Using Options in Wealth Management

Appendices and Author Bio

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Appendix A: Risk Tolerance

Any investor who is considering the use of options needs to understand an additional dimension to the idea of risk tolerance. Most investors think of risk tolerance as a measure of how willing you are to take risks. When we start to think about options, the question becomes more subtle: what kinds of risks are you willing to take? This idea is easily motivated. Let's say that I offer you the following gamble[1]:

The St. Petersburg game is played by flipping a fair coin until it comes up tails, and the total number of flips, n*, determines the prize, which equals* $\$2^n$. *Thus if the coin comes up tails the first time, the prize is* $\$2^1 = \$2$*, and the game ends. If the coin comes up heads the first time, it is flipped again. If it comes up tails the second time, the prize is* $\$2^2 = \$4$*, and the game ends. If it comes up heads the second time, it is flipped again. And so on. There are an infinite number of possible 'consequences' (runs of heads followed by one tail) possible.*

You, the investor, need to say how much money you are willing to pay for an opportunity to play this game once. What makes this investment interesting is that the outcomes are highly skewed—you have a high probability of receiving a modest payout and a small probability of generating an enormous payout. Take a moment to think about how much you would be willing to 'invest' for a chance to play.

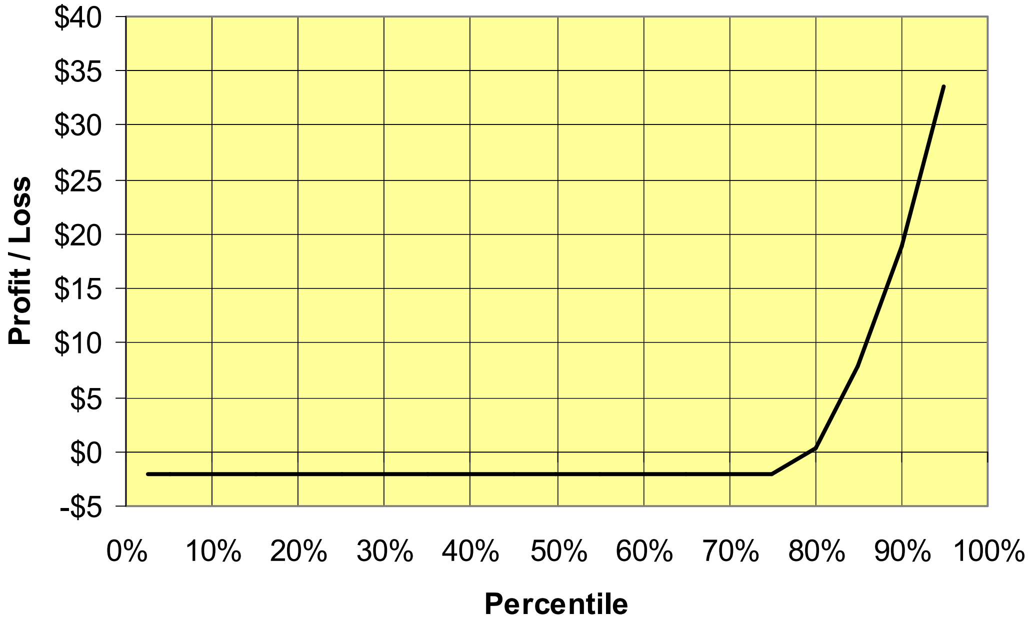
We are accustomed to thinking in the following way. First, we ask what the average payoff of an investment is, and then we decide that the bet is worth taking if we can purchase the right to play for substantially less than the average payoff. The problem in the case of the St. Petersburg game is that the average payoff is infinite (yes, really—see the Stanford link to prove it to yourself). A series of outcomes, their probabilities, and their payouts are shown below.

[1] http://plato.stanford.edu/entries/paradox-stpetersburg/

# of flips before a Tail	Probability	Payoff
1	50.00%	$2
2	25.00%	$4
3	12.50%	$8
4	6.25%	$16
5	3.13%	$32
6	1.56%	$64
7	0.78%	$128
8	0.39%	$256
9	0.20%	$512
10	0.10%	$1,024
11	0.05%	$2,048
12	0.02%	$4,096
13	0.0122%	$8,192
14	0.0061%	$16,384
15	0.0031%	$32,768
16	0.0015%	$65,536
17	0.0008%	$131,072
18	0.0004%	$262,144
19	0.0002%	$524,288

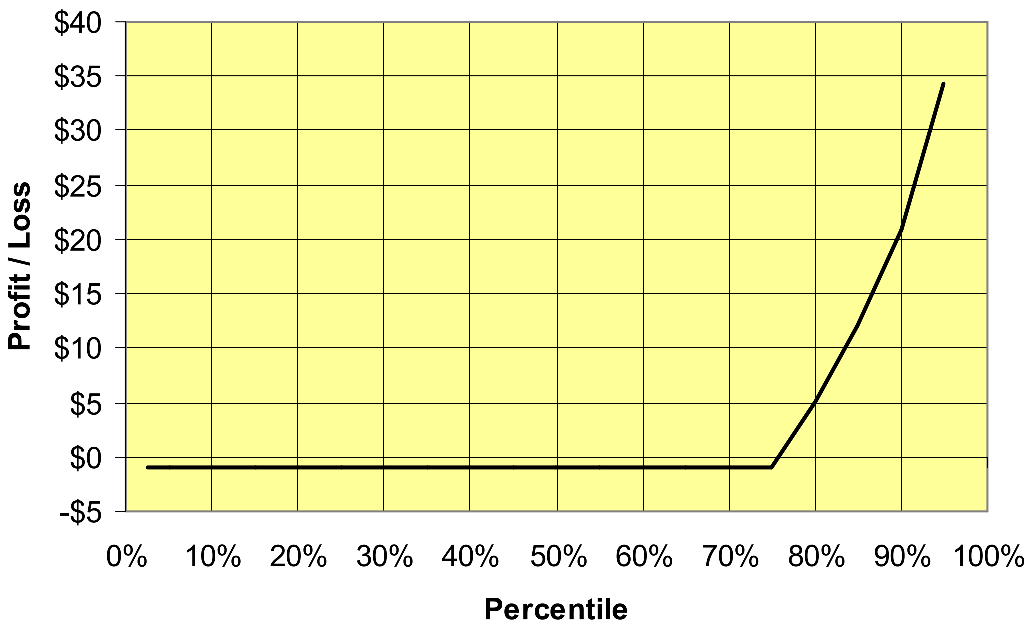
If it is rational to make bets or investments based on expected value (average outcome), then we should be willing to pay any amount of money to be able to play this game. In reality, however, we look at these payouts and most people are willing to pay only a very small amount to play this game. Why? The reason is that the payouts are highly skewed—very big payouts are highly improbable—and this reduces the attractiveness of the bet. This is related to what is known as 'gambler's ruin.' Even if someone offers you a bet at well below expected value, you need to consider the payout probability. If you have to play a very large number of rounds of a game before you are likely to realize the expected value, you can easily run out of money first—this is gambler's ruin.

Let's put this in practical terms. Let's say that SPY is trading at $109. The $150 call options expiring in December 2011 is trading at about $2.05. The payout percentile chart for this option is shown below:



Dec 2011 $150 call options purchased at $2.05 (market price as of this writing)

Buying this option at the market price, you will lose money 80% of the time (see chart above). Not only that, but you will lose 100% of your money 75% of the time. Now, let's say that I come to you and I offer you these options at $1, less than ½ the current fair market price, with the condition that you hold them to expiration. Now, the percentile payout diagram looks like this:



Dec 2011 $150 call option purchased at $1

I am offering you a great deal--$150 call options at half their fair market value, so how much would you invest? Once again, you probably would not invest very much in these options because the outcomes are so skewed—you still lose money about 75% of the time.

The key takeaway from examples such as these is that you need to know about the *skewness* of a bet as well as the expected return. This realization was a key step in the development of game theory and investment theory: it is not ideal to make your bets (investments) just on the basis of expected value.

The St. Petersburg Paradox led directly to the development of what is called Utility Theory, which is a framework for characterizing how investors feel about different types of risk. This is a much richer framework for understanding the concept of ‘risk tolerance’ but it is also hard to effectively build out a ‘utility function’ (which is sort of a higher dimension risk tolerance) for a real investor. That said, I have found that looking at the median return (50^{th} percentile) rather than the expected return of an investment or portfolio is a handy shortcut. If the median outcome of a portfolio is less than the average outcome, you need to be cautious.

Appendix B: Real Options

One area of options theory that has gotten almost no attention in wealth management is what are called 'real options.' Throughout this monograph, we have been discussing financial contracts that give you the right to make a decision at some point in the future—to buy or sell some underlying stock or ETF (a call or a put). 'Real options' are the potentially high-value choices that you can make at some future time but that are not an actual financial instrument. In wealth management, there are many real options that have value for the investor. One of the most powerful is simply the decision of when to retire. Much of wealth management is based on projections in which you set your plans and assume that you will follow the plan, regardless of what happens. This is not only unrealistic but is also needlessly inflexible. One of the big areas in which we can hope to see improvements in wealth management planning is in incorporating an investor's real options. A range of research (including my own) has shown that your odds of successfully funding a long-term goal such as retirement increase substantially if you have the options to alter your behavior—i.e. you have real options in your 'portfolio'[2].

As noted above, one of the most powerful of the real options that an investor can have is the option to delay retirement[3]. Another valuable real option is the option to reduce income draws from a portfolio. Not every person has one or both of these real options, but for those who do, these are worth evaluating. The ability to be flexible in your income draws in retirement dramatically increases your odds of being able to fund a long-term retirement income stream. While this is not a stunning revelation, it is a factor that is too often ignored in wealth management. ***Real options*** theory seems to have considerable potential in informing the world of wealth management, but its application in this area is not well developed.

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[2] http://seekingalpha.com/article/91833-income-planning-and-safe-withdrawal-rates

[3] http://moneywatch.bnet.com/retirement-planning/article/the-payoff-from-retiring-later/277178/

Appendix C: Monte Carlo Analysis and QPP

Throughout this book, I have used Quantext Portfolio Planner (QPP) to generate projected outcomes from options strategies. In this Appendix, I will provide a brief overview of QPP, especially as it pertains to options pricing.

QPP takes historical market data as input for tickers supplied by the user, and generates projections for the future returns and risks of each ticker, as well as providing projections for portfolios comprised of these assets, accounting for the correlation effects between assets. The majority of my work with QPP has been on elements of traditional asset allocation, a topic on which I have written more than one hundred articles. In these articles, I have often used options prices and implied volatilities to inform the asset allocation process and to benchmark QPP. If you are using a Monte Carlo simulation for portfolio planning, it is useful to benchmark the volatilities that the model generates against the implied volatilities in long-dated options.

QPP includes an option pricing component that can be used to value call and put options on any ticker that is entered, given the current price of the underlying asset and the strike prices and expirations of options. This element was added to QPP to allow people with employee stock options grants to account for these holdings as part of their total portfolios[4]. I have found that this component of QPP is very valuable for evaluating standard puts and calls, too. The basic options valuation model is a simple closed-form calculation (similar to Black-Scholes) that accounts for dividend payments.

What makes QPP's options valuation calculations novel are (1) the parameters that QPP generates for projected volatility and return, and (2) how QPP evaluates the evolution of option values over their lifespan. The basic valuations used in the article that I cite here, in which I found that options were mis-priced did not use element (2) at all—this is applied when we look at the evolution of the option value over time, through the lens of Monte Carlo simulation (see the articles linked below on Google, for example).

QPP is not designed specifically for options valuation and trading—this is a side feature of the tool. That said, I have found that the basic options valuation capabilities in QPP are very useful in providing an anchor for the reasonableness of options prices.

The visualizations of payout percentiles for various options strategies in this text were not generated with QPP, even though the statistical projections for the risks and returns of each asset did come from QPP. The visualizations were generated with a custom tool that I developed in EXCEL. This may become the basis for a future product.

[4] http://www.quantext.com/GoogleEmployeeStockOptions.pdf
http://www.quantext.com/GoogleEmployeeStockOptions-2.pdf

Bio of the Author

Geoff Considine has worked professionally on modeling of derivatives and related topics since January of 1999, when he left his post as a research scientist at NASA to work on the trading floor at Aquila Energy at the height of the energy trading boom. At Aquila, Geoff worked on developing models for a range of derivatives, including weather-backed options and combined options that were triggered on the basic of strike prices of energy commodities and specific weather outcomes. One component of his work was derivative instruments combined with elements of insurance. After leaving Aquila to join a consulting firm, Geoff continued to work on developing options valuation tools and management tools for portfolios of options and futures on electricity, natural gas, and weather.

Since founding Quantext in 2002, Geoff has continued to develop derivative models for a range of applications, with a focus on equities and energy commodities. Geoff is the architect of Quantext Portfolio Planner (QPP), a portfolio management tool that allows individuals and advisors to develop portfolio management strategies that include employee stock option grants. QPP is also regularly benchmarked by comparing its volatility projections for a range of asset classes to the implied volatility of options on those asset classes. QPP is used for portfolio management by wealth managers across the United States and internationally.

Geoff has written numerous articles on quantitative topics in wealth management for a range of publications, including ***Advisor Perspectives***, ***FinancialPlanning.com***, ***Horsesmouth.com***, and ***SeekingAlpha.com***. Geoff and his work have been cited in the Wall St. Journal, U.S. News and World Report, and Kiplingers.

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