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# The Rise in Popularity of Zero-Days-To-Expiration Options and the “Broken VIX”

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## **Summary**

Recently, some people have theorized that the rise in popularity of zero-days-to-expiration (“ODTE”) and other extremely short-dated options has had a significant effect on markets, especially the VIX. More specifically, the two main ways in which the rise of ODTE options is theorized to affect markets are:

1. These options are not included in the calculation of the VIX Index, so the increased customer purchases of them are not reflected in the value of the VIX, thereby artificially suppressing it.
2. These options create a need for significant dealer gamma hedging, which increases the volatility of the S&P 500.

## **Summary Conclusion**

Many times, the belief that the VIX is broken, because it was not higher in 2022, is based on one or more of three general misunderstandings.

- The VIX Index is a “fear index.”
- In the past, its level has been a good medium-term forward indicator of S&P 500 returns.
- It is dependent on the size of S&P 500 drawdowns.

However, we believe that when the VIX is properly defined and understood, the idea that it was broken or suppressed in 2022, by the rise in popularity of ODTE options trading, is flawed. Consider two simple responses.

1. *The VIX was rather accurate in 2022.*
  - a. In reality, the VIX Index is a measure of implied volatility or, roughly speaking, volatility market participants’ expectations of S&P 500 volatility over the next month. Viewed in that correct light, it was generally accurate, and not significantly suppressed, in 2022. Its average value was 25.6, compared to S&P 500 volatility of 24.0 for the year.

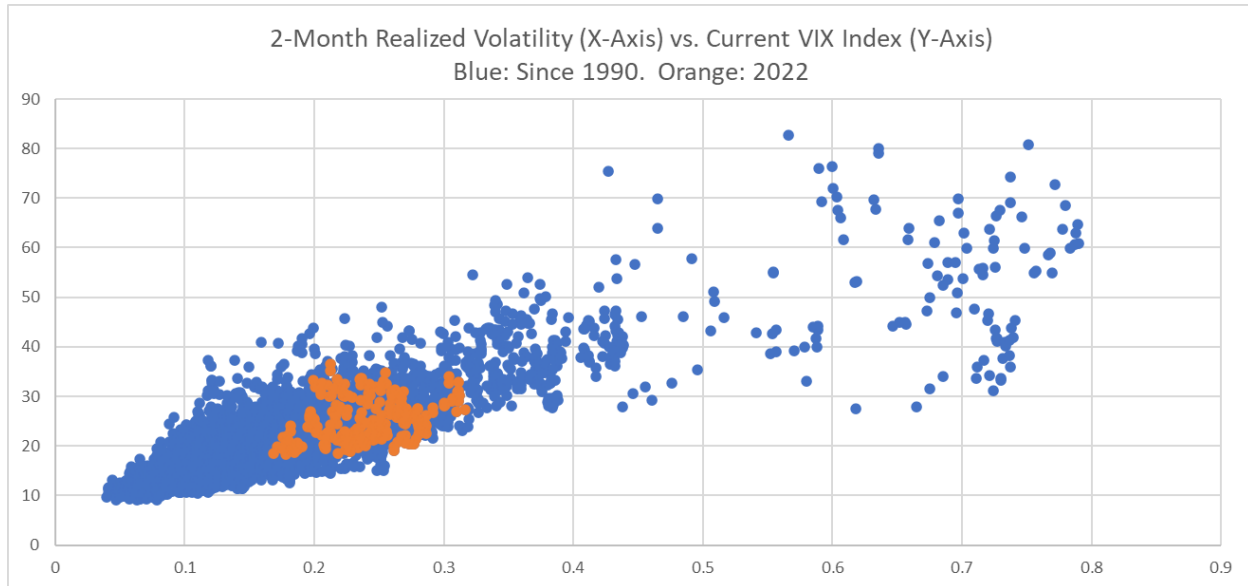
2. *Increased customer purchases of ODTE options would generally be expected to increase, not decrease, the VIX.*
  - a. Specifically regarding the two main ways in which the rise of ODTE options are theorized by some to affect the VIX, the effects have likely been small, and they should actually have increased, not decreased, the VIX.
    - i. Additional customer purchases of very short-dated options would increase the VIX, not decrease it. Volatility is autocorrelated – or sticky – and so purchases on one part of the curve are generally expected to have a non-zero and same-direction effect on other parts of the curve.
    - ii. Additional customer purchases of ODTE options would result in increased short gamma positions for the dealers who sold those options to the customers. Increased amounts of dealer-short-gamma hedging would, if anything, be expected to slightly increase, not suppress, realized volatility. Furthermore, S&P 500 recent realized volatility has been the primary driver of the level of the VIX. Therefore, putting it all together, increased dealer gamma hedging would, if anything, be expected to (slightly) increase, not suppress, the VIX through the (slightly) increased realized volatility it could create.
      1. However, research attempts to quantify the effect of dealer gamma hedging have found only a small impact over only very short time frames, nothing we believe to be significant to long-term investors.

As a result of the above two observations (the general accuracy of the VIX in 2022 and the inflating effect that increased realized volatility would actually have on it), which are supported in more detail below, we conclude that the rise in ODTE option popularity has not meaningfully “broken” or suppressed the VIX.

### **Detailed Response to ODTE Claims**

In response to both aspects of the ODTE claim from the summary section, it is important first to establish that the VIX Index is primarily determined based on the short-term recent realized volatility of the S&P 500 and has still been so determined in 2022. The following scatter plot shows the strong relationship between 2-month trailing volatility (X-axis) and the current level of the VIX Index (Y-axis) over the lifetime of the VIX Index (since 1990). The blue dots are all observations, and the orange dots, which lie squarely in the heart of the long-term observations, are 2022. Over time, recent volatility has been the primary driver of the level of the VIX, and that did not change in 2022.

The reason recent realized volatility is the main driver of short-term expectations for upcoming volatility is that volatility is autocorrelated. In simplest terms, that means its previous reading impacts its current reading – it’s sticky. Volatility market participants know this and set their expectations (i.e., set the VIX) accordingly.



Armed with that knowledge and evidence, we can turn to the two main ways that the rise of ODTE option popularity is theorized to affect markets, from the Summary section. We consider first the logic and then the numbers for both main aspects of the ODTE claims, numbered below as they are in the Summary section.

Note first, though, that, even if they were both correct, these theorized aspects of ODTE are a bit contradictory, or at least offsetting in their directional effect. The first one suggests the VIX Index would be lower, while the second one suggests realized volatility, which we just established is the primary driver of the VIX, would be higher. However, as we explore below, we believe these theories are not correct in the first instance, and not meaningfully impactful in the second instance.

### Logic

1. As for the exclusion of ultra-short-dated options from the VIX calculation, volatility measurements and prices, out to different time periods in the future, aren't exactly the same, but they are related. They are related mathematically because one-month variance is the variance of the first week plus the variance of the next three weeks. They are related conceptually because volatility is autocorrelated, or sticky. Practically, the way this works is that if market makers and other liquidity providers (collectively, dealers) find themselves selling a lot of one-day to one-week volatility, then they raise volatility asset prices in other time periods, such as one month. In this way, the VIX, which directly measures one-month volatility, does indeed indirectly capture shorter-term volatility buying.
  - a. Furthermore, the shape of the S&P 500 implied volatility curve is about as expected, at the time of this writing. Implied volatility on one to two-day options is higher than implied volatility on the normal monthly-expiration options by approximately the mechanically expected amount – one to two-day options do not currently include the obviously lower vol weekends and holidays – give or take a few extra cents that dealers have been happy to extract from instant-gratification gamblers.
2. A full explanation of gamma hedging is beyond the scope of this note but suffice it to say that the seller (buyer) of some volatility instruments may need to buy (sell) stock as it rises and sell

(buy) stock as it falls, in order to hedge or maintain a market neutral position. There is always a buyer and a seller of volatility instruments, which have zero open interest in the absence of any trades. In other words, the net position is always zero, which might suggest no net effect.

- a. However, if dealers – market makers and liquidity providers – (i) are more likely to engage in the hedging activity just described, and (ii) are collectively net long or net short gamma, resulting in any net hedging activity, then this activity could magnify or reduce the size of equity market swings. Nevertheless, research attempts to quantify this phenomenon have found an essentially meaningless effect on the scale of this discussion (time frames that matter to long-term investors), perhaps a few basis-point magnification or reduction of ~1% daily moves in the S&P 500 over time. What possible additional effect may exist has mostly been found in intraday time scales rather than at longer time frames.
- b. Note also that if this effect were occurring to a meaningful extent, it would have led to a higher, not lower, VIX because it would have led to higher realized volatility, which the scatter plot shows was the primary driver of the level of the VIX.

## Numbers

1. The VIX was rather accurate in 2022. It averaged 25.6 with volatility at 24.0. Visible in the scatter plot, volatility market participants set their expectations of short-term future volatility (i.e., set the VIX) according to recent realized volatility, and it worked. That deviation between the VIX and realized volatility is small and unremarkable compared to normal spreads over the years. It's not as though the VIX should've been 40, 50, or even higher in 2022, but something, perhaps the rise of ODTE-option popularity, suppressed it.
2. ODTE-option trading simply isn't large enough to have an impact on the S&P 500 that would be of importance to long-term investors. A high-end estimate of the increased volume, from proponents of these theories, is around 25 million extra contracts per day, across all options in all symbols and all times to expiration (including but not limited to ODTE). A high-end estimate of the dollar amount of trading that gamma hedgers would need to trade is, therefore, \$60 billion per day.

That \$60 billion estimate comes from the fact that 25 million option contracts represent 2.5 billion shares of stock, and it uses \$50 as the average stock price. It further uses the following assumptions, which are all high-end estimates (the highest possible, in some cases), and combine to form what we believe is fairly characterized as a very high-end estimate:

- The market needs to move only 1% before these options have meaningful delta changes.
  - In reality, many of these options barely change their deltas in a 1% market move because they are “wings,” or well over 1% out-of-the-money options.
- The delta change in the last point is 100% (the max possible change) on every single one of these options every single time the market moves at least 1% (which move size happened about 48% of the time in 2022).
  - This estimate is quite high considering none of the options change by that much, and most change by a lot less than that. As a reminder, some of the options aren't even ODTE, which meaningfully reduces this effect.

- Further, as noted above, a 1% move isn't sufficient to meaningfully change the deltas of many wings.
- Yet further, out-of-the-money calls and puts cannot both become in-the-money (i.e., cannot both have a significant delta change) due to a market move in one direction.
- 100% of the increase in option volume represents a customer purchase from a dealer, creating even the possibility of all same-direction dealer gamma hedging.
  - If even 25% of it were customer sales, that would reduce the net dealer gamma hedging to 50% of the total volume (=75%-25%).
- The possibility in the previous point is fully realized; every dealer engages in 100% gamma hedging.
  - Some will not fully, or even partially, gamma hedge.
- 100% of stocks move in the same direction every day, creating the same net effect on the S&P 500 from gamma hedging.

US equities and associated/related/correlated futures trade well over \$1 trillion notional value per day, so the \$60b figure, which we believe was a very high-end estimate, represents less than 5% of the daily volume. That is not a particularly highly impactful participation rate. *And the true number, with more reasonable assumptions, is likely far less than 5%*; recall from the logic section that research attempts to quantify this effect have generally found only essentially unimportant impacts on average over time.

Summarizing the analysis and conclusion of the numbers around ODTE gamma hedging, if every single option of the 25 million additional option contracts went from not being hedged at all to being 100% hedged on a 1:1 basis for every share of stock it represents, and if all of that hedging were always by some miracle in the same direction, and if it all had to take place every single time the market moved just 1% in a day, it still wouldn't really matter all that much over time to long-term investors.

## Conclusion

Ultimately, in our view, the VIX wasn't broken, so no explanation is required. Its level has never been a meaningful forward indicator, a direct reflection of fear, or a measure of S&P 500 drawdowns. Based primarily on very recent volatility, the VIX indicates volatility market participants' expectations of short-term upcoming volatility, and it was quite accurate in 2022, generally reflecting the level of volatility in the S&P 500. However, even if we are wrong, and the VIX was distorted, the increased popularity of very short-term options trading, including ODTE options trading, doesn't appear to hold the answer.

As a final note, given enough time, there may come a one-off day in which the S&P 500 moves 5%, and proponents of this theory declare victory, plausibly arguing that it only would have moved something like 4.0-4.5% in the absence of this effect. If and when that time comes, remember that it was a one-off day, not a daily effect, and the S&P 500 likely bounced right back – which, recall, could be up or down – shortly afterwards. This note is, once again, from the perspective of a long-term outlook. From that perspective, we believe there is still a stark lack of evidence that the tail (volatility markets) is meaningfully wagging the dog (equity markets).

If you have any other questions about volatility in 2022, or in general, please reach out to us at [info@abrfunds.com](mailto:info@abrfunds.com).

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