
AMBRUS
CAPITAL

DISPELLING FALSE NARRATIVES
ABOUT 0DTE OPTIONS



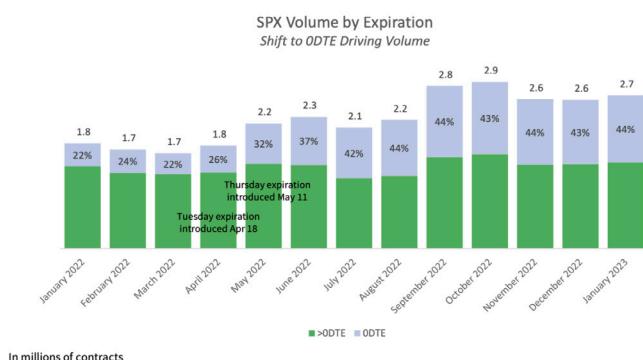
INTRODUCTION

In recent years the growth of derivative trading, specifically zero-day-to-expiration (0DTE) options, has become a popular topic in market risk discussions. In a February 2023 research note, a J.P. Morgan analyst stated that they believe 0DTE options could drop the market more than 20% in one day, citing it as “Volmageddon 2.0”. Many other banks and publications have also released research around 0DTE options, attempting to model out the direct day-to-day impact they have on the broad market. Unfortunately, much of this research is inaccurate or simply fear-mongering, and has led to a false understanding of 0DTE options and what they mean for the market. As a tail risk manager, it is integral to our business to accurately gauge the impact of potentially hazardous flows, including those from the growing 0DTE market. In this paper, we will give a more accurate summary of the historical 0DTE option data and explain its implications for the U.S. equity market.

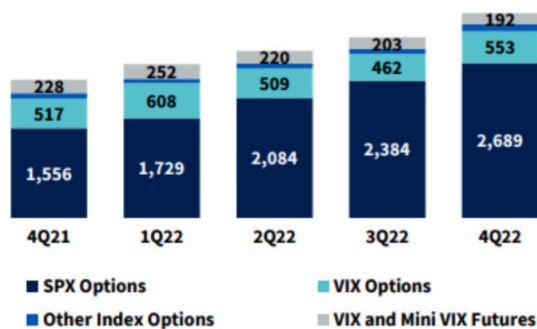
THE RISE OF ODTE OPTIONS:

ODTE options have gained popularity over the last 18 months thanks to increased market volatility, the search for short-term trading opportunities, and their inherent leverage. The Chicago Board Options Exchange (CBOE) has capitalized on this trend, with 56% of its revenue coming from its options business. Exchanges such as the CBOE, Nasdaq, and others continue to list more tenors of these derivatives as the market demand thus far has been enormous.

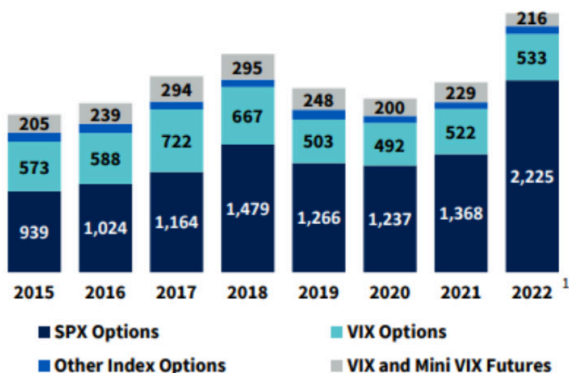
Source: CBOE



Quarterly ADV for Index Options and VIX Futures (in thousands)



Annual ADV for Index Options and VIX Futures (in thousands)



WHO IS TRADING ODTE OPTIONS?

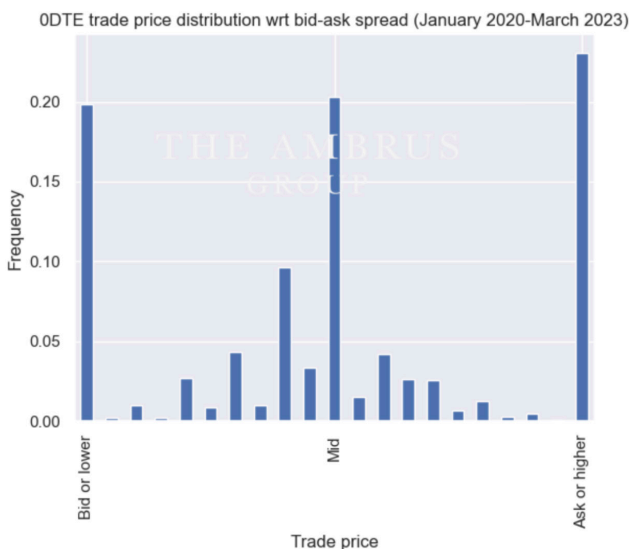
Given their meteoric rise, a natural question to ask is "Who is trading these options?" A commonly held belief is that the retail community is the main participant in these short-dated options. Indeed, a brief examination of regulatory condition codes shows that the majority of these trades are executed electronically, which would seem to support this view. However, when we surveyed ten different market makers that handle electronic and voice orders in the SPX complex, we found a much more diverse set of market participants including wealth managers/RIAs, market makers, speculators, event hedgers, volatility hedge funds, as well as retail. Our survey indicated that institutional flow was actually a much larger proportion of ODTE volume than retail.

Post-March 2020 many institutions began advocating for option overlay programs. During 2021 many of those mandates were approved and put into action. Along with generic hedging mandates, large RIAs also began implementing yield-generating programs. During 2022, rates began to move higher and equities sank. This left wealth managers looking for other sources of yield. With equity volatility remaining muted, these yield programs started to attract more investors towards the end of Q1 of 2022. The addition of short-dated options made these programs very attractive to advisors and other institutions. The shrinking equity risk premium due to the move in rates left investors flocking to the growing volatility risk premium. This is why there was a substantial increase in ODTE volume around Q2 of 2022. Additionally, for volatility hedge funds and market makers, this new tenor allowed a cleaner way to hedge gamma and theta risk. Furthermore, speculative hedge funds that are not derivative-focused began using ODTE to hedge macroeconomic-driven event risk.

Type of participant	Goal	Structure
Wealth advisor/ RIA	Systematically generating yield	Selling Options
Market Makers	Making markets and hedging theta / gamma risk	Agnostic
Volatility Hedge Funds	Speculative trading and hedging theta / gamma risk	Agnostic
Event Driven Funds	Speculative / Hedging	Purchasing Options
Retail Traders	Speculative / Hedging	Purchasing Options

HOW ARE 0DTE OPTIONS BEING TRADED?

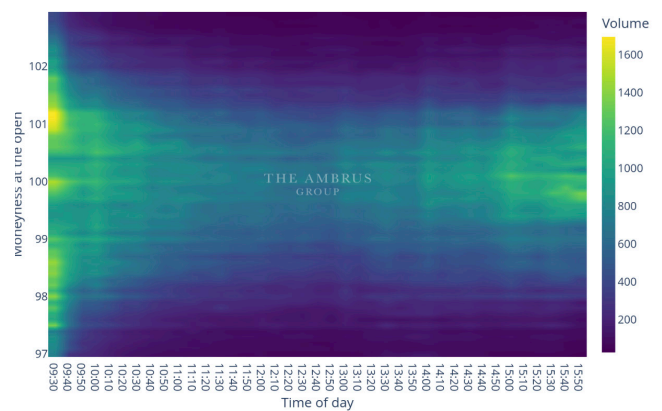
We understood who the participants were, but to accurately estimate their impact we needed to understand how they are trading these options. We came across a slew of sell-side research and publications that incorrectly claimed that the majority of end-users are aggressively purchasing these options. We attribute this to a naive focus on whether each transaction is executed closer to the bid or the offer. This approach can lead to incorrect conclusions as a large proportion of orders are typically executed at mid-price. Other studies track the overall volatility change in the underlying after each trade is executed. That method can also lead to inaccurate findings when end-users are simultaneously buying and selling on different parts of the volatility surface.



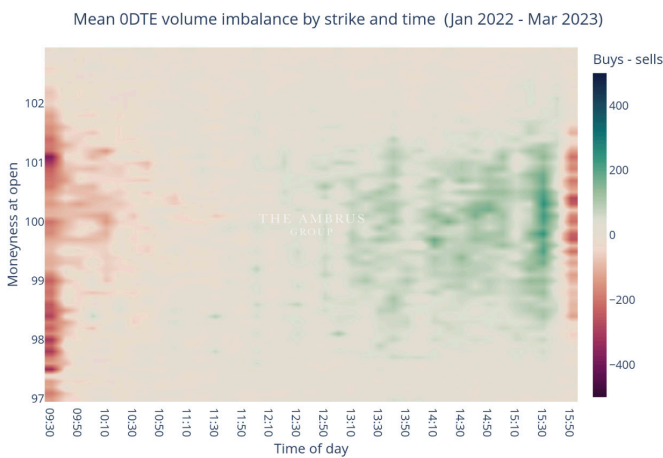
We believe that it is optimal to focus on the local volatility itself as this is what market makers predominantly trade on and mark their books to. We tagged each individual order by focusing on the rate of change of the local volatility of that specific contract. If the local volatility on that specific strike moved up with a rapid rate of change following an order (along with other execution codes), it is reasonable to assume that market makers sold volatility as dealers will raise the volatility in pockets in which they are under pressure. If the local volatility on that specific strike moved down with a rapid rate of change following an order (along with other execution codes), it is reasonable to assume that market makers bought volatility as dealers will drop the volatility in pockets where they are oversupplied. There are other exchange codes and condition codes that help filter this process even further such as intermarket sweep orders, single-leg auction trades, multi-leg execution trades et cetera. We will not go into full detail as the information required to make the final assumption is proprietary to our trading desk.

Before assigning directionality, we broke down all 0DTE volume from January 2022 to March 2023 by strike and time of day. Normalizing the data by moneyness at the open, we found that most of the action took place at the beginning of the day in slightly out-of-the-money contracts, typically in 98% MNY to 102% MNY. In the example listed below, if SPX were to open the day around 4000, the majority of activity would be between 3920 and 4080.

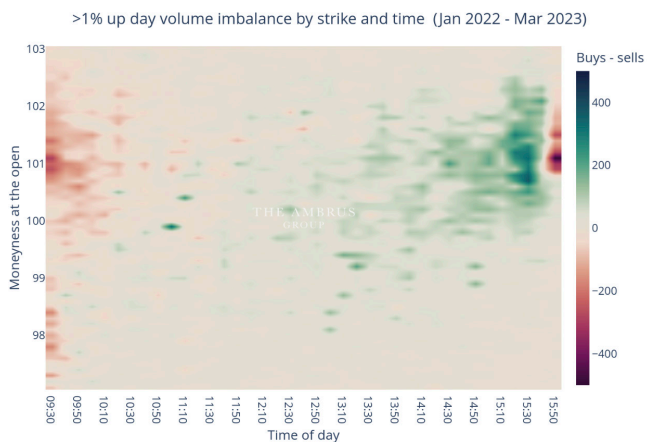
Mean 0DTE option volume by strike and time (Jan 2022 - Mar 2023)



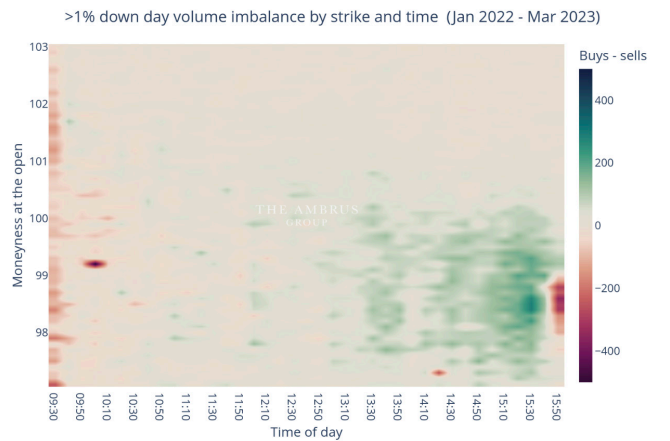
After assigning directionality to the data we found that the majority of contracts that traded at the opening print were opened to sell volatility on strikes that were slightly out-of-the-money. These trades came from institutional flow. The largest activity was around 1% OTM calls and 2% OTM puts. As the day progressed, market participants began to close those contracts and a second wave of end-users came in. The second wave seemed to be opening trades to buy volatility making a speculative bet on the direction of the broad market.



For a more granular look at this second wave of participants, we examined days on which the market closed over 1% up or 1% down from its opening price. What we observed was that on days the market eventually trended up, end users were inclined to sell calls slightly out of the money at the open, consistent with our baseline case that showed heavy volatility selling at the beginning of the day. Later on, throughout the trading day, call buyers came in to bet on a continuation of the upward trend. There was also widespread closing of those short volatility positions.

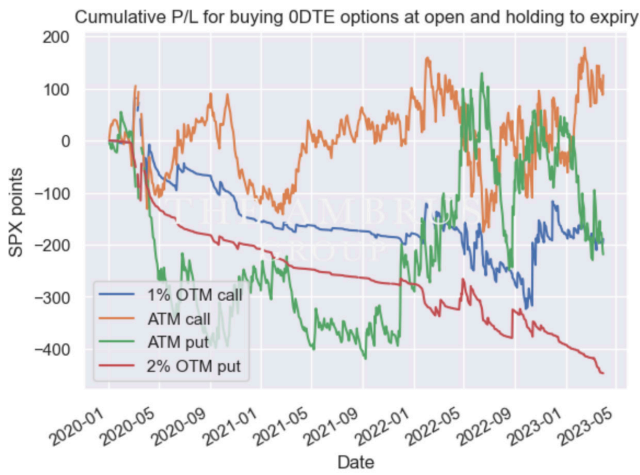


On days the market trended down, we witnessed a slightly different pattern. It was common to see volatility sellers come in at the open. However, there was a wider mix of volatility selling across a range of strikes. As the day progressed, we noticed the closing of the short volatility positions, as well as an influx of directional bettors.



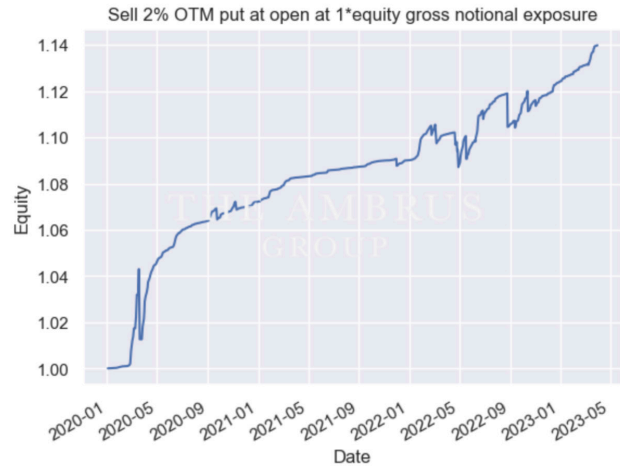
STRATEGY BREAKDOWN:

Increasing volume in ODTE suggests end users are trading them profitably. For this to be the case, the majority of end users would have to be net sellers of these options. This point of view flies in the face of most sell-side research, but put simply if end users were losing money, the volume would have diminished by now. To further prove this we backtested what it would look like if the end user were indeed purchasing these options. In the chart below, the two most actively traded pockets from our previous data are the 1% OTM call and the 2% OTM put. If these were consistently purchased by end-users it would lead to terrible results.

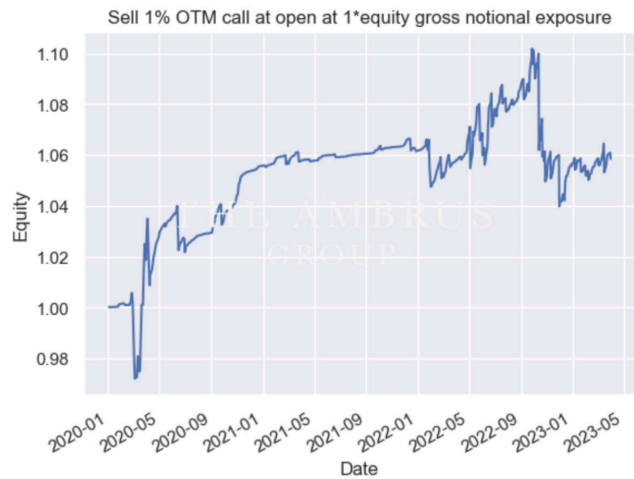


Conversely, selling these options would have been profitable in the recent past. For years wealth management firms and RIAs have had an interest in offering “strategies” to their clients that focus on three main factors—simplistic structures, yield generation, and good recent performance. A popular form of this would be systematic call overwriting during 2022. The short-dated nature of ODTE options has opened the door for these firms to roll out new offerings. Here at Ambrus, it is a cardinal sin to refer to a dogmatic trade structure as a “strategy”. There is inherently no edge in systematically buying or selling a put or a call. However, we wanted to showcase what the performance would look like to sell options on the two most actively traded pockets, 1% OTM call, and 2% OTM put. Listed below are the P&L results of dogmatically selling ODTE options. It is easy to see why structures like this would gain popularity with the wealth management / RIA crowd, particularly as an overlay piece in an inflationary environment where stocks and bonds are underperforming.

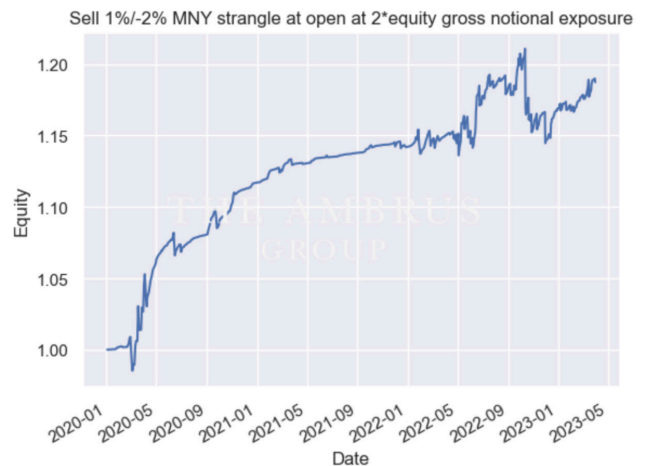
Sharpe:	1.67	CAGR:	4.12%
Win rate:	0.97	2022:	3.12%
Mean win:	4.12 bps	2021:	1.67%
Mean loss:	-58.42 bps	2020:	7.22%



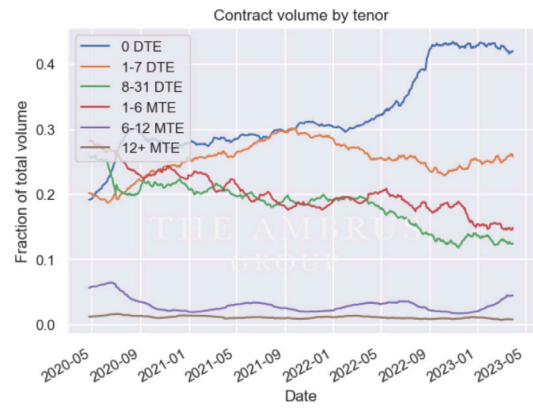
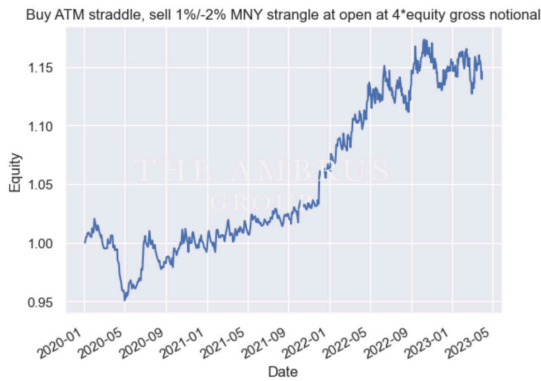
Sharpe:	0.40	CAGR:	1.77%
Win rate:	0.88	2022:	-0.51%
Mean win:	8.46 bps	2021:	0.56%
Mean loss:	-54.12 bps	2020:	5.58%



Sharpe:	1.16	CAGR:	5.44%
Win rate:	0.86	2022:	2.31%
Mean win:	11.27 bps	2021:	2.24%
Mean loss:	-48.91 bps	2020:	11.71%



Sharpe: 0.68 CAGR: 4.29%
 Win rate: 0.47 2022: 8.61%
 Mean win: 39.64 bps 2021: 6.86%
 Mean loss: -31.21 bps 2020: -0.66%

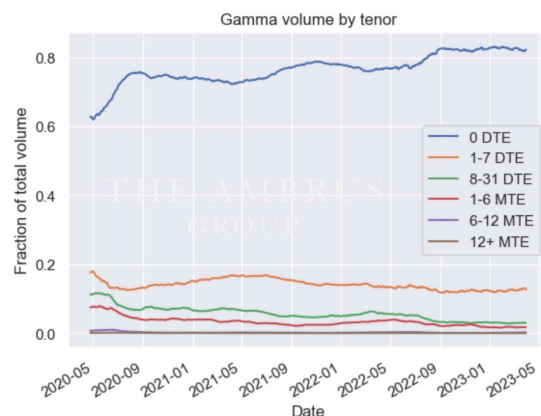
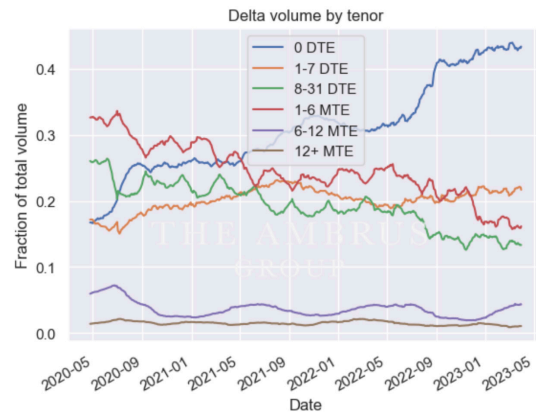


HOW DO 0DTEs IMPACT THE BROADER OPTIONS MARKET?:

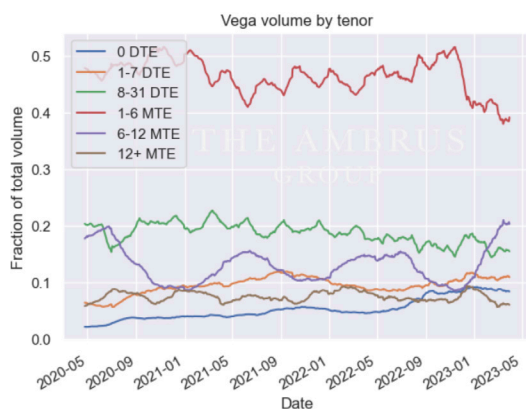
Another common misconception is the idea that investors are hedging their risk with 0DTE options instead of VIX calls. Many financial headlines have alluded to this. However, this idea is contradicted by the high annual volume CBOE reported for VIX options during 2022. It is also worth noting that no large institution will rely on 0DTE options as a hedge in the case of a true crisis since, in the case of a true risk-off event, a large portfolio cannot be efficiently hedged with short-dated options that are subject to timing risk. Take for example the mini banking crisis we witnessed in March 2023. 0DTE options would not be a reliable hedge in such a scenario that could last weeks or months. In fact, during that brief moment we witnessed one of the highest amounts of VIX call buying over the last three years, demonstrating that investors will still rely on 30-day volatility during times of instability and panic.

Since most of the contracts traded are slightly OTM, **they carry a very high amount of delta and gamma risk which can impact the market.** This can be observed in the big intraday price swings in the underlying which occur as a result of market makers hedging their exposure to these contracts.

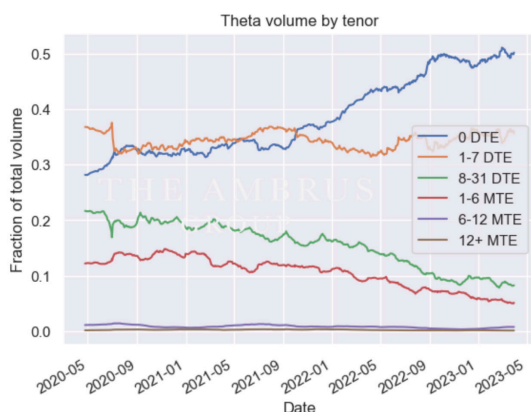
Although these options are not impacting the VIX derivatives complex, the addition of 0DTEs does seem to have had an impact on the SPX complex. To gauge this impact we focused on volume activity as open interest would not be an accurate measure for such short-dated expirations. We examined how contract volume, gamma volume, vega volume, delta volume, and theta volume changed across the entire volatility surface over the last three years. To reduce noise, we partitioned the surface into six tenor ranges and calculated each range's proportion of the total volume traded in a rolling 50-day window. From the graph of contract volume below, **it seems clear that investors are using 0DTE in place of 1-day to 6-month options.** It is also no surprise that 0DTE carries the largest notional exposure in the broad market thanks to the large volume of contracts traded.



Generally, the vega is greater in longer-term options. Shorter-term contracts carry a higher gamma profile. Due to the short-term nature of 0DTE contracts, they do not carry a large vega profile. **Even with all of the active trading that takes place, it seems that the vega from 0DTE options is not disrupting the breakdown and appetite for SPX vega.**



The theta volume impact of these contracts seems to be something that is overlooked. **With a large amount of ODTE contracts traded and such a high theta profile due to the short-dated nature of these contracts, the appetite for theta in the SPX complex seems to be shifting more toward the short-term application.** This seems to be more affirmation around our belief that wealth managers / RIAs and other systematic programs are taking advantage of ODTE contracts in place of longer tenor contracts.



HOW COULD ODTE OPTIONS IMPACT THE U.S. EQUITY MARKET?

Many commentators take extreme views of ODTEs' effect on market volatility—they either believe that ODTEs always increase market volatility, or that ODTE trading will never have a major impact on the broader equity market. Regarding the former view, as we saw in prior sections the most consistent flow in ODTEs is option selling at the open, which actually tends to stabilize markets via dealer hedging. Thus, the idea that ODTEs are causing wild swings in an otherwise normal stock market is highly inaccurate.

On the other hand, it is very possible that ODTEs could exacerbate an exogenous tail event. Our

scenarios are not as extreme as J.P. Morgan's previously quoted possible 20% decline, but we do believe that many investors are overlooking how impactful the prevalence of ODTE can be on the market. In notional, gamma, and volume terms, ODTE options outweigh the rest of the U.S. derivatives market by a wide margin. Although the netting of these positions reduces their impact, it is very naive to believe that sentiment and positioning will never be caught offside. If you play the market long enough you will realize that you should expect the unexpected. Is it unlikely that you get double zero on the roulette wheel three times in a row? Yes. If you play roulette for eight hours every day for the rest of your life, is it reasonable to believe that you will eventually face a day when that happens? Yes. Unlike roulette, derivative markets are driven by sentiment, which is usually driven by behavioral dynamics. Behavioral dynamics generally follow a herd mentality. Human herds tend to be polarized during moments of FOMO or panic.

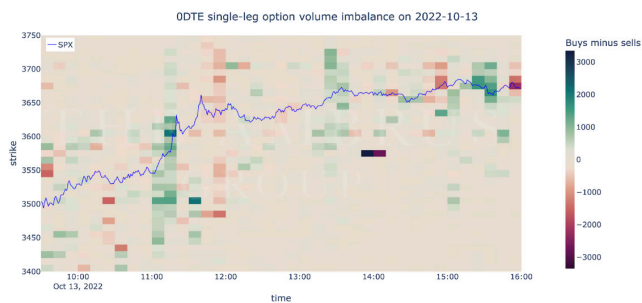
QUICK REFRESHER OF GAMMA HEDGING:

One area of the market where reflexivity can play a significant role is dealer gamma hedging. Gamma hedging involves dynamically adjusting the dealer's position in the underlying asset to offset the risk exposure associated with the options they have sold or bought. This is typically done by buying or selling the underlying asset in a way that keeps the net gamma exposure of the dealer's overall position close to zero.

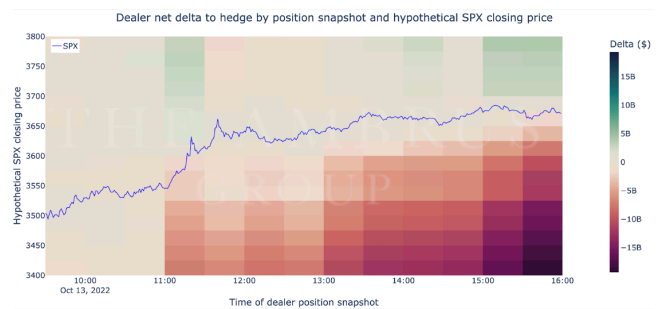
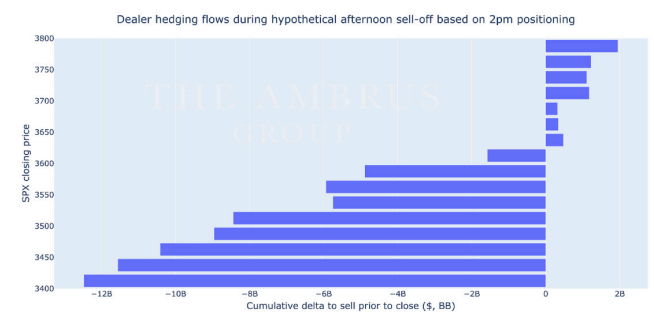
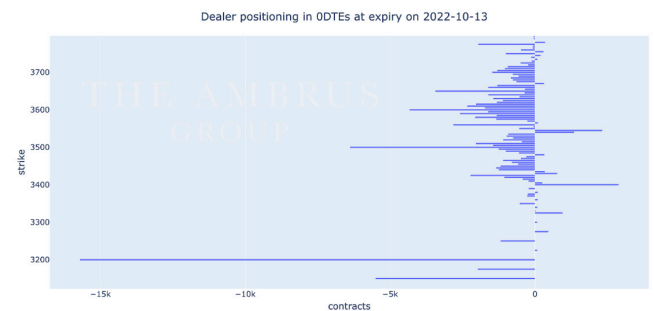
As the price of the underlying asset changes, the dealer needs to adjust their hedge by buying or selling more of the asset. This process of continuously adjusting the hedge is known as "dynamic hedging". By maintaining a gamma-neutral position, the dealer can minimize the impact of the underlying asset's price fluctuations on their options portfolio, thereby reducing their risk exposure. However, reducing their risk exposure does not necessarily equate to reducing overall market risk. More specifically, if dealers are net short gamma, they are forced to trade in the same direction as the market is moving. This process can lead to reflexive feedback loops that accelerate asset prices higher or lower in short periods of time. This effect is most acute with ODTEs since gamma risk increases as time-to-expiry decreases.

REAL LIFE EXAMPLE

Here is a tangible example of where ODTE options could have led to a pretty hairy scenario. On October 13th, 2022 we set an annual intraday low for SPX. According to Ambrus' model, end users bought a large amount of gamma on the days leading up to October 13th with the peak of the buying on the 13th itself. We ran a study on the single-leg activity to isolate speculative positioning that would result in directional dealer hedging. It is worth noting that when we aggregated the data, the multi-leg orders heightened the impact even more. In the chart below, green signifies more end-user buyers than sellers of single-leg ODTE contracts at a strike and time. The chart shows a large imbalance toward buying ODTE, particularly on the put side. It is noteworthy that this behavior was counter to the typical option selling we saw in the overall data. As the market moved up, calls went in the money, and puts decayed as they went deeper out of the money. This caused dealers to buy back a large amount of delta, reinforcing the rally. However, if there had been a reversal the large dealer short gamma position could have fueled an intraday crash.



Adding up all the single-leg open interest expiring that day, an afternoon reversal could have easily caused a chain reaction as down-moves would mechanically cause dealers to sell more delta. For example, if SPX returned to its low of 3489 by the close, then dealers would have to sell over \$10B of delta on the way down, simply based on already existing positioning at 2 pm. If there had been a reflexive panic bid for gamma, the number could be even higher. The charts below show how extreme this could have been in the case of a crash.



It is important to remember that \$10B of delta for sale is not even factoring other automatic liquidation programs that would take place in assets and equities outside of the SPX, which would further intensify the SPX selling.

CONCLUSION:

Many investors are reassured by the fact that ODTE options have not yet fueled a crash. However, as history shows us, systemic risk is often only obvious after the event occurs.

It is true that in the normal course of trading ODTE options do not seem to add systemic risk. However, during moments of market stress, reflexive flow can accelerate extreme price action, and the size of the gamma risk from these contracts can be hazardous. If faced with a scenario with an extreme catalyst similar to the flash crash of 2015, it is reasonable to believe that one-sided panic / speculative put buying would be implemented using ODTE options, which could magnify the move. ODTE options create a new form of risk because of their ability to accelerate negative situations. This is not different from other better-known reflexive effects in markets. However, it's notable that in an already highly reflexive market, we're taking the heat on the pressure cooker and turning it up to HIGH. As long as demand for these products is sky-high the potential unintended consequences for markets will be as well.

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