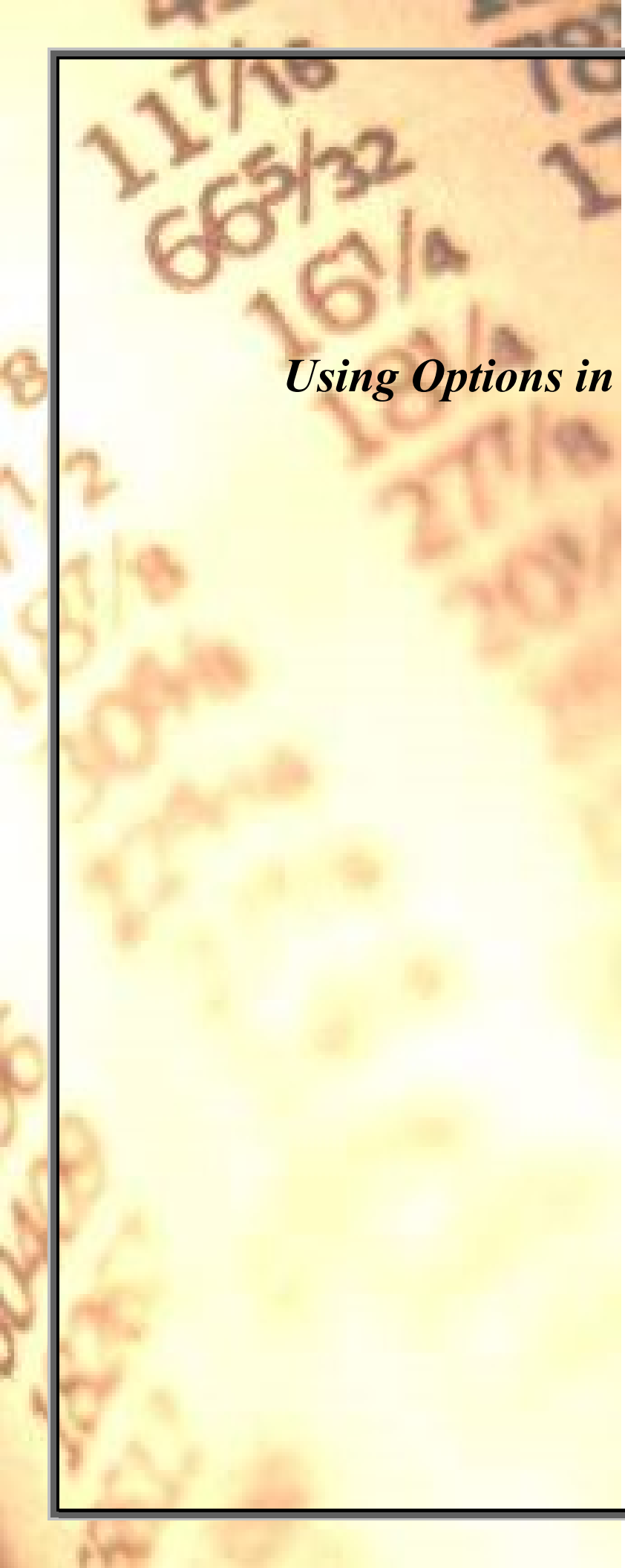

Using Options in Wealth Management

Part 3

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Table of Contents for Part 3

Ways to Use Options: Options on VIX

Another possible strategy to use options is to purchase options on VIX itself[1]. This concept takes some conceptual adjustment. VIX is a measure of volatility, and we are now talking about options on VIX, so we will be concerned with the ***volatility of volatility.***

In times of crisis—such as in 2008—VIX levels tend to skyrocket. Owning call options on VIX can provide a powerful diversification tool in these situations[2]. While there are benefits to being long VIX, there are also challenges. First, there is no reason to believe that there is a positive expected return from being long VIX and, indeed, there is some indication to the contrary. On the other hand, the negative correlation between VIX and the S&P500 tends to become stronger during times of major market upheaval, meaning that the diversification benefits get stronger in these periods, as opposed to the increase in positive correlations between many traditional asset classes in these situations. In other words, simply being long volatility will not add expected return to a portfolio that is long equities, even though it should reduce downside risk. A recent study makes the following proposition[3]:

...the conditional nature of the negative correlation between SPX and VIX (as well as the research results which suggest that VIX calls may have higher payouts than SPX puts) suggests that VIX calls may provide more "bang for the buck" than SPX puts in diversifying a typical portfolio. These observations suggest that a long term passive long volatility position may return negative excess returns. However, a selectively applied long volatility position may provide significant diversification benefits, particularly in times when the diversification benefits of other assets break down, such as in the last two quarters of 2008.

You can buy or sell put and call options on the VIX index itself through a brokerage account (such as E*Trade). It is useful to look at examples. As of this writing (the end of November 2009), VIX stands at 24.5 (annualized implied volatility is 24.5%). The longest-dated options available at this time expire in May of 2010. Let's examine the call option on VIX with a strike of 25 and expiration in May 2010. The options on SPY with the most similar expiration date to the VIX option is June 2010 and the implied volatility for this at-the-money SPY option is 24%.

When I run QPP using ***^VIX*** as the input for a ticker, I can value the options on VIX, after having adjusted the assumed volatility for the S&P500 to 24%. The 'price' used for VIX is $24.5 and the resulting value of the $25 strike / May 2010 call option calculated in QPP is $6.70. The current 'ask'—what you would have to pay for this option today—is $5.70. The value of this option calculated in QPP is driven by a projected volatility of 104%. e*Trade's binomial pricing model puts the implied volatility of the option at about 90%.

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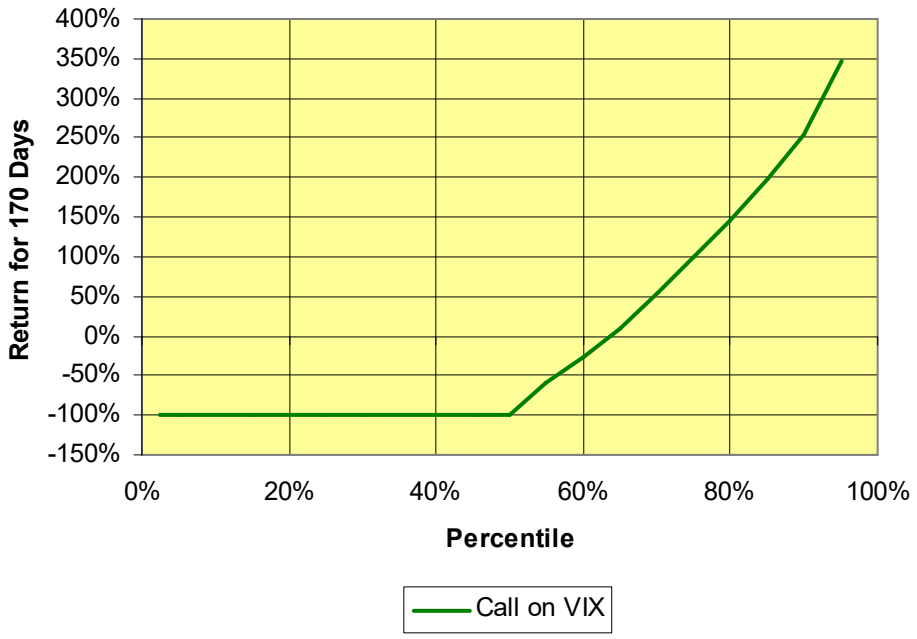
[1] http://www.cboe.com/micro/vix/vixoptions.aspx
[2] http://cisdm.som.umass.edu/SZADO_VIX_July3_2009_SSRN.pdf
[3] See article in footnote 2

QPP's projected volatility for VIX is driven by the Beta of VIX with respect to the S&P500, the trailing historical volatilities of the S&P500 and VIX, and the projected volatility of the S&P500 (which is a user-adjusted input). If I lower the expected volatility for the S&P500 down to 20%, the resulting projected volatility for VIX drops to 86% and the value of the $25 / May 2010 call option drops to $5.60, right on the current ask price. The overall consistency between the price of the VIX calls and projected value, just given current implied volatility for the S&P500 is striking. This provides a sanity check on the pricing of call options on VIX. Note that I am not suggesting that the current price for VIX options is 'correct' or that QPP is correct—but rather that the options markets on VIX and QPP are generally consistent. This is, in fact somewhat remarkable. QPP takes the historical data for VIX and SPY as inputs and calculates a statistical relationship between them. QPP then uses the Monte Carlo simulation to generate a SPY projection (which can be adjusted by the user) and which then drives the projection for VIX. Given that VIX is the implied volatility of SPY itself, the fact that the volatility of VIX (the volatility of volatility) that results from the model is so consistent with where options on VIX are trading is notable.

One major assumption separates VIX from other 'asset classes': the expected return on VIX is somewhat controversial, but analysis of historical performance suggests that the expected return is zero[4], whereas the expected return from buying equities or bonds is positive (because there is a positive assumed equity risk premium). With zero expected return, what is the point of buying call options on VIX? The major motivator is that (1) VIX has a -67% correlation to the S&P500 (as noted previously) and (2) the Beta of VIX with respect to the S&P500 is -280%. This means that VIX is both strongly negatively correlated to returns on the S&P500 and amplifies moves from the S&P500 (in the opposite direction). This, in turn, means that call options on VIX will provide a powerful hedge against downward moves in the S&P500.

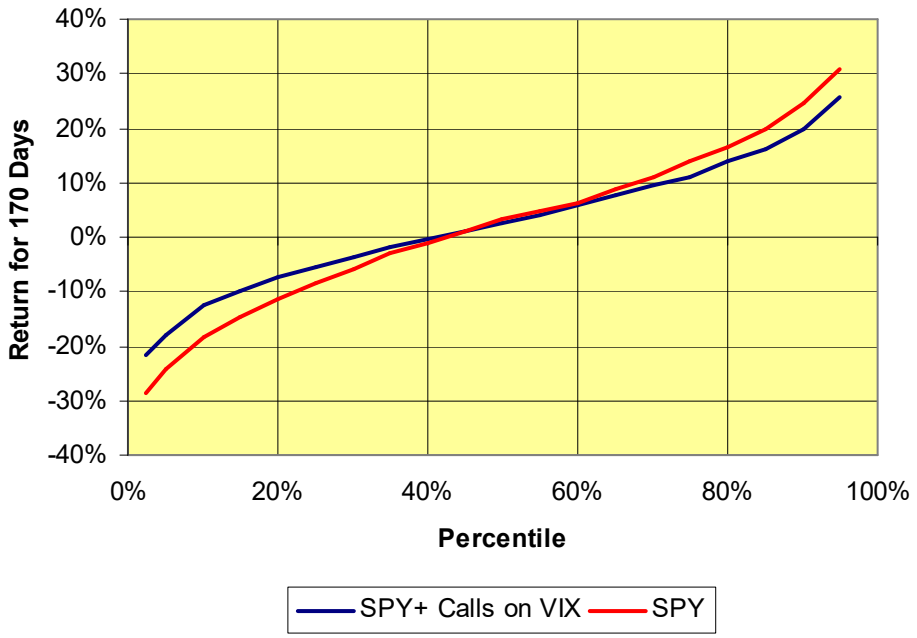
There are 170 days until the expiration of the May 2010 option as of this writing. We will use a case in which we have the volatility of SPY equal to 24% and the volatility of VIX equal to 90% (to match both the options on SPY and the options on VIX). The $25 May 2010 options are projected to end up losing money in 65% of cases, assuming you hold them through expiration (see chart below).

[4] http://www2.standardandpoors.com/spf/pdf/index/SP_500_VIX-ShortTermFutures_WhitePaper.pdf



On the other hand, the 95th percentile return on buying the $25 May 2010 call on VIX is 350%. This demonstrates the power of leverage, not to mention the results of buying an option with 90%-100% annualized volatility. .

Now, imagine that we purchase one share of SPY at $110 and one $25 May 2010 call option on VIX for $5.70. How does this impact the returns relative to holding SPY alone?

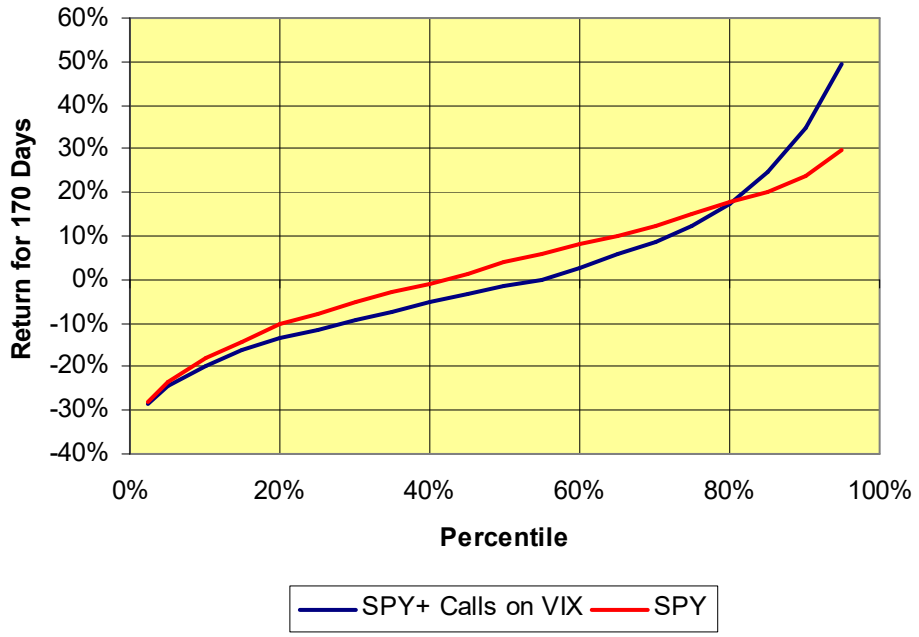


One share of SPY plus one call option on VIX

If you buy one call option on VIX with one share of SPY, you are spending 4.9% of your money on the call option—and you know that there is a substantial probability that the call option will expire worthless. What's more, because of the negative correlation between VIX and the S&P500, if the S&P500 enjoys a massive rally, the options are probably going to expire worthless. This is evident if you compare the 95th percentile outcomes for SPY vs. SPY plus a call option on VIX. The 97.5th percentile outcome on combination of SPY plus the call is about 5% less than that of SPY alone. The 2.5th percentile outcome for the hedged portfolio sees a higher improvement than the loss of possible gain at the high percentiles, however.

The analysis above sounds unattractive, but there is considerable subtlety here. On a percentile chart, a reduction in risk is evidenced by a lower slope. We can see that the slope of the percentiles for the combination of SPY and the call on VIX is significantly flatter than the percentiles of SPY alone. This is where options on VIX have value—as a way to reduce overall portfolio risk. These options will not, in general, add return.

Now imagine that you were willing to spend 17% of your money on the call options on VIX. You would buy four calls (at $5.70 each) for every share of SPY (at $110). Does this help us? The results are shown in the chart below. The volatility of VIX is so high that the maximum downside of the calls + SPY portfolio is now equal to the downside of the 100% SPY portfolio.



1 Share SPY + 4 Calls on VIX

What's more, the median outcomes have suffered—this portfolio is more substantially driven by the options positions. You have loaded the portfolio with more of a lottery ticket component (i.e. you have added more skew) that pays off if VIX gets very high.

What can we summarize with regard to call options on VIX? First, the prices of options on VIX are broadly consistent with the prices of options on SPY, given the correlations between VIX and SPY. With a substantial negative correlation between SPY and VIX, buying call options on VIX might make sense as a way to reduce risk in a portfolio. While this is generally true, there are challenges. There are big questions as to the expected return from VIX over the long term—and evidence suggests that the expected value of VIX is zero.

While options on VIX are hard to justify as a long-term strategic position, there are clear tactical advantages to using VIX options at certain times. As I have noted previously, there was considerable evidence of the likelihood of a volatility shock, standing back in 2007. A purchase of call options on VIX back then would have paid off dramatically and would have provided substantial downside protection to investors with equity exposure in 2008-2009.

Overall, it would seems that options on VIX might make the most sense for investors who want to take a small leveraged position that will pay off in the event of massive market dislocations. These options seems remarkably consistently priced relative to the broader markets (i.e. fair in the context of options on SPY), which has been something of a surprise to me.

Ways to Use Options: Modified Covered Call Strategy

In the summer of 2009, I was analyzing options prices and I came upon a fascinating anomaly: the data suggested that options on some classes of equities were considerably under-priced relative to others[5]. Call options on low-Beta / high-yield stocks tended to be under-priced relative to stocks on high-Beta / low-yield stocks. Since writing this article, I have found a research study that corroborated these findings[6]. This is a fascinating anomaly and has substantial implications for using options in portfolio management.

These results suggested a twist on traditional covered call or buy-write strategies. What if you buy high-yield / low-Beta stocks, sell calls against them, and then buy call options on high-Beta / zero yield stocks?

Ticker	Beta	QPP Projected Volatility	Approximate Price	STRIKE	Option Expirati
EBAY	169%	46%	$17	$19.5	Jan-11
EFA	**119%**	**32%**	**$47**	**$52.0**	**Jan-11**
TIP	**19%**	**13%**	**$100**	**$105.0**	**Dec-0**
EEM	**147%**	**40%**	**$32**	**$37.0**	**Jan-11**
KO	61%	27%	$49	$55.0	Jan-11
WMI	53%	28%	$28	$32.5	Jan-11
IWM	**115%**	**31%**	**$51**	**$56.0**	**Jan-11**
IGE	**112%**	**30%**	**$28**	**$30.5**	**Jan-10**
SO	36%	21%	$31	$33.5	Jan-11
AGG	**9%**	**8%**	**$101**	**$106.0**	**Dec-0**

Chart from article published on July 1, 2009 (see Footnote 4).

The chart above shows a series of cases in which I used Monte Carlo (QPP) simulations to identify stocks for which the implied volatility looked un-realistic. I started by calibrating QPP so that the volatility for the S&P500 going forward was consistent with the implied volatility of long-dated options on SPY. Next, I simply ran the Monte Carlo simulation and compared the projected volatilities from the model with implied volatilities on long-dated options (expirations shown above).

In the table above, the first entry is for EBAY—an example of a high-Beta / zero dividend stock. QPP projected that the future annualized volatility for EBAY was 46%, while the implied volatility was only 38%. In the original article, I note that Jan 2011 call options with a $20 strike prices was trading at $2.30. Using the higher volatility projected by QPP (and the option pricing model in QPP), I estimated that the fair price of

[5] http://seekingalpha.com/article/146466-opportunities-in-options-markets-summer-2009
[6] http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1324605

this option was $3.10: the option was worth 35% more than the current market price. At the start of December (five months since the article was published), this call option is trading at $5.80, for a 150% return in five months.

In another example from the original article, I found that call options on Google (GOOG) were substantially under-priced. The Jan 2011 $440 call option on GOOG was trading at $67, and QPP's projections suggested this option was worth $112. Today, that call option is trading at $170, for a return of 153% in five months.

On the other end of the spectrum, there were high-yield stocks that were projected to have fair-priced call options. The model analysis suggested that these options were fair priced, given the current prices of options on the S&P500. When the original article was published, DUK was trading at about $14 per share and had a yield of 6.7%. The Jan 2011 $15 call option was trading at about $1, which QPP projected was a fair price. As of this writing, DUK is at $17.25 and the call option is trading at about $2.40.

If an investor had followed the proposed strategy: buy DUK, sell the call against DUK, and buy the call on a stock like GOOG or EBAY, how would things have worked out? DUK has gained 23% over the five month period. If we invested $10,000 in DUK and sold covered calls against these shares, the net options position would be down by $928 over this period. If we invested the proceeds from the option sales in purchasing the call options on GOOG, we would have gained $1098. Selling the calls on DUK and buying the calls on GOOG has lead to a net additional gain from the options of 1.7% on the original $10,000 over the five month period. As things have turned out, this is not a spectacular gain when compared to a 23% rally in DUK. In other words, the total performance of the $10,000 investment has been dominated by the rise of DUK along with the market as a whole. Still, a 5-month additional gain of 1.7% is nothing to sneeze at, especially given if this incremental opportunity is still available in a low-growth scenario such as the New Normal.

From the standpoint of an income strategy, this approach makes sense. I further explored this approach as a vehicle for value-driven investing[7]. The types of gains available from this modified covered call strategy are best viewed as an incremental income driver.

There are a variety of ways to exploit potential pricing differences between options on high-yield / low-Beta stocks and options on zero-yield / high Beta stocks that will be a lot more exciting than the modified covered call strategy presented here, of course, and this remains a topic for ongoing research.

[7] http://seekingalpha.com/article/161672-additional-dimensions-of-value-investing

Ways to Use Options: Buying Calls vs. Buying the Asset

One of the most basic considerations for investors who are contemplating options is when it makes sense to buy call options rather than buying the underlying stock or ETF. Buying options is not inherently more risky than buying the stock or ETF that it tracks, provided an appropriate leverage ratio is selected. So how do we choose between the two? I find it notable that there is not more discussion of the choice between these two alternatives. As noted earlier, buying the underlying stock or ETF is simply a special case of buying a call option. When you buy the stock or ETF, you are buying a call option with a strike of zero and infinite expiration (and you get the dividends). When you buy an at-the-money call option, you are only paying for the gains during a limited period of time—so you have an option with a different strike and a finite expiration period. Buying the call option at a given strike provides leverage and a finite expiration.

In September of 2009, ***Advisor Perspectives*** asked me to write an article on gold as an investment[8]. At the time, gold was trading at about $1000 an ounce. Gold had experienced a massive run-up and exhibits substantial volatility, both historical and implied. GLD, an ETF that invests in gold bullion, was trading at $100 at the time article was published at the end of September. GLD is trading at $119 as of this writing (start of Dec 2009), for a 19% gain in about two months.

When I ran GLD through QPP, and adjusted the implied volatility of the S&P500 to be consistent with implied volatility on options on SPY, the projected volatility for GLD was very close to the implied volatility for long-dated options on GLD at about 28%. Annualized volatility of 28% can lead to dramatic swings, which adds a note of caution with regard to a net long position. The Jan 2011 call option on GLD with a strike of $100 was trading at $12.90 at the time the article was written, and *I suggested that a reasonable way to take a position in GLD was to purchase the call and invest the balance in TIPS or other bonds*. Today this call is trading at $25.00, for a price gain of 93%. The return to an investor who used calls plus a low-risk asset class depends on the leverage ratio. If you purchased one call and invested the balance in TIPS (TIP), you would have made 12% (93% on the GLD call which cost 12.9% of your money) from the call and 3.4% from the TIPS, for a total return of 15.4%. This is obviously less than the 19% gain on a long position in GLD, but the risk with the **call + TIPS** position is far lower.

There are many examples that could be made of the same sort of trade-off analysis between buying the underlying stock or ETF vs. simply buying the call option on it. Zvi Bodie's strategy is predicated on the belief that it ***always*** makes more sense to buy calls rather than buying equities outright, if the ultimate goal of investing is to accumulate wealth while managing the risk of massive downward moves.

Under what circumstances does it ***not*** make sense to buy call options in order to gain access to the growth potential in an asset class? The first and most obvious case is

[8] http://www.advisorperspectives.com/newsletters09/Strategic_and_Tactical_Perspectives_on_Gold.php

simply when a large portion of earnings is returned to investors in the form of dividends. When you own the call options, you don't get the dividends. This effect is priced into the options (higher dividend yields means call options are cheaper), but there is simply not much reason to buy calls on high yield stocks unless you have some specific belief that these stocks are going to gain disproportionately in price relative to other assets (i.e. if you have a specific directional view). This also relates to the fact that there is some evidence that call options on high-yield stocks are expensive relative to call options on low-yield stocks (see section called ***Modified Covered Call Strategy***). This effect also adds weight to the argument that dividends can be a deciding factor in buying the stock or ETF vs. buying the call options. If you buy call options on high yield stocks, you also have to worry about the early exercise problem—there are times when you will need to exercise before the ex dividend date or lose value (see earlier section, ***The Basics***)

If call options were too expensive, it might make sense to purchase the underlying stocks rather than the calls. This was the case back at the end of 2008[9]. Not only was VIX at historical highs, but the implied volatilities on a range of stocks were high even if we allowed for the elevated overall market volatility.

Ticker	Expiration	Implied Volatility (at the money options)	QPP Pr Vola
SPY	Dec-09	45%	45
KO	Jan-10	44%	32
JNJ	Jan-10	38%	24
WMI	Jan-10	49%	23
PG	Jan-10	46%	22
DUK	Jan-10	44%	23

The table above is from the original article and was generated in November 2008. If the projected volatility of a stock is much lower than the implied volatility, the call options will be too expensive. DUK has gone from $15.04 when the article was published to $17.25 as of this writing (almost exactly a year since the analysis was published) for a gain of 14.7%. The Jan 2010 call option with a $17.50 strike price was selling for about $1.20 when the article was published. Today that call option is trading at $0.27, even though DUK has massively rallied over the period. The value of a call option goes up with the price of the underlying, but the excessively high implied volatility on DUK back then meant that the call options were too expensive relative to the attractiveness of simply buying the stock. In summary, then, there are times when buying calls rather than buying the underlying stock or ETF is simply too expensive because implied volatility is so high.

If the implied volatility of the options on an asset is reasonable relative to some benchmark, buying call options instead of buying the underlying asset can make quite a

[9] http://seekingalpha.com/article/107756-profiting-from-risk-aversion

lot of sense, not least because of the ability of put an absolute floor on potential loss levels. The challenge for investors and advisors is figuring out what the relevant benchmark for implied volatility is. My research suggests that Monte Carlo projections calibrated using options on the total market (SPY) provide a rational benchmark.

For the investor or advisor who does not want to use valuation tools or Monte Carlo simulation, options can still play a substantive role. At the risk of repetition, it is no more inherently risky to invest in risky asset classes with call options than to invest by purchasing the underlying stock or ETF, once the effects of leverage are taken into account. Further, the floor that call options provide on losses can be very valuable. When I am considering a purchase of a stock or ETF, I now invariably ask myself whether a call option on that stock or ETF might not be preferable.

Ways to Use Options: Nassim Taleb and Black Swans

For our next topic, we will expand our philosophical framework. Nassim Taleb is well-known for his theories that suggest that all of quantitative finance is sophistry and that we cannot calculate risk with any confidence[10]. His central thesis is that risk projections are all developed using the limited data histories that we have available to us and that the really extreme events that can impact our portfolios are simply missed because our data samples are incomplete. Similarly, mathematical models are developed to create a framework for observations (both in science and finance). If models are developed and justified based on their ability to reconcile historical observations, how can they possibly be expected to predict extreme events? Just because you have never seen a black swan does not mean that all swans are white. This is true, but the devil of turning this insight into an effective investment strategy is in the details[11].

It is true that our ability to estimate the probabilities of truly extreme events is poor—and how can it be otherwise? The capital markets (and the world as a whole) are capable of outcomes that we have never imagined. One investment strategy, given an awareness of the potential for events that are both extreme and largely unpredictable, is to own options. If financial markets under-estimate the potential costs of extreme events, options will be systemically under-priced. Taleb believes that investors ought to put the majority of their money in risk-free assets and then take positions with the remaining amount that are the riskiest bets that they can find[12], and options are a natural way to be do this. This all sounds great, but the question of course is as to ***which*** risky bets to take. The 9/11 attacks were a perfect example of a black swan event, but Taleb's hedge fund did not make money during this period[13].

While you can make a lot of money if you place bets on extreme events, you can also lose a lot of money if you consistently bet on extreme events for which you have no way to estimate the frequency or probability[14]. This is related to the problem of gambler's ruin (see Appendix A). Even if the market heavily discounts the probability of extreme events (and thus systematically under-prices far out-of-the-money options), using a meaningful fraction of your money to buy these options is not necessarily a good strategy—and this is easily demonstrated.

Even though I have issues with Taleb's more extreme views, I agree that our ability to characterize the range of possible extreme outcomes and their probabilities is low. What is the chance that the U.S. will go through a period of double-digit inflation within the next ten years? We simply do not know with any confidence. How about another period of $140+ oil in the next three years? How about a pandemic that will radically reduce international travel? How about another major terrorist attack on U.S. soil? We simply

[10] http://en.wikipedia.org/wiki/Nassim_Nicholas_Taleb
[11] http://www.efalken.com/papers/Taleb2.html
[12] http://seekingalpha.com/article/43008-portfolio-allocation-nassim-taleb-s-90-solution
[13] http://www.businessinsider.com/why-didnt-nassim-taleb-make-money-after-911-2009-6
[14] http://www.cnbc.com/id/31386309//

do not know. While I do not agree with Taleb that our ability to characterize the range of possible future events is nil, I do agree that our models are far more likely to fail in putting adequate weight on the truly extreme. Even if the models are correct, however, there is the additional issue that investors (myself included) tend not to plan specifically with the modeled worst 1-in-100 year event in mind. It could happen, of course, but we tend to focus on the more likely events rather than the possibility of extreme events.

If we acknowledge that our ability to model extreme events is poor, and we agree with Taleb that this situation probably leads to an under-pricing of options, what do we do? The first step is to make sure that a systemic under-pricing of the potential for large market moves is in our favor. This is achieved by making sure that we benefit from volatility. As I noted in the earlier section on analyzing whether your portfolio will benefit from volatility (you are ***long*** volatility) or be hurt by volatility (you are ***short*** volatility), a portfolio of traditional assets is net short volatility. If you want to have gains in period when volatility shoots up, you must be ***long*** volatility. As I note in that section, the most direct way to be long volatility is to own put options. This is what Taleb advocates[15]. You can increase a portfolio's correlation to volatility with call options, because the values of calls tend to increase with volatility, but the returns on the market are negatively correlated with volatility, so buying puts is a more direct bet. On the other hand, you could buy calls on the VIX (as explained in a previous section) and this is a very direct way to be long volatility. The more we buy calls on VIX, however, the more our portfolio starts to look like a lottery ticket, with a big payout in which also has a low probability, and anemic returns the rest of the time. Taleb's approach assumes that there is a positive risk premium for being long volatility—but this is not a well accepted or well documented position (see previous section called ***Options on VIX***).

If you had bought far out-of-the-money put options in 2007 (Taleb's preferred strategy), you would have made a lot of money in 2008 because you were net long volatility. On the other hand, if you had consistently made that bet, you would have experienced a long stretch prior to 2007 in which you would have lost money. Volatility can decline for long periods of time, and then spike up fabulously fast. People (and markets) do tend to bet on 'normal' conditions and against the odds of a massive extreme dislocation—the vast majority of investors are short volatility, whether they know it or not. Some people even take leveraged bets that are short volatility. This approach can make you look smart most of the time, but also make you lose everything once in a while[16]. This was what happened in the famous meltdown of Long Term Capital Management (LTCM). The fund made enormous leveraged bets against the odds of very low probability events. They made money for years—spectacular amounts of money—and then lost all their gains and more in a stunning collapse. A nice metaphor for LTCM was that the fund's strategy was like running around picking up nickels in front of a steamroller.

So, what can an investor do if he or she is sympathetic to Taleb's views? We start with a portfolio in which the majority of the portfolio is in very low-risk assets (say 80%-90%). We then look for the cheapest ways to take highly leveraged bets that the market is

[15] See article in Footnote 10
[16] http://www.gladwell.com/2002/2002_04_29_a_blowingup.htm

under-pricing the risk of extreme events with the remainder of our money. A weak form of this approach might end up looking like Bodie's 90/10 portfolio. A stronger form of this approach would be to buy out-of-the-money put options and to try to create a portfolio that would pay out with a reasonably high probability. While any individual option might only pay out at high percentiles, you can improve your odds of a positive outcome by combining multiple options in a portfolio (see ***Diversification and Options*** section). In a Black Swan portfolio, this effect is even more pronounced.

Black Swan Test Portfolios

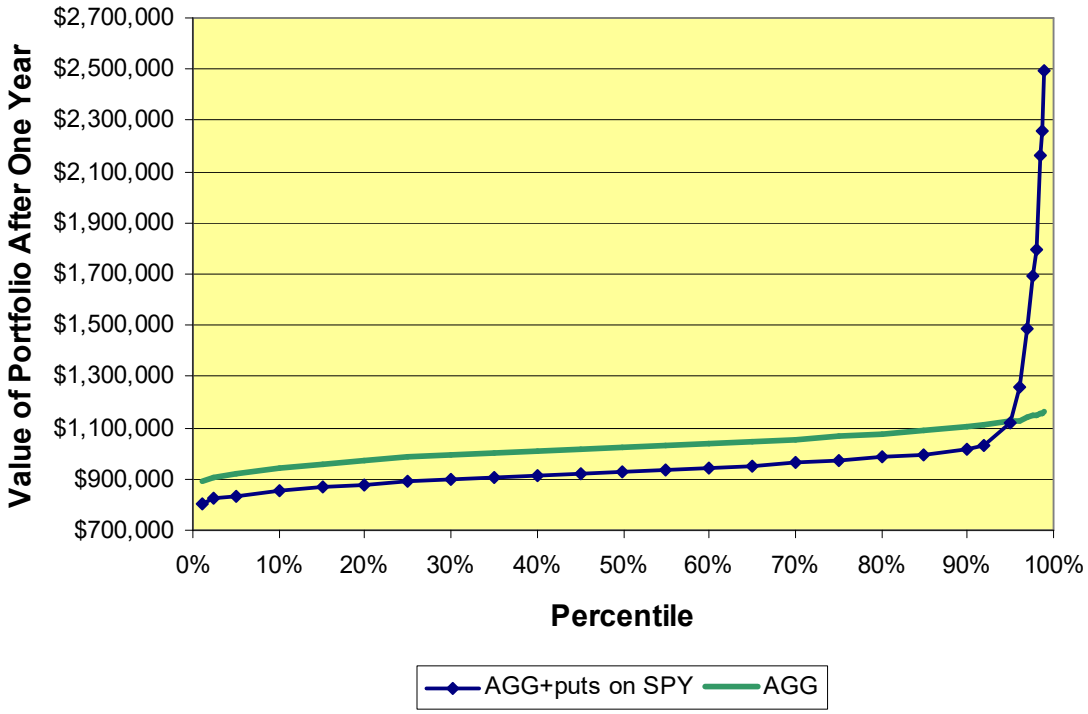
Let's look at some Black Swan kind of strategies from the perspective of Monte Carlo simulation. This is a little funny, because Taleb believes that Monte Carlo and all related methods for simulation of extreme outcomes are fundamentally flawed, but let's have a look anyway.

As of this writing, in the first week of December 2009, SPY is trading at about $112 per share and VIX is at 21%. The simplest possible Black Swan portfolio would be to put the vast majority of our money into a very low-risk asset and buy put options with the remaining fraction—preferably far out-of-the-money put options. I am going to first use an intermediate bond fund (AGG) as my low-risk asset class. My choice of AGG is, of course, not without issues itself. What is the best low-risk asset? Is it cash? Gold? forest land? I am going to choose AGG as my 'low risk' asset class, but this would not be the case in a high inflation environment.

Let's look at a portfolio in which we are going to buy puts on the S&P500 with a strike of $70 and expiration in Dec 2010. I am not certain that Taleb would consider a drop from $112 to $70 a Black Swan event, but it's extreme nonetheless.

The implied volatility of the Dec 2010 ATM (at-the-money) options is 25%, whereas the implied volatility of the $70 options is 31% according to iVolatility.com[17]. This is a manifestation of the volatility smile. Using QPP and calibrating the volatility for SPY to 25%, the value of the put option is projected to be $0.34. The current market value of the put is $1.65. I can increase the baseline volatility of QPP to get closer to the current price of this option and this is a useful variable to play around with. When I increase the volatility for SPY to equal to 31%, I get the following outcome for the portfolio that puts 90% in AGG and uses 10% to buy the $70 put options. We will assume that we are starting with a $1M portfolio.

[17] http://www.ivolatility.com/calc/?ticker=spy



Simple Black Swan Portfolio

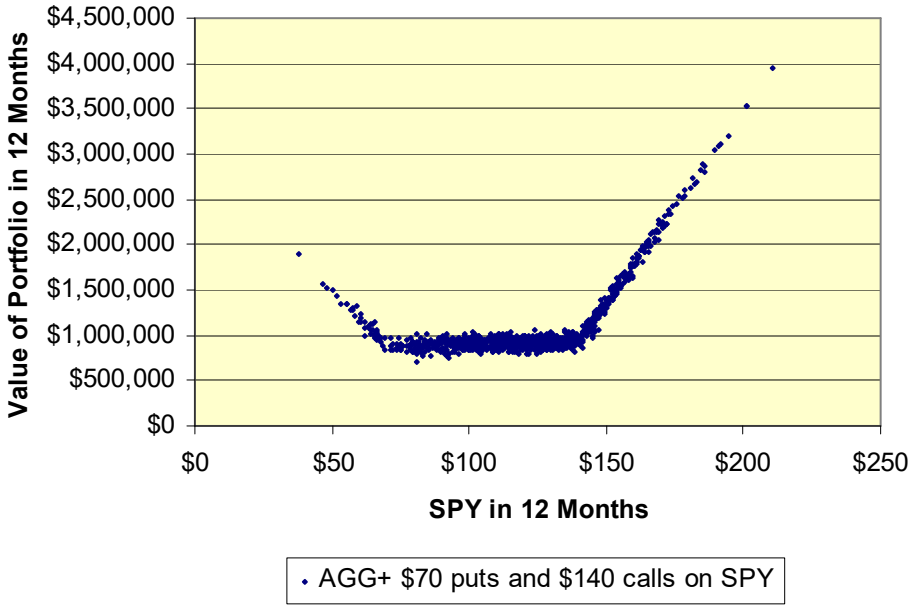
Here we have a perfect illustration of Taleb's strategy. In the vast majority of 12-month periods (95%), you under-perform bonds. In the absolute best-case scenario (99th percentile), you end up turning your $1M into well over $2M in a single year. That's a pretty nice potential scenario for a portfolio that is 90% in bonds.

Now comes the harder part. First, how confident can we be that these options and these percentiles are reasonable? What if these options are too expensive and are implying a higher probability of this large a downward move in the market (which leads to a larger payoff on our put options)? The answer is that this realm of very large market moves is the area in which we have the least possible information. In this regard, Taleb's argument cuts the other way. If we have very little idea about the actually probability of a catastrophic market drop, do we really want to bet our portfolio on catastrophe occurring in the next 12-months? How about 24-months?

Taleb argues that humans and markets are inherently likely to over-estimate the odds of a good outcome than one in the normal range. As such, he asserts that out-of-the-money options will be systemically under-priced. If he is correct, then buying these out-of-the-money puts will be great if we can afford to keep making these bets and we can wait long enough. Let's say that the Monte Carlo model is way off, and the true probability for this strategy to beat bonds in a year is 1-in-10 rather than 1-in-20. Let's imagine that the probability of making 100% in one year is 1-in-20. The point is that we can imagine whatever we want with regard to the under-pricing of these options—and we may be correct—but if the models are as bad as Taleb says, we have no confidence in our ability to figure out if we will make a lot of money or go broke first.

How about splitting up our high risk money and putting half into these puts and half into $140 call options? There could Black Swans that result in the market going up as well as bad ones. The meteoric rise in the Dow from below 6,500 in March to well above $10,000 in December may not be a Black Swan, but it is certainly far out of the ordinary.

As I write this, $140 Dec 2010 calls are trading at $1.20. The payoff diagram for this strategy is shown below:

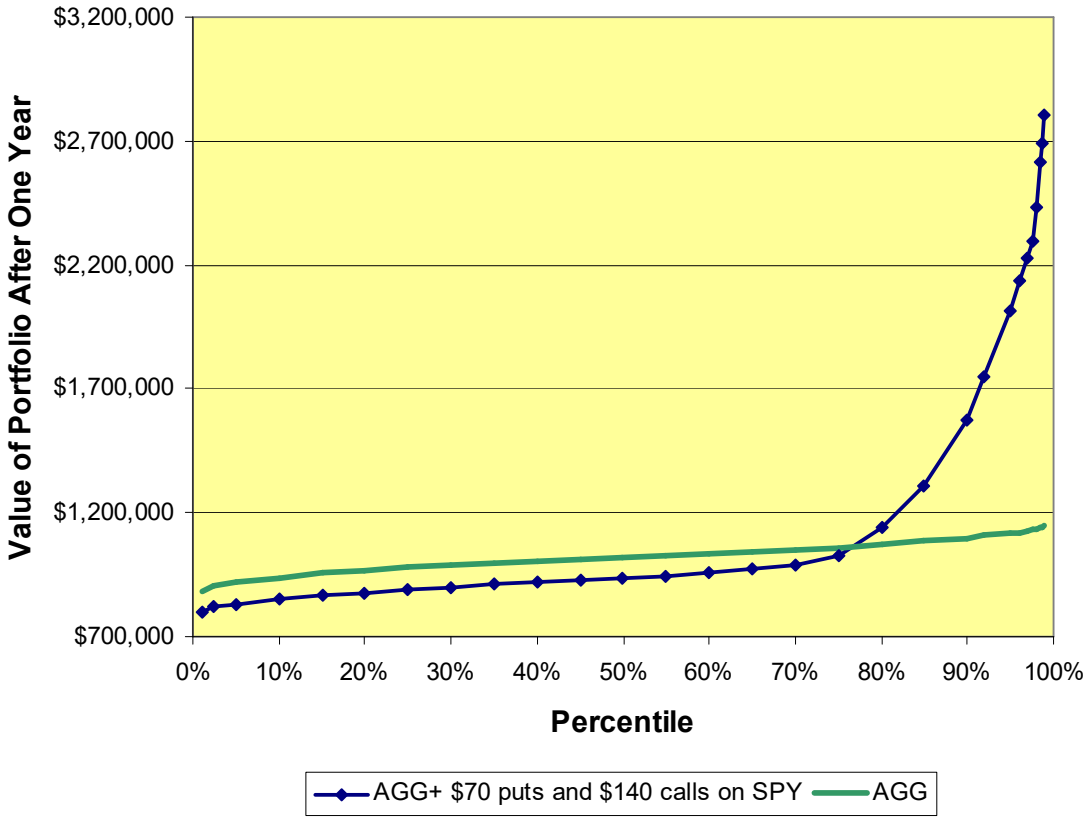


If SPY goes up a lot or down a lot over the next 12 months, we have the potential to make a considerable amount of money. If SPY ranges between $70 and $140, we will lose 10% of our initial wealth, but we can make up some of that from the 90% of the portfolio invested in bonds. The points on this chart show the results from the Monte Carlo simulation, but this is not the same thing as the probability-based chart that I have been using. A notable feature of this chart is that the potential gains from owning the call options (the gains when price goes up) are considerably greater than those from owning the puts. This effect comes about because our model assumes a positive equity risk premium (so that being long delivers expected positive returns). This, in turn, means that owning calls will provide higher expected returns than owning puts—so buying calls will turn out to be a more profitable strategy, if our model is correct.

From Taleb's perspective, this type of illustration would be less than ideal because the model is naturally likely to be flawed by the Black Swan fallacy (assuming that what has gone before is a reasonable basis for planning for the future). Just because we have had positive equity risk premiums over the last forty years and longer does not necessarily mean that we can count on these conditions holding true in the future. Indeed, Taleb would probably argue that the market is pricing options based on the Black Swan fallacy and thus tends to vastly under-price the extreme out-of-the-money puts and calls, as

would Monte Carlo models. The Monte Carlo simulations provide a useful illustration of how a strategy like this would pay off, even if we concede that the probabilities themselves are very much in question.

Perhaps the most useful effect for illustration in a portfolio in which we buy the put and the call is the benefit gained from diversification effects. When the put options pay off, the calls don't—and vice versa. This, in turn, results in a much higher probability of out-performing bonds (see chart below).



While the strategy of buying 90% bonds (AGG) and 10% put options beat bonds at the 95th percentile, the strategy of buying 90% bonds and 5% each of the out-of-the-money calls and out-of-the-money puts beats bonds at about the 77th percentile (see chart above). This is a manifestation of diversification.

Intuitively, we would expect that being un-diversified in our options position (AGG + puts) should provide a higher 99th percentile outcome than the position with both calls and puts. The reason that we do not see this is largely the result of the positive equity risk premium. If we adjust the equity risk premium to zero, the more intuitive outcome results. But is this reasonable?

There are other factors that come into play. If SPY declines, volatility tends to increase (because of the negative correlation between SPY and VIX)—thereby creating a compounding effect that can rapidly increase the value of the put options. The opposite is not true. The negative correlation between volatility and SPY itself means that traditional models (including QPP) are under-valuing puts because there is likely to be a real-time feedback cycle in which VIX rises as the market declines.

In analyzing Taleb's concepts from the perspective of Monte Carlo simulation, I can see the general merits from a conceptual point of view. That said, I know of no evidence (as opposed to a philosophical proposition) that supports the idea that put options are consistently under-priced or that put options further out of the money are especially under-priced. This does not mean that Taleb is wrong—it just means that his position is very theoretical. Taleb's general framework, that the belief that we can effectively price the risks of extreme events is un-supported, is also generally true. I know of no study that demonstrates that the prices of out-of-the-money put options are in fact a good estimation of the risk of big declines. A range of studies have indicated that options are, on average, a reasonable predictor of market volatility but this is quite different from showing that the extreme events are well-priced.

What is most intriguing about Taleb is that he starts from such a different paradigm. How would a rational person act if they believed that the market is putting far too much weight on historical variability and outcomes? We may not be able to quantify the probability or magnitude of extreme events, but we can think about how these events are likely to be mispriced in a market that assumes that we know more than we do.

From a practical standpoint, where does this leave us? Ultimately, I find Mr. Taleb's logic intriguing as an investment theme, but certainly not what I would want to plan my portfolio on. In the best case scenario, you are buying under-priced lottery tickets. The odds are in your favor, but you are likely to go a long time with an under-performing portfolio before you hit the jackpot. Mr. Taleb acknowledges this facet of his world view very candidly. The very truth of Taleb's proposition—that we cannot quantify the probability of extreme events—would mean that we have no firm idea about whether we are likely to go ten years or twenty years seeing our high risk options bets lose money every year before we ever see a bit hit.

If one wished to incorporate Mr. Taleb's thinking into portfolio planning, I see these as the logical steps:

1) Put the majority of money into a low-risk asset class
2) Put a small fraction of the portfolio into high-risk bets
3) Spread the high risk bets to maximize the probability of payout
4) Try to identify extreme situations that are likely to be independent of one another

The first two steps above sound a lot like Bodie's 90/10 concept, except that Bodie suggests putting money into call options and Taleb would lean more towards put options. The last two steps get a little more interesting. We might take a page out of Harry

Browne's world view. Browne believed that there were four major 'states' of the markets, and that each of them would benefit one major asset class[18]:

Inflation: Gold / precious metals outperform
Deflation: Bonds outperform
Prosperity: Stocks outperform
Recession: Cash outperforms

From a Black Swan world view, the states are likely to occur at unpredictable times and with unpredictable extremes. How might one use options to exploit these 'states'?

Inflation: Call options on gold and oil and put options on bond ETF's out-perform
Deflation: Put options on stocks and commodities and call options on long-bond ETF's out-perform
Prosperity: Call options on high-Beta stocks and REIT's out-perform
Recession: Put options on stocks out-perform, call options on VIX out-perform

It is not all that important to get the scenarios right, because we are assuming that the past only weakly informs the future. We might want to create a basket of options that has Beta of zero and that is comprised of these asset classes. In general, Taleb's world view would suggest that we want to be long volatility, which in turn implies more of a negative view.

If one were to decide that the equity risk premium is not necessarily positive over any given time horizon, Bodie's strategy and a Taleb strategy start to look very similar. This is a key variable, however. In my own research, I am continuing to explore the question of how one might create a portfolio out of out-of-the-money options on a range of asset classes plus bonds so as to maximize the probability of beating bonds. How far can we push the diversification benefits of combining these options? If we can go from a portfolio that out-performs bonds at the 95th percentile with put options to a portfolio that out-performs bonds at the 77th percentile with a combination of puts and calls at different strikes, this is compelling. As noted earlier, it is only reasonable to expect diminishing returns from adding more and more options together—just was we get diminishing returns from combining asset classes in traditional asset allocation.

There is no question that there is something compelling about Taleb's world view, not least because we have the exciting 'lottery ticket' payout from the cases in which the options pay out a great deal of money. In the financial literature, this is referred to as 'skewness preference.' Investor preference for portfolios with positive skewness has been studied extensively in the behavioral finance literature[19]. In general, the research suggests that investor's preference for skewness is not justified on the basis of purely

[18] http://www.amazon.com/Fail-Safe-Investing-Lifelong-Financial-Security/dp/031226321X/ref=sr_1_1?ie=UTF8&s=books&qid=1256934562&sr=8-1

[19] http://papers.ssrn.com/sol3/papers.cfm?abstract_id=630821

objective measures of risk-adjusted performance but the fact remains that many investors seems to want the 'embedded lottery ticket' that positive skewness provides.
A portfolio of bonds plus options has substantially higher skewness than a portfolio of equal risk which is a mix of stocks and bonds. On the other hand, there is a strong behavioral bias against continuing to make bets that lose, month after month (or year after year) because you are keeping faith with a specific model or belief. You need an enormous level of faith in your beliefs to keep making these bets. For advisors, it is hard to see how this approach would ever be attractive. How could an advisor possibly convince his/her clients that everything is going according to plan when they lose money every year for the first ten years?

Ultimately, I think that Taleb makes a fair point with regard to the human tendency to ignore the highly improbable events that have not happened in recent memory (if ever). This is well documented in a vast array of studies that look at everything from fear or terrorism to how much people are willing to pay for hurricane insurance. The most conservative approach would be to respond by making sure that you don't hold the downside risk of extreme bad events. This can be achieved by getting your exposure to risky asset classes with call options (as Bodie suggests). A more aggressive approach is to specifically try to build a portfolio of options bets on a variety of extreme events and see if you can get that portfolio to pay out with reasonable frequency.

Conclusions

In this text, I have covered a lot of ground on the ways options can play a role in wealth management, as well as reviewing the basic of options. The goal was to lay out broad strategic strokes rather than delving into options pricing theory. For a quantitatively-oriented discussion of options pricing, I would suggest Hull's classic text, ***Options, Futures, and Other Derivatives***. But books like Hull's are devoted to the details of pricing theory, rather than an overview of strategy. I wrote this monograph because there is a gap in treatments between the high-level quantitative field of options and the practitioner / wealth manager side. It is in the interests of investors and wealth managers to better understand the capabilities that options provide. Zvi Bodie and Nassim Taleb argue that the use of options in portfolio management is not merely advantageous, but rather that it is critical. I have tried to capture a series of the most crucial topics, without getting into the equations.

How much knowledge do people need before they can competently incorporate options as part of portfolio management? I have worked on options modeling for more than a decade, but for most of that time I felt that options were too complex and that transactions costs were too high to make options-based strategies a viable component of wealth management for the vast majority of investors. My thinking on this has evolved, not least because my own research has come to suggest that the pricing of options meshes remarkably well with the prices and risks of the broader market. Over recent years, I have been struck by how consistently options prices signaled market conditions very clearly. Further, I have found that the relationships between historical volatility of stocks and ETF's is very logically related and clearly manifested in options prices. These dynamics have become very evident in recent years, not least because of the maturation of options on ETF's, which provide all investors with access to options on a range of asset classes with low transactions costs.

For years before the market crash of 2007-2008, the options markets were sending very clear signals that a volatility shock was coming. This in turn signaled an elevated risk of a big market decline because volatility runs counter to market direction. I published articles on all of these themes prior to the crash. I say this not to claim prescience, but rather to demonstrate that this is not simply hindsight. When market volatility swung from irrational and complacent lows to record highs that themselves signaled pathological risk aversion, it made sense to bet the other way (that implied volatilities would come down). You could look at options prices on stable well-run companies, relate options prices to default risk, and see that the market was pricing options at such a level that even companies like Johnson and Johnson appeared to have substantial default risk. This just didn't make a lot of sense.

Investors and advisors who are open to considering a role for options in the overall portfolio management process have many avenues to choose from. The simplest is Bodie's approach in which an investor always owns 90% bonds plus 10% call options on the S&P500. This strategy is designed to mitigate the potential for large losses, while

retaining the ability to access the upside of equities. I am the first to admit that I did not appreciate the true merits for Bodie's approach when I first encountered it. It is notable that equity-linked bonds (which are simply packaged versions of bond plus call options approach) account for 7%-8% of total invested assets in Germany and Switzerland[20]. It is not clear why these structured products have not gained more traction in the U.S. The lack of adoption of these types of strategies may relate to how they are marketed, lack of inclusion in 401(k) plans, lack of transparency, fees, or other factors but it is certainly notable that there are countries which have embraced the use of options by retail investors.

I will venture to say that the low level of options use in wealth management for individuals probably has a lot to do with familiarity. Investors are not comfortable with options from either a conceptual standpoint or from a valuation standpoint. A great deal of the lack of comfort with options starts from the issue of valuation. The basic measures of 'fair value' for direct purchase of equities are quite well known (i.e. P/E or price-to-book ratios), but most investors have no 'anchor' for judging the value of a call or put option. Bodie's strategy may sound attractive, but what if we pay too much for the call option component? Are we getting a fair price?

It is reasonable and intelligent to want to anchor the value of options before buying or selling them. The simple-minded answer to this question is that you can determine fair value for the options by using a standard options pricing model, but this does not really address the issue. When you run an options pricing model, you need (at a minimum) to specify the volatility that is to be used to value the option, along with the basic specifications of the option (expiration date, strike price, dividend yield, and the risk-free rate). Most investors and advisors are not all that conversant with metrics of volatility to start with, so where would you get an expected volatility with which to price the options? Again, the simple-minded answer is that you can use the 'implied volatility' but that measure of volatility is simply derived from the options prices themselves—so saying that an options pricing model with implied volatility can provide a 'fair value' for the option is entirely circular---the implied volatility comes from the option price and you use the implied volatility to calculate the options price.

So how can investors and advisors 'anchor' options prices? I believe that the answer lies in Monte Carlo models and related statistical techniques that can at least show how options prices and the risk-return characteristics of the underlying asset classes are related. These models are far from perfect, but they provide a framework for comparing strategies that include options to standard asset allocations in a consistent framework. If we can benchmark the price of an option on a stock or ETF to the price of an option on the broader market using the correlation between the two, this provides a meaningful baseline.

From analyzing implied volatilities (derived from options prices) to Monte Carlo projected volatilities, I consistently find a high level of agreement between the simulation-based values of options and the market-based values of options. This in no

[20] http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1342360

way implies that I believe that options are markets are somehow truly 'fair' but rather that they appear at least as fair as the prices of the underlying asset classes. Options prices are susceptible to bubbles and irrational sell-offs just as the underlying asset classes are, but there is no reason to believe that they are worse. Overall, the balance of evidence suggests that options are markets are more efficient and fair than the markets for the underlying asset classes.

If options prices are (on average) fair (though certainly not all the time), Bodie's strategy deserves consideration by investors and advisors. In a perfect market, the choice between Bodie's 90/10 strategy and a simple mix of stocks and bonds largely comes down to the question of 'shaping' the portfolio outcomes. The 90/10 approach provides more downside protection but also will under-perform equities during all but the most extreme rallies (see earlier section on the 90/10 portfolio outcomes). Let's assume that the average risk-adjusted returns are the same. Which portfolio do you choose? There are additional considerations, such as tax consequences and transactions costs. I have come to believe that investors and advisors should at least understand the costs and benefits of a Bodie-type strategy, whether or not they believe that it makes sense for any specific individual.

If Bodie's 90/10 type of strategy is the options' world equivalent of the basic 'pie chart' in asset allocation, there is a broad universe of other options strategies that are the equivalent to the variety of alternative passive and active management strategies with equities and bonds. Having started with Bodie, what if we like the idea of a 90/10 portfolio but might prefer to buy call options on emerging markets rather than call options on the S&P500? What if we want to consider a combination of call options on gold and call options on equities? There are many plausible variations.

As an all-the-time (i.e. strategic) approach, I am less enthusiastic about selling covered call options. If options are fair priced, you are simply selling off the upside of equities and keeping all of the downside. This means that you are left with a net position that looks like having sold put options. Do retail investors really want to be in the position of selling downside insurance into the market (i.e. selling put options). While studies have suggested that this approach has increased risk-adjusted returns over extended periods, it is the shorter period that is a concern. For individual investors, the gain from selling the call options cannot come close to offsetting the potential downside in a severe bear market. Covered calls make the most sense on a case-by-case basis.

In a world-view in which we explicitly wish to acknowledge the market's (and our own) very limited ability to quantify or conceptualize the impacts of very costly low-probability events, options, options provide a way to remove these 'tail risks' from a portfolio. In light of recent years, this is certainly something to think about. I tend to agree with Nassim Taleb that the prices of out-of-the-money puts are probably too low, in general. Behavioral finance has shown that we tend to put far too much faith in predictions and continuity and too little weight on the possibility of extreme events. This is a great motivation to have a portfolio with rational downside limits on the tails, to the extent that this is possible.

A strong bet on a 'black swan' world view on predictability is to buy put options that will pay out if the stock market tanks, if inflation goes through the roof, if we see deflation, etc, along with a large dose of bonds. This is no free lunch either, though, because of the problem outlined in the St. Petersburg Paradox. Even if we buy our far out-of-the-money put options well below fair value, we can still become insolvent waiting for the big payoff.

A more conservative bet on unpredictability is to buy some long-dated call options with a large allocation to bonds. In its simplest form, this is the Bodie strategy. In more complex permutations, the options part of the portfolio will be a mix of call options on different assets, and perhaps some put options, so as to increase the probability that the options component of the portfolio will pay out (see the section on diversification benefits of options if this is not clear).

Going to a slightly more complex strategy, we can build an income oriented portfolio by purchasing high-dividend / low-Beta stocks, selling covered calls against these, and using the proceeds to buy call options on non-dividend / high-Beta stocks. This approach creates skewness on the upside with the higher Beta calls, but also allows the portfolio to generate considerable income. The attractiveness of this approach partly motivated by research that suggests that implied volatility on high-Beta stocks is too low relative to implied volatility on low-Beta stocks, so that options on high-Beta stocks tend to be cheap relative to options on low-Beta stocks.

Finally, a basic idea that I keep coming back to is that it makes sense to consider buying calls as an alternative to buying the underlying stock or ETF. As in the example of whether to buy gold or a call option on gold, the options prices and implied volatility provide a basis for assessing the costs and benefits. The decision will be a function of risk tolerance, the prices of options, and the investors desire to 'shape' portfolio percentile outcomes. Options provide a unique tool in the shaping process.

Even for investors and advisors who will never buy or sell an option, it is worth understanding and keeping an eye on the options markets as a guide to risk levels in various asset classes that can be used in portfolio allocations. When implied volatility in an asset class is high relative to trailing volatility, this is a good sign that it is time to ratchet down the risk level in the portfolio. When implied volatility is lower than trailing volatility, it is a good signal to become more aggressive. The options markets are far from perfect in anticipating future volatility levels, but a wide range of research suggests that they are valuable in this regard. The last several years have been a perfect demonstration, both with volatility going up and with volatility going down. I hope (and have hoped for quite some time) that advisors will be in a position to discuss the risk levels in their clients' portfolios, given current implied volatilities in the marketplace.