Title: Using the options chain to show that GME is a heavily shorted stock feat. SEC
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Body:
I debated whether or not to write this, but ultimately decided to (obviously). I think there's a lot of back and forth about options generally and (totally anecdotally) I think that's intensified on every run-up. My opinion is that's because: 1) some folks have a genuine irrational distrust of derivatives, 2) gamblers on a certain sub post more gains whenever GME goes up and folks irrationally hate that sub, and 3) shills *really* don't want retail dabbling in derivatives so amplify anti-derivative sentiment. What I tend to see is "ape no fight ape" until it comes to options when there's sharp upwards price movement. Then it's "options bad and damn you if you feel otherwise" for the win.

In short, I think vehement anti-derivative sentiment is FUD and anti-intellectualism in the extreme. Think of it this way: "options bad" is the financial equivalent of "vaccines cause autism" or "global warming doesn't exist." You can debate it, you can politicize it, but ultimately there's one *truth* about it whether you like or acknowledge it or not. A century of empirical evidence demonstrates that: options (and derivatives in general) have an important role in markets and are not "bad," vaccines absolutely do not cause autism, and global warming is real and terrifying. Options are a powerful tool and I think that but for the vehemently strong anti-options sentiment stoked by shills and an anti-intellectualist echo chamber, MOASS would have already happened.

That being said, I strongly do not recommend the purchase of derivatives (not financial advice) and *especially* not for what I'd consider the average trading intelligence in these parts.

This is a DD about what options can show us based on a paper hosted by the SEC from 2006. That paper highlights how to use option price disparities to identify stocks shorted and impacted through fails to deliver even when those fails to deliver are not explicitly identified.

The long and short of it is that the GME options chain price disparities show that there's significant shorting and potentially significant amounts of fails to deliver which are not being reported, but which are invariably expressed through the options chain because capitalists be capitalists. Those price disparities disagree with reported short interest levels based on comparable data points in the market.

[This paper] (https://www.sec.gov/comments/4-520/4520-6.pdf) talks about options pricing disparity indicating short interest on a stock. Essentially, the paper's hypothesis is that synthetic short interest via failures to deliver can be demonstrated through the options chain based on price disparities introduced by MMs to profit where they are also effectively using failures to deliver as a loan to short a stock.

The meat of the calculations used is on page 14 of the article. Effectively, it suggests calculating the implied stock price on options, comparing it to the actual stock price, and then identifying the % deviation between the two. Ideally, that would be 0 but really the median was 0.28%. In the study, the 5th percentile was -0.98% and the 95th percentile was 1.95%. Those are extremes at either end where put-call disparity weighs in favor of puts and put-call disparity weighs in favor of calls, respectively. The minimum was -9.99%. The authors found that synthetic shorting via failures to deliver in the option chain resulted in a stronger negative value and not a positive value—i.e.: synthetic shorting was significantly demonstrated by a negative divergence.

What frustrates me is that they didn't show what a high put-call disparity short position was. Was it 30%? 300%? Very difficult to tell what a -1% looked like, or even the -9.99%, for example. We just know that it correlates with some of the most shorted stocks in the market from 1998-1999 (the time period of their data set). Also (and I'm only speculating on this one) it looks like the work implied that the "specialness" of the stock—very difficult to borrow stocks where there was reduced rebate (interest) on the stock—strongly impacted the put cost, but not the call cost. So negative disparities would be disproportionately impacted for hard to borrow stocks, with reduced rebate rates.

My results are [here] (https://drive.google.com/drive/folders/1PfD76yIBo-1a8dQoedWQ_DfOaoNXcMFj?usp=sharing) for your perusal.

Since collating the data is a little cumbersome and manual for me (I'm using yahoo.com options data cross-referenced against my broker's options data—yahoo reports a lot of strikes not commercially available) I used three dates for now: 9/3/21, 1/21/22, and 1/22/23 based on data available at market close on Friday, 8/27. I picked those dates because: 1) 9/3 is the next options date, 2) 1/22/21 has a massive volume of OTM puts for GME and the authors of the linked paper cite to increased volatility in closer-due options chains, and 3) 1/22/23 is the farthest out common option chain for all stocks chosen.

The authors also used European instead of American options. Investopedia has a great article about the difference between the two—European options are exercise on expiry and American options are exercise whenever—and the authors used European options to minimize volatility in their data. The calculations work the same for American options, but the data is slightly more volatile which does impact the deviation between put-call parity. Since I only have access to American option data and have no idea where to find European option pricing for GME, I didn't use that.

I'm also going to talk about short interest in aggregate via failures to deliver. The article implicitly assumes that because Market Makers alone have a special exemption from finding shares before shorting, that all other players are finding shares before shorting (I.e.: only MMs use their legal naked shorting powers to naked short and no one else naked shorts). I think we can assume one of two things: 1) naked shorting doesn't happen and shorting through the options chain is only conducted by market makers or 2) naked shorting does happen and the options chain pricing accounts for that behavior.

I used Apple as a control for a lack of short interest. It has a 0.52% reported short interest as a percent of float. The deviation for the 9/3 option chain is 0.00402%, the deviation for the 1/21/22 option chain is 0.27%, and the deviation for the 1/22/23 option chain is 1.19%. That aligns with the authors data: low short interest = low divergence.

I then used Tesla as an example of a stock that was heavily shorted, but now is not. The reported short interest as a percent of float is 3.36%. The deviation for the 9/3 option chain is -0.17%, the deviation for the 1/21/22 option chain is -2.49%, and the deviation for the 1/22/23 option chain is 0.58%. Since the 1/21/22 option chain was created during the short squeeze from 2019-2021, it's likely in my opinion that the 1/21/22 chain was priced and still is priced based on that short interest. The 9/3 and 1/22/23 chains account for the lower short interest and therefore shows less divergence.

I think that's supported by the Workehorse (WKHS) option chain. According to Marketwatch (which has good publicly available stonk data, even if their news is crap) that is the second most shorted stock with a short interest of 38.33%. It's also not very volatile, showing that it's steadily been trading downwards.

Remember, that short interest is after S3 and others changed the Short Interest calculation during the GME run-up in order to claim shorts covered from 140%+ to 30% *over a weekend*. I think I'll bring that shit up for the rest of my life in the context of mainstream financial media and supporting institutions being totally corrupt. They literally reported on a Friday that the short interest on GME was 140%+ and then on a Sunday, reported that: 1) shorts covered 110% of their position and 2) that they changed their calculations so no short position would ever exceed 100% again. The new short positions were then reported as fact, instead of just a different way of expressing the same short position data. Ok.

The deviation for the 9/3 WKHS option chain is -0.22%, the deviation for the 1/21/22 option chain is 2.07%, and the deviation for the 1/22/23 option chain is 7.56%. That second value is similar to TSLA (but call-biased) and TSLA was about 40% shorted at its peak when the 1/21 option chain was made. The price arbitrage and ability for MMs to profit off of that doesn't disappear, so I think they've kept the short interest priced in to preserve profits. So those align pretty well. So WKHS is definitely being shorted through the option chain via failures to deliver (though isn't presently on the threshold security list).

This also wouldn't be a proper comparison if I didn't include Movie Stonk. I'm not a fan of the ongoing short

thesis there, though I hold shares because why not. From December to today the float was diluted by 150% - it went from under 200 million to over 500 million in that time and peaked at $70. It doesn't matter who holds what short position (though even there, the claims that Citadel is the mastermind of those shorts is verifiably wrong – I believe they have a verifiably net long position) – the shorts could have and likely did cover much of the short position reported in December/January due to those significant share offerings. Consequently, I do believe the current reported short interest numbers which is 18.06% of float. Still high, but not meme stonk nirvana high. Could it be squeezed? Maybe, but likely not based on publicly available information.

The call-put parity deviation supports that. The deviation for the 9/3 Movie Stonk option chain is -0.66%, the deviation for the 1/21/22 option chain is -0.88%, and the deviation for the 1/22/23 option chain is -0.43%. So short interest and failures to deliver are definitely expressed in the option chain, but not as significantly as other stocks which have a likely true 30%-40% short interest. So shorting happening on Movie Stonk is likely occurring largely via "covered" and not naked shorting.

The question I have about that is: why does the shorter-term option chain show a larger put-call disparity compared to a verifiably heavily shorted stock while the longer-term option chain doesn't? I'd suggest that's due to volatility and I think the short-term TSLA deviation proves that out. Both Movie Stonk and TSLA have been trading with some volatility over the past few weeks and that's expressed in the option chain pricing. WKHS most definitely hasn't. So I think the WKHS option chain is more "accurate" vis a vis short interest and TSLA and Movie Stonk are expressing short-term volatility.

Now on to GME. The deviation for the 9/3 option chain is -2.01%, the deviation for the 1/21/22 option chain is -6.40%, and the deviation for the 1/22/23 option chain is -9.13%. If you've made it this far, take that in. GME is showing around at least 10x more deviation in the immediate options chain compared to other stocks here and at least 3x more in the January options chain.

So what does that tell us? It likely tells us two things: 1) GME is heavily shorted through failures to deliver, whether those actually occur and are publicly reported or are somehow pushed off with synthetic long positions, and possibly also 2) it is a hard to borrow stock with low rebate rates (which if you look on fidelity and iborrowdesk/ibkr seems to be the case).

Playing devil's advocate, it could also tell us something else entirely: MMs and other market players are significantly over-pricing their options for shorted stocks. The paper actually covers that and highlights that if that were the case, it is highly likely an MM (and for our assumptions, other options writers) would offer a cheaper options contract, so they could ensure purchases of their options contracts – i.e.: capitalists would be capitalists. That would really require collusion on a grand scale: all market participants would have to agree to price options similarly and a cartel like that seems almost a little more far-fetched than price arbitrage on heavily shorted stocks.

The idea that GME is heavily shorted and also a hard-to-borrow stock with low rebates has been discussed *ad nauseum* in other DDs. I think it's cool to see it expressed in a place where the numbers aren't only failing to hide that, but also prove it out. MMs and other market participants are in the business to make money. The only way to do so on the options chain where the options chain is impacted significantly via actual ongoing failures to deliver is to introduce pricing disparity between options contracts – i.e.: create an insurance policy in the form of premium for failures to deliver.

The authors of the paper above didn't go as far as deriving the volume of failures to deliver or actual short interest from the amount of deviation. That wasn't the point of the paper, which was just showing the effects of shorting and failures to deliver on put-call pricing parity. I think it's a little difficult to do that without more data points, which I'm going to be working on moving forward. That being said, when comparing different stocks we can see the following:

Company	9/3/21 deviation	1/21/22 deviation	1/22/23 deviation	% Shorted
Apple	0.00402%	-0.27%	1.19%	0.52%
Tesla	-0.17%	-2.49%	0.58%	3.36% (40% for 1/21 data)
Popcorn	-0.66%	-0.88%	-0.43%	18.06%
Workhorse	-0.22%	2.07%	7.56%	38.33%

GME | -2.01% | -6.40% | -9.13% | ?%

The normalized 1/21/22 data plots a really nice linear trendline with an R value of 0.962, so strongly correlated (also using TSLA's short value of ~40%). That's sort of deceptive with so few data points so more would be good. That being said, based on the data available now, the short interest for GME just expressed through pricing based on fails to deliver in the options chain would be 113%.

Unfortunately, the 9/3 data points have an R value of 0.12, so are very weakly correlated and it's difficult to figure out what the GME short interest expressed through the 9/3 option chain would be. If you remove popcorn stock and use an exponential trend line, the R score becomes 0.951 but the short interest for a 2.01% deviation would be 2.11223E23. I'm optimistic about the % short interest, but not *that* optimistic. So I think it's fair to say that the volatility of more recent data points makes short interest difficult to parse.