From Disagreement to Disruption:

Price Bubbles and Strategic Shifts*

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Abstract

We examine the role of investor disagreement during the GameStop (GME) trading frenzy of January 2021 by analyzing discussions on Reddit's r/wallstreetbets. Using a novel metric applied to nested comment threads, we find that disagreement surged in January—disrupting pre-2021 echo chamber dynamics—before reverting soon after. This spike coincided with heightened trading volume and volatility, though prices remained elevated even as disagreement declined. We interpret these dynamics using a speculative trading model, in which disagreement first fuels a bubble and later facilitates long-term capital raising and balance sheet restructuring as speculation gives way to coordination on firm fundamentals.

Keywords: Disagreement, Bubbles, Coordination

JEL: G12, G15, G32

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1 Introduction

The role of investor disagreement in shaping stock market outcomes has garnered significant attention in finance literature, particularly during speculative episodes. Disagreement influences asset pricing, trading volume and the formation of bubbles. However, beyond its impact on market dynamics, disagreement-driven speculation can also drive structural changes at the firm level, influencing corporate finance decisions. This paper examines these dynamics through the lens of the GameStop (GME) trading frenzy of January 2021—a period marked by unprecedented retail interest as documented by the report of the SEC [2021], a sharp surge in prices and trading volume, along with a pronounced short squeeze.

Reddit and other online media platforms are often characterized as echo chambers that reinforce prevailing opinions rather than fostering genuine discourse. Indeed, several studies have documented this phenomenon, highlighting the tendency of social media forums to amplify groupthink and speculative behavior [Cookson et al., 2023]. This characterization raises concerns in financial markets, as it could suggest that online discussions serve as mechanisms for coordinated market manipulation rather than independent information exchange.[1] Legal scholars have debated whether the activities of Reddit traders during the GameStop (GME) episode constituted unlawful collusion or whether they simply represented open, public discourse about a security [Aggarwal et al., 2024, Chiu and Yahya, 2022]. Moreover, the extreme price jumps during this period appear more consistent with a disagreement-driven bubble than with an environment of extremely positive sentiment. We argue that disagreement-driven speculation—particularly in the context of a short squeeze—offers an alternative explanation for the early stages of the GME rally, distinct from consensus-driven momentum behavior often associated with echo chambers.

Specifically, we analyze discussions on Reddit's r/wallstreetbets, where retail investors actively debated GME and other "meme stocks." We analyze a dataset spanning 2013 to 2022 from the Reddit discussion forum r/wallstreetbets, focusing on the GME stock, which experienced an anomalous surge in communication in 2021, associated with the spike in market prices and volume [Pedersen, 2022, Bradley et al., 2024]. A key contribution of our approach is the development of a novel mea-

[1]For example, Bradley et al. [2024], write: "William Gavin, suggested suspending trading in GameStop because "unsophisticated investors are probably going to get hurt by this", CNBC article, and John Coffee of Columbia Law School describes WSB users as a "mob of uninformed, unsophisticated retail traders" Quartz article

sure of conversational disagreement, which evaluates the divergence between each comment and its preceding message—whether between a parent post and its reply or across successive responses. Unlike existing measures that assess disagreement through sentiment dispersion, our approach directly captures how viewpoints evolve within conversations. By leveraging ChatGPT's ability to classify nuanced communication, we track the intensity and persistence of disagreement over time, offering new insights into discourse dynamics during the GameStop event.[2]

Our findings reveal a distinct shift in conversational dynamics during the GameStop trading frenzy. Before 2021, disagreement within Reddit discussions generally increased over successive rounds of communication, contradicting theoretical predictions that repeated interaction should lead to opinion convergence. However, during January 2021, this pattern reversed: initial disagreement surged but subsequently declined over rounds of interaction, suggesting a shift in how participants engaged with one another. In the months following the frenzy, the pre-2021 pattern of increasing disagreement over rounds of communication was re-established. To further refine our analysis, we focus on the first round of conversation—disagreement between a post and its top-level comments—as this appears to be a pivotal point of change in discussion dynamics. Prior to 2021, top-level comments exhibited lower disagreement, indicative of an echo chamber effect where users engaged primarily with like-minded individuals. However, during the GameStop event, first-round disagreement spiked, reflecting a breakdown of these echo chambers, coinciding with a significant increase in both trading volume and volatility. After January 2021, disagreement levels reverted to pre-2021 patterns, suggesting a return to homophily-driven discussions. Notably, while both disagreement and trading activity declined post-January 2021, GameStop's stock price remained elevated, pointing to additional factors that sustained valuations beyond the immediate market frenzy. This decline in disagreement and trading volumes persisted through GME's subsequent capital-raising initiatives. In May 2021, the company raised over $2 billion in equity capital, a significant increase compared to its pre-2021 equity base of $617 million. These equity raises allowed

[2]Our approach contrasts with prior literature that primarily examines disagreement at an aggregate level, using measures such as analyst forecast dispersion [Diether et al., 2002] or sentiment distributions in financial social media [Cookson and Niessner, 2020] to assess its impact on volatility, trading volume, and price adjustments [Hong and Stein, 2007]. These methods often overlook the contextual nature of disagreement in discussions, motivating our focus on how disagreement emerges and evolves within interactive exchanges. Unlike datasets that treat messages as independent observations, our analysis incorporates the sequential structure of conversations, allowing us to examine rounds of communication within a thread. By studying how disagreement develops as participants exchange information, we explore not only its presence but also its persistence and resolution over multiple rounds of interaction [Aumann, 1976, Geanakoplos and Polemarchakis, 1982].

GameStop to deleverage its balance sheet by retiring expensive debt, thereby improving its financial position. S&P Global Ratings also upgraded the company's credit rating in May 2021, attributing the decision to enhanced liquidity and reduced leverage as a consequence of the capital raises. These capital raises suggest that the firm was able to take advantage of the market conditions created by the meme stock surge, effectively converting elevated prices into a tangible financial restructuring.[3]

We next provide a theoretical framework to interpret our results. Our model extends the classic Harrison and Kreps [1978] framework by introducing investor disagreement explicitly through transition matrices that capture shifts in beliefs about future cash flows. Initially, at time zero, all investors share a common belief about the firm's expected dividends and discount future cash flows accordingly, leading to an agreed-upon initial price. At time one, an unanticipated signal from the firm introduces divergence in beliefs, leading to the emergence of two distinct groups of investors who update their expectations differently. This disagreement results in a divergence in their fundamental valuations and generates a resale option premium, as investors anticipate the possibility of selling the asset to those with a more optimistic outlook. Finally, at time two, investors face a strategic decision: whether to continue trading under disagreement or coordinate on a regime shift that alters the firm's governance and strategic direction.

Specifically, following the speculative surge, investors face a trade-off between participating in a disagreement-driven bubble—capitalizing on resale option value—and committing to a longer-term position that supports a capital raise. A successful equity issuance requires investor coordination and credible commitment to remain invested, as rapid exits by speculative traders can undermine the firm's ability to raise funds at favorable valuations. In our model, we derive conditions under which investors are more likely to support the capital raise rather than pursue short-term gains. The key threshold is determined by the level of disagreement and the feedback sensitivity of the firm's overall cost of capital to recent market prices. When disagreement remains high, the resale option value is large, deterring commitment and weakening the firm's ability to raise capital. However, as disagreement subsides and feedback effects diminish, the benefits of long-term participation become more salient, enabling the firm to convert speculative enthusiasm into permanent capital. This framework highlights how investor disagreement, and its resolution, plays a central role in de-

[3]GameStop and AMC were the only meme stocks to issue equity during the 2021 surge. See Chiu and Yahya [2022].

termining whether speculative trading transitions into meaningful firm-level financial restructuring.

The remainder of this paper is structured as follows. Section 5 presents the empirical results, detailing the evolution of disagreement and its relationship with trading volume, volatility, and prices during the GME event. Section 6 develops the theoretical model, illustrating how disagreement drives price dynamics under short squeeze conditions. The conclusion discusses broader implications and directions for future research.

2 Literature

Traditionally, the literature on disagreement in financial markets has focused on macro-level measures of divergence in beliefs, examining its effects on trading volume, volatility, and price adjustments Hong and Stein [2007]. For example, Diether et al. [2002] use dispersion in analysts' forecasts as a proxy for disagreement, finding that greater differences of opinion correlate with higher trading volume and lower future stock returns. Similarly, Cookson and Niessner [2020] measure disagreement from the aggregated distribution of sentiment in financial social media. Bradley et al. [2024] further validate the informational role of Reddit's WallStreetBets, showing that investment research shared on the forum has predictive power for stock returns. Their findings help to the credibility of Reddit as a financial information channel, reinforcing our use of Reddit discussions as a data source for measuring sentiment and disagreement dynamics. However, sentiment and disagreement are conceptually distinct; while sentiment measures broad market outlook or attitude, disagreement emerges contextually within interactions. This motivates our approach to studying disagreement at the micro-level, analyzing its evolution within sequences of communication.

The literature on belief formation suggests that disagreement arises from heterogeneous interpretations of available information, often leading to persistent divergence in expectations. Classical models such as Aumann [1976] and Geanakoplos and Polemarchakis [1982] suggest that repeated communication should, in theory, lead to consensus as agents update their beliefs through information exchange. However, empirical research shows that beliefs do not always converge. Our study contributes to this literature by introducing a framework that captures disagreement as it unfolds within nested discussions. By examining how disagreement evolves at different depths of conversation, we identify patterns in which initial divergence may persist or intensify rather than

diminish. The use of nested communication structures allows us to track how investors interact and refine their views over multiple rounds of engagement, providing new insights into the mechanisms underlying belief formation in financial discourse.

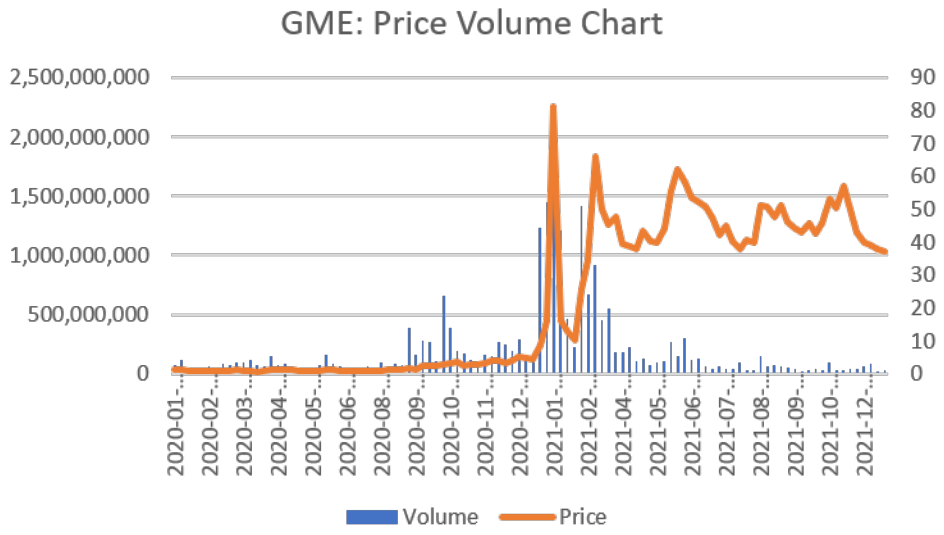
Disagreement has been widely linked to trading volume in financial markets. Harrison and Kreps [1978] propose that when investors hold divergent beliefs, trading activity increases because participants expect to profit from their own information or interpretation of events. Empirical studies such as Cookson and Niessner [2020] and Linnainmaa [2011] confirm this relationship, demonstrating that disagreement is a significant driver of trading volume, particularly in retail investor settings. Our analysis extends these findings by examining how disagreement at different levels of nested communication correlates with trading behavior. Unlike previous studies that aggregate disagreement across messages or analysts' forecasts, we track disagreement within conversational sequences, allowing us to assess its persistence and impact on market outcomes in a dynamic setting.

A theoretical contribution of our study is linking investor disagreement to structural financial decisions at the firm level—most notably, capital raising. While the existing literature primarily examines disagreement as a short-term driver of market activity, we argue that sustained disagreement can also shape firms' ability to raise long-term capital. The GameStop episode provides a compelling example: following a period of intense retail-driven speculation, the company successfully raised over $2 billion in equity—more than tripling its pre-2021 equity base. We interpret this capital raise as a structural shift enabled by the partial resolution of disagreement, where investors transitioned from short-term speculative behavior to longer-term strategic commitment. This perspective aligns with the feedback effects literature [Goldstein et al., 2013, Goldstein, 2023], which examines how investor beliefs influence real firm outcomes. Additionally, models by Pedersen [2022] and Allen et al. [2023] emphasize the amplifying role of social networks in market dynamics, though they do not address how these dynamics can facilitate financial restructuring. By documenting how disagreement evolves into alignment sufficient for a capital raise, our paper introduces a new dimension to the literature on financial disagreement—linking conversational dynamics and investor coordination to firm-level financing outcomes.

3 Background on the GameStop Event

In early 2021, GameStop Corporation (GME), a publicly traded video game retailer, experienced an unprecedented surge in its stock price, drawing significant attention from investors, regulators, and academics. Prior to this episode, GameStop had been experiencing financial difficulties, facing lower revenues due to a decline in the video game distribution industry. These challenges led to GME becoming one of the most heavily shorted stocks in the market, with institutional investors and hedge funds holding substantial short positions, reflecting widespread skepticism about the firm's long-term viability.

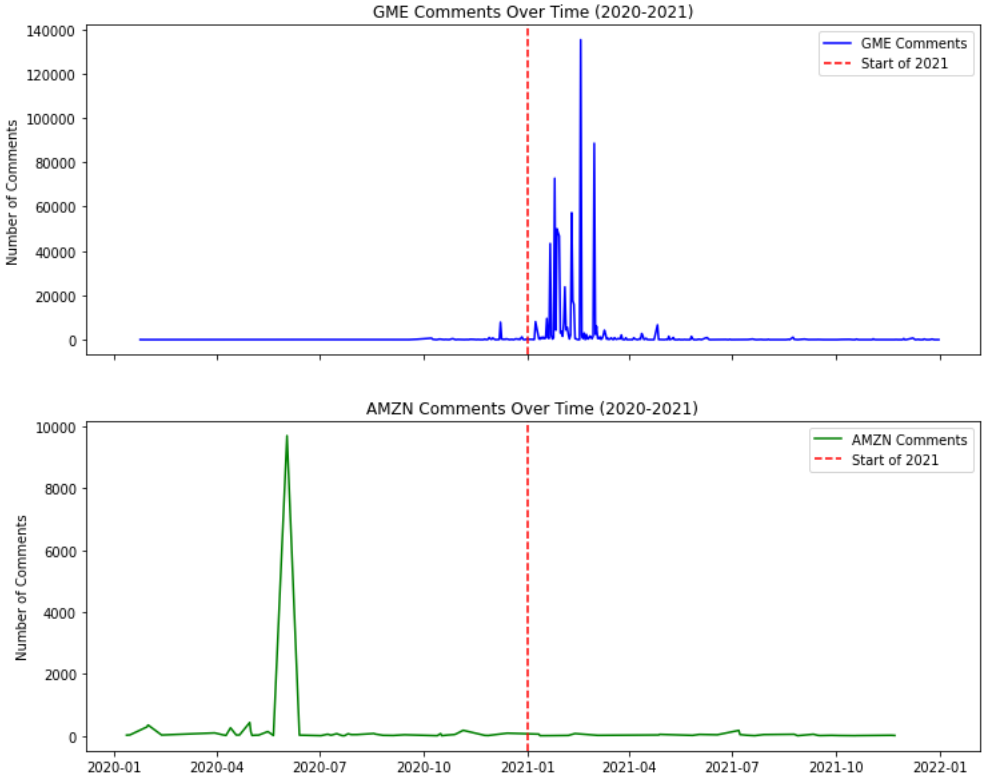
Figure 1: Gamestop: Price and Volume Chart



This figure plots GameStop's (GME) daily trading volume and closing price from January 2020 to December 2021.

Between January 2021 and late January 2021, GME's stock price rose from under $20 per share to an intraday peak of $483 per share, marking one of the most extreme price movements observed in modern financial markets. This increase was accompanied by a dramatic rise in trading volume (see Figure 1). Part of the upward movement was purported to have been driven by increased retail investor interest—particularly from discussions on social media platforms such as Reddit's r/WallStreetBets. During the peak of the GameStop episode in January 2021, Reddit's r/WallStreetBets experienced an unprecedented surge in activity, with daily post volume increasing

Figure 2: Number of comments in Reddit (r\wallstreetbets): GME & Amazon



This figure shows the number of Reddit comments mentioning GME and AMZN over time.

tenfold compared to prior months. The number of comments per post also spiked dramatically, reflecting heightened engagement and real-time discourse among retail investors (see Figure 2). This explosion in user-generated content coincided with the most volatile trading days for GME, suggesting that Reddit played an important role in shaping market sentiment and amplifying speculative interest in the stock.

All of this took place in the backdrop of short-covering dynamics and liquidity risks. Specifically, hedge funds and other short sellers, facing rising margin requirements and losses, were forced to close their positions by repurchasing shares at elevated prices, contributing to a short squeeze that further accelerated the price increase and invited broader speculation.

The sharp rise in GME's stock price coincided with a transformation in the firm's financial strategy. In late 2020, activist investor Ryan Cohen, co-founder of Chewy, acquired a substantial stake in GameStop and publicly advocated for a shift toward an e-commerce-driven business model.

The most significant corporate response came in the form of two at-the-market (ATM) equity offerings in April and June 2021, which collectively raised over $1.6 billion—more than three times the firm's pre-offering equity capital. The proceeds were used to retire outstanding debt, thereby strengthening the firm's balance sheet. In May 2021, S&P Global Ratings upgraded GameStop's credit rating, explicitly citing the equity issuance and debt reduction as key factors. The strategic restructuring also culminated in Ryan Cohen's appointment as chairman of the board in June 2021.

4 Data and Summary Statistics

Our data set originates from Reddit, focusing on r/wallstreetbets, an investing community where participants share and discuss their views on various stocks. Our dataset encompasses all posts and comments from the years 2013 to 2022. We link each post to a specific stock by identifying ticker symbols mentioned in the post titles.

This database enables us to monitor daily discussions about publicly listed companies. We focus particularly on the depth of conversations within posts, defining our key variable as the depth of a comment.[4] A comment that is classified as depth equal to 1 is defined as a first-level comment and is a direct reply to the original post; a second-level comment is a reply to the first-level comment, and higher-level comments are replies to other comments, thus forming a nested conversation structure. This unique aspect of the Reddit platform allows us to track evolving communication processes and study disagreement, which distinguishes our dataset from those of other social networks.

We emphasize that disagreement is a variable that is measured at comment level and is a relative measure with respect to its preceding comment/post in the conversation thread. In contrast, traditional measures of sentiment usually capture the levels of optimism (bullish) or pessimism (bearish) of a comment or specific post, with no link to the parent comment.

To construct a disagreement variable, which is our main outcome variable in this analysis, we adopt a different strategy since we do not have a training sample to measure sentiment as in Cookson and Niessner [2020] for tracking stock sentiment. Unlike Cookson and Niessner [2020], who use user-provided bullish and bearish signals from StockTwits, combined with machine learning techniques to classify other comments where such signals are unavailable, we directly assess disagreement

[4]We synonymously use 'rounds of conversation' or 'rounds of communication' or 'level of the nested message' to imply 'depth.'

between a comment and its parent message using a ChatGPT prompt designed to capture the level of disagreement in communication. Given ChatGPT's inherent conversational structure and our constraints on relevant training data, we conjecture that ChatGPT would perform better at evaluating disagreement in Reddit conversations compared to other traditional ML algorithms (e.g., Maximum Entropy Classifiers, Support Vector Machines) due to its ability to understand context, nuances (e.g., sarcasm), and indirect disagreement. The exact prompt used is:

"Given the following pairs of messages from the r/wallstreetbets subreddit, where individuals discuss stock trading, classify the level of disagreement implied in the communication. Use the following scale: 1 for low disagreement, 2 for moderate disagreement, and 3 for high disagreement. Provide only the scalar value for the classification. Use 0 if you cannot classify."

The prompt provided to the ChatGPT-3.5 API asks for a classification on a scale of 1 to 3: 1 for low disagreement, 2 for moderate disagreement, and 3 for high disagreement and reserving a missing value (0) for unclassified messages. This approach allows us to generate a structured measure of disagreement directly from the content of the conversations, relying on contextual cues within the messages to determine the extent of divergence in views between users, rather than inferring disagreement from the distribution of sentiment. Unclassified messages occur due to limits on ChatGPT usage. In other words, ChatGPT is unable to classify all messages, but the messages it classifies is selected at random and unrelated to the text.

Similarly, we directly measure sentiment of posts and comments using a ChatGPT prompt designed to capture the level of sentiment of the analyzed message defined in a three tiers scale being 1 bullish, 2 bearish, and 0 is neutral or unclear sentiment. The exact prompt used is:

"Given the comment from a post of the r/wallstreetbets subreddit, where individuals discuss stock trading, classify the sentiment conveyed by the comment. Use the following scale: 2 for bullish, 1 for bearish, and 0 for neutral or unclear sentiments. Provide only the scalar value for the classification."

In Table 2 we report the summary statistics for the discussions for GameStop (GME) The average number of comments per post is 204.5, but the median of 4.0 indicates a skewed distribution with a few highly commented posts, as evidenced by a massive standard deviation of 3133.5.

Agreement on GME posts is low, averaging at 2.3% with no posts reaching above 0% agreement

at the 95th percentile. The average depth of comments for GME is 1.8, peaking at 4.0. As we can see in Figure 2, the number of comments in GME are low pre-2021 but explodes in the first 3 months of 2021 and returns at somewhat low levels from July 2021. In the Appendix, we provide a comparison of these metrics with the Amazon stock (AMZN), which was relatively stable during this period.

5 Empirical findings

In this section, we present our method to investigate how disagreement measures from Reddit relate to financial market outcomes.

5.1 Evolution of Disagreement: Echo Chamber Effects and Temporal Dynamics

Using a regression framework, we analyze the evolution of disagreement across different depths of communication, with a particular focus on first-level comments and their temporal dynamics during the GameStop (GME) trading frenzy in January 2021. In such periods of heightened discourse, first-level comments capture the initial reactions to posts and often set the tone for the broader conversation, thus making them critical for understanding the early-stage dynamics of disagreement. Moreover, these replies avoid the noise in discussions (eg. off-topic comments) that could be observed at deeper communication levels. Finally, we are able to better present temporal dynamics of disagreement by restricting ourselves to the first level of comments.

We focus on echo chamber effects to see if initial replies mostly agree with or challenge the original post, highlighting the role of homophily and opinion dynamics in shaping discussions. Our model is specified as:

$$Y_{i,j}^{stock} = \beta_1^{stock} Depth(g=1)_{i,j} + \beta_2^{stock} Depth(g=2)_{i,j} + \beta_{3+}^{stock} + \epsilon_{i,j} \tag{1}$$

where $Y_{i,j,t}$ is disagreement for comment i, with respect to its parent, in post j on day t, categorized as low (1), medium (2) or high (3).

Depth(g=1)$_{i,j}$ is a dummy variable that equals 1 if the comment is a direct response to the original post (depth level 1), and 0 otherwise. Depth(g=2)$_{i,j}$ is a dummy variable that equals 1 if the comment is a response to another comment (Depth=1), and 0 otherwise. β_1^{stock} and β_2^{stock} are

the marginal effect of top-level ($g = 1$) and second level ($g = 2$) comments on disagreement. β_{3+}^{stock} measures the baseline level of disagreement for deeper rounds of communication. Our primary focus is on β_1^{stock}which captures the dynamics at Depth ($g = 1$) where echo chamber effects or disagreement might be most evident.

In Panel A of Table 3 we present the results for GME. The findings reveal distinct patterns of disagreement across communication depths and time periods. First, our findings show that for GME, disagreement about stock valuation increases with rounds of communication when analyzing the entire sample (2013-2022) and pre-2021 comments. This result contradicts theoretical predictions on learning, where differences in opinion are expected to decline over rounds of communication [Geanakoplos and Polemarchakis, 1982]. According to the Geanakoplos and Polemarchakis [1982] model of learning through communication, repeated rounds of information exchange should lead to convergence in beliefs. Our findings challenge this notion, suggesting that before the period of market frenzy during the GameStop's event, the dynamics of disagreement may deviate from traditional learning models. However, during the heightened trading activity of January 2021, we observe a breakdown in the pattern of increasing disagreement over rounds of communication: finding that disagreement in the first round of communication increase abnormally but it decreases by round of communication.

Next, we present below the temporal dynamics of the disagreement in more detail, focusing on the first round of communication.

Pre-2021 Period: Echo Chamber Dynamics

In the pre-2021 period, disagreement at Depth $g = 1$ exhibits a negative and significant coefficient ($\beta_1^{stock} = -0.058$). This suggests that top-level comments are less likely to express disagreement, potentially reflecting *echo chamber effects* , where participants self-select into discussions with like-minded individuals. These results also align with the notion of *homophily*, as initial replies often mirror the sentiment of the original post.

Disagreement at Depth $g = 2$ is slightly positive ($\beta_2^{stock} = 0.020\$$), not significant), indicating mild divergence in second-level responses.

January 2021: Breakdown of Echo Chambers

During the GameStop trading frenzy in January 2021, the dynamics change dramatically. Disagreement at depth $g = 1$ becomes positive and significant ($\beta_1^{stock} = 0.136$), signaling a sharp rise

in contention among top-level comments. This shift suggests a breakdown of echo chambers as the discussion draws a broader range of participants with divergent views.

At Depth $g = 2$, disagreement also increases ($\beta_2^{stock} = 0.064$), though the effect is less pronounced. This highlights a cascading effect, with heightened contention spilling over into second-level responses.

Post-January 2021: Return to Echo Chambers

After January 2021, disagreement at Depth $g = 1$ reverts to negative values in February, March, and June, with significant coefficients in these months ($\beta_1^{stock} < 0$). This suggests a re-establishment of echo chamber dynamics as speculative excitement wanes. Similarly, disagreement at Depth $g = 2$ trends downward by June ($\beta_2^{stock} = -0.369$, not significant), further indicating a return to pre-2021 patterns of homophily and reduced disagreement.

In summary, we observe echo chamber effects (negative values of β_1^{stock}) in the pre-2021 and post-January 2021 periods driven by homophily and alignment with the original post. The breakdown of echo chambers in January 2021 reflects a period of heightened disagreement and broader participation in discourse, followed by a reversion to pre-2021 dynamics in the subsequent months.

5.2 Disagreement, Trading Volume, and Volatility

This section examines the broader market implications of echo chamber effects and temporal shifts in disagreement, focusing on how early-stage interactions influence trading volume and volatility. Figures 3 illustrate the relationship between disagreement and two key market outcomes for Gamestop: trading volume and conditional volatility.[5]

To maintain continuity with the previous section, disagreement is measured as β_1^{stock}: the marginal effect at Depth $g = 1$, derived from the regression framework presented earlier. By focusing on top-level comments, we isolate the immediate response that emerges in response to initial posts, which are most likely to set the tone for broader discussions. This early-stage disagreement is particularly relevant for understanding market outcomes, as it reflects the initial polarization or alignment among participants before deeper rounds of communication influence the discourse.

[5]The analysis of conditional volatility relies on simple averages of the logarithm of trading volume and conditional volatility, the latter estimated using an Autoregressive Conditional Heteroskedasticity (ARCH) model (detailed in Table 4) The ARCH model captures time-varying volatility, providing a better understanding of market uncertainty during the period under review.

In Panel (a) of Figure 3, we observe a strong spike in both log trading volume and disagreement during January 2021, followed by a gradual decline in both metrics over the subsequent months. This pattern suggests that heightened disagreement among investors aligns closely with increased trading activity, possibly due to polarized views on GameStop's valuation. This observed relationship between higher disagreement and elevated trading volume aligns with the existing literature on disagreement, see of example the comprehensive review by Hong and Stein [2007].

Similarly, Panel (b) of Figure 3 shows that volatility mirrors the trend in disagreement, with a sharp rise in January 2021 followed by a steady decline. This relationship implies that higher disagreement correlates with increased volatility, likely driven by conflicting beliefs about GameStop's future prospects. The subsequent reduction in both volatility and disagreement points to a stabilization phase, as the intense debate around GameStop's valuation dissipates.

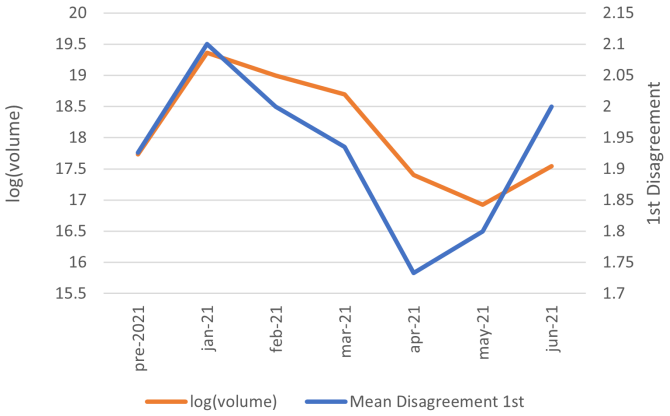
5.3 Comparison with other measures of disagreement

We compare our direct measure of conversational disagreement to two alternative sentiment-based proxies, all normalized for comparability. As shown in Figure 4, our primary measure—classified by ChatGPT based on whether a comment agrees or disagrees with its parent message—spikes in January 2021 and then declines, closely tracking the intensity of the GME episode. For comparison, we construct two sentiment-based measures using ChatGPT-generated classifications (described in the data section). The first follows Cookson and Niessner [2020], capturing daily dispersion in sentiment across all comments. The second measures the average difference in sentiment between comments and their parent messages. While the aggregated measures reflect general trends, they fail to capture the sharp dynamics observed in our disagreement metric. This highlights the value of tracking disagreement within conversation threads, which offers a more behaviorally grounded view of investor interaction that can be specifically relevant during speculative events.

5.4 Price and disagreement under short squeeze conditions

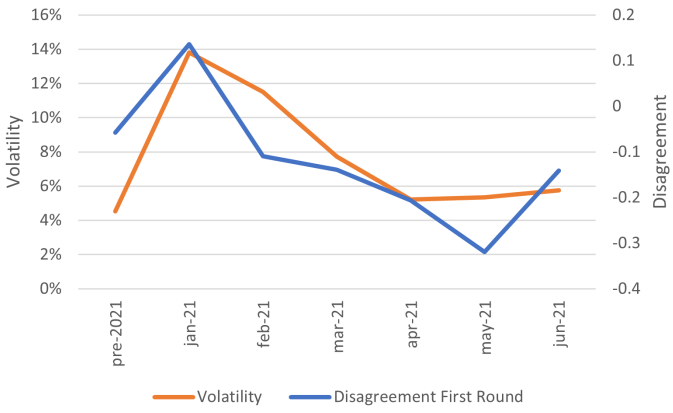
We begin by presenting evidence of a short squeeze that we argue began in January 2021, which is a key assumption underlying the idea that higher disagreement can lead to higher stock prices through a bubble effect. This concept is consistent with the theoretical frameworks in Harrison and Kreps [1978] and Harrison, Scheinkman, and Xiong (2003), which are further explored in an

Figure 3: GME: Disagreement, volumes and volatility



This figure displays the relationship between the logarithm of tr

(a) Volume and Mean Disagreement (first round)



This figure shows the relationship between conditional volatility

(b) Volatility and Disagreement

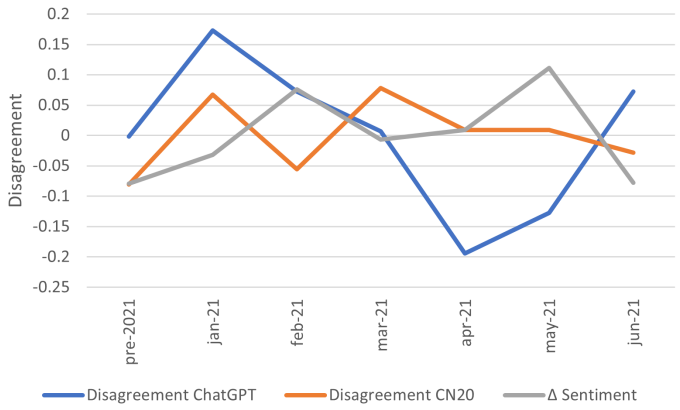


Figure 4: Comparing Measures of Disagreement

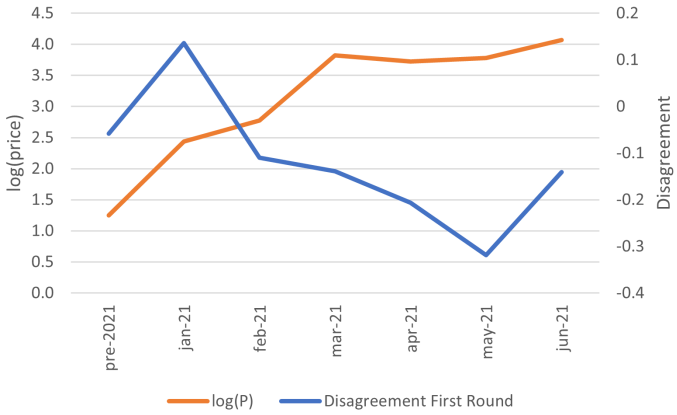
This figure compares our direct measure of conversational disagreement (Disagreement ChatGPT) with two sentiment-based proxies: sentiment dispersion across all comments (Disagreement CN20) and average sentiment difference between comments and their parents (ΔSentiment).

off-the-shelf version of the Harrison-Kreps model in Section 6.

In Figure 6, we present the "Days to Cover" metric over the period from pre-2021 through June 2021. The Days to Cover metric is calculated as the ratio of short interest to average daily trading volume, representing the number of days required to close out all short positions if no new shares are available for shorting. This indicator is used for understanding the constraints on short-selling, with higher values indicating more difficulty for short sellers to exit their positions. The Figure 6 reveals a dramatic drop in the Days to Cover from over 12 days before 2021 to fewer than 2 days by January 2021, signaling the onset of a short squeeze—a market condition where the ability to short sell is severely constrained, which is a central factor in the theoretical relationship between stock prices and disagreement.

Figures 5 illustrate the relationship between disagreement and log-transformed prices for GameStop (GME) across the early months of 2021. These figures are designed to provide insight into the impact of disagreement on price dynamics, particularly during and after the January 2021 trading frenzy. We observe that an initial spike in disagreement aligns with the surge in prices observed during the GameStop event. This spike supports theories suggesting that disagreement among investors can lead to bubble-like price behavior under short-selling constraints. However, as disagreement begins to decrease in the post-January 2021 period, prices remain elevated.

Figure 5: GME: Price and Disagreement



This figure shows the relationship between disagreement at the first round of communication and the log of GameStop's (GME) stock price from pre-2021 through June 2021.

6 Theoretical explanation

We develop a framework to analyze the impact of investor disagreement on asset pricing and trading dynamics, focusing on how shifts in investor disagreement influence market prices and fundamental firm outcomes. The model unfolds over three discrete periods, $t = 0, 1, 2$, where investors hold differing beliefs about the firm's future cash flows. Initially, at $t = 0$, all investors agree that the firm will pay dividends of 1 unit with probability θ and zero with probability$1 - \theta$, continuing into perpetuity. Investors discount future cash flows at a discount factor γ (or equivalently, cost of capital r), where $\gamma = \frac{1}{1+r}$, and consequently, the initial price of the asset is given by $P_0 = \frac{\gamma\theta}{1-\gamma} = \frac{\theta}{r}$ (we use γ and r interchangeably depending on whichever provides clearer representation in the context).

At $t = 1$, an unanticipated signal from the firm introduces divergence in beliefs among two groups of investors, denoted as group 1 and group 2, who differ in their valuation of the firm's fundamentals. This disagreement is represented through transition matrices, Q^1 for group 1 and Q^2 for group 2. We define the transition matrices for each investor group i as follows:

$$Q^i = \begin{pmatrix} Q^i(0,0) & Q^i(0,1) \\ Q^i(1,0) & Q^i(1,1) \end{pmatrix}$$

where $Q^i(0,1)$ represents the Markov transition probability from the state where the dividend $= 0$ to the state w'ohere the dividend $= 1$, and so on. We assume the specifically, for group 1, that the

transition matrix Q^1 remains consistent with their initial valuation beliefs at $t = 0$:

$$Q^1 = \begin{pmatrix} 1-\theta & \theta \\ 1-\theta & \theta \end{pmatrix} \tag{2}$$

For group 2, however, the matrix Q^2 incorporates a disagreement parameter ϵ (where $0 < \epsilon < \min(\theta, 1-\theta)$, in the following manner:

$$Q^2 = \begin{pmatrix} 1-\theta+\epsilon & \theta-\epsilon \\ 1-\theta-\epsilon & \theta+\epsilon \end{pmatrix} \tag{3}$$

Here, θ represents baseline sentiment, and ϵ denotes the degree of disagreement, distinguishing the groups' perspectives on future cash flows. These matrices encode each group's expectations for dividend transitions, with group 2 showing higher optimism in scenarios where the dividend is 1.

Given these transition matrices, the fundamental valuations of investors are derived from their expectations about future cash flows, represented as $f_1(0), f_1(1), f_2(0)$, and $f_2(1)$ for the two groups. For investor group 1, the valuations are:

$$f_1(0) = \gamma \left(Q^1(0,0) f_1(0) + Q^1(0,1)(f_1(1)+1) \right) \tag{4}$$

$$f_1(1) = \gamma \left(Q^1(1,0) f_1(0) + Q^1(1,1)(f_1(1)+1) \right) \tag{5}$$

while for group 2, they are defined similarly but based on Q^2:

$$f_2(0) = \gamma \left(Q^2(0,0) f_2(0) + Q^2(0,0)(f_2(1)+1) \right) \tag{6}$$

$$f_2(1) = \gamma \left(Q^2(1,0) f_2(0) + Q^2(1,1)(f_2(1)+1) \right) \tag{7}$$

Beyond their fundamental valuations, both groups factor in the resale option value associated with trading based on disagreement. This resale value, similar to Harrison and Kreps [1978], allows investors to profit from selling to relative optimists during periods of high disagreement. In our model, group 1 investor can buy stock in state zero with the intention of selling it for the first

time that a transition to state one occurs (that is, the first time a dividend is declared). When the market is in state one, investors of group 2 are optimistic about receiving dividends in the immediate future. This is because they assess a relatively higher probability that a dividend will be declared in the next period. Members of group 1 are pessimistic about immediate dividend prospects starting from state one, but they cannot sell short on the basis of their belief. On the other hand, when the market is in state zero, group 1 investors are more optimistic than group 2 investors about a transition to state one, and this opens up for them the possibility of (expected) capital gains. They can hold the stock until a dividend is declared, knowing that group 2 will view this as a positive development. At that point, group 1 can unload the stock at what it believes is an inflated price. Members of group 1 are willing to pay more than the fundamental price in state zero not because they foresee a future of many one dollar dividends, but because they foresee an event that members of group 2 will take as a signal of good times ahead. The same logic applies to group 2 investors in state zero. Members of group 2 can buy in state one, hold until a transition to state zero occurs, and sell at that point to members of group 1. Iterating over this resale behaviour, we derive the resale value adjusted prices derived by incorporating this option value:

$$p(0) = \gamma\left((1-\theta)p(0) + \theta(p(1)+1)\right) \tag{8}$$

$$p(1) = \gamma\left((1-\theta-\epsilon)p(0) + (\theta+\epsilon)(p(1)+1)\right) \tag{9}$$

The equilibrium prices reflect a premium over fundamental values, stemming from the resale option embedded in the disagreement-driven trading dynamics. The solutions for the prices are given in the Appendix.

Let $\pi_i(0)$ and $\pi_i(1)$ denote the steady-state probabilities for investor i in states 0 and 1, and define the fundamental value for each investor as:

$$f_i = \pi_i(0)f_i(0) + \pi_i(1)f_i(1) \tag{10}$$

The prices inclusive of expected resale option value is given by:

$$P_i = E_i[p] = \pi_i(0)p(0) + \pi_i(1)p(1) \tag{11}$$

Thus, the expected resale option value for each investor is given by the expected difference between the :

$$R_i = \pi_i(0)(p(0) - f_i(0)) + \pi_i(1)(p(1) - f_i(1)) \tag{12}$$

Finally, for each investor i:

$$P_i = f_i + R_i \tag{13}$$

We now express prices and resale option values from the perspective of investor 1 (without loss of generality) as they are easier to interpret.

Proposition 1. *The fundamental valuations, expected prices and resale value (from the perspective of investor 1) are given by:*

$$f_1 = \frac{\gamma\theta}{1-\gamma}$$

$$P_1 = \frac{f_1}{(1-\epsilon\gamma)} + \frac{\epsilon\gamma\theta}{(1-\epsilon\gamma)}$$

$$R_1 = f_1(\frac{\epsilon\gamma}{(1-\epsilon\gamma)}) + \frac{\epsilon\gamma\theta}{(1-\epsilon\gamma)}$$

Further, the expected prices and the resale option value are increasing in the disagreement parameter ϵ.

Proof. In Appendix. □

Next, we emphasize the persistence of high prices despite the waning of disagreement and trading volumes and provide a theoretical model that is consistent with the observed market outcomes, particularly in the context of capital raising. Following a dramatic surge in its stock price—largely driven by speculative retail interest—GME faced increasing pressure to justify its valuation through credible long-term strategy. While leadership changes followed this spike and signaled a pivot toward e-commerce, the most tangible response came through two major at-the-market (ATM) equity offerings in April and June 2021. Together, these raised over $1.6 billion—more than triple the firm's

pre-issue equity capital. The capital raised was used to pay down existing debt, leading to a stronger balance sheet. In May 2021, S&P Global Ratings upgraded GameStop's credit rating, highlighting the firm's equity issuance and improved leverage as primary reasons for the revision. These offerings illustrate how firms may strategically time capital raises during episodes of speculative overvaluation, leveraging elevated prices as a low-cost financing opportunity fueled by investor demand.

In period 2, investors in group 1 (chosen without loss of generality) have the opportunity to coordinate on a successful capital raise, which depends on sustained investor interest (without disagreement-driven trading) and elevated stock prices. This coordination game follows an (invest, invest) structure, where investors collectively benefit if they maintain confidence in the firm's valuation during the capital-raising process. Naturally, if the investors of group 1 are able to successfully coordinate on the capital raise, they are the only ones holding the stock and disagreement drops to zero.

The impact of such a capital raise can be interpreted as a price multiple expansion, as it strengthens the firm's balance sheet and provides liquidity for potential strategic shifts, such as repaying debt or investing in business transformation. While leadership changes may have occurred regardless of the bubble, the successful equity raise reduced financial constraints, making a strategic pivot—including the e-commerce transition under Ryan Cohen—more viable. The lower effective cost of capital, shaped by investor sentiment and stock price feedback effects [Goldstein et al., 2013, Goldstein, 2023], illustrates how firms can capitalize on speculative surges to enhance their financial position.

To simplify analysis, we assume the overall cost of capital post-regime change depends on the bubble effect, that is, on prices with and without resale option values in the following manner:

$$r' = \frac{r}{1 + \beta R_1} = \frac{r}{1 + \beta(P_1 - f_1)} \tag{14}$$

where R_1 represents the resale option value, f_1 is the fundamental valuation of the stock and $P_1 = f_1 + R_1$ represent firm valuations after the price bubble (but before the capital raise). We note that the overall cost of capital after the capital raise decreases in the bubble effect on prices. Absent the bubble component (R_1), there is no change in cost of capital for the firm. β is a parameter indicating the feedback sensitivity of higher stock prices in the cost of capital post issuance, and

	Invest	Do not invest
Invest	Mf_1, Mf_1	$f_1, f_1 + R_2$
Do not invest	$f_1 + R_1, f_1$	$f_1 + R_1, f_1 + R_2$

Table 1: Payoff matrix from action choices of investors

depends on factors such as debt-equity ratio before the capital raise (which is modeled in this paper).

This also implies that the discount factor increases ($\gamma' > \gamma$), leading to an expansion in the price multiple. The payoff to investors from successfully coordinating to invest in a capital raise is modeled as $P_R = Mf_1$ where $M > 1$ represents the regime change multiplier, defined as :

$$M = \frac{r}{r'} = 1 + \beta R_1 \tag{15}$$

However, if investors choose not to coordinate and continue trading under disagreement, they retain the resale option value but forgo the benefits of multiple expansion. Their resulting payoff is $P_1 = f_1 + R_1$, where R_1 captures the resale option value from trading under disagreement.

This setup creates two potential equilibria: one where all investors coordinate to invest and another where all investors choose not to invest. While the selection of a unique equilibrium is beyond the scope of this analysis, we examine conditions under which one equilibrium is Pareto optimal. Specifically, the attack action is Pareto optimal when the payoff from coordination exceeds the combined value of disagreement trading and the fundamental value:

$$Mf_1 > f_1 + R_1 \tag{16}$$

Proposition 2 formalizes this result, establishing that the attack action is Pareto optimal when the level of disagreement exceeds a critical threshold. Furthermore, the threshold decreases with greater feedback sensitivity (β), highlighting the importance of strategic complementarities in investors' coordination decisions.

Proposition 2. *The Attack action is Pareto optimal when the disagreement level is greater than a certain threshold, given by:*

$$\epsilon > \epsilon^* = \frac{1}{(1 + \gamma - \beta\gamma\theta(\frac{1}{r} - 1))}$$

Further, the threshold is decreasing in feedback sensitivity parameter β.

Proof. In the Appendix □

The prices at which the investor is indifferent between choosing the regime change and trading under disagreement is given by:

$$P_R = \gamma\theta\big(\frac{1}{1-\gamma(1-\epsilon^*\gamma)} + \frac{\epsilon^*}{(1-\epsilon^*\gamma)}\big)$$

Consistent with empirically observed outcomes, our model delivers high prices in the context of low disagreement and trading volumes as investors potentially trade off resale option values for long term value.

7 Conclusion

This paper provides a new exploration of the interplay between investor disagreement, asset pricing dynamics, and strategic shifts in the context of the GameStop saga. Our findings reveal that disagreement among investors, as captured through social media forums, can be associated to trading volume, volatility, and price fluctuations. The January 2021 episode highlights the role of heightened disagreement in generating a speculative bubble under short-squeeze conditions, aligning with the theoretical insights of Harrison and Kreps [1978].

Beyond the initial bubble dynamics, our analysis suggests that the prolonged elevation of GameStop's prices post-January 2021 reflects a coordination on firm fundamentals rather than purely speculative outcomes. This transition redefined the firm's strategic trajectory, enhancing its perceived long-term prospects and reducing its effective discount rate. Concurrently, we observe a fall in disagreement and trading volume, indicative that the short term "flipping" of stocks to profit from speculation had ebbed. In this new equilibrium, high-conviction investors' commitment to long-term capital raising highlights the importance of coordinated action in altering firm fundamentals. The resulting stabilization of prices suggests a dual influence of investor coordination and strategic capital raising on market prices.

Our findings contribute to the broader literature on asset pricing under disagreement. The GameStop episode serves as a case study of the trade-off between speculative premium and long term commitment. Future research could extend this framework to other instances of social media-driven trading phenomena, exploring how disagreement interacts with firm-specific sentiment and macroeconomic factors to shape market outcomes.

References

Dhruv Aggarwal, Albert H Choi, and Yoon-Ho Alex Lee. Meme corporate governance. *S. Cal. L. Rev.*, 97:1419, 2024.

Franklin Allen, Marlene Haas, Eric Nowak, Matteo Pirovano, and Angel Tengulov. Squeezing shorts through social media platforms. 2023. Working Paper.

Robert J Aumann. Agreeing to disagree. *The annals of statistics*, pages 1236–1239, 1976.

Daniel Bradley, Jan Hanousek Jr, Russell Jame, and Zicheng Xiao. Place your bets? the value of investment research on redditâs wallstreetbets. *The Review of Financial Studies*, 37(5):1409–1459, 2024.

Victoria Chiu and Moin A Yahya. The meme stock paradox. *Corp. & Bus. LJ*, 3:51, 2022.

J Anthony Cookson and Marina Niessner. Why don't we agree? evidence from a social network of investors. *The Journal of Finance*, 75(1):173–228, 2020.

J Anthony Cookson, Joseph E Engelberg, and William Mullins. Echo chambers. *The Review of Financial Studies*, 36(2):450–500, 2023.

Karl B Diether, Christopher J Malloy, and Anna Scherbina. Differences of opinion and the cross section of stock returns. *The journal of finance*, 57(5):2113–2141, 2002.

John D Geanakoplos and Heraklis M Polemarchakis. We can't disagree forever. *Journal of Economic theory*, 28(1):192–200, 1982.

Itay Goldstein. Information in financial markets and its real effects. *Review of Financial Studies*, 2023. Forthcoming.

Itay Goldstein, Emre Ozdenoren, and Kathy Yuan. Trading frenzies and their impact on real investment. *Journal of Financial Economics*, 109(3):566–582, 2013. doi: 10.1016/j.jfineco.2013.03.011.

J. Michael Harrison and David M. Kreps. Speculative investor behavior in a stock market with heterogeneous expectations. *Quarterly Journal of Economics*, 92(2):323–336, 1978. doi: 10.2307/1884166.

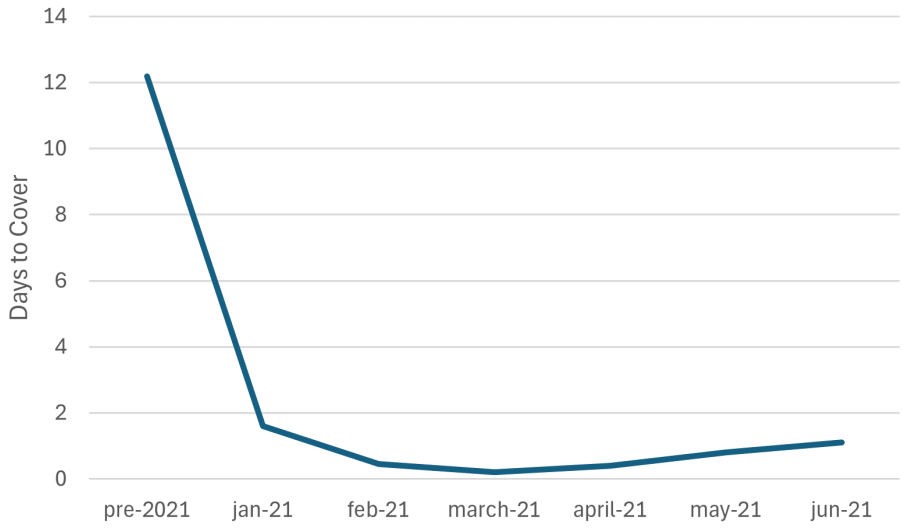
Harrison Hong and Jeremy C Stein. Disagreement and the stock market. *Journal of Economic perspectives*, 21(2):109–128, 2007.

Juhani T Linnainmaa. Why do (some) households trade so much? *The Review of Financial Studies*, 24(5):1630–1666, 2011.

Lasse Heje Pedersen. Game on: Social networks and markets. *Journal of Financial Economics*, 146 (3):1097–1119, 2022.

SEC. Staff report on equity and options market structure conditions in early 2021. *SEC Report. October*, 2021.

Figure 6: Days to cover: GME



This figure shows the "Days to Cover" for GameStop (GME) using data from MarketBeat.

8 Appendix

8.1 Evidence of a short squeeze

This section documents evidence that justifies the short-selling constraint assumption, using data from MarketBeat, a financial information platform that provides stock market data, research tools, and news to individual investors.

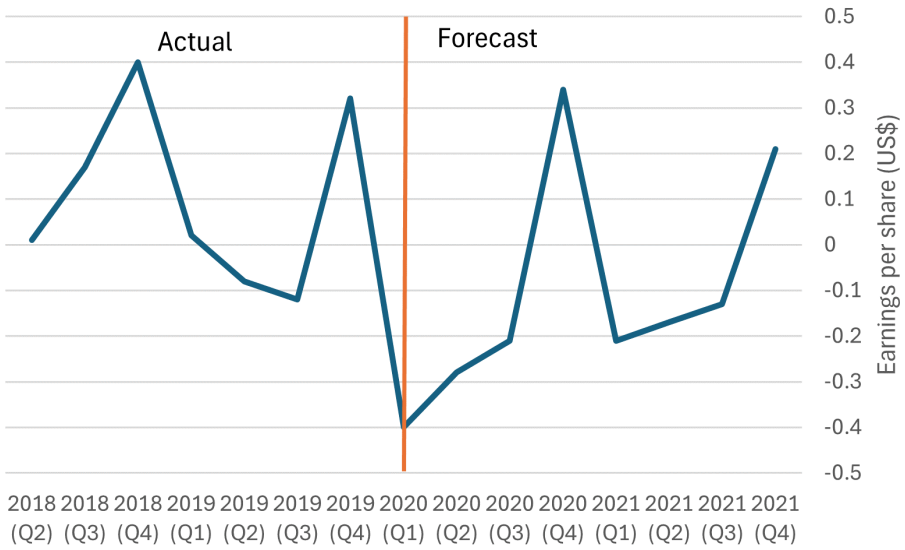
8.2 Other stylized facts on GME's analysts forecasts

This section documents general evidence on two GME's forecast financial performance and analysts' target prices, using data from TipRanks, a financial technology company that provides data and analytics on financial markets, focusing on stock analysis and analyst ratings.

Figure 7 shows GameStop's quarterly earnings per share (EPS), with actual EPS data until early 2020 and when available the forecasted EPS for subsequent quarters through 2021. The chart reveals seasonally volatile earnings performance prior and after the 2021, largely reflecting GameStop's struggles in a transitioning retail environment.

On the other hand, Figure 8 documents sell-side analysts' target prices for GME, showing

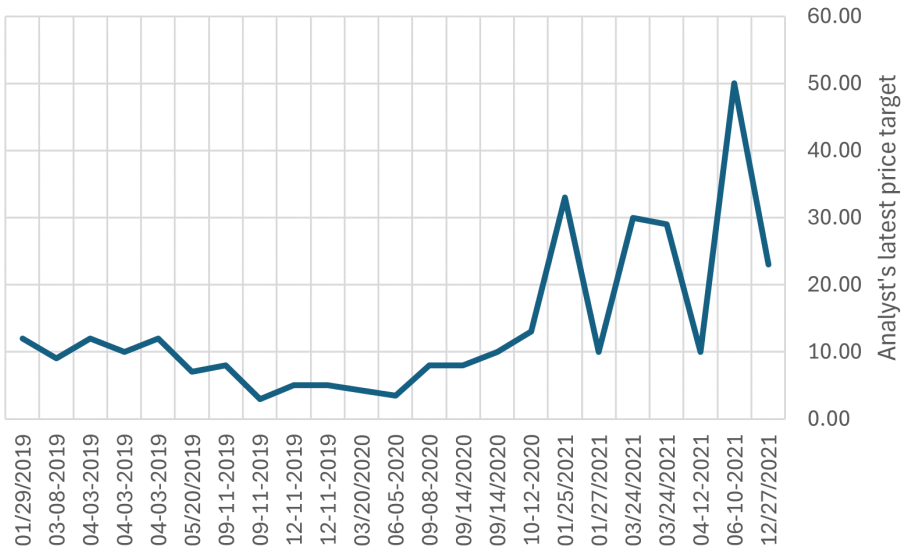
Figure 7: Analysts'quarterly earnings per share: GME



This figure presents GameStop's quarterly earnings per share (EPS) from 2018 to 2021, distinguishing between actual reported EPS and forecasted EPS beyond early 2020. Data are sourced from TipRanks.

a gradual rise beginning in late 2020 and peaking during the early 2021 trading frenzy. This evidence suggest that target prices increased in response to market enthusiasm and the potential for operational turnaround, which is consistent with a reduction in the cost of capital, more than a substantial increase in financial performance to justify the new valuations.

Figure 8: Analysts' target price: GME



This figure shows the evolution of analysts' target prices for GameStop (GME) between 2019 and 2021, based on data from TipRanks.

8.3 Proof of Proposition 1

To determine the fundamental valuations, expected prices, and resale value for investor 1, we start with the equations for the fundamental values $f_1(0)$ and $f_1(1)$, based on the transition matrix Q^1:

$$f_1(0) = \gamma \left(Q^1(1,1) f_1(0) + Q^1(1,2)(f_1(1) + 1) \right)$$

$$f_1(1) = \gamma \left(Q^1(2,1) f_1(0) + Q^1(2,2)(f_1(1) + 1) \right).$$

Substituting the values from Q^1, it simplifies to:

$$f_1(0) = \frac{\gamma\theta}{1-\gamma}, \quad f_1(1) = \frac{\gamma\theta}{1-\gamma}.$$

Thus, the fundamental value f_1 for investor 1, given by $f_1 = \pi_1(0) f_1(0) + \pi_1(1) f_1(1)$, also evaluates to:

$$f_1 = \frac{\gamma\theta}{1-\gamma}.$$

Next, using the resale option value equations, the equilibrium price $p(0)$ is derived as:

$$p(0) = \frac{\gamma\theta}{(1-\gamma)(1-\epsilon\gamma)} = \frac{f_1}{1-\epsilon\gamma}.$$

For $p(1)$, substituting the disagreement-adjusted parameters gives:

$$p(1) = \frac{f_1}{1-\epsilon\gamma} + \frac{\epsilon\gamma}{1-\epsilon\gamma}.$$

The resale option value R_1 is determined by the expected price difference and the fundamental value:

$$R_1 = \pi_1(0)(p(0) - f_1(0)) + \pi_1(1)(p(1) - f_1(1)).$$

Simplifying, we have:

$$R_1 = f_1\left(\frac{\epsilon\gamma}{1-\epsilon\gamma}\right) + \frac{\epsilon\gamma\theta}{1-\epsilon\gamma}.$$

Finally, the total price P_1, which includes the fundamental value and the resale option value, is given as:

$$P_1 = f_1 + R_1 = \frac{f_1}{1-\epsilon\gamma} + \frac{\epsilon\gamma\theta}{1-\epsilon\gamma}.$$

As disagreement (ϵ) increases, both the expected price (P_1) and resale option value (R_1) increase, confirming the role of disagreement in amplifying asset prices beyond fundamental values.

8.4 Proof of Proposition 2

The attack action is Pareto optimal when the payoff from coordination exceeds the combined value of trading under disagreement and the fundamental value. This is expressed as:

$$Mf_1 > P_1$$

Substituting P_1, the total value under disagreement trading ($P_1 = f_1 + R_1$), we have:

$$Mf_1 > \frac{f_1}{(1-\epsilon\gamma)} + \frac{\epsilon\gamma\theta}{(1-\epsilon\gamma)}.$$

Reorganizing:

$$Mf_1 > \frac{1}{(1-\epsilon\gamma)}\left(f_1 + \epsilon\gamma\theta\right).$$

Dividing through by f_1, this becomes:

$$M > \frac{1}{(1-\epsilon\gamma)}\left(1 + \frac{\epsilon\gamma\theta}{f_1}\right).$$

Using the expression for $f_1 = \frac{\gamma\theta}{1-\gamma}$, the inequality becomes:

$$M > \frac{1}{(1-\epsilon\gamma)}\left(1 + \epsilon - \epsilon\gamma\right).$$

Simplifying further:

$$M > 1 + \frac{\epsilon}{(1-\epsilon\gamma)}.$$

From the definition of $M, M = 1 + \beta(P_1 - P_0)$, we know that $M > \frac{\epsilon}{(1-\epsilon\gamma)}$. Thus, combining these results:

$$1 + \beta R_1 > \frac{\epsilon}{(1-\epsilon\gamma)}.$$

Substituting $R_1 = \frac{\gamma\theta}{(1-\gamma)} \cdot \frac{\epsilon\gamma}{(1-\epsilon\gamma)} + \frac{\epsilon\gamma\theta}{(1-\epsilon\gamma)}$, we derive:

$$1 + \beta\left(\frac{\gamma\theta}{1-\gamma} \cdot \frac{\epsilon\gamma}{1-\epsilon\gamma} + \frac{\epsilon\gamma\theta}{1-\epsilon\gamma}\right) > \frac{\epsilon}{1-\epsilon\gamma}.$$

Expanding and reorganizing:

$$(1-\epsilon\gamma) + \beta\frac{\epsilon\gamma^2\theta}{1-\gamma} + \beta\epsilon\gamma\theta - \epsilon > 0.$$

Grouping terms:

$$\epsilon \left(-\gamma + \frac{\beta\gamma^2\theta}{1-\gamma} + \beta\gamma\theta - 1 \right) > -1.$$

Solving for ϵ:

$$\epsilon > \frac{1}{1 + \gamma - \frac{\beta\gamma^2\theta}{1-\gamma} - \beta\gamma\theta}.$$

Rewriting the denominator using the cost of capital adjustment:

$$\epsilon > \frac{1}{1 + \gamma - \beta\gamma\theta \left(\frac{\gamma}{1-\gamma} - 1 \right)}.$$

Substituting $\frac{\gamma}{1-\gamma}$ with $\frac{1}{r}$ (since $\gamma = \frac{1}{1+r}$):

$$\epsilon > \frac{1}{1 + \gamma - \beta\gamma\theta \left(\frac{1}{r} - 1 \right)}.$$

This establishes the critical threshold ϵ^* as:

$$\epsilon^* = \frac{1}{1 + \gamma - \beta\gamma\theta \left(\frac{1}{r} - 1 \right)}.$$

Thus, the attack action is Pareto optimal when $\epsilon > \epsilon^*$. Furthermore, since ϵ^* decreases with higher β (feedback sensitivity), greater feedback increases the likelihood of coordination.

References

Dhruv Aggarwal, Albert H Choi, and Yoon-Ho Alex Lee. Meme corporate governance. *S. Cal. L. Rev.*, 97:1419, 2024.

Franklin Allen, Marlene Haas, Eric Nowak, Matteo Pirovano, and Angel Tengulov. Squeezing shorts through social media platforms. 2023. Working Paper.

Robert J Aumann. Agreeing to disagree. *The annals of statistics*, pages 1236–1239, 1976.

Daniel Bradley, Jan Hanousek Jr, Russell Jame, and Zicheng Xiao. Place your bets? the value of investment research on redditâs wallstreetbets. *The Review of Financial Studies*, 37(5):1409–1459, 2024.

Victoria Chiu and Moin A Yahya. The meme stock paradox. *Corp. & Bus. LJ*, 3:51, 2022.

J Anthony Cookson and Marina Niessner. Why don't we agree? evidence from a social network of investors. *The Journal of Finance*, 75(1):173–228, 2020.

J Anthony Cookson, Joseph E Engelberg, and William Mullins. Echo chambers. *The Review of Financial Studies*, 36(2):450–500, 2023.

Karl B Diether, Christopher J Malloy, and Anna Scherbina. Differences of opinion and the cross section of stock returns. *The journal of finance*, 57(5):2113–2141, 2002.

John D Geanakoplos and Heraklis M Polemarchakis. We can't disagree forever. *Journal of Economic theory*, 28(1):192–200, 1982.

Itay Goldstein. Information in financial markets and its real effects. *Review of Financial Studies*, 2023. Forthcoming.

Itay Goldstein, Emre Ozdenoren, and Kathy Yuan. Trading frenzies and their impact on real investment. *Journal of Financial Economics*, 109(3):566–582, 2013. doi: 10.1016/j.jfineco.2013.03.011.

J. Michael Harrison and David M. Kreps. Speculative investor behavior in a stock market with heterogeneous expectations. *Quarterly Journal of Economics*, 92(2):323–336, 1978. doi: 10.2307/1884166.

Harrison Hong and Jeremy C Stein. Disagreement and the stock market. *Journal of Economic perspectives*, 21(2):109–128, 2007.

Juhani T Linnainmaa. Why do (some) households trade so much? *The Review of Financial Studies*, 24(5):1630–1666, 2011.

Lasse Heje Pedersen. Game on: Social networks and markets. *Journal of Financial Economics*, 146 (3):1097–1119, 2022.

SEC. Staff report on equity and options market structure conditions in early 2021. *SEC Report. October*, 2021.

Table 2: Summary statistics

This table presents summary statistics for key variables: the number of comments per post (Comments), the probability that a comment disagrees with its parent message, and the position of the comment within the conversation thread (Depth). It includes means, medians, 5th and 95th percentiles, and standard deviations for each variable.

GME	**Comments**	**Agreement**	**Depth**
Average	204.5	2.3%	1.8
Median	4.0	0.0%	1.0
5th Quantile	1.0	0.0%	1.0
95th Quantile	218.0	0.0%	4.0
Standard Deviation	3133.5	15.1%	1.3
Amazon	**Comments**	**Agreement**	**Depth**
Average	77.6	5.9%	2.8
Median	18.0	0.0%	2.0
5th Quantile	2.0	0.0%	1.0
95th Quantile	184.7	100.0%	7.0
Standard Deviation	474.0	23.5%	2.3

Table 3: The effect of rounds of communication on disagreement and sentiment, reduced form estimates.

This table presents predicted disagreement from the estimation of Equation 5.1. The dependent variable is a dummy variable that identifies disagreement, *DisAgreement*. Key explanatory variables included are a dummy variable that identify first round messages (Depth=1) and second round messages (Depth=2). The table show the predictions and their corresponding robust standard errors of predictions (in parenthesis)..

GME

Panel A: Disagreement							
	pre-2021	jan-21	feb-21	mar-21	apr-21	may-21	jun-21
Depth=1	-0.058***	0.136***	-0.110*	-0.139*	-0.206	-0.319	-0.141*
	(0.017)	(0.016)	(0.064)	(0.084)	(0.181)	(0.243)	(0.084)
Depth=2	0.020	0.064***	-0.019	0.025	0.061	-0.369	0.259
	(0.015)	(0.007)	(0.042)	(0.065)	(0.098)	(0.223)	(0.239)
Depth=3+	1.984***	1.965***	2.110***	2.075***	1.939***	2.119***	2.141***
	(0.009)	(0.005)	(0.011)	(0.022)	(0.098)	(0.046)	(0.084)
Observations	8742	32569	3225	848	51	157	72
Adjusted R-squared	0.002	0.004	0.001	0.002	-0.009	0.015	-0.015

Table 4: Autoregressive Conditional Heteroskedasticity (ARCH) Regression: Gamestop

This table presents the results from an Autoregressive Conditional Heteroskedasticity (ARCH) model, used to estimate the conditional volatility of GameStop stock prices. The model is specified as follows:

$\log(\mathrm{P}_t) = \alpha_0 + \alpha_1 \log(\mathrm{P}_{t-1}) + \varepsilon_t,\ \varepsilon_t \sim N(0, \sigma_{\varepsilon,t})$

$\sigma^2_{\varepsilon,t} = \omega + \alpha_2\, \varepsilon^2_{t-1} + \alpha_3\, \sigma^2_{t-1}$

GME	
Outcome variable:	$\log(\mathrm{P}_t)$
α_0	0.002
	(0.001)
α_1	0.140
	(0.005)
ω	0.001
	(0.001)
α_2	0.688
	(0.012)
α_3	0.129
	(0.018)
Log likelihood	5513.154
N	3087