+*WSB Activity*)**High Short Interest*	0.508	0.192	0.557	1.172	3.024
	(0.49)	(0.40)	(0.48)	(1.20)	(1.71)
Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Settlement Cycle Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.007	0.007	0.007	0.008	0.008
#Observations	51,112	51,112	51,112	51,112	51,112

Table 6: **WSB activity and stock returns: The impact of WSB posts that reflect coordination attempts against hedge funds and short sellers**

In this table, we replicate the analysis tabulated in Table 4, but now include interaction terms with measures of the degree to which posts reflect ideological or strategic coordination attempts. To gauge the degree to which posts reflect ideological or strategic coordination attempts, we count the number of posts that include the terms "short seller" (Panel A), "shorts" (Panel B), "squeeze" (Panel C), and "Melvin" (Panel D). We consider the term "Melvin" because retail investors may refer to Melvin Capital, a prominent hedge fund that incurred significant losses from its short position in GameStop, to rally others against hedge funds and short sellers in general. We also count the number of posts that include the names of hedge funds that currently have short positions in the corresponding stock, as inferred by the funds' reported put option holdings (Panel E). Finally, we count the number of posts that include the names of hedge funds with large short positions in the stock (Panel F). A fund is considered to have a large short position if its put option position is in the top quintile for the corresponding reporting quarter. The sample period is from January 1, 2020 to March 31, 2022. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

Regressions based on raw stock returns (%)					Regressions based on Fama and French (2015) five-factor adjusted returns (%)				
WSB activity									
#Posts	*Comments*	*#Posters*	*#Emojis*	*#Lingos*	*#Posts*	*Comments*	*#Posters*	*#Emojis*	*#Lingos*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Interaction between ln(1+*WSB Activity*), *High Short Interest*, and ln(1+*#Short Seller*)									
0.811***	0.898***	0.779***	1.115***	1.021***	0.815***	0.694***	0.781***	1.101***	0.950***
(4.45)	(7.88)	(4.41)	(7.42)	(4.39)	(4.82)	(6.87)	(4.78)	(7.40)	(4.31)
Panel B: Interaction between ln(1+*WSB Activity*), *High Short Interest*, and ln(1+*#Shorts*)									
0.527***	0.515***	0.495***	0.391***	0.901***	0.449***	0.466**	0.416***	0.401***	0.798***
(7.47)	(4.57)	(6.64)	(6.26)	(6.14)	(4.06)	(2.01)	(4.32)	(2.88)	(2.59)
Panel C: Interaction between ln(1+*WSB Activity*), *High Short Interest*, and ln(1+*#Squeeze*)									
0.265***	0.295***	0.242***	0.155**	0.507***	0.241***	0.266***	0.215***	0.143**	0.457***
(4.13)	(6.95)	(3.86)	(2.58)	(5.58)	(4.07)	(4.93)	(3.65)	(2.56)	(4.26)
Panel D: Interaction between ln(1+*WSB Activity*), *High Short Interest*, and ln(1+*#Melvin*)									
0.767***	0.812***	0.718***	1.098***	0.928***	1.036***	0.946***	0.999***	1.347***	1.244***
(7.07)	(15.24)	(6.52)	(12.53)	(6.54)	(15.10)	(27.37)	(14.49)	(19.97)	(13.33)
Panel E: Interaction between ln(1+*WSB Activity*), *High Short Interest*, and *#HF Short*									
0.055***	0.046***	0.059***	0.064***	0.072**	0.041**	0.034***	0.043**	0.058***	0.050
(3.71)	(4.75)	(3.64)	(6.10)	(2.49)	(2.53)	(4.07)	(2.43)	(4.58)	(1.61)
Panel F: Interaction between ln(1+*WSB Activity*), *High Short Interest*, and *#HF Large Short*									
0.274***	0.217***	0.291***	0.281***	0.338***	0.206***	0.163***	0.213***	0.253***	0.240*
(4.44)	(5.29)	(4.34)	(4.61)	(2.80)	(3.00)	(4.98)	(2.90)	(3.70)	(1.96)

Table 7: **WSB activity and stock returns: The impact of Robinhood's trading restrictions**
In this table, we replicate the analysis tabulated in Table 4, but now include interaction terms with a measure of whether Robinhood restricted trading in a particular stock on a particular day. In particular, *Restriction* is an indicator variable set to one if Robinhood imposed trading restrictions on that stock that day. The sample period is from January 1, 2020 to March 31, 2022. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

	WSB activity				
	#Posts	*#Comments*	*#Posters*	*#Emojis*	*#Lingos*
Independent variable	(1)	(2)	(3)	(4)	(5)
Panel A: Regressions based on raw stock returns (%)					
High Short Interest	-0.223*	-0.181	-0.218*	-0.156	-0.151
	(-1.92)	(-1.55)	(-1.90)	(-1.38)	(-1.39)
*High Short Interest*Restriction*	-0.261	1.573	0.164	1.581	-1.208
	(-0.04)	(0.30)	(0.02)	(0.29)	(-0.26)
ln(1+*WSB Activity*)	0.196	0.074	0.230	0.177	0.471*
	(1.21)	(1.58)	(1.24)	(0.77)	(1.79)
ln(1+*WSB Activity*)**High Short Interest*	0.964***	0.436***	1.018***	1.173***	1.773***
	(3.56)	(3.03)	(3.73)	(4.78)	(7.65)
ln(1+*WSB Activity*)**Restriction*	0.516	0.431	0.538	0.316	-0.728
	(0.34)	(0.45)	(0.35)	(0.24)	(-0.49)
ln(1+*WSB Activity*)**High Short Interest*Restriction*	-1.901***	-1.450***	-2.056***	-2.459***	-2.535***
	(-3.39)	(-4.59)	(-3.70)	(-4.59)	(-2.97)
Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.112	0.112	0.112	0.112	0.112
#Observations	463,999	463,999	463,999	463,999	463,999
Panel B: Regressions based on Fama and French (2015) five-factor adjusted returns (%)					
High Short Interest	-0.117	-0.075	-0.113	-0.046	-0.041
	(-0.99)	(-0.62)	(-0.95)	(-0.39)	(-0.36)
*High Short Interest*Restriction*	-2.622	-1.170	-2.255	-1.133	-3.838
	(-0.34)	(-0.21)	(-0.30)	(-0.20)	(-0.77)
ln(1+*WSB Activity*)	0.237	0.098**	0.270	0.215	0.556**
	(1.43)	(2.00)	(1.44)	(0.91)	(2.06)
ln(1+*WSB Activity*)**High Short Interest*	1.023***	0.478***	1.077***	1.164***	1.760***
	(4.66)	(4.26)	(5.01)	(6.12)	(11.32)
ln(1+*WSB Activity*)**Restriction*	0.684	0.501	0.701	0.458	-0.626
	(0.46)	(0.55)	(0.48)	(0.37)	(-0.45)
ln(1+*WSB Activity*)**High Short Interest*Restriction*	-1.918***	-1.399***	-2.060***	-2.346***	-2.361***
	(-3.48)	(-4.55)	(-3.77)	(-4.46)	(-2.75)
Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.020	0.020	0.021	0.020	0.021
#Observations	449,557	449,557	449,557	449,557	449,557

Table 8: **WSB activity and hedge fund performance**
In this table, we present coefficient estimates from regressions of hedge fund performance measures on measures of WSB activity among stocks the funds have short positions in. The dependent variable is either a fund's monthly return (Panel A) or its monthly seven-factor adjusted return from the Fung and Hsieh (2004) model (Panel B). Our key independent variables are *WSB Activity Top Shorted Stocks*, which represents one of our five WSB activity measures aggregated over the previous month across all top shorted stocks in which the corresponding fund has short positions (as per the fund's reported put options holdings), and *WSB Activity Non-Top Shorted Stocks*, which is the analog for non-top shorted stocks. *Size* is fund assets under management in US$ millions. We include fund and year-month fixed effects. Statistical inferences are based on White (1980) robust standard errors that are clustered by hedge fund management company and year-month. The sample period is from January 1, 2020 to March 31, 2022. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

	WSB activity				
	#Posts	*#Comments*	*#Posters*	*#Emojis*	*#Lingos*
Independent variable	(1)	(2)	(3)	(4)	(5)
Panel A: Regressions based on hedge fund raw returns (%)					
ln(1+*WSB Activity Top Shorted Stocks*)	-0.273**	-0.203**	-0.280**	-0.206*	-0.235*
	(-2.33)	(-2.46)	(-2.41)	(-2.10)	(-2.22)
ln(1+*WSB Activity Non-Top Shorted Stocks*)	0.103	0.006	0.101	0.108	0.082
	(0.84)	(0.05)	(0.76)	(0.66)	(0.82)
log(*Size*)	-0.905**	-0.874**	-0.902**	-0.909**	-0.899**
	(-2.52)	(-2.64)	(-2.53)	(-2.49)	(-2.51)
F-test: ln(1+*WSB Activity Top Shorted Stocks*) − ln(1+*WSB Activity Non-Top Shorted Stocks*) = 0	14.69***	5.23*	13.19***	3.29	8.14**
Fund Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.374	0.374	0.374	0.373	0.372
#Observations	2,034	2,034	2,034	2,034	2,034
Panel B: Regressions based on hedge fund Fung and Hsieh (2004) seven-factor adjusted returns (%)					
ln(1+*WSB Activity Top Shorted Stocks*)	-0.408**	-0.278**	-0.413**	-0.320**	-0.434***
	(-3.12)	(-3.14)	(-3.21)	(-2.93)	(-3.88)
ln(1+*WSB Activity Non-Top Shorted Stocks*)	0.282**	0.131*	0.277**	0.162	0.308
	(2.55)	(1.95)	(2.40)	(1.03)	(1.83)
log(*Size*)	-0.329	-0.295	-0.324	-0.332	-0.321
	(-1.26)	(-1.25)	(-1.25)	(-1.27)	(-1.23)
F-test: ln(1+*WSB Activity Top Shorted Stocks*) − ln(1+*WSB Activity Non-Top Shorted Stocks*) = 0	40.50***	25.77***	41.08***	7.54**	13.77***
Fund Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.066	0.065	0.066	0.063	0.065
#Observations	2,017	2,017	2,017	2,017	2,017

Table 9: **Impact of retail investor coordination on the pricing of highly shorted stocks: Evidence from subsequent earnings announcements**
In this table, we replicate the analysis tabulated in Table 4, but now consider a different dependent variable. The dependent variable is now *PositiveEarningsSurprise*, which equals one if a firm announces a positive earnings surprise that day, and zero otherwise. Earnings surprise is the difference between the actual quarterly earnings-per-share and the average quarterly earnings-per-share forecast across sell-side analysts in IBES. The sample period is from January 1, 2020 to March 31, 2022. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

	WSB activity				
	#Posts	*#Comments*	*#Posters*	*#Emojis*	*#Lingos*
Independent variable	(1)	(2)	(3)	(4)	(5)
High Short Interest	-0.001	-0.001	-0.001	-0.002*	-0.001
	(-1.22)	(-1.30)	(-1.22)	(-1.76)	(-1.45)
ln(1+*WSB Activity*)	0.004***	0.002***	0.004***	0.001	0.005***
	(3.56)	(4.33)	(3.55)	(1.08)	(2.31)
ln(1+*WSB Activity*)***High Short Interest*	-0.004***	-0.002**	-0.004***	-0.001	-0.006*
	(-2.90)	(-2.57)	(-2.99)	(-0.67)	(-2.52)
Firm Controls	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.026	0.026	0.026	0.026	0.026
#Observations	463,999	463,999	463,999	463,999	463,999

Table 10: **Impact of retail investor coordination on the pricing of highly shorted stocks: Evidence from changes in long-run stock performance around the GameStop episode**
This table reports regressions of raw returns and alphas of portfolios on a post-versus pre-GameStop Indicator. On each short interest publication date t, we form a portfolio of top-shorted stocks and a portfolio of non-top-shorted stocks. The portfolios are value-weighted and held for a quarter. We skip day *t+1* to eliminate concerns about patterns induced by the bid-ask bounce in the CRSP data (Kaul and Nimalendran, 1990). The dependent variable is the performance of the portfolios in terms of daily raw performance over the risk-free rate (Panel A) and daily Fama and French (2015) five-factor alphas (Panel B). The independent variable is an indicator set to one for the post-GameStop short squeeze period (after 2021Q1) and zero for the pre-GameStop short squeeze period (before 2021Q1). Columns 1 and 2 show t-statistics in parentheses. Column 3 reports the difference in coefficient estimates between Columns 1 and 2 and, in brackets, the p-value from a Wald test (Zellner, 1962). The sample period is from January 1, 2020 to March 31, 2022. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Top-Shorted Stocks	Non-Top-Shorted Stocks	Difference
Independent variable	(1)	(2)	(3)
Panel A: Regressions based on raw stock returns (%)			
Post-GameStop	-0.431	-0.064	-0.367**
	(-1.64)	(-0.39)	[0.03]
Adj. R^2	0.004	-0.002	
#Observations	488	488	
Panel B: Regressions based on Fama and French (2015) five-factor adjusted returns (%)			
Post-GameStop	-0.267*	-0.003	-0.264*
	(-1.74)	(-0.38)	[0.09]
Adj. R^2	0.005	-0.002	
#Observations	458	458	

Table 11: **Impact of retail investor coordination on institutional investor behavior: Survey-based evidence**
This table reports our survey responses. Our subject pool comprises 30 institutional investors from each of the following 15 countries for a total of 450 investors: Australia, Brazil, Canada, China, France, Germany, India, Italy, Japan, Mexico, Singapore, South Korea, Spain, the UK, and the USA. Column 1 reports the results across all 450 investors. Columns 2-5 separate the responses across four regions: APAC, which includes 180 investors from Australia, China, India, Japan, Singapore and South Korea; Europe, which includes 150 investors from France, Germany, Italy, Spain and the UK; Latin America, which includes 60 investors from Brazil and Mexico; North America, which includes 60 investors from Canada and the USA.

		Region			
	All Investors	APAC	Europe	Latin America	North America
	(1)	(2)	(3)	(4)	(5)
(D1) "How old are you?"					
Below 35 years	8.90%	10.60%	6.00%	11.70%	8.30%
35-44 years	38.40%	46.10%	36.70%	30.00%	28.30%
45-54 years	35.10%	28.90%	44.00%	36.70%	30.00%
55 years and above	17.60%	14.40%	13.30%	21.70%	33.30%
(D2) "What is your gender?"					
Male	90.40%	88.90%	91.30%	91.70%	91.70%
Female	8.40%	9.40%	7.30%	8.30%	8.30%
Prefer not to say	1.10%	1.70%	1.30%	0.00%	0.00%
(D3) "For how many years have you worked as an investment professional / fund manager?"					
5 years or less	6.90%	10.00%	2.00%	13.30%	3.30%
6-10 years	17.80%	23.30%	12.70%	16.70%	15.00%
11-20 years	43.10%	44.40%	45.30%	38.30%	38.30%
More than 20 years	32.20%	22.20%	40.00%	31.70%	43.30%
(D4) "What is your organization's total assets under management (in US Dollars)?"					
$10m to $99.9m	12.90%	12.20%	13.30%	15.00%	11.70%
$100m to $249.9m	9.30%	10.60%	9.30%	6.70%	8.30%
$250m to $999.9m	9.10%	8.30%	8.70%	13.30%	8.30%
$1bn to $4.99bn	17.80%	16.70%	18.70%	25.00%	11.70%
$5bn to $9.99bn	12.20%	13.30%	6.70%	21.70%	13.30%
$10bn to $19.99bn	8.40%	8.90%	7.30%	6.70%	11.70%
$20bn to $49.99bn	9.60%	9.40%	12.00%	8.30%	5.00%
$50bn+	20.70%	20.60%	24.00%	3.30%	30.00%

Table 11. Continued.

	All Investors	Region			
		APAC	Europe	Latin America	North America
	(1)	(2)	(3)	(4)	(5)
"To what extent do you agree or disagree with the following statements?"					
(S1) "I or my team regularly monitor social media outlets/blogs/online forums to gain an understanding of what retail investors are saying about different stocks, either through direct review or by receiving summarized data from a data vendor."					
Agree	27.30%	29.40%	28.70%	26.70%	18.30%
Neither agree nor disagree	24.40%	23.90%	26.70%	25.00%	20.00%
Disagree	48.20%	46.70%	44.70%	48.30%	61.70%
(S2) "The meme stocks phenomenon (i.e. stocks gaining viral popularity due to heightened attention on social media/blogs/online forums) is likely to continue or intensify over the next few years."					
Agree	42.90%	47.20%	48.00%	31.70%	28.30%
Neither agree nor disagree	24.70%	23.30%	21.30%	26.70%	35.00%
Disagree	32.40%	29.40%	30.70%	41.70%	36.70%
(S3) "In the last 12 months, we have made changes to our portfolio (e.g. sold, bought or hedged a stock) as a direct result of information gleaned from online forums."					
Agree	18.00%	20.00%	14.70%	18.30%	20.00%
Neither agree nor disagree	15.60%	17.20%	18.70%	11.70%	6.70%
Disagree	66.40%	62.80%	66.70%	70.00%	73.30%