

Seeking Gamma: Lessons From the Meme Frenzy

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What Happened

- Short squeeze: Short interest hit 122.97% of float by Jan 2021.
- Retail traders: Meme stocks had clear increase in retail interest.
- Gamma squeeze: Market makers forced to hold massive delta-hedged positions.

What is a Gamma Squeeze?

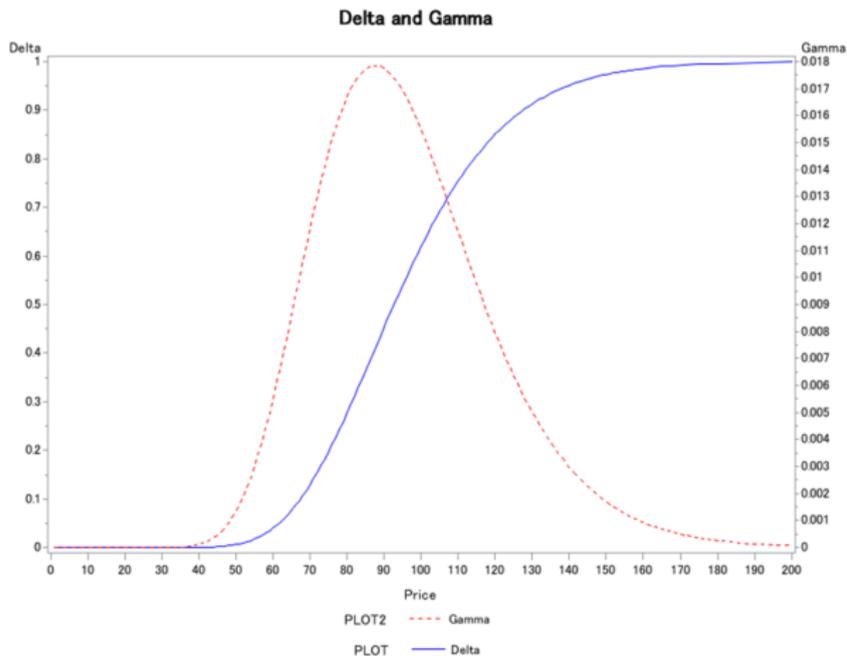


Figure: Delta and Gamma of Vanilla Call Option

Was there a Gamma Squeeze?

“[The SEC] staff did find GME options trading volume from individual customers increased substantially, from only \$58.5 million on January 21 to \$563.4 million on January 22 until peaking at \$2.4 billion on January 27. However, this increase in options trading volume was mostly driven by an increase in the buying of put, rather than call options. Further, data show that market-makers were buying, rather than writing, call options. These observations by themselves are **not consistent** with a gamma squeeze.”

– SEC Staff Report

GME Option Volume Through January 2021

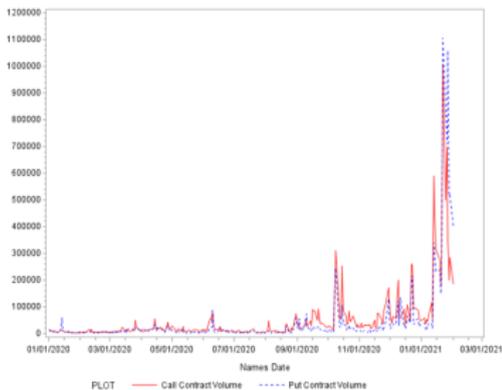


Figure: A

GME Contract Volume

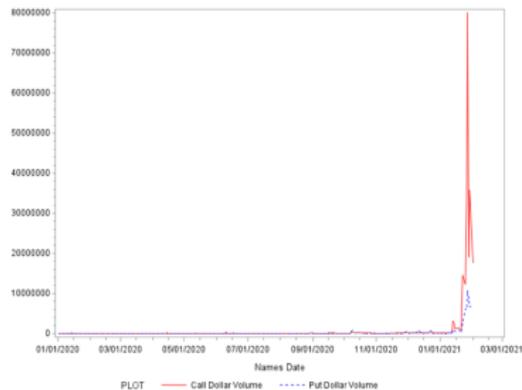


Figure: B

GME Dollar Volume

GME Option Volume through December 2020

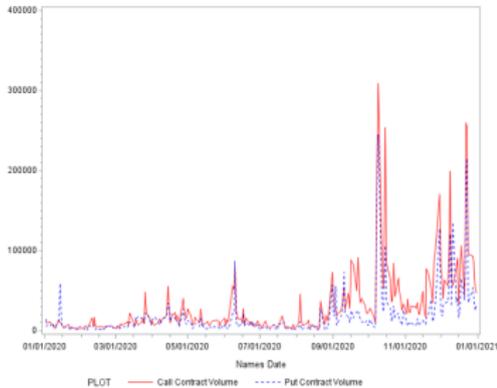


Figure: C

GME Contract Volume

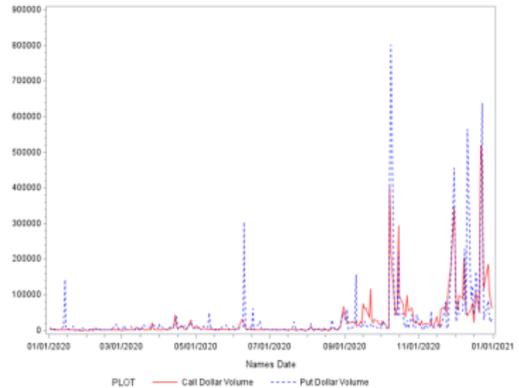


Figure: D

GME Dollar Volume

Literature

- Market conditions indeed created the possibility of a gamma squeeze.
 - Mitts, Battalio, Brogaard, Cain, Glosten, and Kochuba (2022)
- There is also evidence of an after-hours gamma squeeze during the meme frenzy.
 - Zhou and Zhou (2023)
- However, there is limited evidence of put–call parity violations during this period. (Hilliard and Hilliard, 2023)
- Like the SEC report each of these studies focus on January 2023.

Literature (cont.)

- Option trading predicts future stock returns.
 - Relatively high option volume compared to stock volume leads to predictable returns (Roll et al., 2010; Johnson and So, 2012; Ge et al., 2016).
- Stocks with higher put–call ratios have lower subsequent returns (Pan and Poteshman, 2006).
- Option market makers play a critical role in market quality.
 - Battalio and Schultz (2011); Grundy, Lim, and Verwijmeren (2012).

Key Findings

- We find novel evidence that a **gamma squeeze occurred in GME** stock in the fall of 2020, *months earlier* than previously believed.
- We also identify gamma squeeze activity in a broader set of meme stocks during the same period.
- These gamma squeezes are associated with:
 - Higher short-term returns, and
 - Higher long-term returns.
- Generalizing our methodology, we identify over **669 potential gamma squeezes** across all U.S. stocks from 2019 to 2023.
- These events have a **CAR of 5.79%** during the first month of the squeeze.

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Data

- Sample: 2019–2023.
- Data sources:
 - CRSP
 - Compustat
 - OptionMetrics
 - WRDS Short Volume

How Do We Identify a Gamma Squeeze?

Delta Volume

$$DeltaVolume_{k,t} = Delta_{k,t} \times OptionVolume_{k,t} \times 100$$

$$NetDeltaVolume_{i,t} = \sum_{k=1}^n DeltaVolume_{k,t}$$

$$NetDeltaVolume\% = \frac{NetDeltaVolume}{StockVolume}$$

Delta Open Interest

$$DeltaOpenInterest_{k,t} = Delta_{k,t} \times OpenInterest_{k,t} \times 100$$

$$NetDeltaOpenInterest_{i,t} = \sum_{k=1}^n DeltaOpenInterest_{k,t}$$

$$NetDeltaOpenInterest\% = \frac{NetDeltaOpenInterest}{SharesOutstanding}$$

Gamma Squeeze Event Definition

- Net Delta Open Interest Percent increases above 7.5% (95th percentile).
- The average Net Delta Open Interest Percent over the following 1-month period (22 trading days) stays above 7.5%.
- To avoid overlapping gamma squeeze events, we require at least 60 days to pass before a new event can be identified.

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GME Net Delta Volume

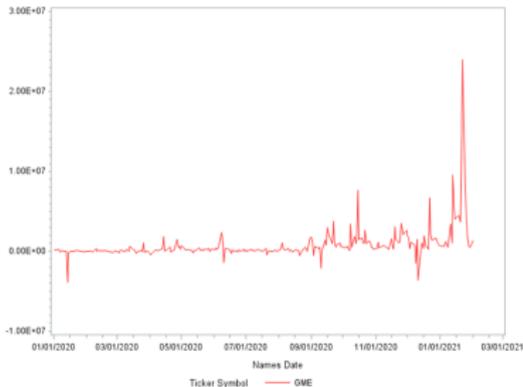


Figure: A

Net Delta Volume

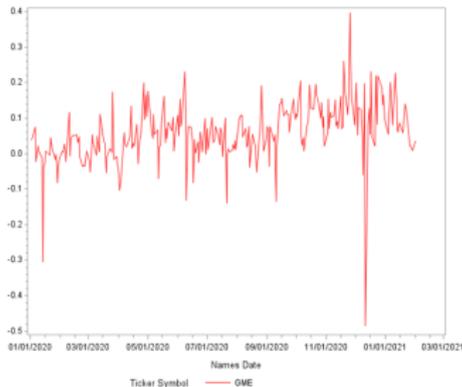


Figure: B

Net Delta Volume Percent

GME Net Delta Open Interest

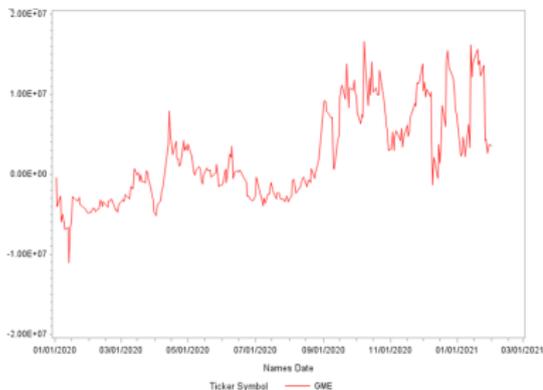


Figure: C

Net Delta Open Interest

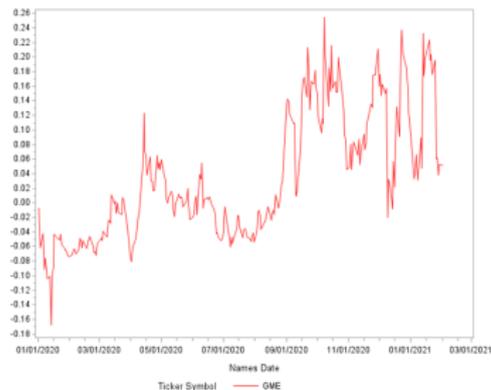


Figure: D

Net Delta Open Interest Percent

The Meme Stocks

- AMC Entertainment Holdings (AMC)
- Blackberry (BB)
- Bed Bath & Beyond (BBBY)
- Vinco Ventures (BBIG)
- Churchill Capital (CCIV)
- Carvana (CVNA)
- Express Inc. (EXPR)
- Jaguar Health (JAGX)
- GameStop (GME)
- Naked Brand Group (NAKD)
- Nokia (NOK)
- Palantir Technologies (PLTR)
- SNAP Inc. (SNAP)

Average Daily Return for Gamma Squeeze (Meme Sample)

VARIABLES	(1) Return	(2) Return	(3) Return	(4) Return
net Δ vol	3.936*** (4.041)			
Net Δ vol%		0.181*** (3.649)		
net Δ OI			0.086 (0.884)	
Net Δ OI%				-0.067 (-0.830)
O/S	-0.016** (-2.889)	0.023 (1.748)	-0.026*** (-4.580)	-0.026*** (-4.487)
Short Int. Ratio	0.031*** (5.775)	0.020** (2.771)	0.032*** (4.677)	0.038*** (6.529)
Amihud	0.205 (0.804)	0.214 (0.785)	0.191 (0.770)	0.105 (0.355)
Constant	-0.004 (-1.081)	-0.004 (-0.920)	-0.003 (-0.610)	-0.001 (-0.131)
Observations	9,134	9,134	9,134	9,134
R-squared	0.202	0.204	0.182	0.183

CAR Around Meme Stock Gamma Squeeze

Meme Sample (n=15)

	-5	-3	-1	0	1	3	5	10	15	22
Ab. Ret	-0.13%	-0.95%	3.86%	19.50%	3.35%	4.19%	-3.04%	-0.06%	1.85%	2.71%
T-Stat	(-0.06)	(-0.39)	(1.92)	(3.73)	(0.86)	(1.88)	(-2.11)	(-0.03)	(0.81)	(0.81)
CAR	-0.13%	-0.83%	3.20%	22.70%	26.10%	30.20%	28.10%	23.60%	32.20%	39.30%
T-Stat	(-0.06)	(-0.18)	(0.78)	(3.60)	(2.78)	(3.95)	(3.15)	(2.85)	(3.18)	(3.82)
CAR				19.50%	22.90%	27.00%	24.90%	20.40%	29.00%	36.10%
T-Stat				(3.73)	(2.73)	(4.12)	(3.41)	(2.92)	(3.32)	(3.29)
CAR					3.35%	7.48%	5.35%	0.86%	9.48%	16.60%
T-Stat					(0.86)	(1.97)	(1.05)	(0.15)	(1.54)	(1.85)

Average Daily Return for Gamma Squeeze (Whole Sample)

VARIABLES	(1) Return	(2) Return	(3) Return	(4) Return
net Δ vol	1.489*** (3.924)			
Net Δ vol%		0.011*** (6.404)		
net Δ OI			0.075*** (2.999)	
Net Δ OI%				0.028*** (3.103)
O/S	0.000*** (2.719)	0.004*** (6.490)	0.000 (0.675)	0.000 (1.421)
Short Int. Ratio	-0.002 (-1.570)	-0.002* (-1.718)	-0.002 (-1.585)	0.000 (0.119)
Amihud	-0.001** (-2.374)	-0.002*** (-4.176)	-0.002** (-2.472)	-0.002** (-2.475)
Constant	-0.001 (-1.530)	-0.001 (-1.575)	-0.001 (-1.346)	-0.001** (-2.044)
Observations	3,403,254	3,403,254	3,403,254	3,403,254
R-squared	0.019	0.018	0.018	0.018

Table: CAR Around Gamma Squeeze Events

Panel A: Whole Sample (n=669)

	-5	-3	-1	0	1	3	5	10	15	22
Ab. Ret	0.22%	0.81%	2.40%	5.02%	0.34%	0.78%	0.57%	0.08%	0.27%	0.17%
T-Stat	(1.22)	(3.25)	(6.78)	(10.71)	(1.10)	(3.14)	(1.36)	(0.27)	(0.98)	(0.65)
CAR	0.22%	2.05%	5.57%	10.60%	10.90%	12.10%	12.90%	14.20%	16.20%	16.40%
T-Stat	(1.22)	(4.08)	(7.97)	(12.56)	(12.34)	(12.17)	(11.36)	(9.77)	(9.61)	(8.58)
CAR				5.02%	5.36%	6.56%	7.36%	8.63%	10.60%	10.80%
T-Stat				(10.71)	(9.43)	(9.74)	(8.72)	(7.28)	(7.43)	(6.40)
CAR					0.34%	1.54%	2.34%	3.61%	5.54%	5.79%
T-Stat					(1.10)	(3.25)	(3.45)	(3.41)	(4.31)	(3.73)

Conclusion / Contributions

- We provide novel evidence that the gamma squeeze in GameStop originated months before the Jan 2021 frenzy.
- We introduce and formalize a model with robust metrics, Net Delta Volume and Net Delta Open Interest, to identify gamma squeeze events.
- Our findings show that gamma squeezes are not a niche anomaly, but rather a widespread and economically impactful feature of modern markets.
 - We identified **669** gamma squeeze events across the U.S. stock market from 2019 to 2023.

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Appendix: Gamma Measures Across Market Outcomes

VARIABLES	(1) Return	(2) Ab. Return	(3) Spread	(4) Range Volatility
Net Δ vol%	0.027*** (3.077)	0.024*** (3.016)	-0.001*** (-3.454)	0.004* (1.795)
Net Δ OI%	0.011*** (6.353)	0.009*** (6.267)	-0.000 (-0.718)	0.000 (0.801)
O/S	0.004*** (6.442)	0.003*** (6.465)	-0.000 (-0.234)	-0.000* (-1.839)
Short Int. Ratio	0.000 (0.062)	-0.001 (-0.827)	-0.001*** (-2.688)	0.009*** (2.744)
Amihud	-0.002*** (-4.085)	-0.001*** (-3.633)		0.002* (1.936)
Constant	-0.001** (-2.022)	-0.003*** (-8.782)	0.002*** (43.839)	0.042*** (77.940)
Observations	3,403,254	3,403,254	3,403,269	3,403,254
R-squared	0.019	0.021	0.416	0.352

Appendix: Propensity Score Matching Results

Variables	(1) Return	(2) Ab. Ret	(3) Spread	(4) Range Volatility
gamma_squeeze	0.048*** (7.697)	0.048*** (7.591)	-0.002*** (-4.425)	0.026*** (3.414)
Price	-0.000 (-1.502)	-0.000* (-1.680)	-0.000*** (-4.483)	-0.000*** (-3.376)
Turnover	0.014 (0.818)	0.018 (0.985)	0.001 (0.879)	0.033 (1.421)
Spread	-2.392 (-1.147)	-2.260 (-1.143)		4.570*** (4.349)
P/C	-0.013* (-1.918)	-0.013* (-1.875)	0.000 (0.029)	-0.005 (-0.670)
C/S	0.001 (0.142)	0.003 (0.427)	0.002 (0.761)	0.002 (0.421)
O/S	-0.004 (-0.594)	-0.006 (-1.015)	0.000 (-0.345)	-0.006 (-1.256)
Constant	0.013** (2.090)	0.012** (1.985)	0.003*** (9.521)	0.040*** (9.626)
Observations	1,539	1,539	1,539	1,539
R-squared	0.135	0.142	0.102	0.202

Panel A: 22-day CARs with Different Two-Prong Thresholds

22-day $\Delta OI\%$ Level		Day 0 $\Delta OI\%$ Level				
		1%	2.5%	5%	7.5%	10%
1.0%	CAR	5.46%	-2.09%	-3.03%	-5.17%	-4.36%
	t-stat	(9.19)	(-2.70)	(-3.12)	(-4.47)	(-3.05)
	N	4,507	3,078	1,697	1,164	851
2.5%	CAR	12.10%	5.30%	-1.23%	-4.56%	-3.84%
	t-stat	(12.74)	(5.76)	(-1.21)	(-3.80)	(-2.63)
	N	2,128	2,133	1,557	1,106	825
5.0%	CAR	16.20%	14.20%	6.81%	-1.00%	-2.11%
	t-stat	(-5.53)	(11.86)	(6.20)	(-0.77)	(-1.39)
	N	1,073	1,082	1,072	942	754
7.5%	CAR	12.70%	11.60%	9.45%	5.79%	1.05%
	t-stat	(7.49)	(6.92)	(6.10)	(3.73)	(0.67)
	N	674	675	676	669	624
3*10.0%	CAR	17.10%	17.10%	14.40%	11.80%	8.67%
	t-stat	(7.81)	(7.87)	(7.35)	(6.18)	(4.83)
	N	471	472	473	479	477

Panel B: 22-day CARs with Declining O/S Ratio

22-Day / Day 0		Net Delta OI Percent Level				
		1%	2.5%	5%	7.5%	10%
100%	CAR	5.23%	6.02%	5.20%	8.12%	7.64%
	t-stat	(8.98)	(6.95)	(4.42)	(5.21)	(4.00)
	N	4,565	2,031	989	612	424
50%	CAR	3.55%	3.43%	3.69%	4.99%	5.67%
	t-stat	(6.56)	(3.87)	(3.09)	(3.04)	(3.13)
	N	3,895	1,475	674	376	247
25%	CAR	2.89%	2.62%	2.85%	5.37%	5.51%
	t-stat	(3.49)	(1.62)	(1.54)	(2.98)	(2.39)
	N	1,641	506	196	103	58
20%	CAR	2.79%	1.97%	2.58%	3.42%	2.66%
	t-stat	(2.65)	(0.91)	(1.02)	(1.70)	(1.25)
	N	1,158	351	124	59	34

GME Volume OTM

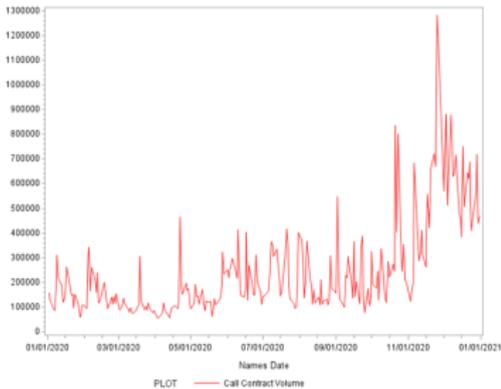


Figure: Calls

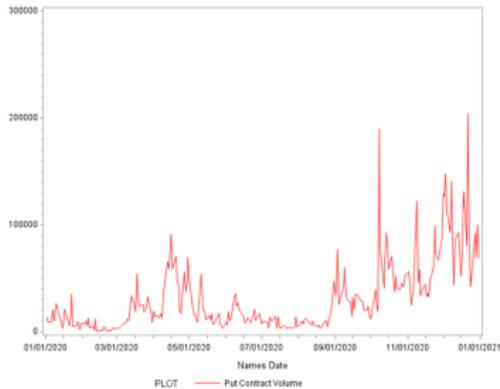


Figure: Puts

GME Volume ATM

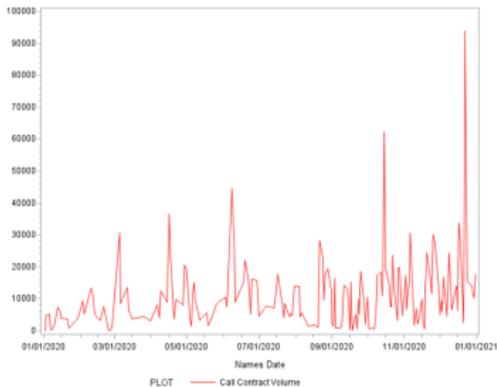


Figure: Calls

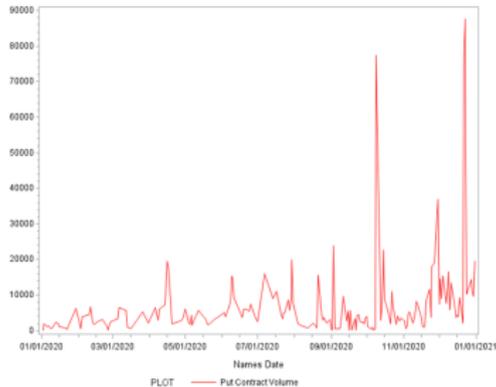


Figure: Puts

GME Volume ITM

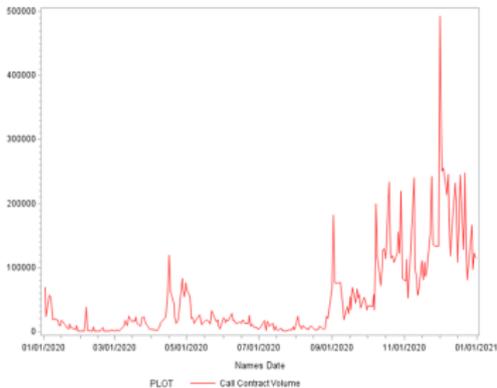


Figure: Calls

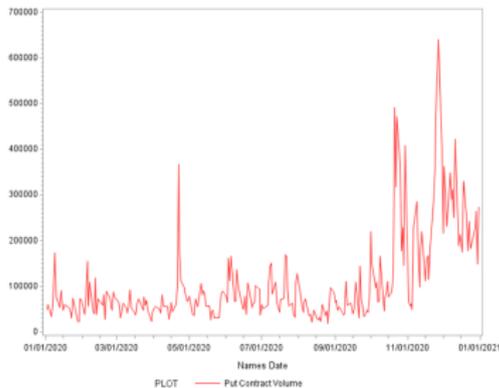


Figure: Puts