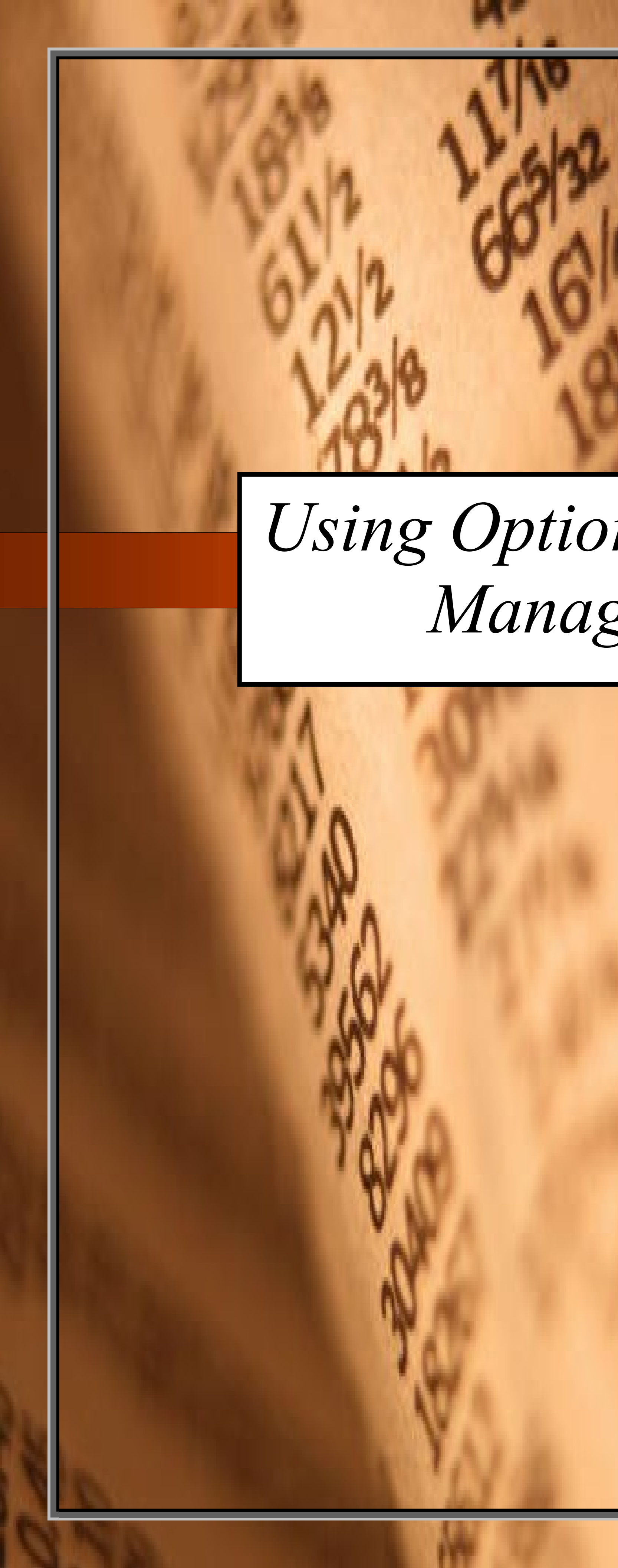

Using Options in Wealth Management

By Geoff Considine
Quantext, Inc.

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Introduction

The world of options gets too little attention in wealth management and portfolio planning discussions. Strategies go through periods of novelty (as is periodically the case with buy-write funds), but most wealth managers and certainly most individual investors view options as speculative and risky. Options can be used in speculative ways, but they can also be used as part of a well-designed wealth management strategy that does not entail frequent trading. The effective use of options does require some specialized knowledge, but the investor or advisor who ignores the capabilities that options provide is effectively handicapping his performance. It is worth noting that leading investment thinkers including Zvi Bodie, Nassim Taleb, and Mohammed El-Erian have written about the utility of options in portfolio management. Why does the mainstream of wealth management essentially ignore strategies involving options? I do not know the answer to this question, although it is notable that there are some substantial differences between Europeans and Americans in this regard. Structured products, financial offerings that include options in various forms, have achieved substantial adoption in Germany and Switzerland but have seen far less popularity in the U.S[1]. Fully 7%-8% of invested assets in Germany and Switzerland are invested in these structured products[2]. Structured products can be expensive and lack transparency, so an understanding of how they work is essential for potential purchasers.

From a broader perspective, advisors and investors can use options directly to tailor risk and return characteristics of portfolios, as well as how to derive market insight from simply following options markets. It is my hope that the reader will gain substantial knowledge of the four following areas:

1) What options are and (broadly) how they are valued
2) How the options markets can inform traditional portfolio management
3) How and why it is worth exploring options as part of wealth management
4) The range of ways that options can help in achieving specific goals

In this monograph, I will discuss how options work, what types of information they provide, and how options can be used as part of a total portfolio management approach. While some of the early material in this book will be familiar to those who are already conversant with the mechanics of options, there will be information provided here that is new to the majority of even financially sophisticated readers.

Over the last two decades, I have worked on quantitative topics relating to financial markets and a considerable portion of that time has been taken up with a topic that appears at first glance to be arcane and basically irrelevant to individual investors. This

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[1]http://www.advisorperspectives.com/newsletters09/pdfs/Zvi_Bodie_on_the_Future_of_Retirement_Products.pdf
[2] http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1342360

topic is the assessment and pricing of risk. I have come at this from the framework that risk is the central element of investing rather than trying to project expected return. This is not a radical idea in many circles, but it is new for most advisors and individual investors. Most investors are familiar with the idea that the price of a stock should represent the market's consensus estimate of value of expected future earnings. That's the 'return' part of the equation. But what about the risk part? A rational investor must look at the universe of investment alternatives and compare return to risk in deciding whether or not an investment makes sense. But how does an investor get information on risk? The answer lies in the options markets. Financial options provide a basis for determining the market's consensus view of the current and future risk of individual stocks and broad asset classes. In looking at the world from this perspective, financial options are not a peripheral part of the market ('side bets' as Burton Malkiel said) but are rather a crucial source of information in investment planning.

For investors who are willing to take the conceptual step of considering the use of options in their portfolio planning, there are many potential sources of value. A thinking person would not consider implementing options strategies without understanding how options work however. For those who are skeptical about any notion of using options, I simply ask your forbearance in reading on. The skepticism is good. There are many books by 'market gurus' who wave their hands and talk about options as if they are some kind of free lunch. These sales pitches notwithstanding, there is evidence that the options markets embody valuable information—even for those investors who will never actually use options, but will instead use information from options prices as an indicator[3].

When I first entered the field of finance, my job was to develop trading models for options (on energy commodities and weather indexes). I have worked with options pricing models for more than a decade. For most of that time, I felt that options were not appropriate in managing individuals' portfolios. My research in recent years has changed my opinion. The emergence and growth of ETF's (and the attendant growth of options on ETF's) allows individual investors and advisors access to valuable strategies that can be implemented at low costs. My work has led me to believe that options strategies can play a useful role in portfolio management for even very conservatives investors. The starting point, however, is to develop an understanding of options as part of portfolio theory and how options relate to traditional asset allocation models that are the basis of wealth management. This monograph is my attempt to provide a coherent view of options as a natural component of wealth management.

[3] http://www.nytimes.com/2006/08/13/business/yourmoney/13stra.html?_r=2

The Basics

In this section, I will explain the basics of how options work. To begin, let's simply define call options and put options. An option gives you the right to buy or sell something (a stock or ETF, for example) at a certain specific price (the strike price) for a specific period of time. Options have a limited lifespan, and the date at which an option ceases to be in force is called the expiration date. A call option gives you the right to buy and a put option gives you the right to sell. Calls and puts are often referred to as 'plain vanilla' options—they are the simplest options structures. For the right to buy (call) or sell (put) a stock or ETF, you pay the option premium. In the common parlance, you are ***long*** an option if you have bought it and ***short*** the option if you have sold it. You can buy or sell options at any point during their lifetimes back into the market. If you choose to exercise the option (i.e. to use the option to buy or sell the underlying share of the stock or ETF), the option ceases to exist.

Imagine that you hold a call option on stock X. Stock X is selling for $100 per share and your call option has a strike at $90, and an expiration date one year in the future. You can exercise the option and buy the stock at $90 which gives you an immediate gain of $10 (because the stock is trading at $100 and you bought it at $90). The amount of cash value that you can gain by early exercise is referred to as the ***intrinsic*** value of the option. The one year option on stock X will be trading at more than $10, however, because the option also has ***extrinsic*** value which is the value of the right to buy the stock at the strike price over the course of the next year (this is also called the ***time value*** of the option). Neither the intrinsic value nor the extrinsic value of an option can ever be less than zero. If an option has intrinsic value greater than zero, it is said to be 'in the money.' If the strike price of the option is very close to the current price of stock X, the option is said to be 'at the money,' which is often abbreviate as ATM. If the intrinsic value of the stock is zero and the strike price is far from the current price of the stock, the option is said to be 'out of the money.' This is a lot of jargon, but it is actually very simple. The call option with a $90 strike on stock X, when stock X costs $100 is *in the money*. The call option with a $110 strike on stock X is *out of the money*. The call option with a strike price of $100 is at the money.

You can get quotes on options from many brokerages (I use e*Trade), as well as from financial sites like Yahoo! Finance. For these examples, we can use Yahoo! As of this writing, SPY (an ETF which tracks the S&P500) is trading at around $107 per share[4]. Note the 'options' tab on the left hand side of the screen in the footnoted screen. If we click on this tab, we can see what call and put options are trading for[5]. For this example, I will look at options expiring in December of 2011. The December 2011 call option on SPY with a strike price of $110 currently costs $12.20. The December 2011 option expires on 12/16/2011 and it is 11/8/2009 as of this writing. The standard way to understand the behavior of the call option is with the following diagram:

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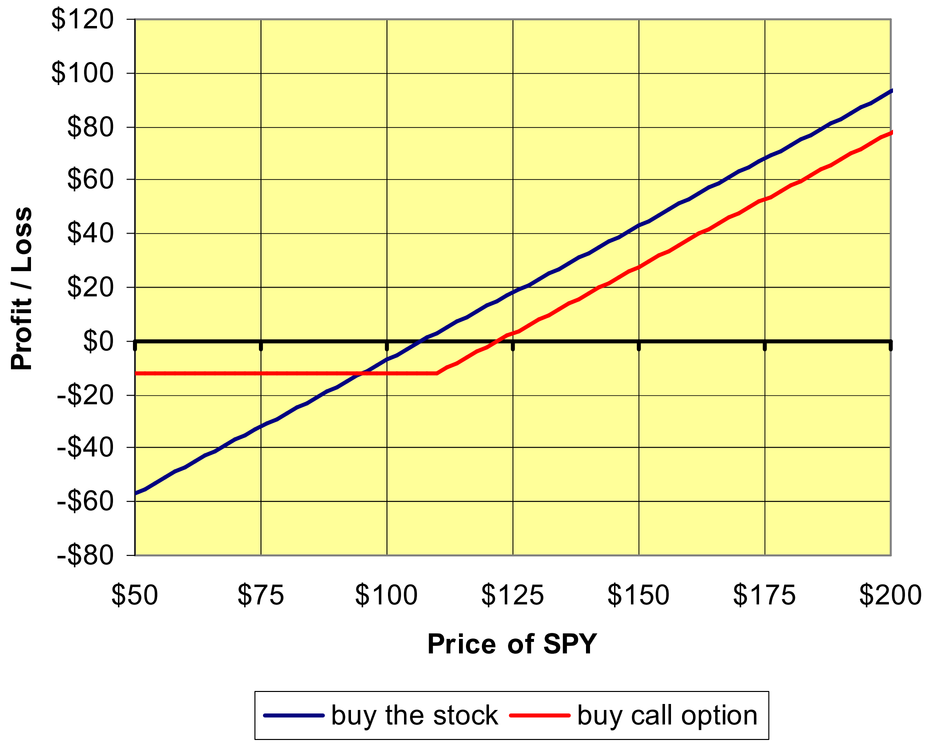
[4] http://finance.yahoo.com/q?s=spy

[5] http://finance.yahoo.com/q/op?s=SPY



The horizontal axis shows the price of SPY and the vertical axis shows the payout from the call option. If the market experiences a big rally, you will be better off with simply buying SPY because you did not pay any option premium, but rather held the downside risk. If the market suffers a big decline, you are far better off with the call option because your downside is capped at what you paid for the call option: $12.20, no matter how much the market declines. For perspective, SPY was below $69 in early March of 2009. Could the S&P500 decline anything like this much again?

Bottom line: if SPY is below $95, you would be in better shape owning the call option rather than owning the stock. If SPY is above $95, you would be better off owning the stock.

The payout diagram (shown above) provides the instantaneous value of the option for any given value of the index, SPY. There are two types of plain vanilla options: European and American. An American option can be exercised on any date between when it is purchased and when it expires. If you were to buy the Dec 2011 call option on SPY went to $200 sometime in 2010, you could exercise the option and be paid the difference between the strike price and $200, because options on SPY are American. A European option can only be exercised on the expiration date. Options on indexes tend to be European and options on ETF's and individual stocks tend to be American.

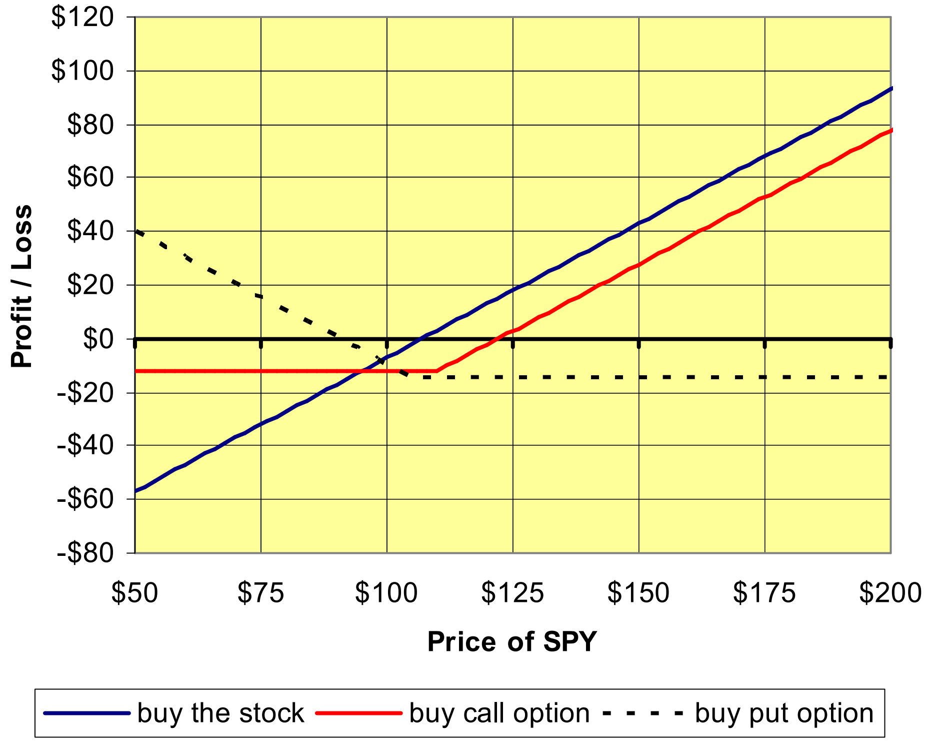
Let's imagine that you buy this call option on SPY and SPY increases dramatically in value sometime in 2010. What are your choices? You can exercise the option (thereby ending the contract and pocketing the gains). You can simply continue to hold the option. Finally, you can sell the un-exercised option back into the market. As a general rule, the second or third choices make the most sense. Even if you want to lock in your gains, it makes more sense to sell the option than to exercise early. The exception to this general rule is with dividend-paying stocks[6]. If you exercise the call just before the stock pays dividends (prior to the ex dividend date), you can receive the dividend payment because you now own the stock —and that can be sufficiently attractive to make up for the loss of the future potential for price appreciation that you lose by exercising early[7].

This payouts shown on the chart above may be thought of as equivalent to a choice between buying a share of SPY for $107 vs. buying a call option on SPY for $12.20 and the investing the difference in cash with no rate of return ($107-$12.20). In reality, one would never actually do this. Assuming you were actually considering buying a call on SPY rather than buying SPY, you would invest the balance in a very low-risk asset class, or perhaps in inflation protected bonds (which have significant volatility, but also provide inflation protection—more on this later). Let's keep this high level for the moment. You have $94.8 ($107-$12.20) to invest in a risk-free investment. At the current risk-free rate of 1.3%, with 2.1 years to expiration on the option (and assuming that you hold the option to expiration), you would make $2.68 on the cash portion of the portfolio. This is not huge, but it does offset a substantial portion of the option premium. To consider more complex comparisons, we need to account for the correlations between SPY and the other asset class—something to be addressed in a later section.

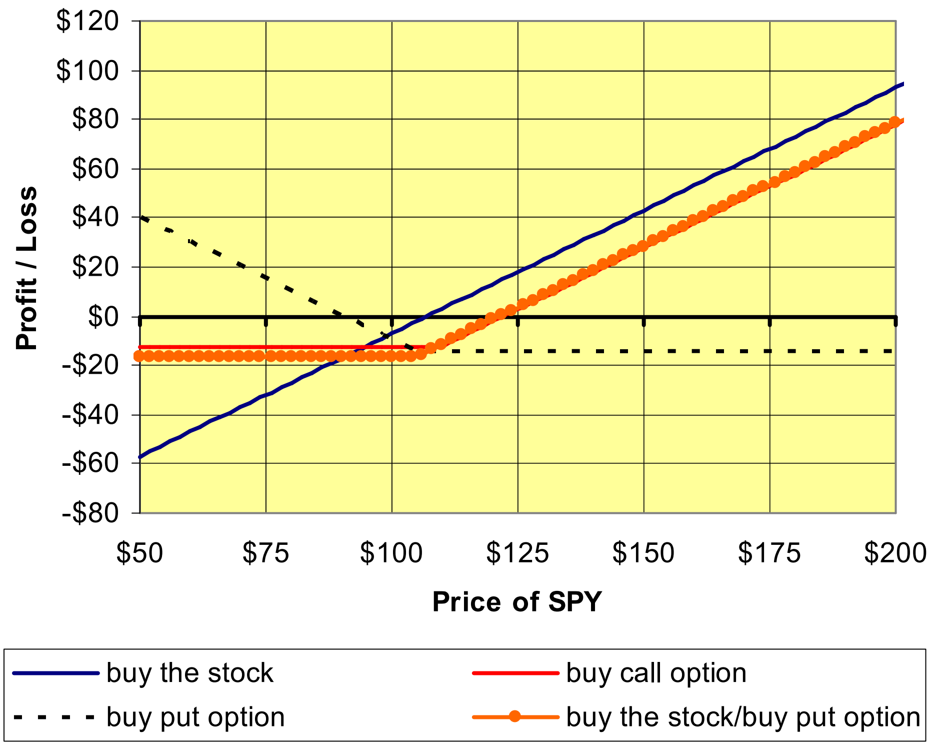
At this point, we have introduced call options. Now let's look at put options. A put option gives you the right to sell an investment at a specified price (the strike price) for a certain period of time. As in the example above, let's look at the cost of a put option with Dec 2011 expiration but with a strike price of $105. An investor might buy a put option because he/she wants to bet on a market decline. As the market drops, the put option is worth more and more.

As of this writing, this put option would cost you $14.50. The payout diagram for buying this put option is shown below:

[6] http://faculty.chicagobooth.edu/robert.novy-marx/teaching/35100/Lectures/lec05.pdf
[7] http://faculty.fuqua.duke.edu/~hengjie/finance353/Files/Lecture%20Notes/Lecture%20Slides/DTopic04_2009.pdf



It is fairly common for put options to be explained by a metaphor with insurance. If you own an index fund, buying a put option is similar to buying insurance against a decline in the value of the index. Let's now look at that example: we own a share of SPY and we buy the put option to protect us against declines in the value of that share (see below).



What is immediately apparent is that owning the share of SPY and buying the put option is almost identical to simply buying the call option. The results would be almost indistinguishable if we have options with identical strike prices. Take a moment to be sure that you understand what this means: owning SPY (the S&P500) and buying a put option to protect that share of SPY leaves you with a position that is almost identical to simply owning the call option. If you own the stock and buy the put, you receive the dividends. If you own the call option, you do not receive the dividends. As I will show later, however, this effect is priced into options—but we have simply used the market prices of options, so this may be a bit opaque at this point.

I am not going spend more time with simple options payout diagrams—you can easily jot them down on a piece of paper. I have shown long options positions, but short options positions are the mirror image of long positions about the horizontal axis. If you sell the put option shown above, the 'hockey stick' flips over. You simply keep the option premium if the prices of the underlying asset are high, but you lose an increasing amount of money as the price declines.

Conceptual Issues with Options

When you buy a call option on a stock, you are buying the rights to the potential gains in price for a certain period of time, but you do not receive the dividends paid out on the stock. If we imagine that the market is both prescient in knowing the future and fair, what would we expect from owning the call? The answer to this question is closely related to the equity risk premium, the return that we expect to get for bearing risk, and to the expected future volatility of the underlying asset. If equity risk premiums are positive (which we are all assuming if we hold equities in any form), then owning a call option will result in positive expected returns (and owning a put option will result in negative expected returns). If the equity risk premium is positive, being net long (owning) a risky equity asset has positive expected returns and calls are long equity risk. On the other hand, if you buy a put option, your expected return is negative because you are betting against the equity risk premium. You are long the put but implicitly short the equity risk premium. The expected future return of the instrument associated with an option does not mean that the expected value of the option is negative. Furthermore, whether the buyer of an option has a positive expected return from buying the option depends on the price (the option premium) that she pays. So, for example, the expected return of the S&P500 might be 7% over a 12-month period, an at-the-money S&P500 put option might have a fair value of $20 a share and the expected outcome for a put option buyer might be -$3. This would occur if the buyer pays $23 for the put option. Even though the S&P500 is expected to rise by 7%, having the right to sell a share of the S&P500 if the value falls has a substantial value.

When you think of how options work, it should be clear that *when you buy a stock or an ETF, you are implicitly buying a call option on that asset, albeit an option with special qualities*. Buying a stock is equivalent to buying a call option on that stock, but with a strike of %0 and infinite expiration date[8]. As long as the price of the stock is greater than zero, your position gains in value in line with gains in the price—but your losses are limited to what you paid for the stock or ETF in the same way that your losses on a call option are limited to the option premium. Granted, this may seem like a bit of a theoretical aside, but it is quite useful conceptually to realize that purchasing a stock or ETF is similar to buying a call option—the difference is in the expiration and strike price.

Another central idea in options pricing is that the prices of call and put options depend on each other, as well as on the price of the underlying index or security. So, for example, if you buy an S&P500 index, sell the ATM call option and but the ATM put option, you have a net position with zero risk. You have sold all the upside from the S&P500 index by selling the call and you have purchased protection from any declines by buying the put. If the market is efficient, you should also have zero expected return. If this is not the case, you have an arbitrage trade—you can make a positive return with zero risk. In general, the options market does not allow this situation to exist because it is very easy to detect and exploit. *A related implication of this situation is that the expected value of an ATM call option must be equal to the expected value of an ATM put option.*

When you buy the stock or ETF or when you buy call options on that stock, you are making the same directional bet and you are betting on a positive equity risk premium. Conversely, when you sell a stock or ETF short (or buy an inverse fund) or when you buy a put option, you are making an equivalent bet against the equity risk premium. The choice between buying a call option and buying the stock is a decision based on a range of factors. The call option gives you access to the upside potential of a stock or ETF for a limited period of time, but it is also much cheaper than buying a share of the stock or

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[8] http://news.morningstar.com/articlenet/article.aspx?id=275386&pgid=optionarticle

ETF. The buyer of the call options does not receive the dividend payments, whereas the owner of the stock does. An investor who is considering purchasing a stock or ETF should also be willing to consider simply buying a call option on that stock or ETF as an alternative, depending upon the price of the options.

Conversely, an investor who is considering buying inverse funds should also consider buying put options. I am somewhat baffled by the popularity of inverse ETF's when put options are easily available on all major indexes. Why would you pay a management fee to a fund to obtain a position that increases in value when markets decline (an inverse fund), when you can simply buy a put? The same is true for leveraged funds (inverse or not).

The fact that so few investors and wealth managers ever consider these alternatives is unfortunate. For the informed investor or advisor, understanding the ways that options can be used opens an array of new channels for tuning portfolio strategies. In the next several sections, I introduce some of the nuts and bolts of options. If this is not of interest, you can skip ahead to the strategies sections for now. If you do skip ahead now, be sure to come back and go through these more technical sections on options later.

Put-Call Parity

The market adjustment to remove options arbitrage mentioned above is called put-call parity. The definition of put-call parity is very simple. For a non-dividend paying stock, the cost of a call option at a given strike and expiration date minus the cost of the put option at the same expiration date and strike must equal zero. The reason is quite simple. If they were different, an investor could reap a risk-free gain.

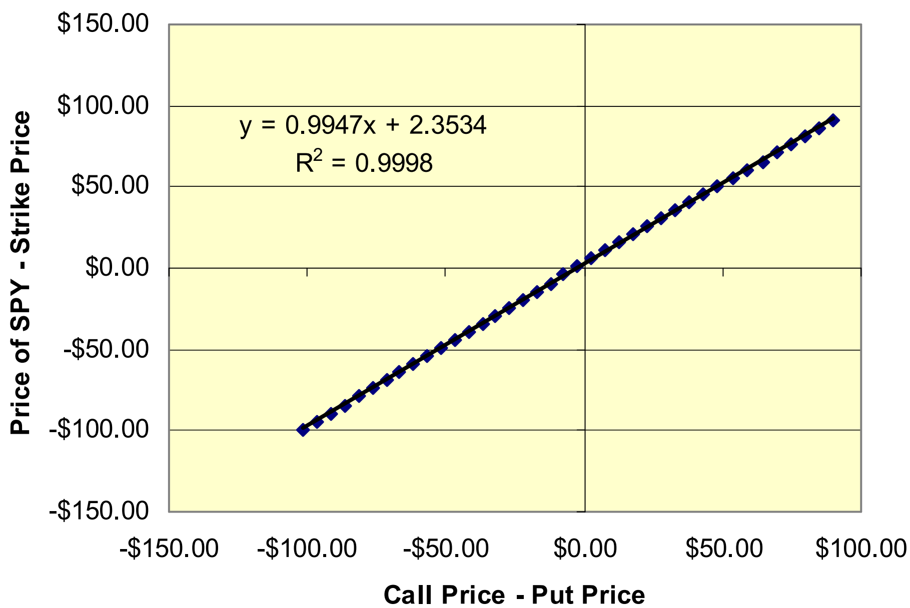
As we showed in the previous section, you can create a position that is essentially identical to a call option by buying the stock and buying the put option with the same strike and expiration (this is referred to as a synthetic position). We have created a synthetic call option by buying the stock and the put. If put-call parity is violated, you can make a risk-free gain by exploiting the difference in price between the call option and the ***synthetic*** call option.

The simplest way to test put-call parity is to look at this in a different form. *If you buy the call and sell the put, you have a synthetic position equivalent to owning the stock (except that you don't receive dividend payments, if any). Buying the put and selling the call should be equal to the difference between the current price of the stock and the strike price.*

Let's look at an example. As of this writing, eBay is selling for $23.45 per share. A Jan 2011 call option with a strike of $25 has a bid/ask of $3.10 / $3.20. The Jan 2011 put option has a bid-ask of $4.45 / $4.55. If you buy the put option, sell the call option, and buy a share of eBay, you have a risk-free position. If you can make money doing this, put-call parity is violated and you have an arbitrage opportunity.

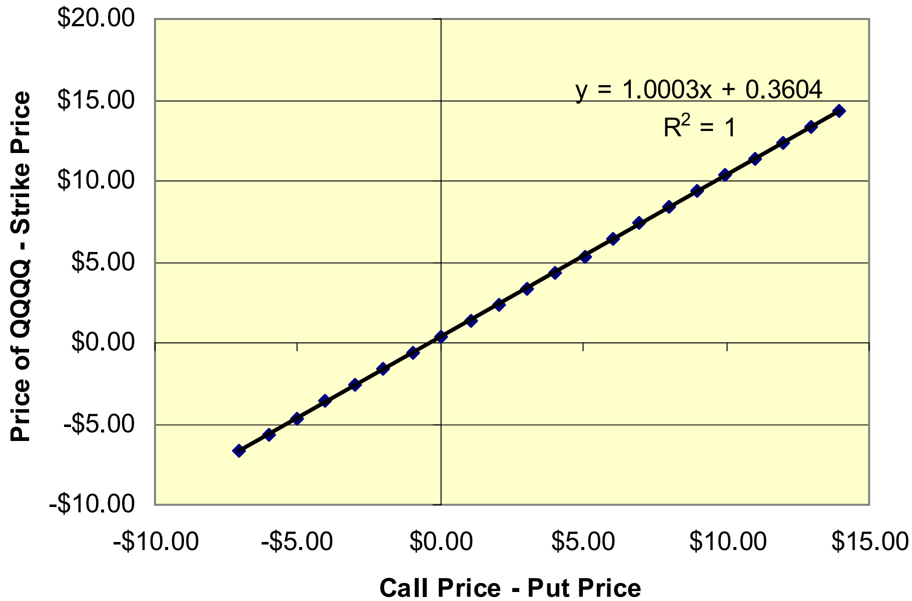
You can sell the call at the bid price ($3.10) and buy the put at ask price of $4.45. If you sell the call and buy the put, you have net proceeds of -$1.15 per share and a position that is identical to simply owning a share of the stock. The difference between the strike price of $25 and the stock price of $23.45 is $1.55. Thus, put-call parity is almost perfectly satisfied ($1.15 vs. $1.55).

Let's make this example more general. The difference between the call price and the put price with the same strike price and expiration should be very close to the difference between the price of the underlying and the strike price of the option. As of this writing, I downloaded the prices of puts and calls on SPY, an S&P500 ETF. The options all expire in December of 2011. When I plot the difference between the price of SPY and the strike price on the horizontal axis and the price of the Call minus the price of the put on the vertical axis for all strike prices, I get the following:

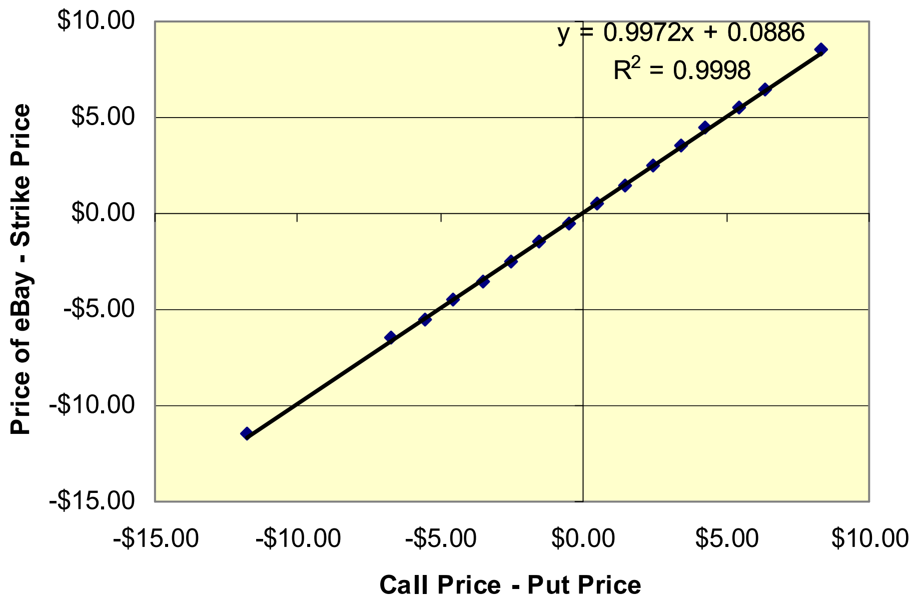


There is a perfect 1-to-1 relationship here, as expected. Why is the intercept $2.35 for the best-fit line rather than zero? This is due to dividends. When you buy the call and sell the put, you have a synthetic position in the stock but you do not receive the dividends as you would if you owned the stock.

Now let's look at options on QQQQ expiring in September of 2010 in the same way:



We have a much smaller intercept value ($0.36) because QQQQ pays lower dividends and because this is a shorter period option. Now let's return to eBay and look at the same type of chart:



In a nutshell, the markets exhibit remarkably consistent put-call parity. You cannot simply make money by buying the stock or ETF, selling the call, and buying the put and ending up with a risk-free gain.

When stocks do exhibit differences from put-call parity, research suggests that it should be possible to exploit these differences, at least as a way that the market can signal when it is attractive to buy or sell a stock[9]. When call options are expensive relative to put options, this is a signal to buy the stock and vice versa. A 2008 paper by Martin Cremers of Yale University called ***Deviations from Put-Call Parity and Stock Return Predictability*** (cited below) found that stocks with call options that are expensive relative to put options (from the perspective of put-call parity) tended to out-perform stocks with expensive put options by 0.5% per week. The authors also find, however, that this apparent arbitrage opportunity has been decreasing over the period in the study—suggesting that the market is exploiting this out of existence. That said, this is a useful anomaly to keep an eye on. This is a very interesting example of how options prices can inform the investing choices of investors who simply seek to buy and sell the assets and will never trade options.

Options and Leverage

One of the most useful attributes of options is that they allow investors to employ leverage. You can buy the 2.1-year call option on SPY that gives you access to almost all of the upside of SPY for $12.20 vs. $107 to buy a share of SPY. This means that you have a leverage ratio of almost 9-to-1 (you can control 9 shares of SPY using options for the same price as buying one share of SPY). Leverage cuts both ways of course—you also have a substantial chance of losing 100% of your investment with the leveraged strategy. Leverage can be useful tool, however, in portfolio planning. This is a central component of the portfolio management strategies espoused by both Zvi Bodie and Nassim Taleb.

The amount of leverage that an investor gains by using options is determined by (1) the percentage of the portfolio invested in options, (2) the strike prices of the options, and (3) the expiration dates of the options. As the strike price of call options moves above the current price of the underlying asset, the price of the call options decreases and the leverage ratio increases. As that occurs, however, the probability of losing 100% of your investment also increases. The shift in the probability distribution of outcomes when options are employed is a crucial consideration.

Going Beyond Payoff Diagrams

The charts shown in the previous section are typically referred to as 'option payoff' diagrams because they show you how much the option will pay out for each possible price of the underlying asset. This is useful but entirely incomplete information. The previous chart (above) shows that if SPY goes to $200, the option will pay out $80. Fair enough, but this does not tell you anything about the probability of SPY going to $200—and that is a crucial piece of information. Knowing the payoffs from a call option without knowing the probability of these payoffs is not very useful. To go beyond this point, we need to introduce a different kind of diagram which captures both the payoffs

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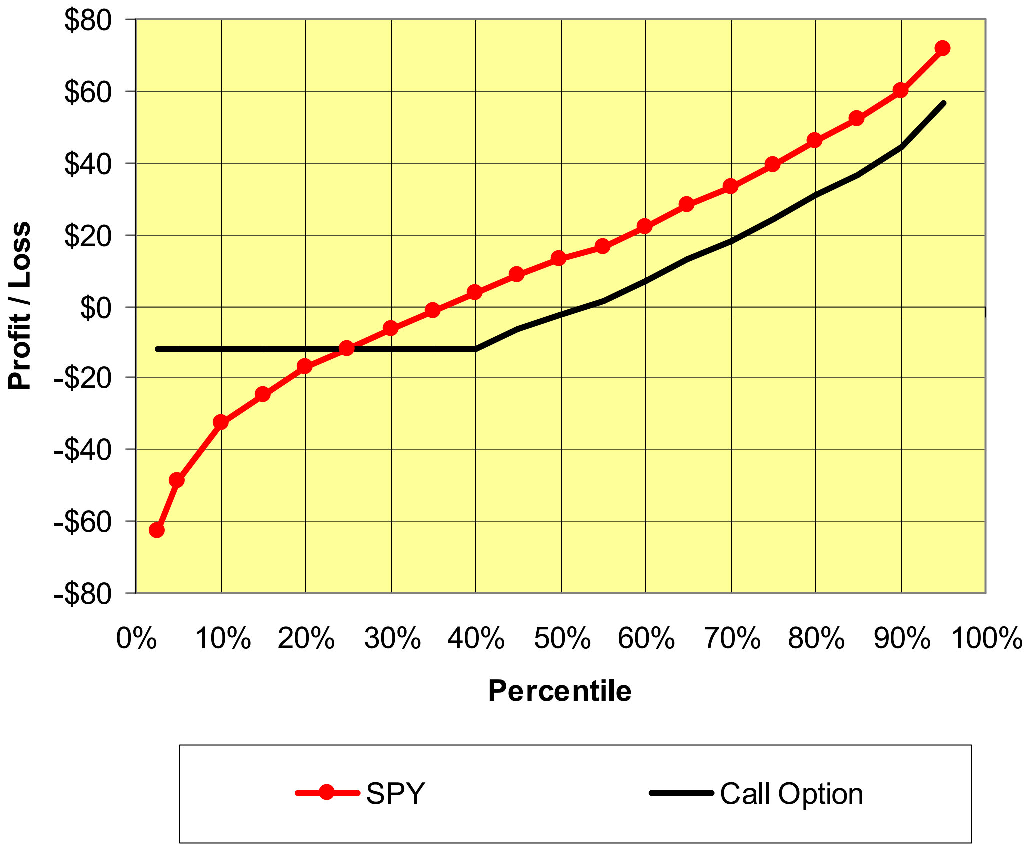
[9] Deviations from Put-Call Parity and Stock Return Predictability
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=968237&rec=1&srcabs=971141

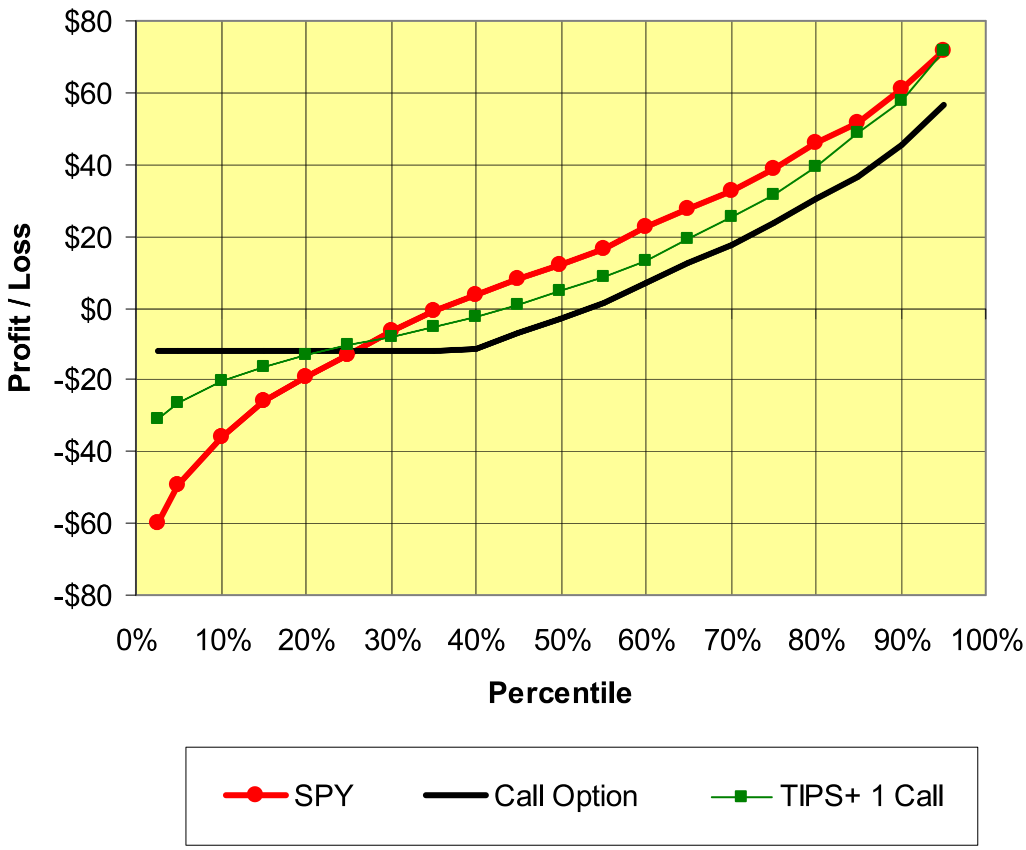
and their probabilities. There are various ways to do this, but I am partial to the ***percentile chart***. To introduce this concept, I have generated an example for the call option in SPY used in the previous examples (strike of $110 with SPY at $107 and 2.1 years to expiration)—the chart is shown below.



Percentile Chart for Call Option on SPY for a 2.1 Year Horizon

The horizontal axis of this chart shows the cumulative probability of having the gain or loss shown on the vertical axis. This chart shows results for both SPY and for the call option. Buying SPY today at $107, these results suggest that you have a 10% chance of losing $32 or more over the next 2.1 years (see the 10% percentile on the horizontal axis, and then look at the total profit/loss on the vertical axis). By contrast, the 10^{th} percentile for the call option is -$12.2, the amount of money that you pay for the call option. The downside cost of holding the option is limited to the premium. On the other hand, the median outcome (the 50^{th} percentile, which you have a 50% probability of being above and a 50% probability of being under) is much higher if you simply hold SPY than holding the call option. When I calculate the expected total two-year return from owning SPY, I get 18.5%. When I calculate the expected total return from owning one call option on SPY, the expected return is vastly higher (about 115%), but we have the prospects of losing 100% of what we spend on the option if the option expires out-of-the-money. In other words, buying a call option is simply a very different risk/return proposition than buying a share of the underlying asset class. Note, however, that the median value is essentially zero. This is also a key idea to understand. Options have payouts in which the average and the median may be very different. For the more quantitatively-oriented reader, the divergence between the average return and the median return is due to the increase in ***skewness*** in the options-based strategy.

To make more of an apples-to-apples comparison on an investment in SPY to an investment that uses the call option, we can examine strategies in which we buy one call option and then invest the difference in the price of the call and the share itself in bonds (I will use TIPS for this example). With this calculation, we end up with the following:



Now things look more reasonable, as well as providing some foreshadowing for later discussion. The combination of one call with TIPS provides a lot of downside protection, while sacrificing return at the median. Note, however, the 95th percentile for SPY and the *TIPS + 1 Call* strategy are identical. This is our first powerful example of how options can be used as part of wealth management. Which portfolio would you prefer to own? Owning SPY directly will provide you with better outcomes in most cases—but you can also end up losing dramatically more money. Options allow an investor or advisor to tune the portfolio to create the risk-return tradeoffs that are most suitable.

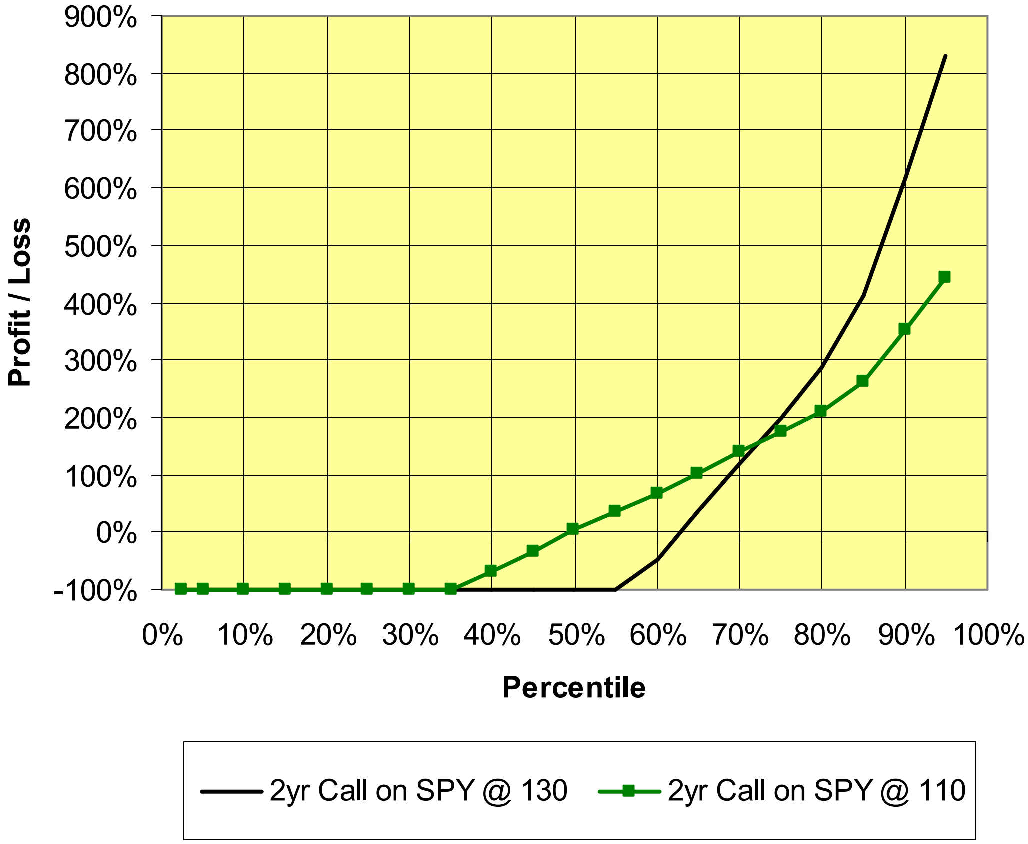
One of the shortfalls in human perception is that we have a hard time conceptualizing probability. Percentile charts provide a way to grasp probability in a reasonably simple way. The reason that you won't see more presentations like the one above is that they require that you have a model that specifies the volatility and expected returns of the underlying asset classes. We will be getting these basic statistics from Quantext Portfolio Planner throughout this monograph.

The percentile chart above projects that there is a 5% chance that SPY will increase by $70 or so over the next two years, from its current level at $107 (see the 95th percentile above)—and this would be an 65% increase. This would be an enormous gain, and the probability is fairly small—but is this is remotely possible. The volatility used to drive the Monte Carlo is 24% and this is consistent with the current implied volatility of the December 2011 ATM call options. A quick and dirty approximation for scaling volatility with time is to multiply by the square root of time. If annualized volatility is 24%, then volatility for a 2.1-year period is 35%. Even if we assume that the expected return on SPY is zero, a two-standard deviation event would get us beyond this level of return—albeit not at quite this high a probability.

Varying the Strike Price

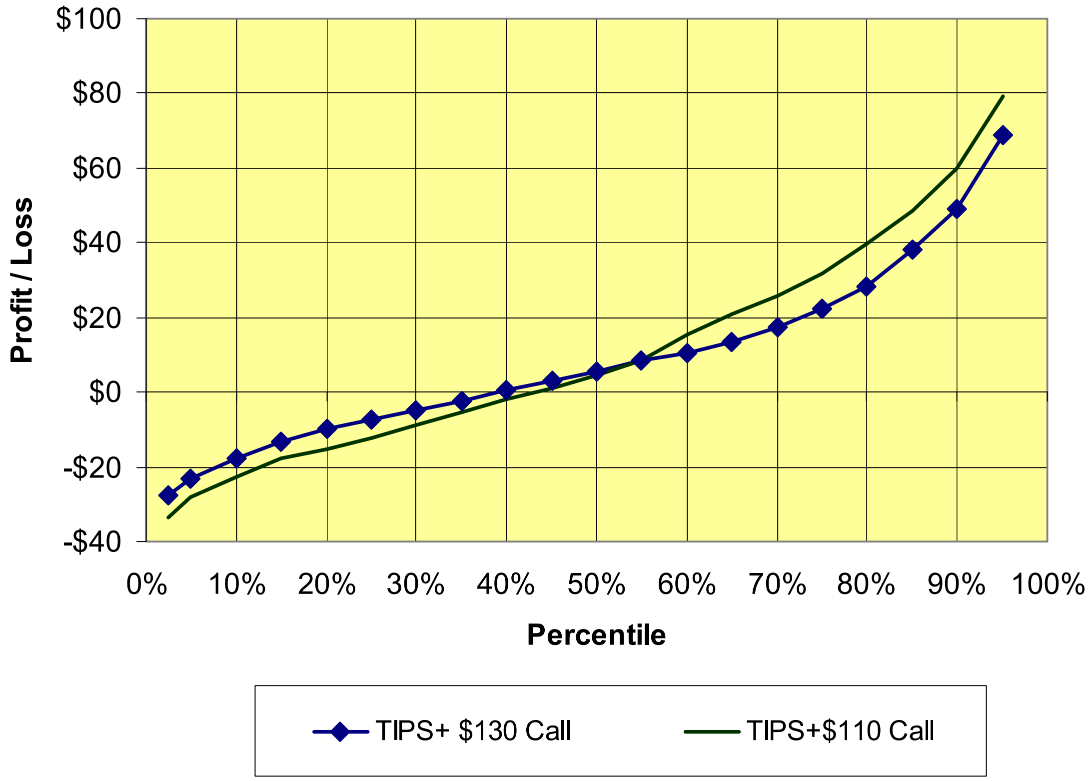
Armed with the very useful concept of the percentile chart, we can now start to think in more sophisticated ways about what kinds of risks we take. Let's stick with the example of options on SPY expiring in December of 2011. In the previous examples, we looked at options with strike prices very close to the current price of SPY. Now let's look at how changing the strike price alters the value proposition of options. SPY is at $109 as of this writing, and we will look at the Dec 2011 call options with strike prices at $110 and at $130. At the time of this writing, the option with a strike at $130 is trading for $5.90 and the option with a strike at $110 is trading at $13.8. The market has moved somewhat since the examples in the previous section: SPY has increased a bit.

The returns from simply buying each of these options are shown in the chart below. The $110 call option has a 5% chance of delivering more than a 400% return over two years. If we pay $13.8 for the option and SPY goes up $60 over this period, we've got a 400% return on the option: a gain of $60 on an investment of $13.8. Note, however, that we will lose money 55% of the time (see where the percentile chart crosses zero). Now let's look at the option with a strike of $130. Even though it costs less than half what the $110 option costs, the probability of losing money increases to 68%. On the other hand, the potential gains increase also. There is a 5% chance of making more than 800% in return if you buy this call option.



Clearly, moving the strike price of the option away from the current price of the underlying asset (SPY in this case) increases the expected return but also increases the risk of the position. This effect can be used to make a portfolio more or less risky—and in more subtle ways than it may at first appear.

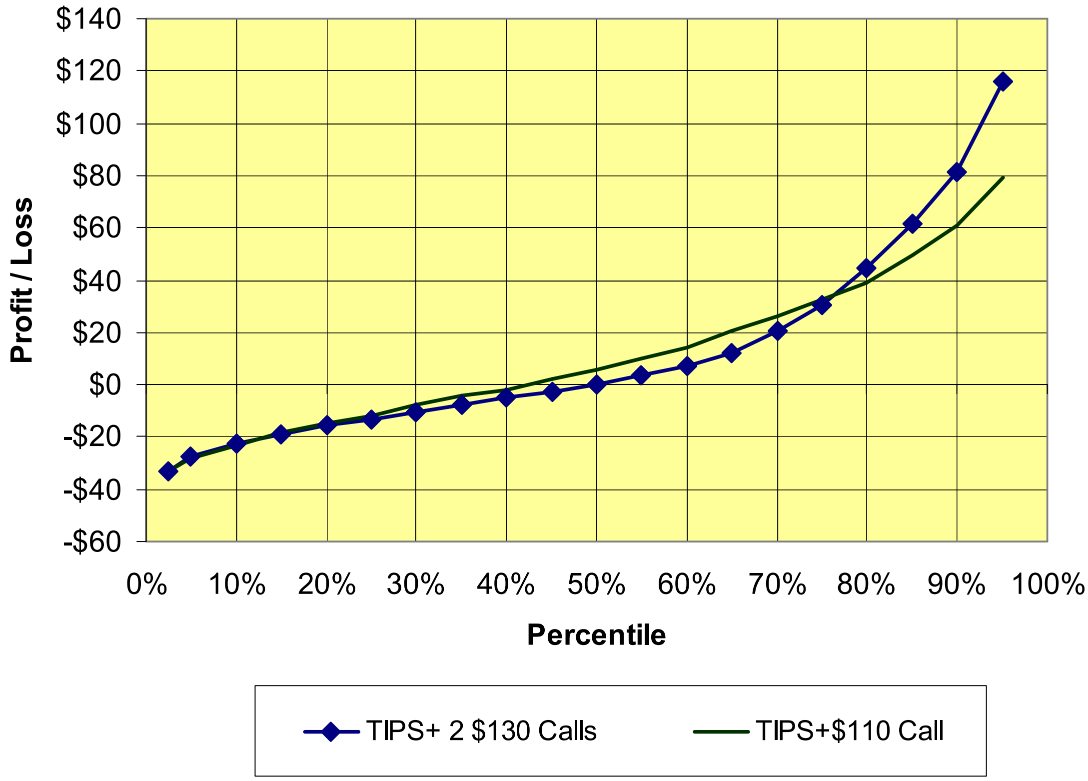
To begin, let's consider the case in which the investor has enough money to buy a share of SPY but wishes to buy one call option contract on SPY and invest the balance of his/her money in TIPS. Even though the $130 call is riskier on a standalone basis, it makes up less of the total portfolio because it is cheaper than the $110 option, so the resulting portfolio with the $130 option is actually less risky than the portfolio with the $110 option. These two portfolios end up with essentially identical probabilities of generating positive returns over the two year period (the 40th percentile is zero for both).



TIPS + 1 Call Contract

On the other hand, what if the investor buys two $130 call options rather than one—and he/she is then spending almost the same percentage of the portfolio on options as if he/she buys one $110 call (on the order of 10%). When we have two $130 calls + TIPS, the portfolio has almost exactly the same worst case downside as the case with one $110 call—this reflects 100% loss of option premium combined with a bad year for TIPS.

As we look at the higher percentiles, however, the differences between these two approaches are evident. The portfolio with two $130 call options has a lot more upside, but under-performs up until the 76^{th} percentile. In other words, we have skewed the outcomes of the portfolio on the high side, but we have a higher probability of under-performing when we buy the out-of-the-money options. Neither portfolio is inherently better or worse, but the preference between them depends on your risk tolerance (see Appendix A).



In this section, I have simply explained what call options are and what put options are. This is the easy part of the discussion. Nonetheless, I wanted to start with a firm understanding of what you are paying for when you buy an option. Of course, you can also sell options. If you own a stock or ETF and sell a call on that stock or ETF, you have what is called a *covered call* position, and this is effectively identical to simply selling a put option on that stock or ETF in terms of payoff. This can be shown using the same simple process of adding positions as we did with the example of owning SPY and buying a call option (except that you do not get the dividends if you sell a put).

While the option payoff diagrams show what an option will pay out, given the price of the underlying stock or ETF, they do not give any sense of the probability of these outcomes over a given time horizon. This is, of course, crucial information in motivating whether or not an option may be attractive. If the probability that SPY will go to $69 is zero, we don't need to worry at all about this contingency. If there is a 5% chance that SPY will go to $69 over the next two years, this is an entirely different matter.

It is especially important to understand probabilities when considering options because using options makes a portfolio's range of possible outcomes very different. If you just invest in stocks over extended periods, your range of possible outcomes is pretty close to a Gaussian (or normal) distribution. The tails are a bit fatter in many cases, but the Gaussian distribution is not a bad approximation, in general. When you add options, however, you introduce the potential for high levels of skewness in the probability distribution of outcomes—the range of possible returns on the upside is far greater than that on the downside if you own an option (and vice versa). The introduction of skewness and the ability to tailor the portfolio's level of skewness is crucial as a point of understanding (see Appendix A).

Understanding How Options Are Valued

While the previous section is very straightforward, this section gets somewhat complex—but it is crucial information. In the examples above, we simply used market prices of options on SPY. But how do we determine whether those prices are reasonable? I believe that part of the low adoption rate of options in financial planning applications is that investors and advisors do not feel comfortable in sanity checking options prices. With stocks we have price-to-earnings ratios, dividend yields, price-to-book, and other metrics that can be used to bound the fair value of a stock. How do we do this for options?

Options pricing theory is very interesting, but gets quite involved. In this section, I will discuss the basics of option pricing—the key ideas that investors need to understand. First, let's simply use logic to explain the key factors that determine the price of an option.

1) Volatility: the more likely the stock price is to move substantially, the more valuable a call or put option will be. The value of a call or put option is determined by how far the price of the underlying ETF or stock moves from the strike price. Higher volatility means that there is a higher probability of big moves.

2) Dividend yield: the higher the dividend yield, the lower the value of a call option and the higher the value of a put option. This is because with a high dividend stock, a higher portion of the potential earnings of the stock are being paid out to investors rather than going into price appreciation.

3) The risk-free rate: the higher the risk free rate, the higher the value of the call option and the lower the value of the put option. You get the risk-free rate with no risk. If you are willing to take on risk, you expect the underlying asset to have higher expected returns, which increases the value of the call and reduces the value of the put.

4) The distance of the strike price from the current price of the asset: if the strike price of a call option is well above the current price, the call option is worth less because the price of the asset must move up further before the holder of the call option ever starts to get paid.

5) Expiration date: the longer the time until expiration, the more an option is worth.

6) Depending on the option pricing model, you may have to specify an expected rate of return. The higher the expected rate of return, the more the call option is worth and the less the put option is worth.

There is a range of standardized option pricing models that take these variables as inputs and will generate a projected 'fair price' for an option. The most famous models are variations on the original Black-Scholes model, but there are many others. It is useful and interesting to play around with how these variables impact the theoretical price of an option. A nice free online tool is available at iVolatility.com[10]. This tool has the very nice feature that it will obtain all of the key inputs for a given ticker, strike, and expiration date as well as calculating the theoretical fair option price from these. Another handy and very simple online tool is available from Zvi Bodie's website[11]. This is a very simple calculator, and it only shows the price of a call option. There is other stuff on the page that you can ignore for now—just look at the value of the call option vs. the inputs.

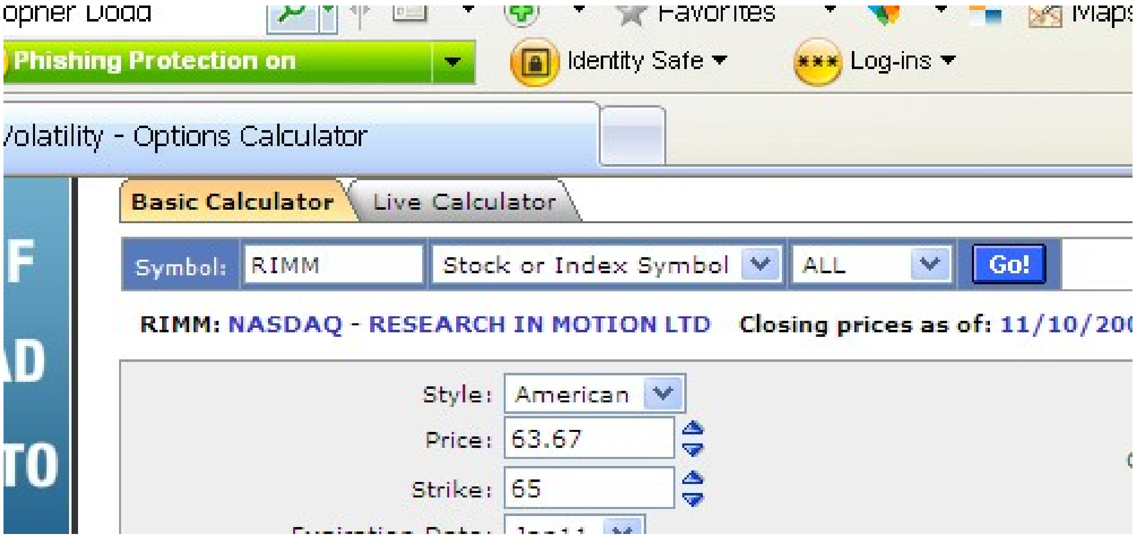
All options pricing models make a series of assumptions about the ways that future prices are likely to evolve. This is what makes option pricing a challenge. To price an option, you need to calculate the probability of every possible future price change over a given time horizon. The most flexible classes of model are binomial tree models and Monte Carlo simulations, and these are related. That said, these models also require more inputs and the quality of the results will depend on the inputs.

How can an advisor or investor determine reasonable values for options without being a serious egghead? The simplest approach is to use a model that has been tested for your specific application. The most basic options strategies for individual investors and advisors do not require that you have the perfect option pricing model, any more than you need a perfect stock valuation tool if you want to choose between stocks.

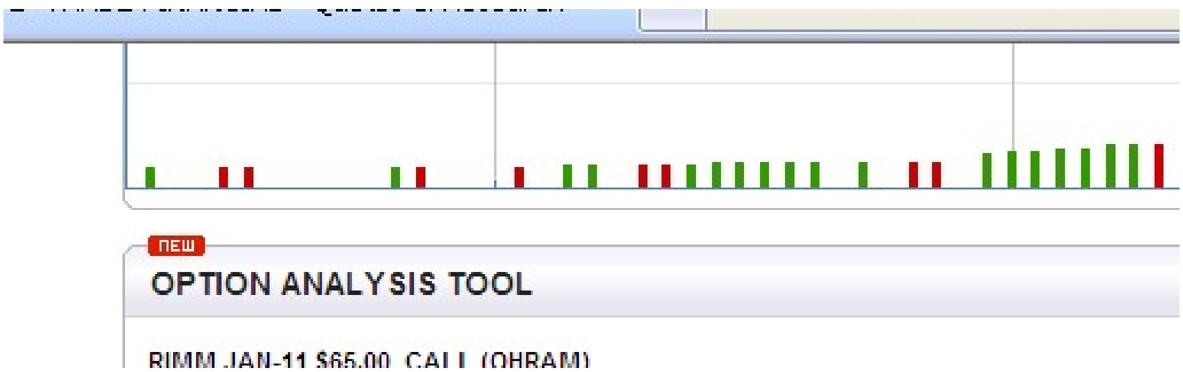
While many people argue back and forth about what the best option pricing model is, it is actually the inputs to the option pricing model (listed above) that are the hardest things to get. Most of these are simple to obtain, but two are hard: the expected rate of return on the underlying asset and the expected future volatility on the underlying asset.

The calculator at iVolatility.com uses the Cox-Ross-Rubinstein binomial tree model, a very well-known model[12]--and it obtains all the basic inputs for you:

10 http://www.ivolatility.com/calc/?ticker=spy
11 http://www.wealth2k.com/downloads/zb/epn.html
12 http://fedc.wiwi.hu-berlin.de/xplore/tutorials/sfehtmlnode36.html



There is also a nice calculator at eTrade called the Option Analysis Tool[13] that provides option valuation using Black-Scholes or a binomial tree model:



The eTrade tool is free, but you need to have an eTrade account to be able to use it.

The most fundamentally challenging variable to obtain in pricing options is the assumed future volatility. Given all of the other inputs and a basic pricing model, you can back out the volatility that the market seems to be assuming, based on the prices at which options are trading. This approach to getting an estimate of volatility gives you what is referred to as the ***implied*** volatility. If you think about it, there is something inherently circular about getting the implied volatility from options prices and then using this volatility as the input for sanity checking options prices. Nevertheless, the implied volatility has proven to be a useful predictor of future volatility in the underlying assets.

[13] https://us.etrade.com/e/t/invest/optionsnapshot?content=3&ochain=1&prod=OHRAM:CINC:OPTN

Implied Volatility

The implied volatility is perhaps the most important statistic for options investors to understand. In the same way that we can think about the price of a stock as representing the market consensus on its value, we can think about the implied volatility as the market consensus opinion on the future risk of a stock (or an asset class, if you look at options on ETF's).

To get the implied volatility, you must back it out of options prices—so implied volatility depends on the specific choice of option model used. That said, I have found that implied volatilities vary quite consistently with historical volatilities and that there is not too much sensitivity to the pricing model if the options have strike prices reasonably close to the current price of the underlying asset.

Many investors have read about or seen a statistic called VIX. VIX, often referred to as the fear index, is the implied volatility on S&P500 options that will expire in the near future (less than a month). These options are for whatever the next expiration date is (you can see this on Yahoo! Finance). This is referred to as the ***prompt month***. So, VIX is telling you the near-term volatility on the S&P500 that the prices of options on the S&P500 imply. Not surprisingly, VIX tracks the recent historical volatility very closely. Why is VIX called the fear index? When returns on the S&P500 are positive, VIX tends to decline and vice versa. This occurs because investors tend to try to buy put options to cover the downside risk of their portfolios when the market is dropping. This drives up the prices of the options and raises the VIX. VIX was developed as an index by the Chicago Board of Exchange (CBOE) and a range of interesting articles on this topic can be found at the CBOE site.

The VIX is the best-known of implied volatility measures but it is not the most important for investors. Longer-term investors should care more about the options with longer expiration periods.

Morningstar has a free tool that shows the implied volatility for options on a specific ticker[14]. One nifty feature of this tool is that it shows the implied volatilities for calls and puts separately. This is an interesting variable to keep an eye on because asymmetry in implied volatility can be a buying signal. A 2008 study showed that asymmetries in implied volatility could be used as a timing signal for buying or selling the underlying stock to add 50 basis points in return ***per week***[15]. This study finds that stocks with expensive call options (high implied volatility on the calls relative to the puts) tend to out-perform. When the implied volatility on calls is higher than that on puts (or vice versa), put-call parity is violated. Because this situation is easy to exploit, such anomalies tend not to last a long time. This study is discussed in the earlier section on put-call parity.

[14] http://quote.morningstar.com/Option/Options.aspx?Ticker=rimm
[15] Deviations from Put-Call Parity and Stock Return Predictability
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=968237&rec=1&srcabs=971141

Perhaps the most immediate question about implied volatility, whether it is derived for individual stocks or for the entire market, is whether implied volatility is a decent estimate of future volatility. Remarkably, there is considerable evidence that implied volatility is a good estimate of future volatility from a range of studies[16]. One of the best reviews on this topic concludes[17]:

Implied volatility is an unbiased and efficient forecast of future volatility, and subsumes the information content of historical volatility.

A more recent paper looks at the specific information provided by options prices on different kinds of stocks[18]. This analysis looks at option pricing as a function of the Beta, Book-to-Market, market map, and momentum and finds some systematic biases in option pricing as a function of these variables. The paper demonstrates, however, that implied volatility is a good predictor of future volatility.

Volatility Across Asset Classes

At the time of this writing, the market volatility stands index stands at 22%[19]. The at-the-money options on SPY expiring in November 2009 are at an implied volatility below 20%[20]. Looking out further in time, to the December 2011 options, the implied volatility is at 24%. There is a fairly continuous decline in implied volatility on the S&P500 from today out to the end of 2011. This means that the options market is suggesting that current volatility is lower than its longer term expectation in the options market. SPY is trading at around $110 as of this writing. The at-the-money call options on SPY have much higher open interest[21] on the calls than on the puts.

One of the basic sanity checks that we can apply to the implied volatilities across various markets is to look at projected volatilities of various asset classes, contingent on the volatility of a benchmark index (we use the S&P500). The projections of volatility come from Quantext Portfolio Planner (QPP) with all default settings[22], but we have adjusted the volatility projected for the S&P500 to be consistent with options on SPY. The Dec 2010 ATM options on SPY have implied volatility of about 24%.

[16] http://seekingalpha.com/article/15585-options-markets-suggest-a-bumpy-ride-for-spy-and-eem
[17] http://mit.econ.au.dk/vip_htm/chansen/bjc_csh_ejf02.pdf
[18] http://ssrn.com/abstract=1324605
[19] http://finance.yahoo.com/q?s=%5Evix
[20] http://www.ivolatility.com/calc/?ticker=spy
[21] http://finance.yahoo.com/q/op?s=SPY&k=110.00
[22] Three years of trailing data to initialize the model

Ticker	Projected Volatility	Implied Volatility	Option Expiration
SPY	23.9%	24.0%	Dec-10
IWM	28.0%	29.6%	Dec-10
EFA	29.1%	25.7%	Jan-11
EEM	35.3%	31.9%	Jan-11
GLD	25.3%	27.7%	Jan-11
ICF	42.1%	41.4%	May-10
TLT	19.9%	18.7%	Jan-11
AGG	6.8%	6.8%	Jun-10

There is remarkable consistency in the projected volatilities and the implied volatilities of the various asset classes, ranging from small cap stocks (IWM) to emerging markets (EEM) and bonds (AGG and TLT). This consistency is striking because the only information that QPP uses to project volatilities for these ETF's is their historical data, accounting for the correlation to the core index (the S&P500) and its volatility.

Are Options Prices Fair?

When you buy an asset, you want to get a fair price. If you pay too much, your odds of getting a reasonable return are low. There are legions of smart derivatives traders who use different models and analytics to try to find errors in where the markets are trading options and to exploit these mis-priced options. I spend plenty of time on this endeavor, looking for an edge. Those who have read my articles on option pricing will have come across my arguments on why and how my models and analysis suggest that options are mis-priced. This monograph is intended as a primer on option pricing, however, so we will not delve deeply into this kind of theory.

Let's start a consideration of options prices from the top. First, if there was an obvious error in the market's pricing of options (which is really the pricing of risk), those who saw the error would step in and exploit this to drive options prices towards fair value. This is the concept of the efficient market, as applied to options prices. This argument has the same limitations as the efficient market idea applied to asset prices, however. The existence of bubbles and massive declines suggests that there is a strong behavioral component to asset pricing that is not perfectly rational—and sometimes not even remotely rational.

One way to avoid getting too bogged down in this type of argument is to look at prices of call options in the same way that we look at buying stock. Imagine an investor who wants to invest money in the S&P500 because the S&P500 has historically provided solid returns (on average) over long periods of time. This investor can approach the choice in terms of what information is available and how confident he or she is in that information.

As of this writing, SPY is trading at $109 and change, so let's look at options with a strike price of $110[23]. As of this writing, the Dec 2011 call option with a $110 strike is trading at about $13.6 with 2.1 years until expiration. What this means is that you can

[23] http://finance.yahoo.com/q/os?s=SPY&k=110.00

purchase the right to all of the price appreciation on the S&P500 over the next two years for $13.6. What do you think this claim is worth? If the answer to this question is that we have no idea about what the rights to the future price appreciation on a stock or asset is then you probably should not consider buying SPY or the option. Both options prices and a direct purchase of the underlying asset require an assessment of the probabilities of future outcomes—positive and negative—in order to make an informed decision. One way that people respond to this dilemma is by arguing that they are confident that an asset will rise in price, but not how long it will take to rise in price. When you buy the option, you are betting on price gains or declines within a specified time horizon. Thus, simply buying the underlying stock seems like a safer bet or one that is more resilient in the face of imperfect knowledge. But is this outlook correct? When you buy the stock, you are going to receive its dividends and any price appreciation forever. On the other hand, very few (if any) of us are investing forever. We need or want the gains within some time horizon. Second, of course, is the time value of money. The money that is invested in the stock could alternatively be invested in a risk-free asset that will provide certain returns.

There is a further problem with the argument that stocks are a safer bet because you don't have to bet on time horizons for changes in price: downside risk. In a world of imperfect and limited knowledge, how confident can we be in the amount of downside risk that we are taking on? When you buy the S&P500 or any other risky asset class, there is no guarantee that you will necessarily receive a positive return or any specific time horizon. The old 'stocks for the long run' argument makes the case that the longer you hold stocks, the more likely it is that you will not under-perform cash or bonds. Fair enough. On the other hand, this is certainly not guaranteed and even simulation models that assume that equities will provide a solid **average** rate of return make it clear that there are non-vanishing probabilities that you will lose a lot of money, even over long time horizons. If you get your exposure to the market through call options, your downside risk is absolutely bounded by the price paid for the call options.

A useful way to think about options vs. the underlying asset is by thinking about renting vs. buying equipment for a business. Buying options is analogous to renting. The rent (option premium) is gone once the lease is over (the option has expired), but there are advantages to leasing. This is not a perfect analogy, but it makes the point that owning something (whether it is a physical asset or a financial asset) may or may not be preferable to owning an option on it.

I am not arguing that all investors should have their exposure to equities via options rather than owning the underlying index fund or individual stocks. What I am saying is that it is a mistake for investors to believe that options are riskier or require more information about the market than owning the underlying assets.

How Options Prices Inform Traditional Portfolio Management

Back in early 2007, before the crash, I wrote the following[24]:

One of the most important variables for portfolio planning is also one that most investors pay no attention to: volatility. I have written about this in a number of articles and it is time for an update. Given a range of investing alternatives, the probability that you will able to draw a specific amount of income against your portfolio for the duration of retirement or that you will reach target portfolio values is strongly a function of how volatile your portfolio is…

The article then goes on to discuss projections for market volatility (risk) and notes that both Monte Carlo simulation and the prices of options were signaling the potential for a massive surge in market volatility. The article comes to the following conclusion:

If we see a market reversion to these levels of volatility, the results could be financially devastating for many people — especially those near or at the start of their retirement years.

While I use Monte Carlo simulations in my work, you didn't need this tool—all you needed to do was to understand the basics of options prices and what they mean, and this important market signal would have been available to you. The implied volatility from options prices very clearly forecasted that every asset class would be much riskier going forward than it had been in recent years.

Even if the only thing investors and advisors look at options quotes for is to provide an outlook on risk, this is well worth the trouble. But understanding options can actually provide enormously more value than just this. The discussion in the article from 2007 also suggests that put options on the S&P500 and on the EAFE index with expirations through November 2008 were quite fairly priced—which meant that it was possible to buy downside insurance on a portfolio at a reasonable price.

A 2008 study showed that asymmetries in implied volatility between call options and put options could be used as a timing signal for buying or selling the underlying stock to add 50 basis points in return ***per week***[25]. This study finds that stocks with expensive call options (high implied volatility on the calls relative to the puts) tend to out-perform. When the implied volatility on calls is higher than that on puts (or vice versa), put-call parity is violated. Because this situation is easy to exploit, such anomalies tend not to last a long time. This study is discussed in the earlier section on put-call parity.

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[24] http://seekingalpha.com/article/27508-foreign-and-domestic-market-risk-outlook-from-february-2007
[25] Deviations from Put-Call Parity and Stock Return Predictability
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=968237&rec=1&srcabs=971141

Another way that implied volatility can be used is to adjust the volatility of a Monte Carlo (MC) simulation so that the projected volatility from this model is equal to implied volatility on a range of asset classes. This is routine in institutional risk management, where it is referred to as Mark-to-Market risk analysis. One important outcome that you would hope to see when you adjust volatilities in the MC model is that the volatilities are consistent across asset classes. In a previous section (*Volatility Across Asset Classes*), I showed that Quantext Portfolio Planner generated volatilities across a wide range of asset classes that were remarkably close to the implied volatilities on those asset classes when I adjusted only the input volatility for SPY. This suggested that the model and the market were consistently capturing the relationships in risk between asset classes. For investors and advisors who use Monte Carlo tools for planning, this is a useful test. We do not know, of course, that the implied volatility for a given asset class or stock is actually a good predictor at any given instant in time, but implied volatilities provide a reasonable benchmark test. Does this really help with creating improved asset allocations? Recent research suggests that this is indeed the case[26].

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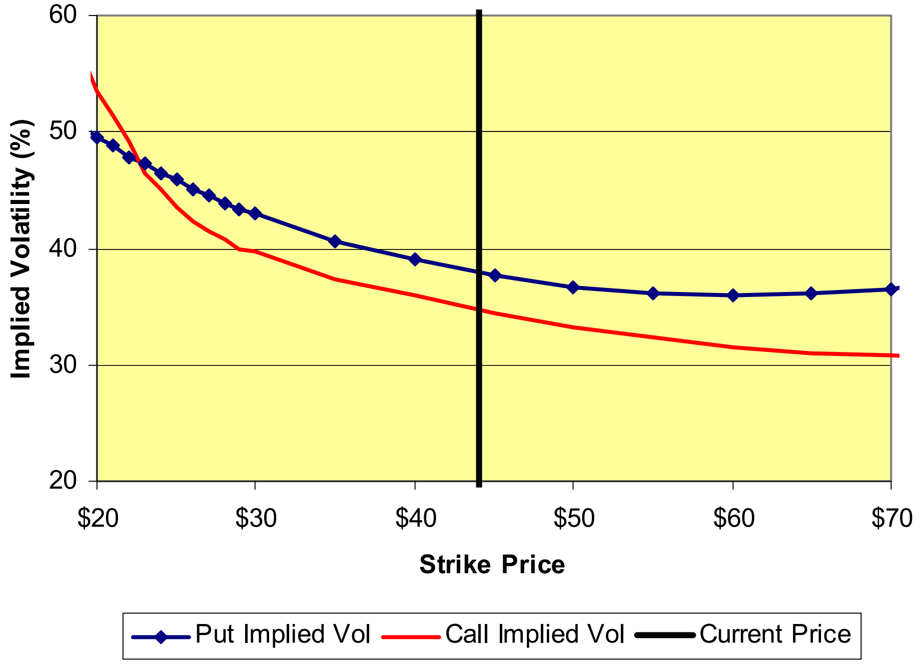
[26] http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1288103

The Volatility Smile

One very important feature of options prices is called the 'volatility smile.' This is an effect in which the implied volatility of options that are either deeply in the money or far out of the money tends to be higher than the implied volatility of at-the-money options[27]. In reality, the 'smile' is typically lopsided and this has been referred to as a volatility 'smirk'. Examples are shown below for a China ETF (FXI) and an ETF that tracks the NASDAQ (QQQQ).



FXI options, Jan 2011

The implied volatility for options with strikes considerably less than $45 is considerably greater than for options with strikes in the $45-$50 range. The asymmetry in this 'smile' shows that put options are trading at a premium relative to put options. This also makes sense when you think about the fact that an investor can be long FXI and sell a call on FXI and be perfectly hedged (i.e. have no net risk exposure from having sold the option). To sell a put option and be hedged, you need to be net short FXI which implies additional costs because short positions require margin. Thus, it makes sense that calls should be relatively cheaper than puts.

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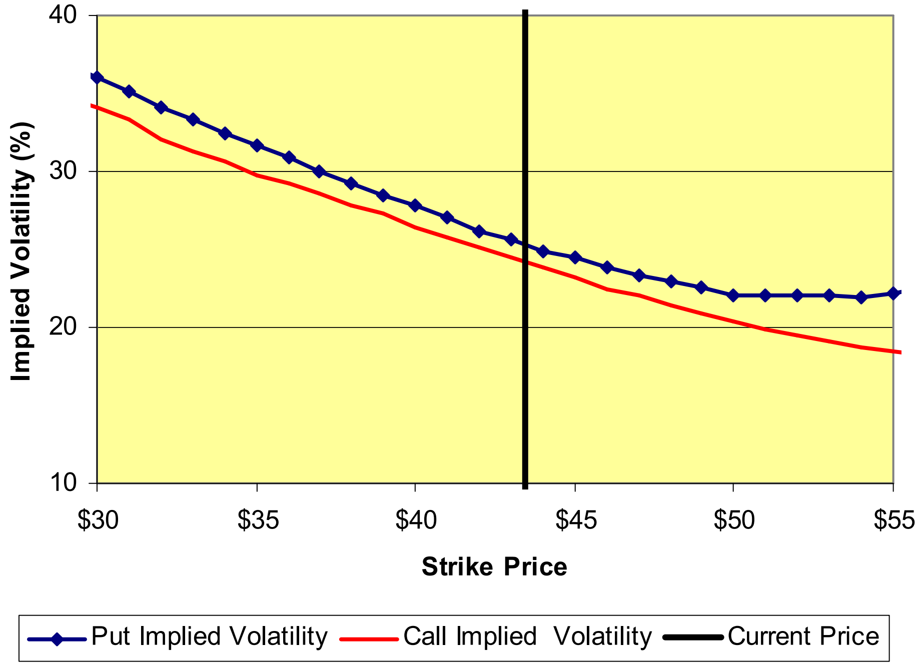
[27] http://en.wikipedia.org/wiki/Volatility_smile



QQQQ options, Jun 2010

One issue that must be kept in mind is how actively traded a contract is. Options on QQQQ with strikes above $50 strikes are very thinly traded, so I would not put any real meaning in the very high strike prices.

What does the volatility smile (or smirk) tell us? First, if implied volatilities increase as strike prices move away from the current price of the underlying asset, this means that the options market is implying 'fat tails'—that large price movements are more likely than a bell curve distribution of returns would suggest. Higher implied volatility means higher options prices, so the smile means that you will have to pay disproportionately more for options that have payouts that will be primarily impacted by large price moves.

For both QQQQ and FXI, the implied volatility is much higher for low prices and this means that the market is assessing a high price for hedges to manage big downward moves relative to what it charges to allow investors to benefit from big upward moves. This is partly a reflection of natural risk aversion, but also of the fact that most investors are natural purchasers of puts rather than sellers of puts. As such, the demand for out-of-the-money put options tends to be higher than the natural supply, so the prices will be at a premium.

The results shown above also imply that there is a 'fat tail' on the downside for these sectors at the present time (late 2009), but not on the upside. What this means is that investors can acquire the upside potential of China and the QQQQ very cheaply by buying call options. This is, of course, something of a contrarian strategy.

It has been widely noted that a volatility smile implying elevated risks of very large and rare moves became common after the crash of 1987[28]. There is some evidence that the volatility 'smirk' on individual equities (the tendency of the implied volatility at very low strike prices to be greater than the implied volatility of very high strike prices) is a predictor of future equity returns[29]:

Stocks exhibiting the steepest smirks in their traded options underperform stocks with the least pronounced volatility smirks in their options by around 10.9% per year on a risk-adjusted basis. This predictability persists for at least six months, and firms with the steepest volatility smirks are those experiencing the worst earnings shocks in the following quarter. The results are consistent with the notion that informed traders with negative news prefer to trade out-of-the-money put options, and that the equity market is slow in incorporating the information embedded in volatility smirks.

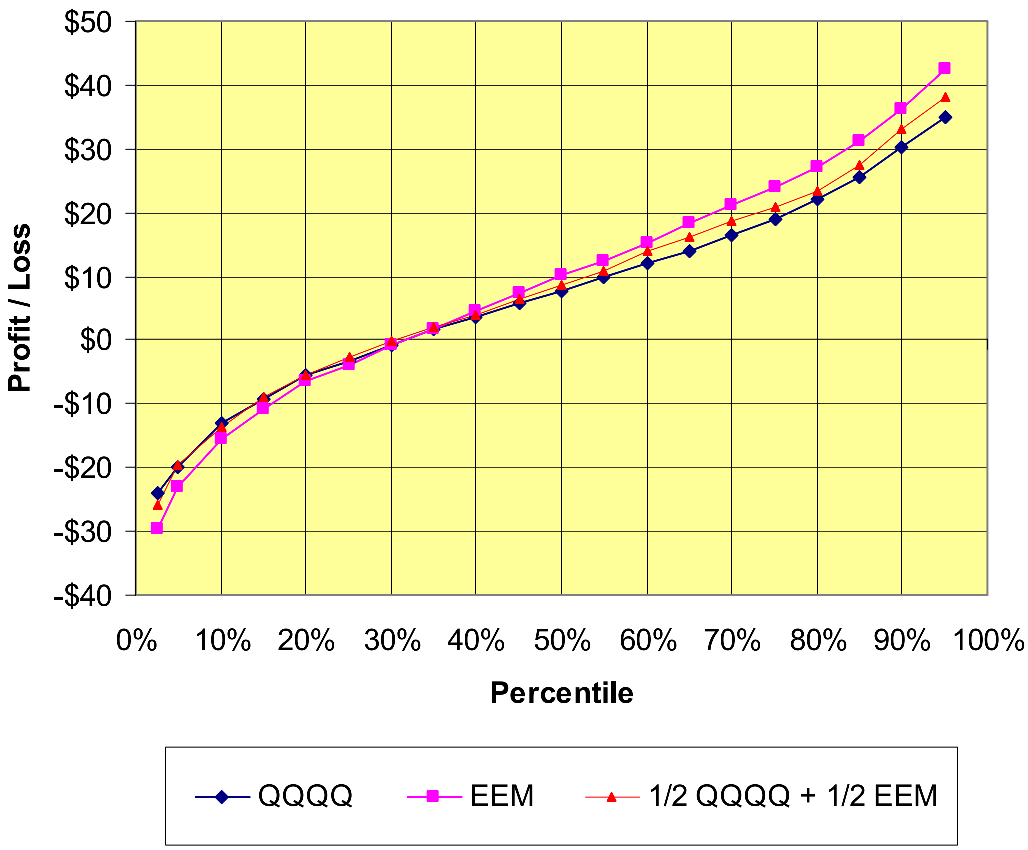
I am not arguing that trading around the features of the volatility smile is a strategy well-adapted to wealth management for any but the most sophisticated investors. Nor am I arguing that the volatility smile is predictive of future performance (though this may be the case). *These caveats notwithstanding, it makes sense to understand the volatility smile, particularly in explaining why simply buying put options as a form of downside insurance for your portfolio may not be the most cost-effective solution for risk management.* Further, the volatility smile may provide a data point in the decision to buy or sell an asset. For traders with the best information, the options markets provide the most powerful way to exploit this information. If there is truly actionable information available, it makes some sense that the options markets are where it will show up first.

[28] http://econophysics.blogspot.com/2006/04/sardonic-smirk-volatility-smile-and.html
[29] http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1107464&rec=1&srcabs=968237

Diversification and Options

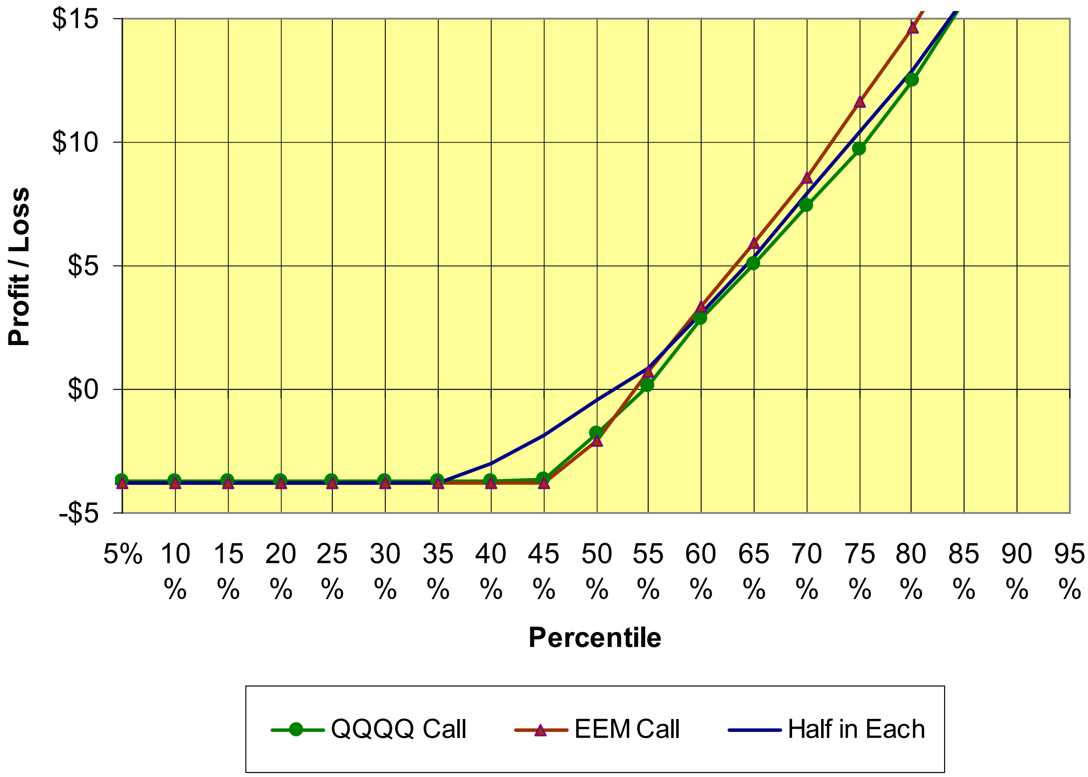
One important and useful feature of options that gets very little attention is the diversification benefit of combining options in a portfolio. Most investors are well aware that during the bear market of 2007-2009, diversification benefits between asset classes were diminished because correlations between all the major asset classes went up considerably. What most investors are not aware of is that the correlations between options on these asset classes are lower than between the asset classes themselves and thus provide a way to obtain diversification benefits.

Let's consider an example. There are January 2012 options on both EEM (an emerging market ETF) and QQQQ (which tracks the NASDAQ 100). EEM is trading at $40.8 as of this writing, and QQQQ is trading at $43.7. EEM and QQQQ have returns with 86% correlation to one another. First, let's look at what the percentile outcomes look like for EEM and QQQQ with a 2.17 year period (from the time of this writing to Jan 20th 2012, when the long-dated options expire). The chart below shows projected percentiles (from QPP) for EEM, QQQQ, and for a portfolio that is made up of one share of EEM and one share of QQQQ. The lack of strong diversification effects is evident here because the portfolio that combines the EEM and QQQQ has risk and return that is very similar to both EEM and QQQQ individually.



If there were substantial diversification benefits, you would expect the low percentiles return of the combined portfolio to be less severe than for either EEM or QQQQ. This is not the case.

Now let's look at what call options with $50 strike prices and Jan 2012 expirations look like for QQQQ and EEM. The EEM call is trading at $3.80 and the QQQQ call is trading at $3.70. The percentile payouts are shown below for these two options, as well as for a portfolio with one EEM call and one QQQQ call.



What should be immediately noticeable is how the portfolio with half of its funds in each option has reduced the skewness of the payouts. For each of the two individual options, the 50th percentile outcome is for a payout of -$2, which corresponds to a loss of more than 50% relative to the price paid for the option. The 50th percentile outcome for the combined portfolio is -$0.40. This improvement at the 50th percentile is very important in reducing gambler's ruin effects.

What this shows us is that the diversification benefit from combining options is quite high, albeit providing its value in a different way than in traditional asset allocation. In a portfolio in which you combine positions in the underlying assets (i.e. if you buy shares of index ETF's), diversification shows up when you combine assets which have returns that are not perfectly correlated. The impact of diversification is that the return of a portfolio is higher for a given risk level than can be achieved with the individual assets. This effect is present in options, but there is also a different component. By combining options on even highly correlated asset classes, which may have very limited diversification benefits when combined in a traditional portfolio, you can reduce the skewness effects and improve the median returns. This means that the portfolio of options will tend to pay out more consistently than the individual options. Increasing the probability of payouts in the net portfolio (reducing skewness) provides considerable value (see Appendix A).

This effect can build incrementally as we combine more options, but there is also a natural limit to how far this effect goes—just as with combining assets in a traditional portfolio. The diversification effects of combining options together can be quite substantial and this has interesting implications for portfolio management strategies.