Gamma Scalping 102 – The Undisclosed Risks

OptionSellers, LJM, Catalyst are among the prominent fund managers currently facing litigation for large losses due to short gamma positions. Retail investors regularly lose their savings by shorting options as well. It is time to explain a few things about the short gamma and the "gamma scalping" strategies.

This article is split in two parts for convenience. The first part, Gamma Scalping 101 – Gamma/Theta Trading, explained

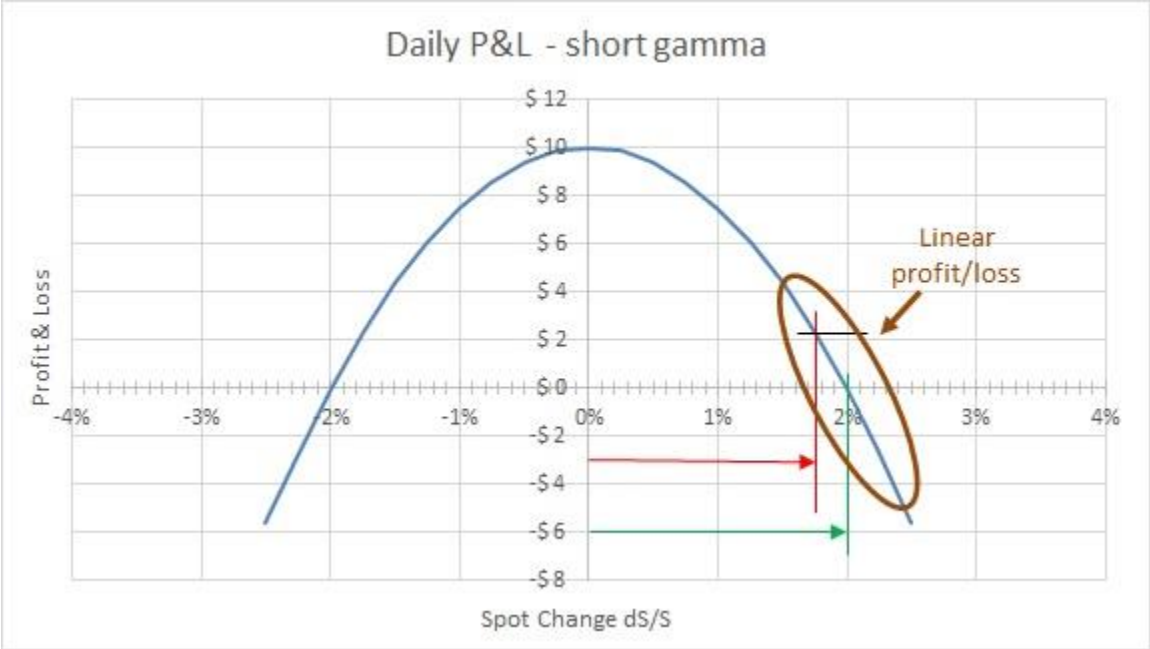
- How the daily P&L of a portfolio of derivatives can be expressed with a simple parabola.
- The concept of break-even, and when gamma brings more value than theta.
- How historical and implied volatilities explain the gamma scalper's long-term P&L.
- How this trader can improve his odds by trading options of high implied volatility.

This second article explains some of the un-stated risks associated with the gamma scalping strategy.

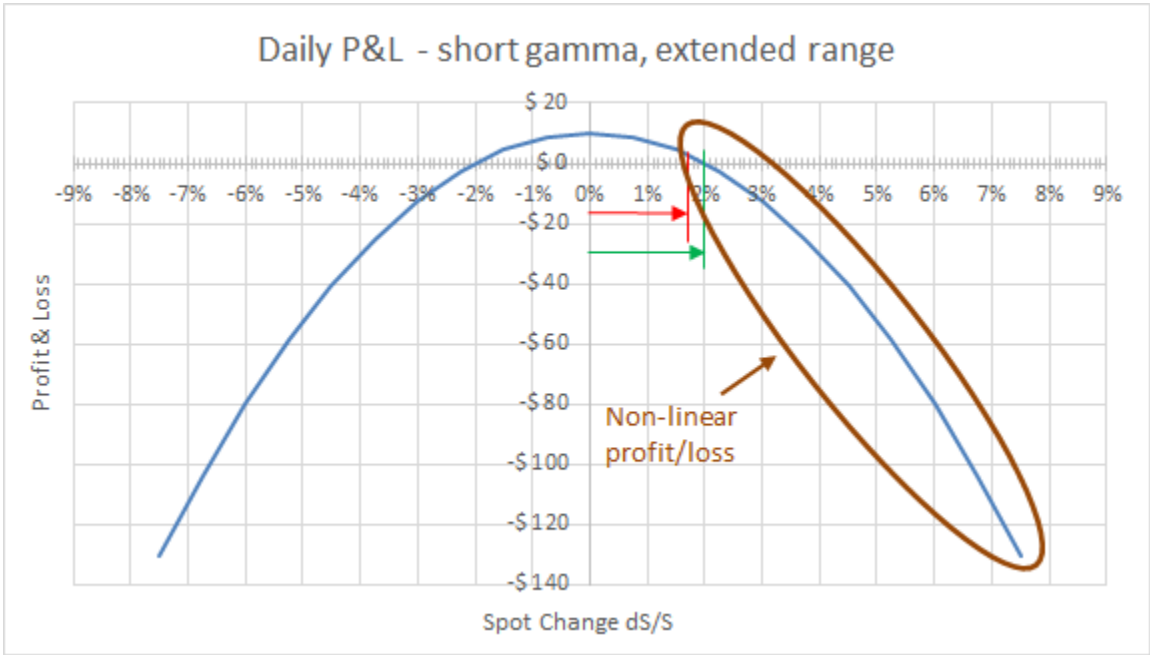
Risks 1: Large moves are costly and not rare

You've seen in the previous article the benefits of shorting gamma, but let's look at some of the drawbacks now.

The graph explaining the gamma/theta daily gain also shows that when you are slightly above or under the break-even, your losses are more or less linear with the stock move or your histo/implied difference.



Unfortunately, due to the quadratic shape, those losses become much larger as the move becomes larger:

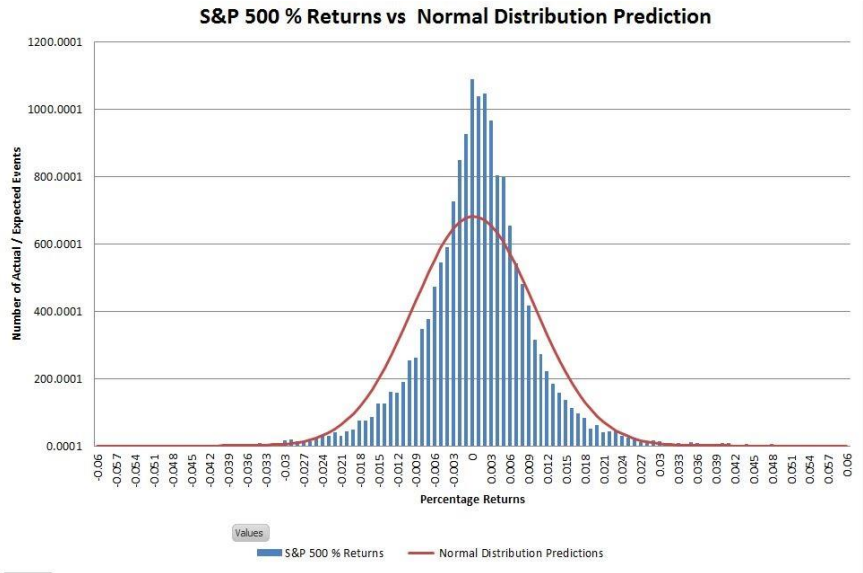


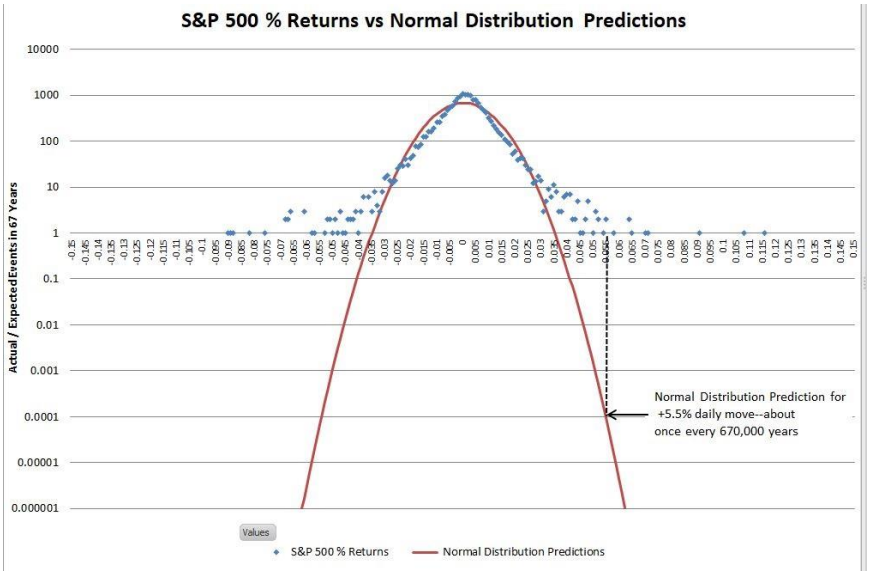
When you play the gamma/theta strategy, your theta gains/losses are limited, but your gamma gains/losses are not. As mentioned regularly with shorting options – there are unlimited losses on the upside when selling calls.

The questions that follows, is how frequent are the large moves? If they come once in a century, you'll be long gone before you lose some money. If they come every week, that's another issue. Well, how often they happen can be measured as well.

In Black Scholes and the early days of option trading, we thought that returns were "well" distributed. "Well" in that sense means "normal", "Gaussian" or "bell-shaped". It is a precise mathematical concept. We now know that it is far from the truth. Search a bit online, and you will see numerous articles demonstrating the non-normality of stock daily returns.

For the S&P for instance, in this article[1], we can see with the distribution of returns vs a standard 'gaussian' distribution of same standard deviation (standard Y scale, and logarithmic scale):



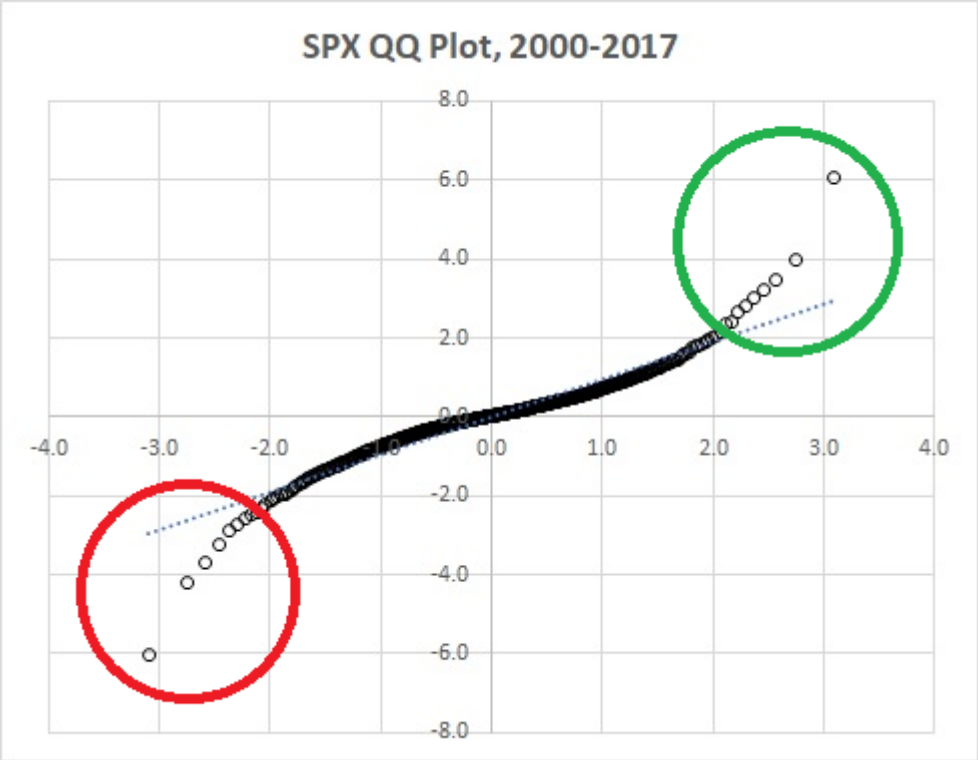


This ab-normality is easily put in evidence with a QQ plot. This type of graph compares, in standard deviation normalized terms, the moves of each percentiles[2] in reality (Y-axis) vs normal (X-axis). The plot

[1] https://sixfigureinvesting.com/2016/03/modeling-stock-market-returns-with-laplace-distribution-instead-of-normal/):

[2] This QQ plot contains 500 points instead of 100

of all the returns of the 2000-2017 period shows a clear downward curvature to left (red circle). This deformation points to downside moves having a fat tail. The upward curvature to the right (green circle) points to the fat tail of upward moves:

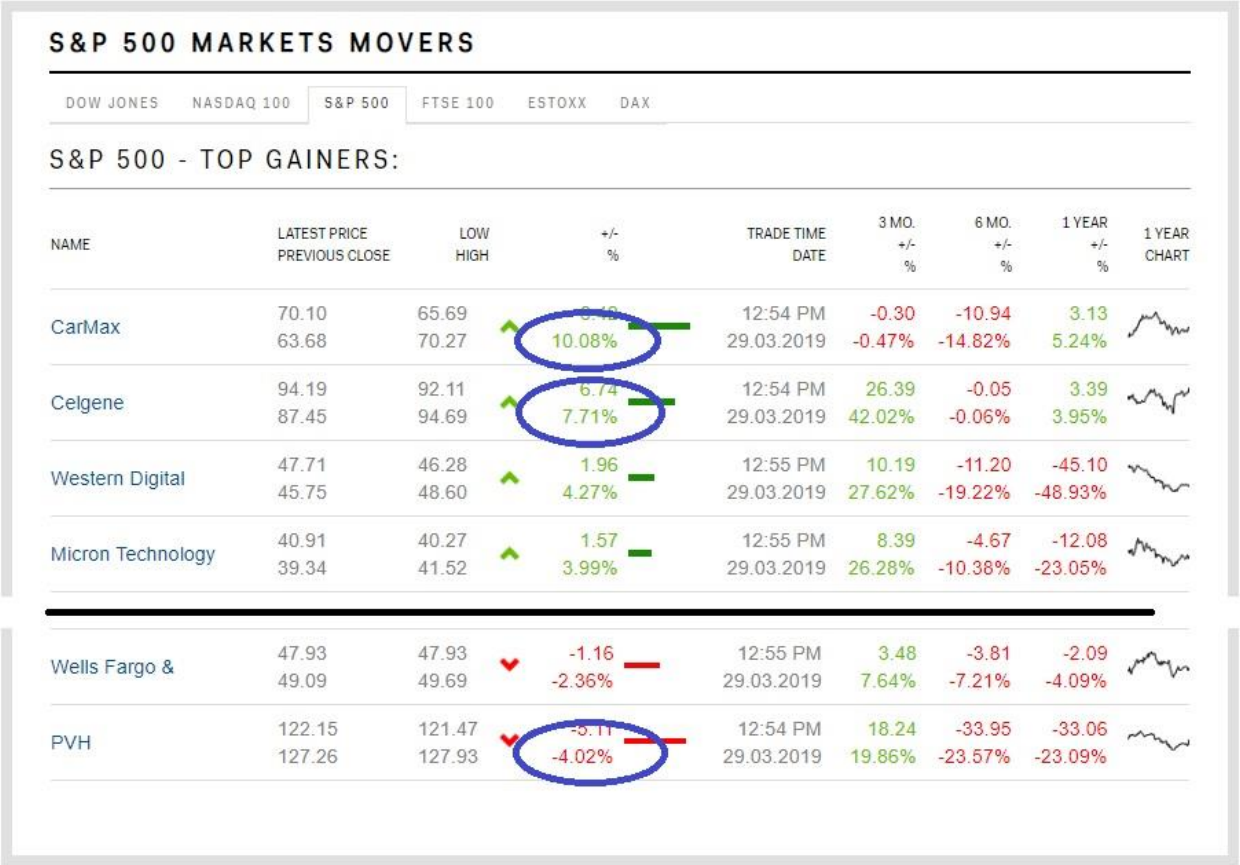


In a normal / Gaussian distribution, the extreme percentiles would see moves 2 or 3 stdev away from center. For the S&P, they go up to 6 standard deviations. Considering the exponentially decreasing probabilities of normal distributions, these deviations are statistically significant.

Both analysis demonstrates that large moves in the S&P 500 are far more frequent than the usual math would indicate.

For single stocks, this effect is even more pronounced than for a widely diversified index like the S&P 500; stocks have idiosyncratic risks that indices do not have. Unfortunately, each stock is different and there's quite a few of them, so we can't display each of those distribution graphs.

Instead, here are "movers" of the S&P as of now. Today is a random Friday where the S&P 500 is up 0.4%, Europe was up 0.7%, the US 10Year is up 0.02% and away from reporting season. It is only 13:00, and you can already see a few large moves:



S&P 500 MARKETS MOVERS

DOW JONES | NASDAQ 100 | S&P 500 | FTSE 100 | ESTOXX | DAX

S&P 500 - TOP GAINERS:

NAME	LATEST PRICE / PREVIOUS CLOSE	LOW / HIGH	+/- %	TRADE TIME / DATE	3 MO. +/- %	6 MO. +/- %	1 YEAR +/- %	1 YEAR CHART
CarMax	70.10 / 63.68	65.69 / 70.27	10.08%	12:54 PM / 29.03.2019	-0.30 / -0.47%	-10.94 / -14.82%	3.13 / 5.24%	
Celgene	94.19 / 87.45	92.11 / 94.69	6.74 / 7.71%	12:54 PM / 29.03.2019	26.39 / 42.02%	-0.05 / -0.06%	3.39 / 3.95%	
Western Digital	47.71 / 45.75	46.28 / 48.60	1.96 / 4.27%	12:55 PM / 29.03.2019	10.19 / 27.62%	-11.20 / -19.22%	-45.10 / -48.93%	
Micron Technology	40.91 / 39.34	40.27 / 41.52	1.57 / 3.99%	12:55 PM / 29.03.2019	8.39 / 26.28%	-4.67 / -10.38%	-12.08 / -23.05%	
Wells Fargo &	47.93 / 49.09	47.93 / 49.69	-1.16 / -2.36%	12:55 PM / 29.03.2019	3.48 / 7.64%	-3.81 / -7.21%	-2.09 / -4.09%	
PVH	122.15 / 127.26	121.47 / 127.93	-5.11 / -4.02%	12:54 PM / 29.03.2019	18.24 / 19.86%	-33.95 / -23.57%	-33.06 / -23.09%	

Those types of large "outliers" in an index's constituency are common place.

So the short answer is yes, these large moves happen, and they happen much more often than you would guess otherwise. It's not because a company has a large market capitalization that the stock won't move a bunch. Experienced derivatives traders have all seen large stock moves – announcement of a fraud or undisclosed loss, litigation outcome, take-over or cancellation thereof, FDA approval, plane crash or fires in California… the list of possible causes is endless. But the fact is that a 10% or 20% move on your precise stock will not happen every day, but those moves DO happen, up and down, and they are far from rare.

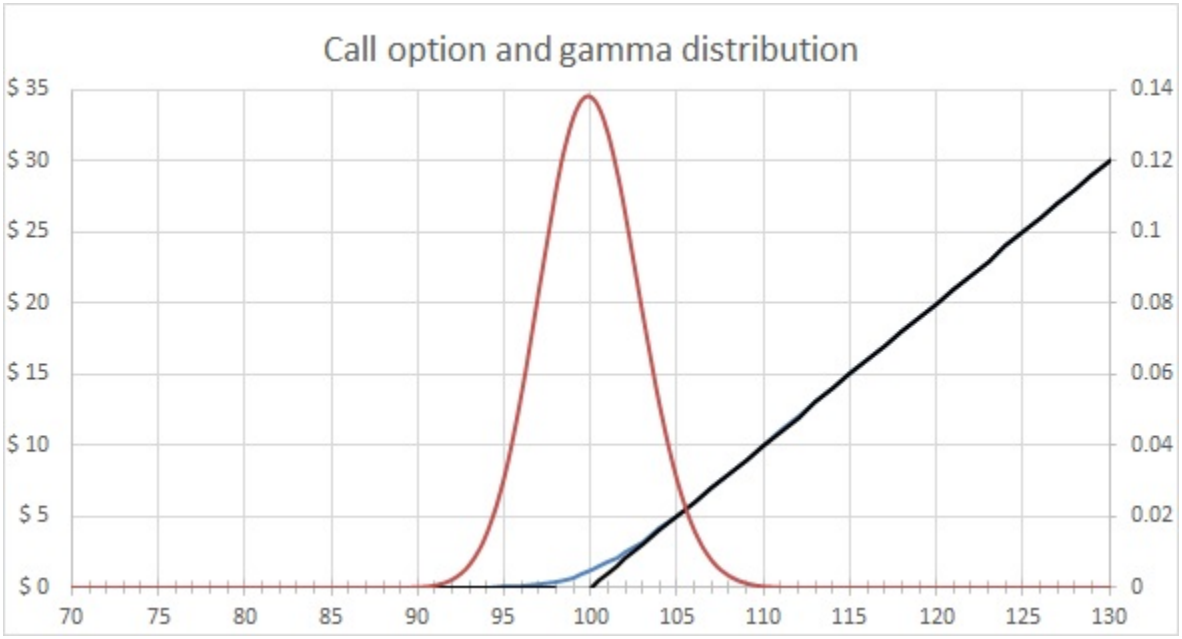
The consequence of non-linear losses and more-frequent-than-thought large moves, is that shorting gamma on single stocks is akin to picking up pennies in front of bulldozers. It usually pays, but when it doesn't, it really hurts. And it happens more frequently than not.

There are ways to protect against these large moves, but let's say it simply - there are many more ways to lose money than to make money.

Risks 2: The gamma distribution has an effect on large moves

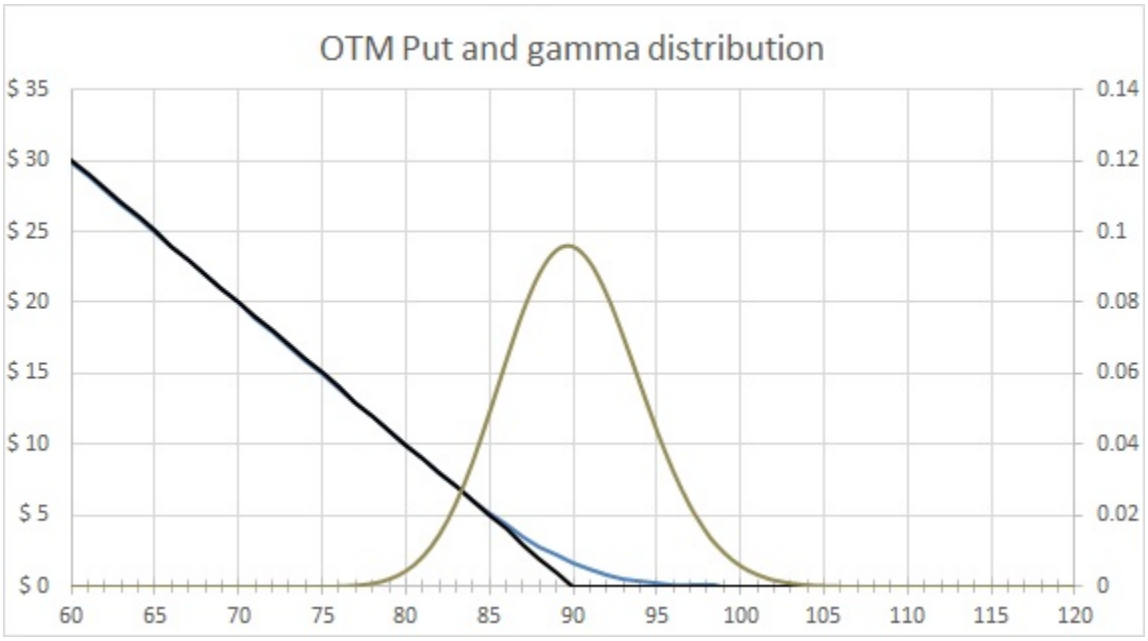
The gamma/theta strategy can only be implemented where the option has some convexity. Since different options have different gamma & theta profiles, you can't implement the strategy in the same way with different options.

Below is the gamma distribution for a European call of 1-month maturity at 10% vol. When you move $5 away from the strike, you have only 22% of the gamma available at the strike, 6% at $7 away and virtually zero at 10$:



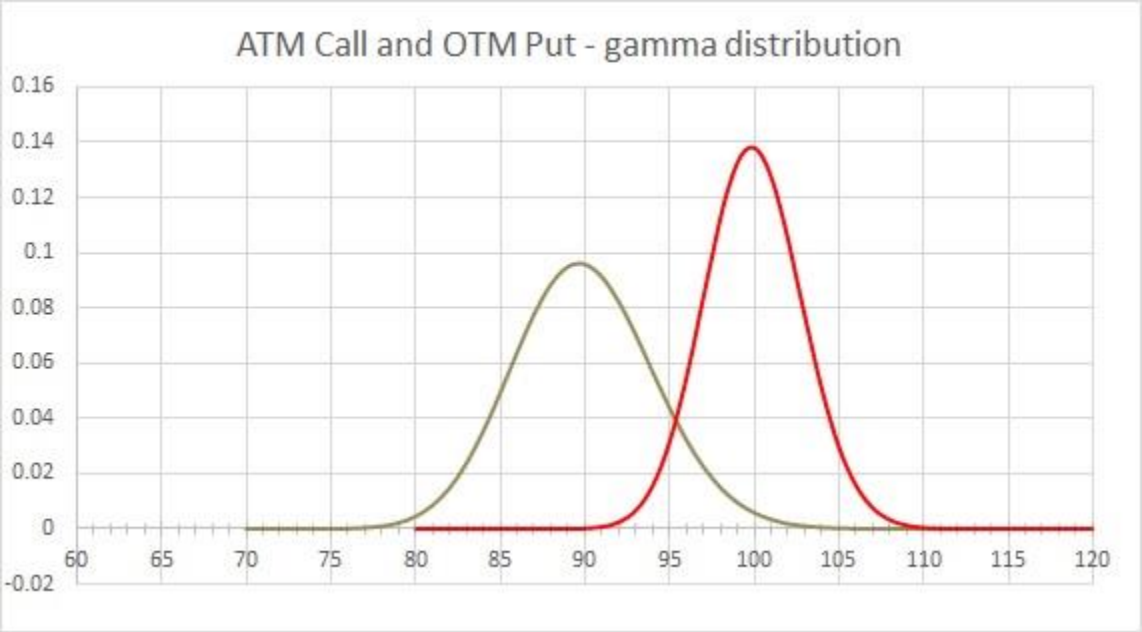
That concentration of the gamma around the strike is typical of all vanilla options. The concentration depends on volatility and maturity. The shorter the option or the lower the volatility (the two effects are similar), the more the gamma concentrates around the strike.

Here is a 1-month European $90 put at 16% vol (lower strikes have higher vols, estimated skew):



As you can see, since the volatility has increased, the gamma has flattened (higher vol). The top is lower, and the gamma is spread further out. At $95 or 5$ away from the strike, you still have 46% of the gamma available at the strike. At $97, you now have 24% (3x more than the call at the same distance).

At $100, you still have 6% of the put's ATM gamma (12x more what the call would provide at the same distance).

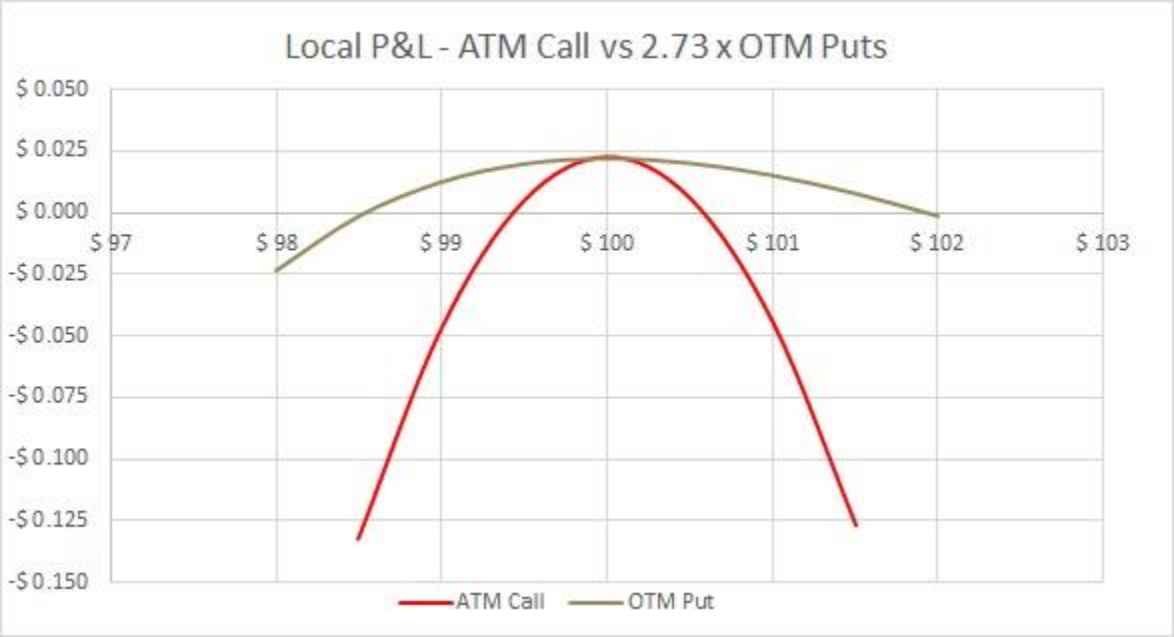


This put could also be used for the gamma/theta strategy. It offers a higher volatility, and therefore a better break-even and histo/implied profile. Unfortunately, because it has less convexity it provides less theta than the ATM call ($0.0082 vs $0.0223). You would have to trade 2.73x more options ($0.0223/$0.0082) to have the same theta when your stock is worth $100, or 23x more options to have the same gamma (0.138/0.0059). It would require a 71x leverage to cover the same premium ($1.1703 / $0.0165).

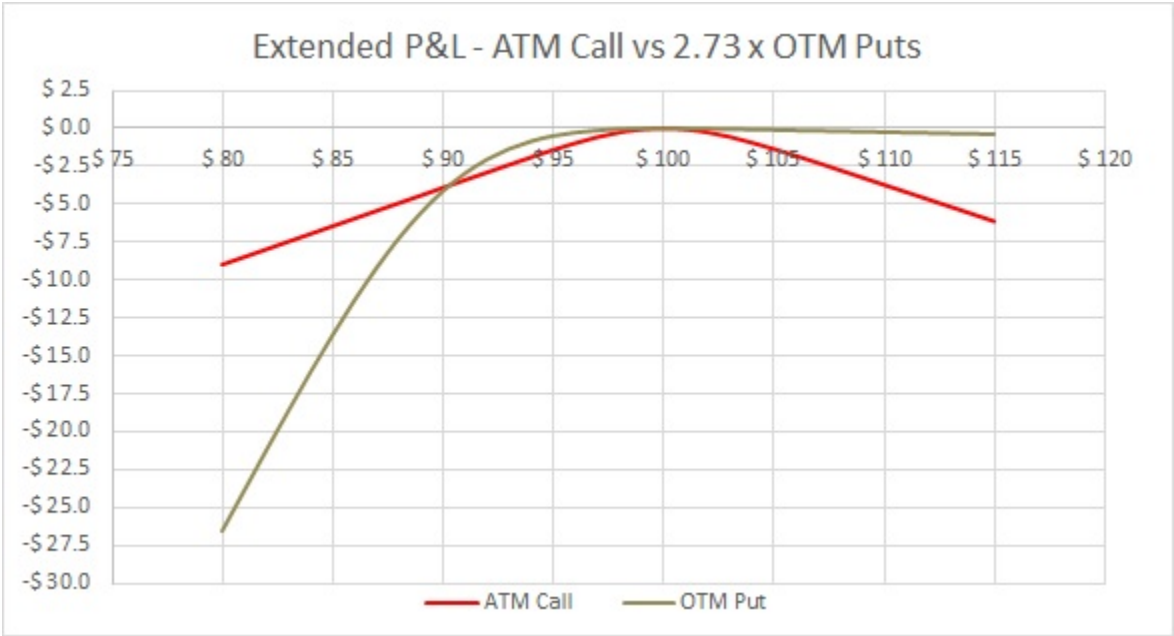
Let's assume you are a theta-oriented trader, and let's compare what happens if you either use either one of the calls or 2.73 of these puts to implement your gamma/theta strategy.

	1x ATM call	**2.73 x OTM Puts**
$ price	$1.17	2.73 x $ 0.0165 = $0.045
Delta at S=$100	51%	2.73 x 1% = 3%
Gamma at S=$100	0.138	0.006
Theta at S=$100	$ 0.0223	$0.0223
P&L at $100 (Unchanged)	$0.0223	$0.0223
P&L at $99.5 (down 0.5%)	$0.0047	$0.0202
P&L at $99 (down 1%)	-$0.1322	-$0.0014
P&L at $98.5 (down 1.5%)	-$0.2480	-$0.0238

Isn't that wonderful? For the standard moves above, the puts definitely offer a much better return profile – same theta, but the stock can move much more before you start losing more money:



Unfortunately, here is what happens when the stock moves a bit more:



With just 2.73 x leverage, the losses are significantly larger when the stock gaps down. There are two reasons for this:

- We used more options (2.73 instead of 1). Just imagine if we had used the 23x leverage we considered to reach the same gamma, or the 71x leverage that your $ premium target would have required.
- With the call, as the stock moved down, we went further and further away from the strike, and the gamma decreased as we went. The convexity reduced, and we were collecting less and less delta.

- With the put on the other hand, as the stock moved down, we got closer and closer to the strike, and eventually went through it. During that period the gamma and the convexity increased. We collected the delta later, but there was more in total.

Because we crossed an extended area with gamma, the OTM puts generate more losses when there is a sudden move. The distribution of gamma out of the money is more relevant than the At-the-money gamma, when we consider large moves. Selling more puts means taking more leverage and larger losses when the underlying moves a lot.

You can also see this effect with the dissymmetry of the P&L for a move upward. For the call, there is as much gamma on the upside as on the downside, and the losses generated for an upward move are the same as a downward move. For the puts, as we run away from the strike on the upside, there is virtually no gamma, and the strategy doesn't lose any money. An upward gap when you are short the puts is not a problem at all.

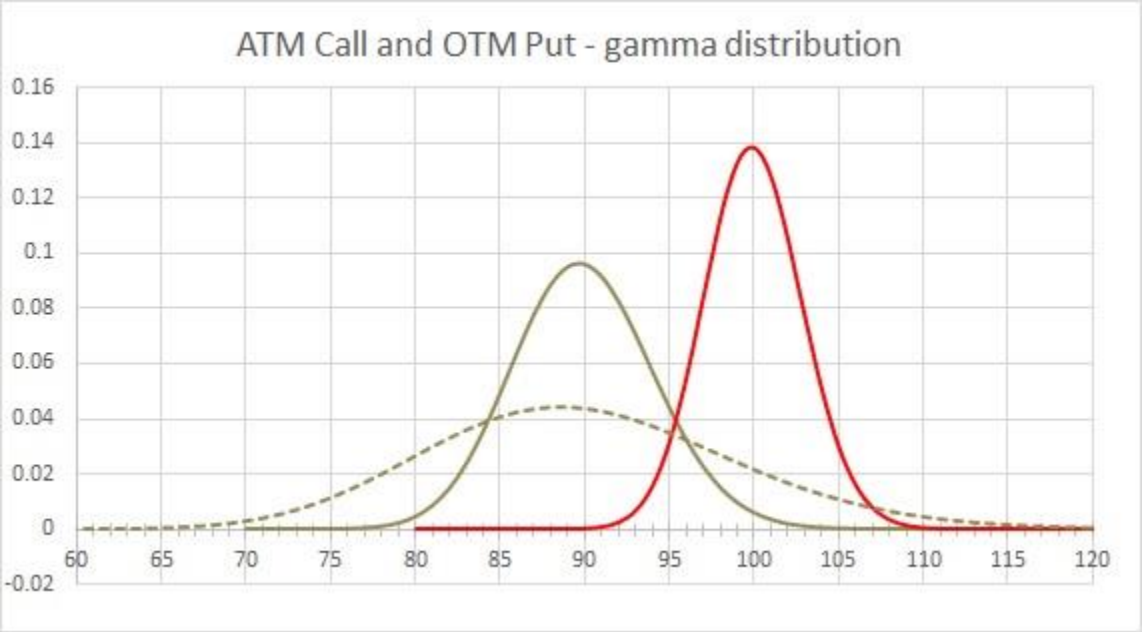
Risks 3: Vega effect in a large move

At the very beginning of this article, we indicated that we would ignore the effect of volatility changes. There is nevertheless one effect that should be mentioned in case of a large move down, it is the combination of vol increase and stock move on the gamma/theta strategy.

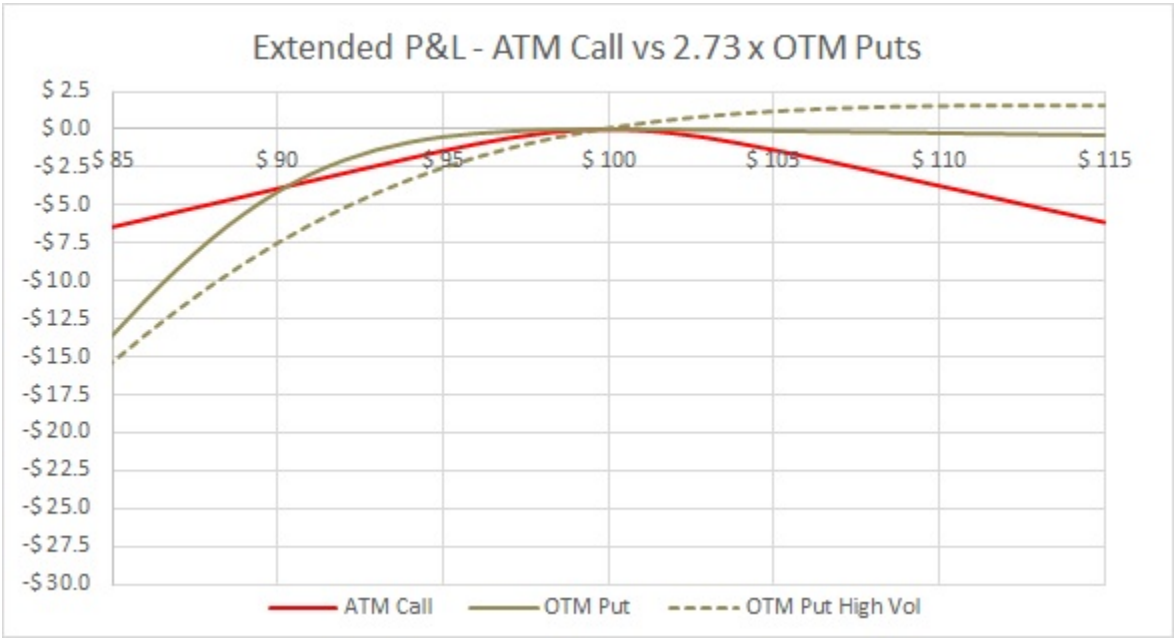
When a stock suddenly drops down from 100$ to 90$ or even 85$, the market panics – there is a strongly negative information, and nobody quite knows how to price it. Everyone is concerned that the stock could go even further. Many option traders, reeking from their short gamma losses, will close their short positions (short covering), if they are not forced to do it by their management. Sometimes also, their broker-dealer jumps in and liquidates their positions, if it believes the traders will not be able to pay for their losses or will generate further losses. The outcome is that, when a stock gaps down, everybody screams for those lower puts, and their volatilities rises significantly. Those tiny little puts with no Vega suddenly have some, and they turn into gold. It is not rare to see, not only their $ value jump up (due to the spot move), but also their implied double or more.

Here is what this would mean for the gamma scalper who was short 2.73 of these puts, assuming that the puts' implied volatility moves up, say from 16% to 35%.

Because of the vol increase, the gamma distribution widens a lot. Those little puts, which had barely any gamma when we were at $100 suddenly have some:

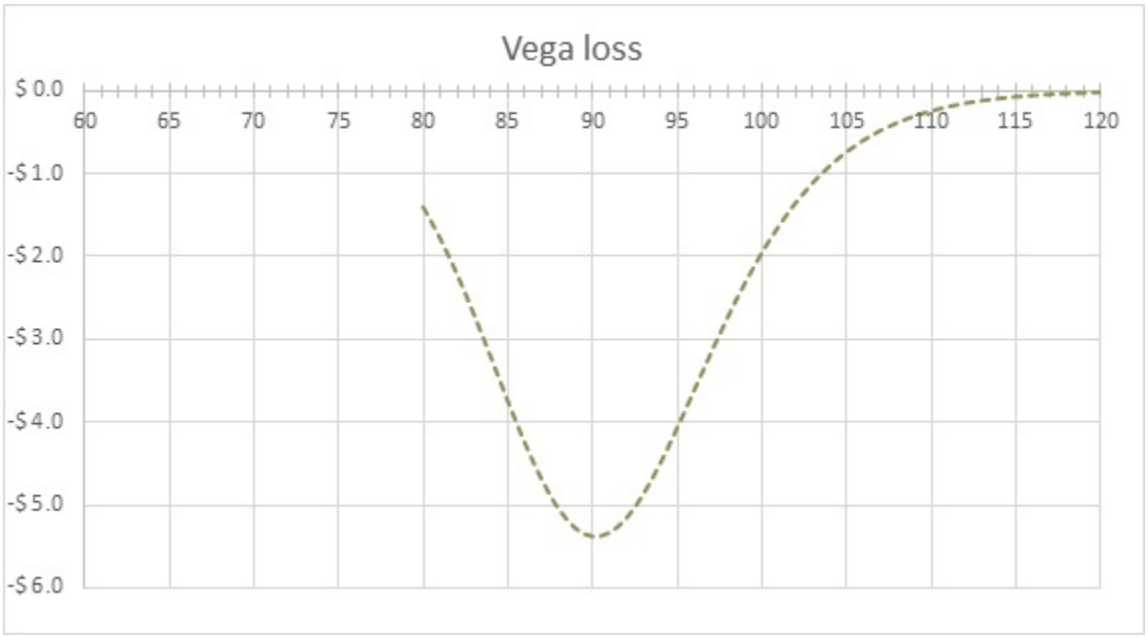


The volatility increase also impacts their deltas. The scalper, which had virtually no delta yesterday, suddenly becomes long the underlying even before the stock has moved. The P&L afterwards becomes this (notice the positive P&L if the stock was to move up – it's the new delta):



In other words, due to the volatility rise and the widening of the gamma area, the stock crosses meets a large gamma immediately, and the book becomes long stock way earlier in the fall than before. At 90$, the losses are already double what they would have been if the trader had used ATM calls or if the volatility would not have changed. The volatility increase amplifies the gamma losses.

This effect is not the vega loss due to the remarking of the options to a higher volatility level:



[Purists will actually debate if this vega loss is actually due to the traders managing their gammas/deltas at the improper vol. This question is moot - scalpers do not have the liberty of adjusting their risk/valuation surface in gap moves]

Most option traders who have learned option trading on their own do not know this cross-effect (a parameter, volatility, impacting a risk/parameter, gamma). You learn those subtle effects at a large broker dealer's trading floor or at a top hedge fund, not in your basement. Traders working together teach each other; older traders have seen this effect before.

Risks 4: Amateurs vs institutionals

Amateur traders do not necessarily know all the abnormal behaviors appearing from time to time in a portfolio of derivatives (even vanillas). But the difference between amateurs and institutionals go much further.

An institutional trader is not on his own, by far. First of all, he is provided with the experience of many traders around him, who have taught him the ropes for years and will help him in a difficult situation.

Large institutions also provide impressive risk & P&L monitoring systems. Not only do those in-house systems calculate P&L extremely accurately, for thousands of products, but they also provide scenario analysis (what if the market goes down 10%, volatilities go up 5%, skew doubles, and rates drop by 0.25%... all at the same time?). P&Ls and instrument valuations are also stored ('historized'), so that changing an old trade, amending a product definition, or changing a parameter in the past is immediately picked up. Risks are diced up for the many groups who independently supervise the positions. Trades are integrated automatically, often flowing directly and seamlessly from the trading system, and often providing real-time Greeks.

Large institutions also provide supervisors, who are experienced, as well as independent support & verification services, who will double and triple check all the parameters, risks, valuations and trades: middle-office, risk control, product control, trader rotations & core leaves…

Management generally takes risks seriously. A trader has strict guideline on which instruments he can and cannot trade, in which quantities, with limits on all the Greeks for each instrument, each maturity or bucket, as well as for the overall portfolio. Scenario analysis are also under limits. Any breach is immediately reported to the management, which immediately investigates. Procedures are implemented. Errors (or occasional frauds) rarely go unreported for more than a few hours.

All this to say that there is not much room left for large losses, without the senior management being aware of the potential risks. Larger losses are usually due to really complicated products, going through a relatively rare scenario.

How big can the losses be? Here are some orders of magnitude. You can't pretend to be an institutional derivatives trader if you have never lost $1m in a day. You really won't feel proud that day, but everybody knows that it goes with the job, including as well having a gain of $1m. My largest loss ever was $7.5m, most likely due to a computer malfunction during an execution (we've never figured it out). At that level, it is definitely not a pleasant experience – you are suddenly asked a lot of question by a lot of people. At $15-20m, you will have a bunch of meetings, each taking a long time, involving some pretty senior people. They are really not pleasant. At $50, $100m or more, there's only one meeting – human resources – followed by a lot of finger pointing after your departure. I have seen it happens more than one time.

But those large numbers are rare, because protections are taken by the firms. Most importantly, a proper derivatives organization is able to size and diversify its risks. BNP lost $80m in December 2018 / January 2019 (the trader took a massive short gamma position before the holidays to take advantage of the days when markets are closed. Unfortunately, the market tanked upon reopening and for a month afterwards). This is a large number by any mean, but the prop trading entity had $2.9 bn of capital. We are therefore talking of a ~3% loss. It's not pleasant for anybody, but it is an acceptable amount of risk, which will not break the house. I have no doubt that the losses were not larger because BNP is a very serious house, where traders, no matter how senior and experienced, have strict guidelines and risk limits and where control procedures are duly implemented. The management have left the trader run his limits, and they accepted the risk knowingly. No trade will jeopardize such a group.

Compare this to the long list of individual investors who lost their house when their OptionSellers PM eventually recognized in a YouTube video[3] that he had wiped them out by selling the small puts. Look as well at the loss percentages some of the larger funds currently in litigations have met on February 5th, 2018.

[3] https://www.bloomberg.com/news/articles/2018-11-19/hedge-fund-s-accounts-liquidated-amid-energy-market-volatility

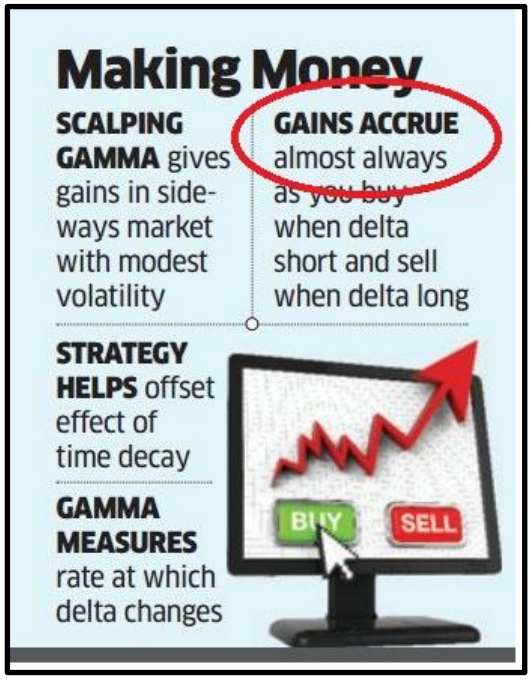
Conclusion

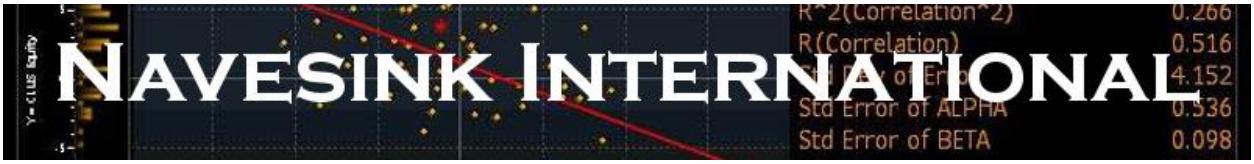
Gamma scalping is more complicated than it looks, and it is easy to take significant risks if you don't do it properly. If there were a few points to remember, they would be:

- Never sell the small puts (or calls) – it's a beginner's mistake, and a joke on institutional trading floors. if you want to short gamma, sell the ATM options, even if the implied is not as advantageous.
- Actually, since small puts do offer gamma protection in a range that doesn't generate too much premium (if no leverage), you should buy these options as a protection as you sell the ATM. Yes, it will reduce your profitability, but they are called "protection" for a reason.
- Institutional traders know that these 'penny' options cost a lot in carry and often expire worthless. But they also know that if you can buy them at a decent price, you should. When the market crashes, tiny puts are worth gold, and it's Christmas if you have them - it will pay back for all the bad years, and more.
- That's the reason why they are expensive in volatility terms and why there is a smile on short maturities! Do you really think you are the first one to see their implied levels? Why do you think the market buys them?
- Never believe the pseudo professionals who recommend selling small options as a regular business, just because they "usually expire out-of-the-money".
- Before selling options, ask yourself if you are among the professionals with the right experience, infrastructure, procedures, supervision and capital.

Selling insurance on the world creates beautiful cashflows and a gorgeous Sharpe… until the earthquake strikes.

Instead, here is what you see online these days:





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Gontran de Quillacq, consultant / expert witness

Gontran de Quillacq has over 20 years of experience in portfolio management, derivatives trading, proprietary trading, structured products and investment research. He has worked with top-tier banks and hedge funds in both London and New York.

Background Experience - After his European and US education, Mr. de Quillacq traded derivatives for two decades, from vanillas to exotics, both proprietary and client-facing, at top-tier banks in the square mile and on Wall Street. As a portfolio manager, he researched and managed investment strategies, delivered both in hedge fund and in structured note formats. He initiated the distribution of investment strategies through derivatives, an activity now called 'portable alpha' and 'smart beta'. For the following five years, Mr. de Quillacq ran due diligence on investments strategies and selected senior investment personnel for some of the world's most famous and most demanding hedge funds and asset managers. In 2017, he co-founded a quantitative activity deploying the latest machine learning techniques in global long/short equities. Mr. de Quillacq is a quantitative researcher and portfolio manager for an asset management firm deploying volatility trading strategies.

Litigation Support - Mr. de Quillacq's own investment experience and his cross-sectional review of other professionals give him unique experience on what can be done, what should be done, what should not be done, and the grey areas in-between. During a personal case, his legal team was so impressed by his wide and thorough knowledge in finance, his capacity to explain complicated ideas in simple terms, and his strong performance on the stand, that they strongly recommended he expand into litigation support services. Mr. de Quillacq is now a FINRA/NFA arbitrator, a member of the **Securities Expert Roundtable** and an IMS Elite Expert. He has consulting affiliations with **Barrington Financial Consulting Group, Ankura** (Navigant), **The Bates Group** and several other litigation support firms.

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