

## **Your Risk Aversion is My Reward**

***“The dangers of life are infinite, and among them is safety.”***

**- Goethe**

The world, on average, is risk averse. Most people will prefer a riskless payoff compared to a risky payoff when the expected returns are the same. This makes intuitive sense. Why take an unnecessary risk when another option exists with the same expected return but zero risk? This natural risk aversion also creates a significant profit opportunity.

We can get a sense of individual levels of risk aversion by posing the question: “How much are you willing to give up in order to trade your gamble or future uncertainty for a sure thing?” For example, if an investor had a 50% probability of getting \$1.25 and a 50% probability of getting \$0.75 in the next period (an expected payoff of \$1.00), what would an investor be willing to take instead to give up this risky gamble? Would they take \$0.99? \$0.95? \$0.90? If we poll the universe of investors and the average answer is, say \$0.94, we can determine aggregate risk aversion in the population.

***“Go out on a limb. That’s where the fruit is.”***

**- Jimmy Carter**

Just as an individual is willing to forego future expected returns to reduce the variance of a risky payoff, there is opportunity for the risk taker to make profits from risk-averse individuals. When the market becomes more risk averse, due to combinations of fear and wealth constraints, there is an even bigger opportunity for those willing to step in and take on risk. An investor’s ability to capitalize on this risk aversion and succeed over time is going to depend on his ability to adequately manage and diversify risk.

In our example of the risky bet above, the expected return of this payoff is \$1.00. Due to investor risk aversion, imagine owners of this payoff were willing to trade it for a guaranteed payment of \$0.94.

If we took the other side of this bet, paid \$0.94 for each occurrence, constrained our bet size (limited leverage) and maintained enough money to fund our losses, we can generate an increasing equity line with positive expected returns and shrinking standard deviation (relative to the mean) through time.

Figure 1 shows one sample of a simulation of the cumulative profit and loss of this strategy over 100 distinct bets.

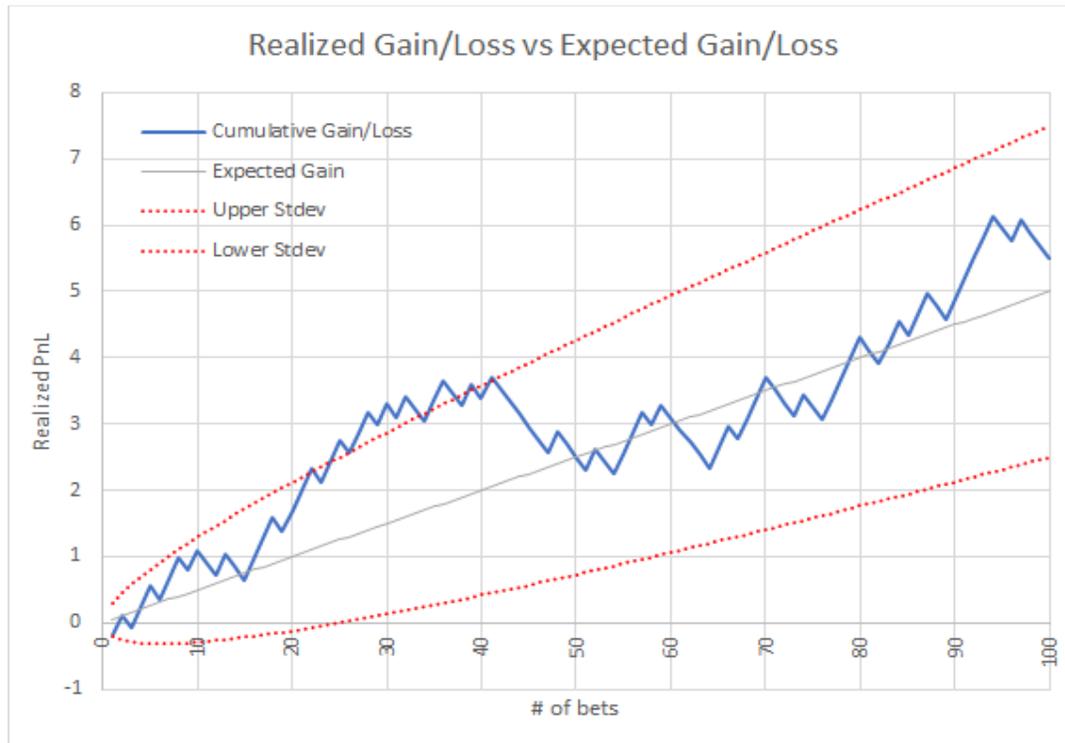


Figure 1

This is not an arbitrage or guaranteed payout. We are only expecting to make money because of other people’s desire to avoid risk. Their risk aversion becomes our (statistical) reward. For each bet we make, we expect to make \$0.06 ( $= 50\% \times \$0.75 + 50\% \times \$1.25 - \$0.94$ ). The variance for one bet is 0.0625, or \$0.25 standard deviation ( $= \sqrt{0.0625}$ ).

As we repeat this process and make more and more bets, our standard deviation of the cumulative profit-and-loss shrinks relative to the expected return (i.e. separating the signal from the noise). For  $N$  periods, the expected return grows by the factor  $N$  but the standard deviation only grows by  $\sqrt{N}$ . For a single bet, our standard deviation is 4 times our expected return. After 100 bets, the standard deviation shrinks to roughly 41% of the size of the mean. After 1000 bets, our probability of being profitable is very high. After 1000 bets in our example, the standard deviation shrinks to about 13% of the value of the mean.

***“If at first you don’t succeed... so much for skydiving.”***  
**- Henny Youngman**

One issue with trying to profit because of other people’s risk aversion is diversification. Ideally, we would be presented with lots of opportunities to take on risk simultaneously and we could make all our bets at once. Our expected return would be the average payoff of these bets, and the more bets we make simultaneously, the more we can shrink the variance of our payoff,

relative to our expected return. However, in reality, the opportunities to take advantage of others' willingness to swap a gamble for a sure thing at a good price are spread out unevenly across time. Why is this an issue?

In probability theory, there is a concept called ergodicity. The descriptive statistics of an ergodic process (the mean, variance, etc.) measured through time are the same as the process measured at once across all possible states.

As an example, the happiness that Henny Youngman's skydivers experience is non-ergodic. If we look at the aggregate happiness from skydiving across all skydivers at a moment in time, we'd see that, on average, it's a fun, exhilarating albeit perhaps nail-biting experience. The average happiness is "good". But in the timeline of happiness that an individual skydiver can experience, the skydiver can encounter a moment of "getting stopped out" (i.e. death). There are no more chances to participate again and change the average of our time-series process. We are stopped out, sent home, done.

In money management, this is what we mean when we say, "you can't diversify through time." What's the implication? It means that as we take on risk, it is critical to avoid getting stopped out, tapped on the shoulder and told to go home. If at first you don't succeed, just like in skydiving, there are no second or third chances if you go bust. You always want to stay in the game.

It is also important for the risk taker to realize that just because your expected return is positive each period or with each gamble, your actual payoff is not guaranteed to be positive. You are now in the risk business and your equity line will reflect the variance of the riskiness of the bets as well as their size and frequency. Drawdowns happen and are expected.

Pulling out, bailing or "tapping yourself on the shoulder" on a positive return business when experiencing a drawdown and without allowing the signal to separate from the noise will almost guarantee failure and subpar performance.

***"Pearls don't lie on the seashore. If you want one, you must dive for it."***

***- Chinese proverb***

The options market provides a myriad of ways for investors to reduce risk and swap gambles for less risky payoffs. One can sell calls to reduce both upside and downside variance (you limit the downside by the amount of premium taken in). One can buy puts to limit downside, but you limit upside by the amount of premium paid. There are plenty of option combinations such as spreads, butterflies, condors, risk-reversals, etc. that can all be used to reduce risk and variability.

The "cost" of these option trades (and by "cost" I don't mean the premium paid; I am referring to the difference between the market price and the fair value) is a function of an investor's risk aversion and what he is willing to forego to reduce risk. At Lake Hill, we refer to this difference between the market price and the fair value price of the option as the variance

risk spread (VRS). Many academic papers and other market participants refer to this as the variance risk premium (as many equity options may trade rich relative to their fair value), but we prefer VRS as we believe options at different moneyness and maturities can be rich or cheap—it's not always at a "premium".

One way to think of the VRS is the price investors are willing to pay to reduce their risky holdings to a less risky position, i.e. the price of risk aversion. The VRS, if sufficiently large, can entice risk takers to take the other side of the trade.

Lake Hill's business generates expected returns by looking for options where we see a non-zero VRS, positive or negative. We try to buy the cheap options, sell the rich ones, hedge out the risks we believe are not worth taking and run a balanced book. By taking the risks that other investors may not want or cannot afford to have, and managing those risks through diversification and position sizing, Lake Hill generates positive expected return. By hedging and repeating the process, we reduce the variance of future payoffs, far less than the variance of the individual trades. The net result is a positive edge business with reduced variance. This is a good example of a risk taker generating return from other investors' risk aversion.

***"Behavior is the mirror in which everyone shows their image."***

**- Goethe**

In the fall of 2008, risk aversion was exceptionally high. If one backs out the implied skew from the S&P 500 index options market, one can see the market was expecting a highly negatively-skewed return going forward. But another way of interpreting this is not that investors were predicting negatively-skewed returns, but that investors were paying dearly for downside protection as they did not want to incur further losses. Either they did not want to incur losses, or, probably in many cases, they could not afford to take any further losses. This extreme risk aversion is not necessarily irrational; if further losses would put you out of business or force a liquidation (likely due to leverage), you'd be willing to pay any price for protection. If you were near death and had a fatal disease, you'd pay up to your last dollar to stay alive. Avoid getting stopped out!

The average investor's dislike of losses far exceeds the benefit of gains. This is just the "utility curve" of wealth. The average investor's dislike of losses is so great that they may be willing to pay an excessive price to avoid losses. Avoiding losses that occur due to a random process costs money and it translates to a reduction of long term wealth creation.

Most investors would love to have achieved the long-term track record of either Warren Buffet or George Soros. However, their long-term returns are negatively skewed and have Sharpe ratios less than 1.0. After the fact, we want Soros and Buffet, but can we handle the drawdowns? For those willing to live with negative skew and drawdowns, there is opportunity for not just higher returns but also higher long-term Sharpe ratios. Figure 2 shows the average

Sharpe ratio versus the realized skew of a number of different hedge fund strategies. The slope is negative. The more negatively skewed a return is, the higher the Sharpe ratio is on average.

Investors love positively skewed returns with high returns and high Sharpe. But to avoid the negative skew, one has to ask, what price are you willing to pay? What does it cost? Can I be compensated for taking risk others may not want? The answer is pretty clearly yes.

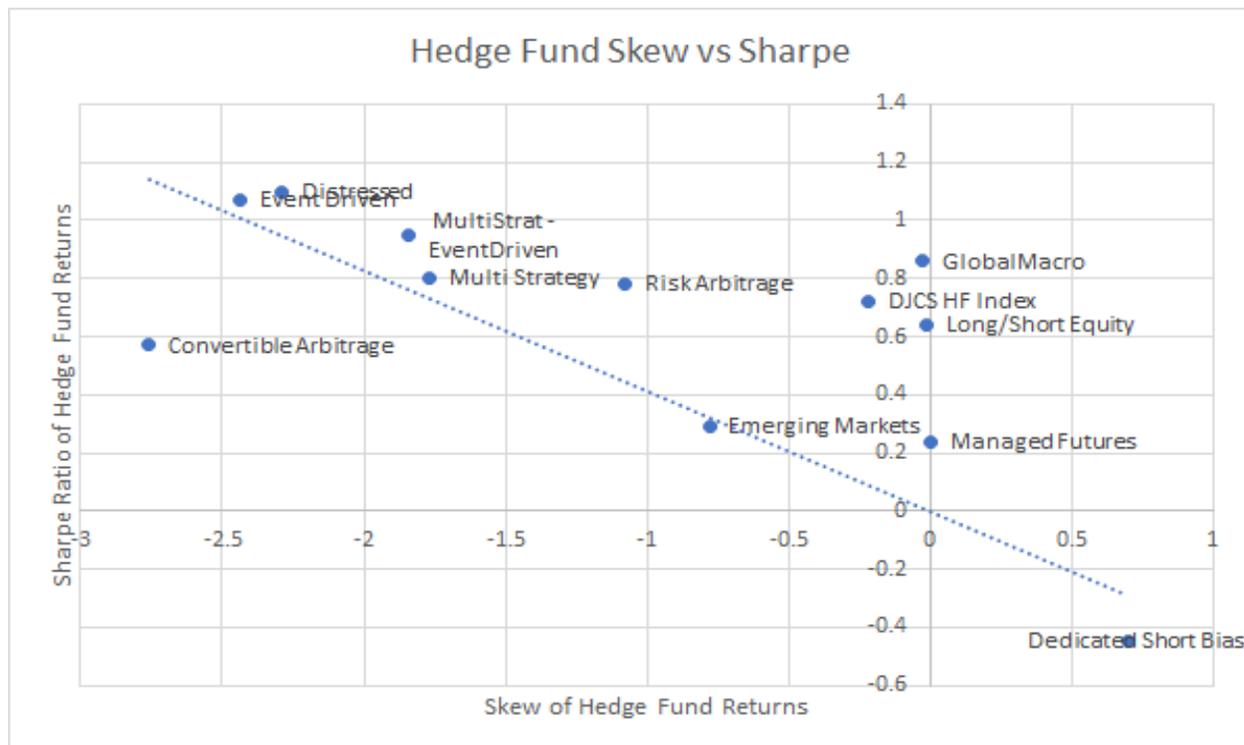


Figure 2

***"It is our choices, Harry, that show what we truly are, far more than our abilities"***  
**- Albus Dumbledore**

Investors may choose lower return strategies in return for lower downside risk and variability. This can be explained easily enough by risk aversion. So why exactly do investors avoid strategies with negatively-skewed returns when they can provide better risk adjusted returns?

Most investors would be thrilled with the long-term returns of George Soros or Warren Buffet after the fact. Many of these same investors would counterintuitively also be averse to investing in and sticking with return characteristics of a Soros or Buffet (negatively-skewed returns, large drawdowns, high variability and a Sharpe below 1.0) in advance. Why?

Both Soros and Buffet had periods in their careers where they had 30-year spans with an average annual return of over 30%. Nearly any sane person would take these track records ex-post. You would be among the wealthiest persons in this country, as are both Buffet and Soros today. However, if you look ex-ante at their drawdowns and Sharpe ratios, many investors today would pass. Both had annual Sharpe ratios less than 1.0. Both experienced high levels of volatility (to get a Sharpe < 1.0 and a return > 30%, your standard deviation would have to exceed 30%). George Soros suffered some severe drawdowns and his downside variability was higher than his upside variability.

This investor behavior of foregoing a universally-recognized, phenomenal investing strategy (i.e. Buffet or Soros) in favor of something less risky and less profitable is due primarily to a mismatch on investing time horizons and a big flaw with wealth utility curves—the lack of a time component.

Here is an example of how the time component is critical. Let's create two different strategies. Our first strategy will be called the High-Risk/Negative-Skew Strategy. The second strategy will be called the High-Sharpe/Zero-Skew Strategy. Figure 3 describes their characteristics:

Strategy	High-Risk / Neg Skew	High-Sharpe / 0-Skew
Annual Drift	12.0%	6.0%
Annual StDev pre-shock	8.0%	3.0%
Annual Prob. of Shock	10.0%	0.0%
Shock Size (1-day return)	-20.0%	0.0%
Expected Annual Return	10.0%	6.0%
Expected Annual St Dev	10.3%	3.0%
Sharpe	0.97	2.0
Skew of Daily Returns	-12.2	0.0

Figure 3

The High-Risk strategy has a Sharpe of just under 1.0 and is also extremely negatively skewed due to the existence of shocks. The High-Sharpe strategy has a 2.0 Sharpe and an annual expected return of 6%.

The equity line of the High-Sharpe strategy will rise fairly consistently year-in, year-out with a low probability of loss in any given year. Figure 4 shows a random sample of four years of daily trading of the two different strategies.

If you take any random four-year sample, you'll find some samples have no shock in the High-Risk strategy. Other samples could have a lot of them. You'll find samples where the High-Risk outperforms and some where it underperforms the High-Sharpe strategy.



Figure 4

Over time, the High-Risk strategy should outperform the High-Sharpe strategy, with plenty of bumps along the way. But how long do we need to wait for this outperformance? We need enough time to separate the signal from the noise.

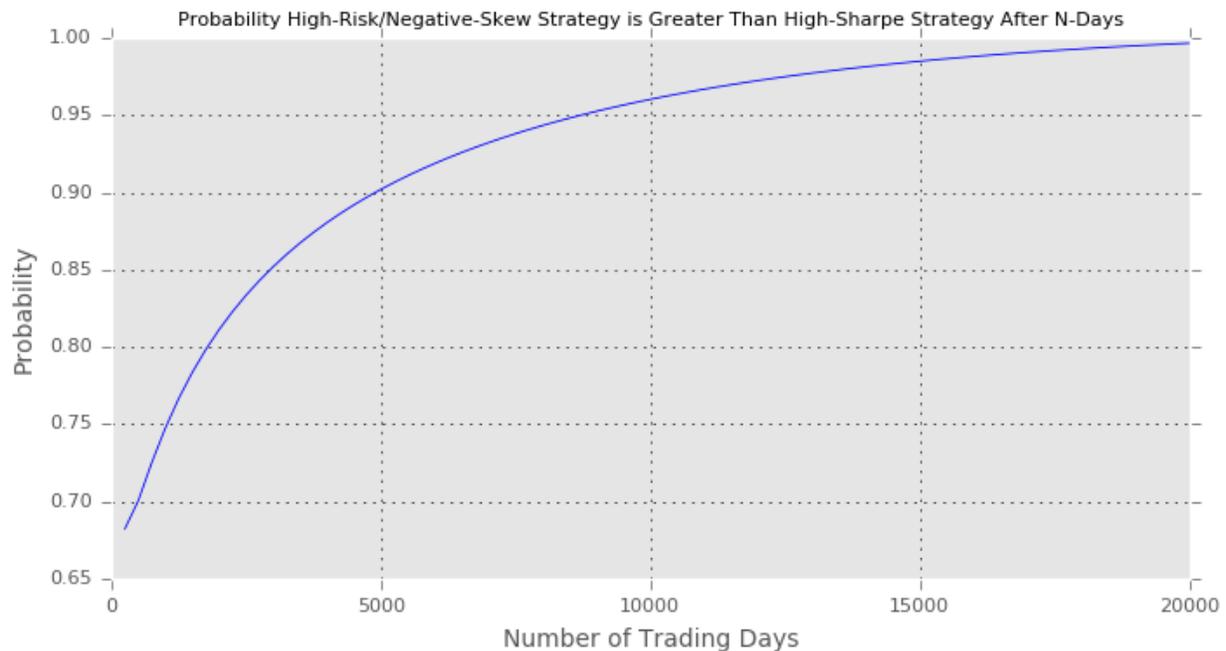


Figure 5

Figure 5 shows the probability that the High-Risk Strategy outperforms the High-Sharpe Strategy after  $N$  trading days (252 days per calendar year in this example). After one year, the probability that the High-Risk strategy has a higher return is over 68%. After two years, the probability rises to 70.4%. After four years, 76%. After 10 years, 83%.

After 30 years, the length of the long-term track record of Buffet and Soros, the High-Risk strategy has a 95% probability of outperformance. Over time, the standard deviation of the strategy shrinks relative to the mean, and the signal comes out and is separated from the noise.

But investors don't just select the highest return strategies. The fear of loss compels investing behavior. Instead of maximizing expected returns, investors tend to maximize expected utility of wealth as this takes into account their risk aversion (shocks, variability, drawdowns, etc). The utility curve is a simple tool that measures the relative benefit (positive utility) or pain (negative utility) of changing wealth levels.

But here is a problem. The wealth utility curve doesn't have a time component.

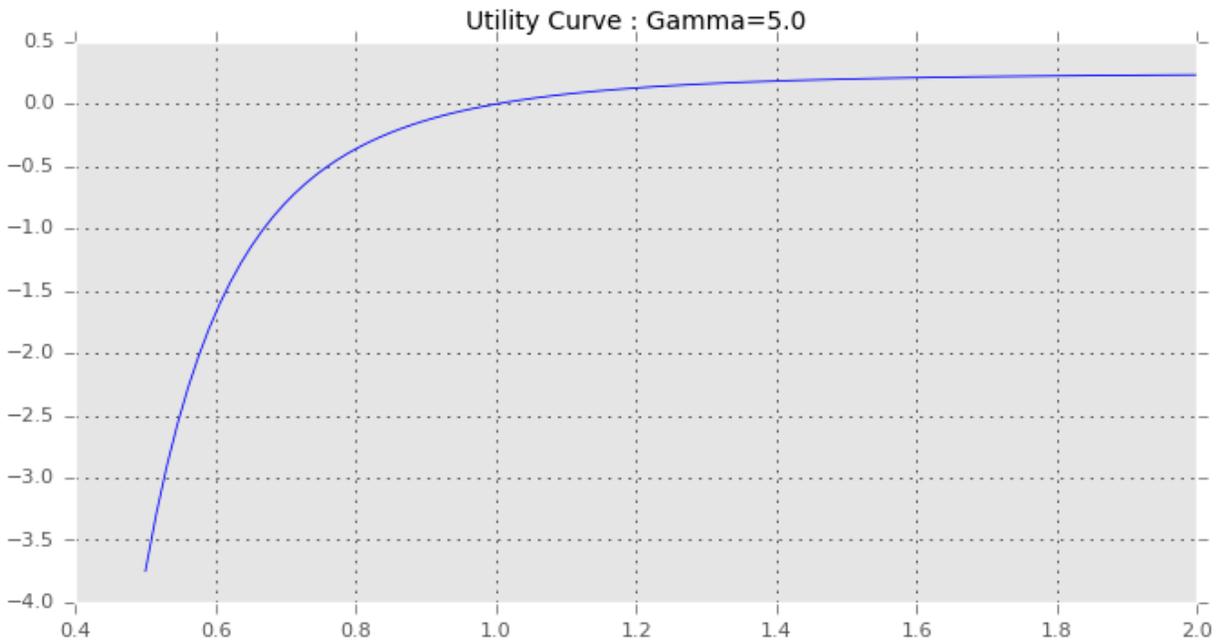


Figure 6

Figure 6 shows an example of a utility curve for wealth. One can see at the starting value of wealth of 1.0, there is zero utility (i.e. there is no change in wealth). As wealth goes up, say from 1.0 to 1.4, there is an increase in utility. But it is very asymmetric. As wealth falls, say from 1.0 to 0.6, the decrease in utility far exceeds the gain from 1.0 to 1.4.

This utility curve doesn't really answer the question about my utility of wealth tomorrow versus say 30 years from now. If I'm 40 years old and am looking at retiring at age 70, I may be willing to suffer losses and drawdowns in my wealth tomorrow or next year if I can improve my overall wealth at retirement at age 70. At age 70, my pain (i.e. negative utility) from having 50% lower wealth than today at age 40 could be far more severe.

So, let's add our own time component and look at the utility of wealth (positive or negative) that can be generated by these example strategies through different investment horizons. Figure 7 shows the expected utility an investor would get for investing in the High-Risk versus High-Sharpe Strategy over different time horizons. If you expect to invest for 500 trading days or less, effectively two years, an investor would receive a higher expected utility investing in the High-Sharpe strategy. The likelihood is high in a shorter horizon that the High-Risk strategy would incur losses which are more heavily penalized by the utility curve of wealth.

Just before the two-year mark is where the average utility of the High-Risk strategy exceeds and permanently exceeds the High-Sharpe average utility. After several years, the signal separates from the noise and longer term higher wealth and higher utility is expected.

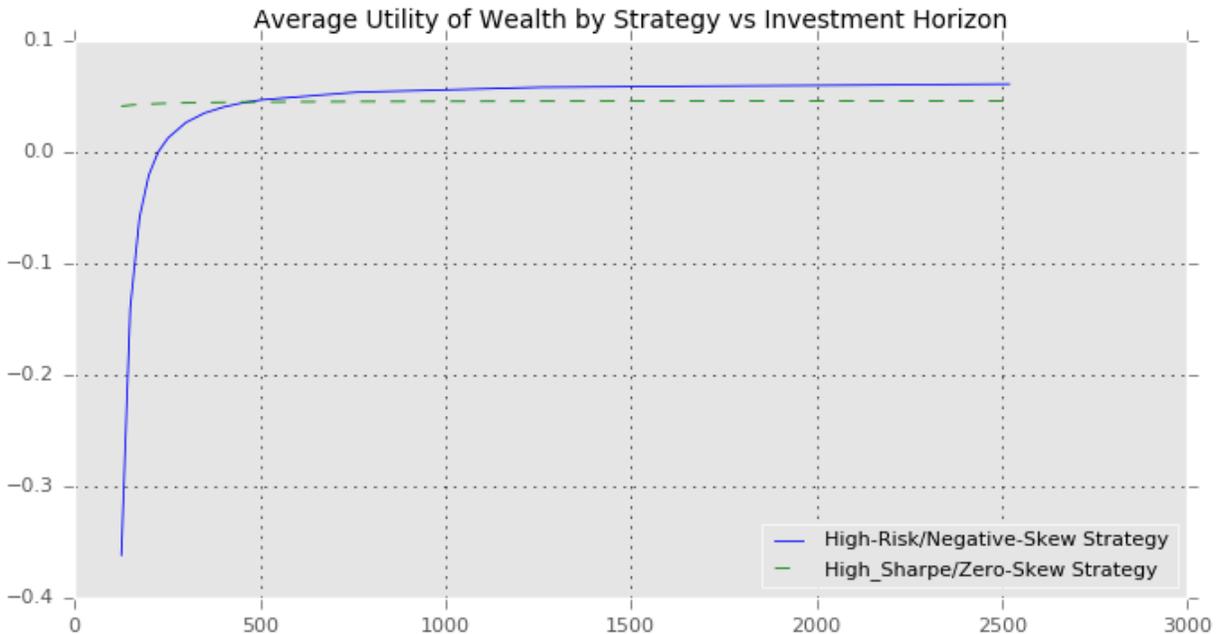


Figure 7

When looking at the utility an investor receives, the High-Risk Strategy is going to lose out to the High-Sharpe strategy when the investor has a short-term investing horizon. When investors instead look at longer-term performance, they can not only get better returns but higher utility.

For an investor such as a university endowment, charitable foundation, pension fund, annuity provider, life-insurance company or family office, its investment horizon can span decades, certainly more than a couple of years. These investors can take advantage of their unique ability to generate higher long-term wealth by taking shorter-term risks that other, more risk-averse investors, cannot or will not shoulder. If they have the willingness to stick with a riskier strategy in the short term and avoid heading for the exits during drawdowns, they will be rewarded with both higher returns and higher utility in the long term.

## Summary

- Investors in aggregate are risk averse. Some risk-averse behavior can adversely affect longer-term wealth creation. There is opportunity for the risk taker to profit from the market's risk aversion.
- It's important to size bets correctly and realize edge will accumulate through time, with drawdowns along the way. Most importantly, the risk taker must minimize the risk of being stopped out.

- When investors invest in risk-taking strategies, those strategies that actively take the other side of the risk-averse investor, they need to consider their investing time horizon along with the time needed for the strategy to confidently pay off. Misaligning an investing time horizon with the time horizon of an investing strategy can lead to poor decisions, undesired outcomes and subpar performance.
- Those investors with a multi-year time horizon can take advantage of opportunities created by other investors' risk aversion that the short-term investor cannot take.

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