Future Volatility for SPY and QQQQ: Monte Carlo vs. Options Quotes

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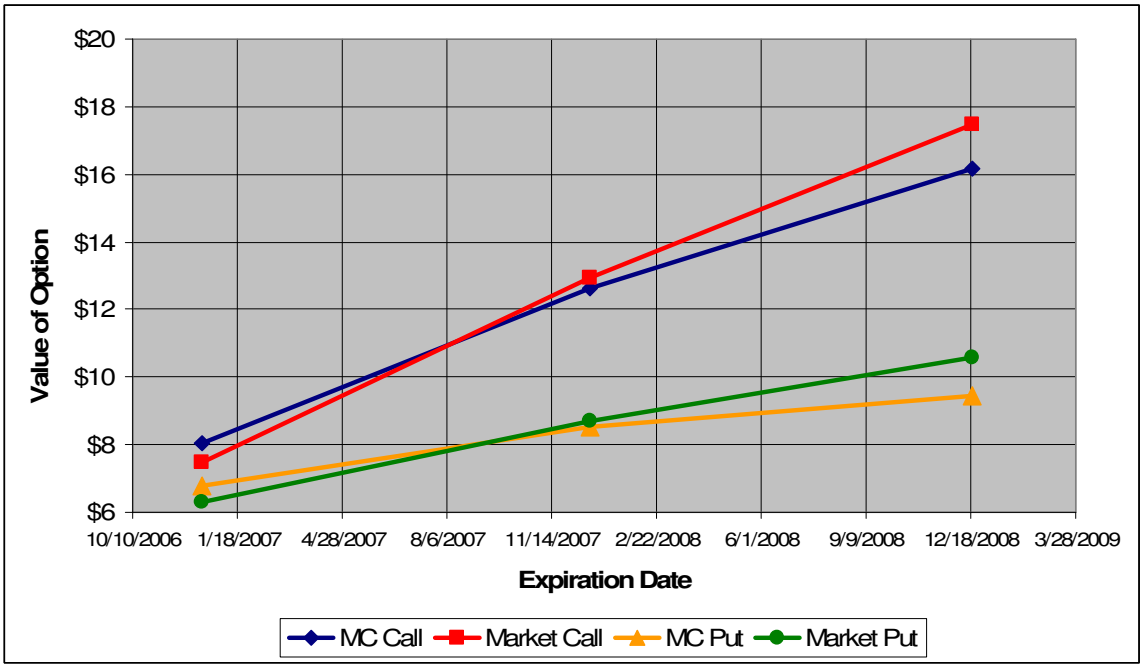
Executive Summary

A reasonable way to determine an estimate for future volatility in a stock or fund is to look at options prices and back out the implied volatility. If you have a portfolio simulation tool, you can run the simulation, price options from the simulation, and (if levels agree), you can look at the projected market volatility in the portfolio model. This is a good way to sanity check a Monte Carlo model, as well as providing insight. We have compared put and call option prices on SPY and QQQQ in the market to simulated prices from Quantext's Retirement Planner (QRP), a Monte Carlo (MC) portfolio simulation. Results are for SPY are shown below:



$130 Calls and Puts on SPY valued using the MC model (QRP) and market levels

The same analysis has been performed for QQQQ (with full results in our paper). The agreement between options prices simulated within the Monte Carlo portfolio simulation and the market prices of the options are quite close, but there are also some interesting differences.

Both QQQQ and SPY options are consistent with market prices. The projected future volatility in the MC model is substantially higher than the volatility that we have seen in the markets for the last several years. The options markets clearly are pricing in expectations that the next two to three years will be substantially more volatile than the most recent three years. That said, the projected volatility is closer to long-term historical levels in these markets. The full paper is available at:

http://www.quantext.com/RiskOutlook2006.pdf

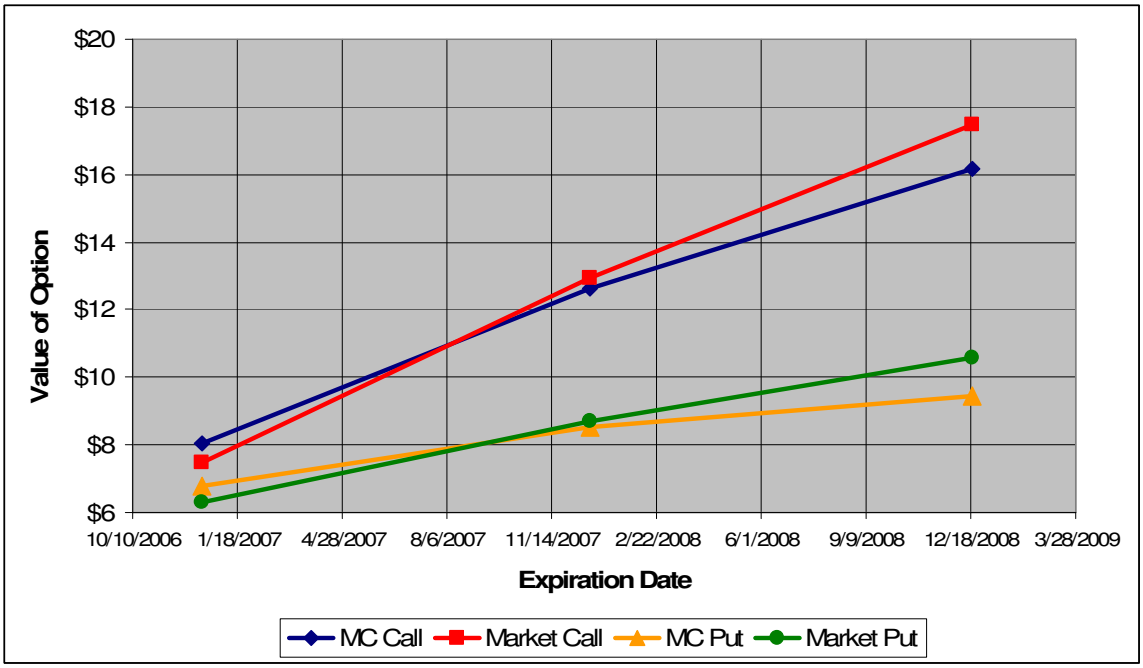
Future Volatility for SPY and QQQQ: Monte Carlo vs. Options Quotes

One of the most basic validations of a portfolio projection of risk and return in specific funds, ETF's or stocks is to compare a Monte Carlo simulation of volatility to the prices at which options are trading. Even if we all agree on the expected rate of return on an investment, the future volatility will be important to whether you want to add a position to your portfolio at some allocation. In fact, you might think that portfolio allocation strategies would require that you have some estimate of future risk. Oddly, you don't see much discussion of this issue. Ultimately, we are all concerned about risk associated with a specific position and in the total portfolio. If you are planning your portfolio for specific future income or simply want to manage risk levels, it is important to have some sanity check to determine if you are carrying too much volatility or if you can afford to be a bit more aggressive.

One of the great features of ETF's is that there are reasonably liquid options markets on a number of major ETF's. This means that you can look at the options on specific ETF's to see the implied levels of volatility. This type of analysis is called 'marking to market' for risk levels and is one of the best ways to test a Monte Carlo model. Quantext routinely benchmarks its portfolio projections from Quantext Retirement Planner using options quotes and this process is useful in terms of getting a handle on the market.

How volatile does the market think SPY will be for the next year or two? How about QQQQ? Furthermore, can we establish a reasonable relationship between volatility in SPY and volatility in QQQQ? In other words, from a portfolio standpoint it is important to see if you can understand the correlation between QQQQ and SPY if you wish to estimate the total portfolio impacts of including these in the same portfolio.

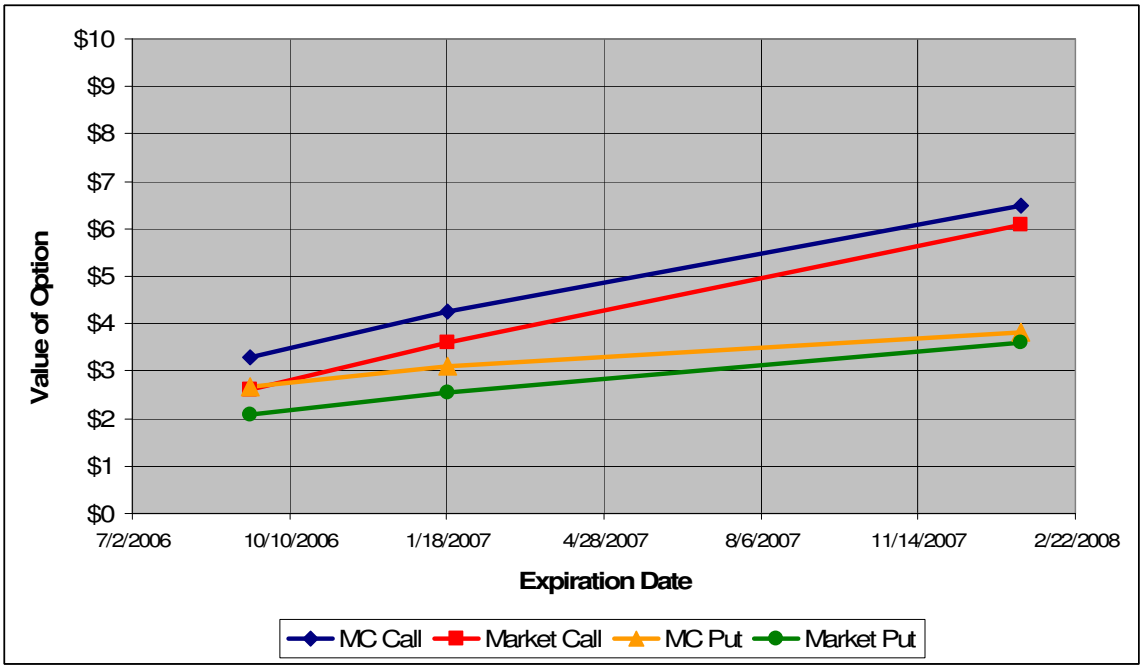
We have used Quantext's Retirement Planner (QRP), a Monte Carlo (MC) tool, with market data for the three years to 12/31/2005, to generate all parameters for QQQQ and SPY. The model simulates the underlying market (the S&P500) and then simulates SPY and QQQQ to maintain their correlation to one another via Beta. QRP prices options so that you can compare the volatilities that drive the Monte Carlo projections to the implied volatilities in the options markets. First, for example, we look at close-to-the money options for SPY. These data are from Jan 19, 2006. SPY was trading at $128.60 and we calculated value for options with $130 strikes:



$130 Calls and Puts on SPY valued using the MC model (QRP) and market levels

When we look at the value of call and put options with a strike of $130 for three expirations (going out to December 2008), we see a high level of agreement between the baseline options valued from the Monte Carlo engine (MC) and the market pricing (Market). The market prices for the long-dated options on SPY (puts and calls) are greater than the values simulated by the MC model (above), but the agreement is generally very good. The projected annual standard deviation in return for SPY is about 15.4%. The Monte Carlo model (which blends medium term market data with long-term risk-return data on the market as a whole) and the current options quotes (which tend to reflect shorter-term market action) both support this general level of volatility over the next couple of years. This projected level of volatility is considerably higher than we have seen for SPY over the past three years. Over the past three years, SPY has experienced annualized standard deviation in return of less than 9 ½ %. Bear in mind that the long-term standard deviation for the S&P500 index is around 15-16%, consistent with where the market is trading these options. Note that these options values generated from the MC model, QRP, have note been 'tuned' or adjusted—these are baseline calculated values for medium to long-term planning.

When we look at the options on QQQQ, the options values are largely impacted by the modeled levels of Beta and total volatility for QQQQ, as well as the projected volatility for the S&P500.



$43 Calls and Puts on QQQQ valued using the MC model (QRP) and market levels

The values of put and call options generated by QRP for QQQQ are higher in the near-term than market levels, with increased agreement for the longest dated options (Jan 2008). Aside from an offset in value of 50-60 cents in the value, the evolution in value in time is consistent between the market and the model. The difference between the projected Monte Carlo volatility levels for QQQQ and the market levels are largely due to the recent low-volatility environment for QQQQ. QRP projects long-term standard deviation in annual returns on QQQQ of 22%, considerably higher than the most recent three years (15%-16%), but markedly lower than the average over the last five years (32%). The current options market implies options values that are lower than QRP. This means that the market currently expects volatility closer to the recent few years—i.e. continued low volatility for QQQQ.

The prices of options on SPY and QRP agree quite well on the future volatility in SPY. QRP calculates statistical parameters from historical prices data, but does not use options quotes, so the agreement between QRP and the options quotes is a good 'sanity check' that both the options prices are reasonable and that the risk projections from the Monte Carlo model are consistent with the market's assessment of the volatility in SPY. These results suggest that the low volatility environment that we have seen for SPY over the past several years may yield to higher levels of volatility.

For QQQQ, with Beta of 140%-150%, the higher future volatility in SPY translates into a significantly higher future volatility for QQQQ. Interestingly, the options market slightly discounts this effect. For QQQQ to have volatility below the levels projected by QRP, Beta for QQQQ would have to be decreasing. The value of QQQQ options will also decrease if the dividend yield on QQQQ increases (from basic option pricing theory).

Both of these scenarios seem unlikely to me. I see no reason why Beta would drop for QQQQ and it is not likely that the dividend yield will increase in the next couple of years.

The issues in the previous paragraph notwithstanding, the implied volatilities for QQQQ and SPY are remarkably consistent with the levels calculated by QRP from historical data. For users of QRP, this provides confidence that the Monte Carlo projections for a portfolio are both consistent with history and with the levels at which volatility is trading (in the form of options) in the market.

Technical Note: QRP gives the user the option to preserve R^2. This option is not used for this analysis. We also used standard default settings for future SD on the S&P500