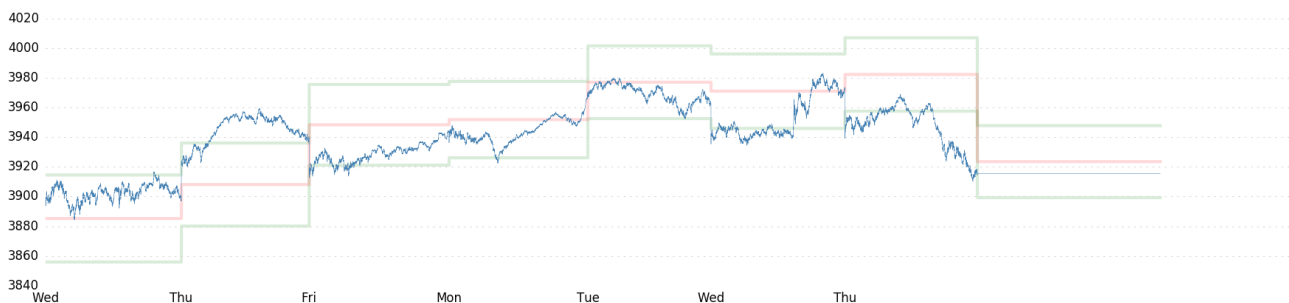


S&P 500 Weekly Forecast 3/21

From: SqueezeMetrics <info@sqzme.co>
To: SqueezeMetrics <info@sqzme.co>
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Hey guys,

A couple weeks ago, we wrapped up talking about SuMo (Support-Momentum) bands. SuMo bands describe the way tomorrow's movement of S&P 500 spot price relates to the implied volatility (IV) of the prior close. We knew intuitively that there must be a relationship between IV and future spot price, and we found something pretty compelling -- and weirdly simple.



And so, now that we're feeling overconfident in our abilities, we set out to find a similar relationship between realized volatility (RV) and implied volatility. Because in the same way that IVs must correspond to next-day volatility (else there'd be free money), IVs must *themselves* correspond to RVs (else there'd be free money).

The problem is that there's no *hard limit* on how much IVs can stray from RVs. The only limit is a bunch of things like market access, liquidity, systemic risk, and a bunch of other stuff that really just boils down to human behavior. But this doesn't mean we can't try to logically describe and map out the relationship.

What it *does* mean is that we need to make an attempt at quantifying that human behavior aspect. What we want to know is,

"how has the market recently responded to changes in realized volatility?" In other words, we don't *just* want to look at current IV and current RV, but also *past IV* (and implicitly, *change* in IV) -- because this will help us guess at how people will respond to *subsequent* changes in RV and IV, and whether things are "out of whack" in any particular direction.

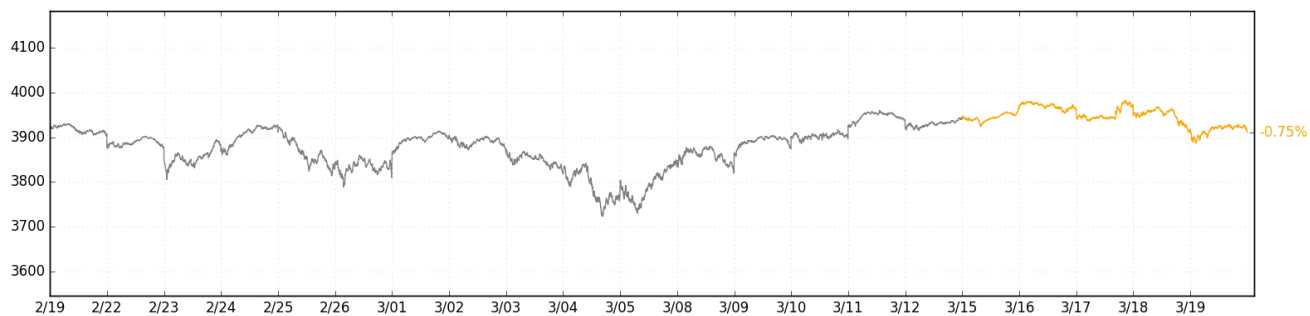
For this, we need a sort of "tension model." But first...

1. That was then
2. This is now
3. Angle C

That was then

With the index down modestly and with VXX down from 14 to 12.77, we feel that our short VIX position was

ultimately the right way to go -- as it has often been lately.



The market "knew" that OpEx was the dominant force this week. Rallies were weak, dips were bought. Both VIX and SPX ended approximately flat, Friday-to-Friday. It was a holding pattern -- getting ready for a bit more volatility in the coming week (and trying to frontrun it).

We used to get excited about this. We would wonder: "Is the market starting to really understand gamma exposure?!" It seems we've officially gotten there: People definitely understand GEX now, at least with respect to OpEx effects.

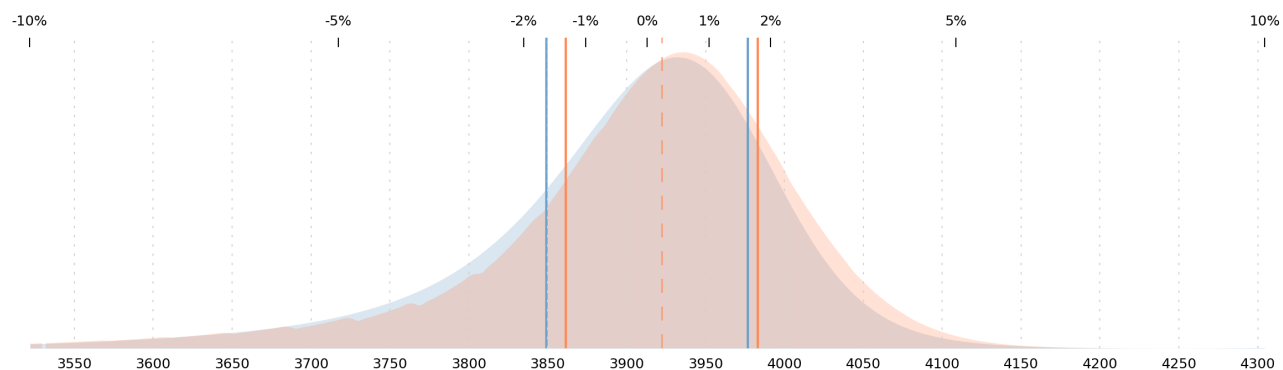
This is now

But the market's reaction to OpEx leaves us in an unusual situation, with respect to dealer and customer positioning.

Usually, the index would have drifted up a tad over the course of the week, and customers would end up exposed to excess vanna risk after the expiration (a shallow negative VGR) -- and with less clamping action coming from gamma, they'd be more likely to get scared out of those positions as GEX adjusts lower and volatility picks up during the following week. This would have been a great time to buy a near-term SPX put.

But that's *not* what happened. The -0.75% weekly SPX return means that customers *aren't* offside with respect to their vanna positions. Indeed, the index is more or less properly "centered" with respect to spot-vol positioning dynamics (VGR -4.38), and nor do investors seem to be under-hedged (NPD -7.34 means folks are still buying puts). Still, none of this changes the fact that a bunch of stabilizing gamma/liquidity just disappeared on Friday, and that more movement is likely this week as a result (GIV up to 12.11 from 9.67).

So let's combine all of this disparate information, then mix it together with this 1-week probability density...



To us, it actually looks like... *a good time to buy calls.*

See how the GEX+ density (orange) indicates a [slightly] higher probability of reaching 4000 to 4050 SPX than the market (blue) implies? To target that possibility, we'd probably want to be long some 1-week (Friday) calls in the SPX 3980 area. Which dovetails nicely with the thesis that broader moves are likely, but that the classic downside volatility isn't likely to happen, owing to customer positioning.

But then if we buy some OTM calls, we'd be short April VIX *and* long SPX calls, and that's a lot of long delta. If that were a worry of ours, though, we'd just pick up some short E-minis. The more important exposure to us is the long weekly volatility paired off against the short ~monthly volatility. To make things a bit more comfortable, one could even bring the long call closer to the money and delta-hedge it for the gamma PnL.

But laziness is what we do best, so we're probably just going to buy a couple 3980 calls and let 'em ride alongside our small short April VIX. For the indolent (like us), reasonable position sizing beats fancy footwork any day.

Should be an interesting week, in any case.

Angle C

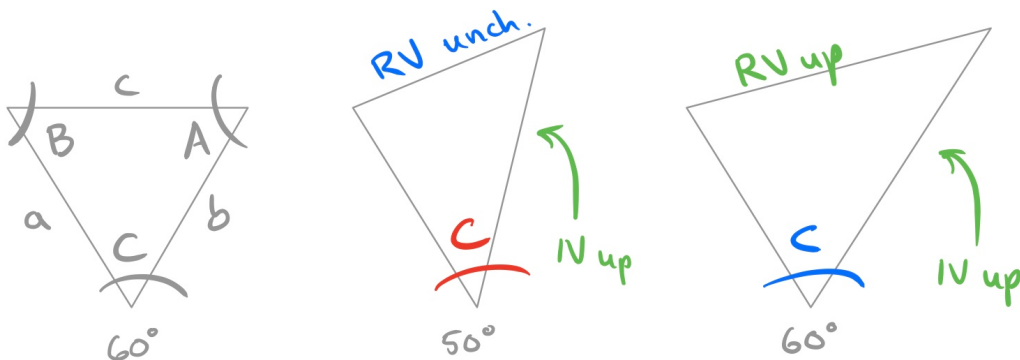
Way up there at the top, we said that we need a way to model the "tension" between three weakly correlated variables:

- (a) Past implied volatility (PIV)
- (b) Current implied volatility (IV)
- (c) Realized volatility (RV)

Specifically, we want to know about the way RV (c) relates to both IV (b) and PIV (a) at any given moment. When any one changes, our model needs to tacitly acknowledge that the whole "system" is affected. So how do you distill these three variables into one number?

Why, by a generalization of Pythagoras's theorem, of course: *The law of cosines*.

If we envision each of these volatility numbers as sides of a triangle, each with their own length, then we can draw that triangle. And if we can draw that triangle, we can wiggle that triangle around, increasing and decreasing PIV, IV, and RV as we see fit, and watching how the angles of the triangle *must* change. The law of cosines is a nice, tidy, and logically necessary property of triangles that tell us what any of these angles must be.



The angle that we're especially interested in is Angle C, because it's the angle that, as we said before, describes "the way RV (c) relates to both IV (b) and PIV (a) at any given moment."

So let's imagine a normal-ish scenario for the S&P 500: 1-month IVs spiked a month ago, and have been coming down slowly ever since. The average IV over the past month was 20 ($a=20$). Currently, 1-month IV is 15 ($b=15$). Looking backward, RV over the last month was 18 ($c=18$). If we imagine this as a triangle, we get *Figure 1* below.

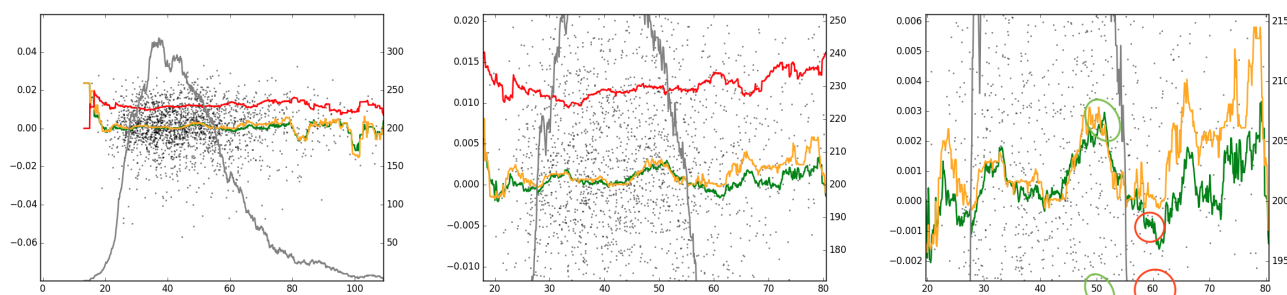
Angle C (the angle that "looks at" RV) is a 59.89-degree angle. Now imagine that a *nasty*, sharp AM drop in the index scares 1-month IVs back above 20, but that after a gentle afternoon rally, IVs settle right at 20, and *close-to-close RV remains unchanged*. What happens to Angle C?



According to *Figure 2*, it becomes a 53.49-degree angle.

Now, our intuition tells us that IVs at 15, when RV was still 18 (*Figure 1*), may have represented a bit too much complacency, and we can't be too surprised by the subsequent spike in IVs. But after that cathartic selloff and vol spike, and with IV now higher than RV (*Figure 2*), we would say that the market is safer, and more immune to shocks. At least that's the way *we think* about it.

And, lucky for us, the data (2012 to present, 1-day returns against "Angle C") ended up agreeing:



From left to right, we zoom in on the data. The green line is mean 1-day returns (orange is median). When "Angle C" closes at 59.89 (which is where we started in the example above), historical next-day average returns are somewhere around -0.001 (-0.10%). When it closes at 53.49, historical next-day average returns are more like 0.002 (+0.20%). A 30 basis point per day difference in returns.

Nerd note: The y-axis returns are, as usual, normalized to the mean absolute deviation implied by 1-month IVs, so we're basically normalizing all historical returns to a market where VIX is held constant at 20, so we don't mistake positive returns for risk premium, which is what people do all day every day, in more or less unacceptable ways.

It's interesting that 60 degrees is where a lot of drama occurs here, because an equilateral triangle has three

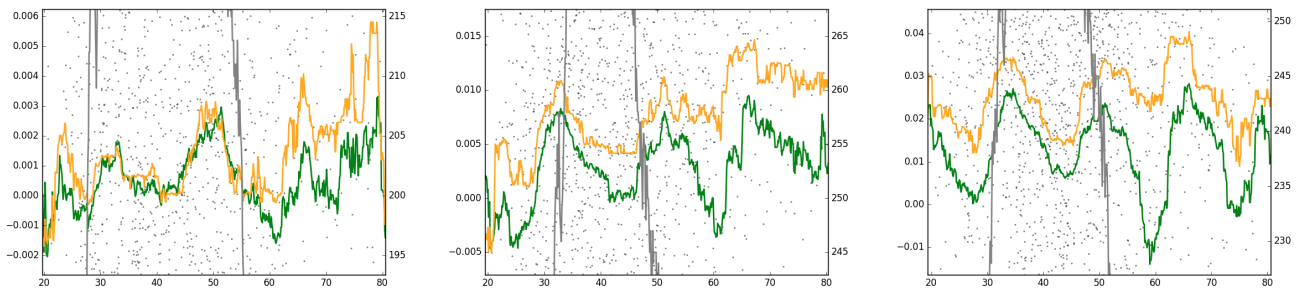
60-degree inside angles -- so a 60-degree Angle C is representative of a sort of *unstable equilibrium* between realized volatility and implied volatilities. As soon as the angle narrows to 50 degrees (IVs slightly higher than RV), you get something very stable and bullish.

If we're honest, we were actually expecting this result, and it's *really* cool to see that the ~60-degree number is meaningful. Feels good, man.

Nerd note 2: You know how when the Probability Page tells us that GEX+ and market IVs agree about the probability distribution for the week, we'll often be getting long vol in those moments? That's because the market basically tries to build a +20% buffer into option prices, making them more expensive than they're actually worth, because bearing convexity risk is really that dangerous. So when GEX+ agrees with the distribution of returns implied by IVs, that's pretty much a sign that IVs are too low. Same thing is going on here! A 60-degree angle describing the relationship between RVs and IVs suggests that they're "in balance," or "agreeing." And when it comes to volatility, anything or anyone "agreeing" with anything or anyone else is pretty much always bad.

Ok, sounds cool, right? Well, if we haven't already, here's where we go off the rails, because while we had some idea of what a 60-degree Angle C would mean, we have *no* idea what a 30-degree Angle C means -- or should mean. What about 40? No clue. So what we did was we figured, "Hey, let's see if this "vol triangle" model gives us anything on a 1-week or 1-month timeframe." Because usually, a signal like this totally gets drowned out with noise when you extrapolate across a long period of time -- but we were figuring that the 60-degree angle would maintain *some* meaning, because it ought to be a stronger signal (like a line of demarcation between vol regimes).

Instead, this is what we found. From left to right: 1-day returns, 1-week returns, 1-month returns.



Yeah, sure the 60-degree angle maintains its meaning, but we didn't expect it to stay *that* strong (mean 1-month 1.00% loss at 60 degrees?!) -- and we also didn't expect to see this very clear "wavy" pattern emerging (20 is bearish, 30 is bullish, 40 is meh, 50 is bullish, 60 is real bearish). The implication being that there are natural pockets of stability and instability in the relationship between RV and PIVs/IVs.

Why?

No idea. Taking suggestions. Very interested in where this "Angle C" idea leads us.

Have a lovely week!

The SqueezeMetrics Team

