

Measuring risk-adjusted returns in alternative investments

From a presentation given by *Hilary Till* of Premia Capital Management, LLC to the Chicago chapter of QWAFEFW¹ on 20 June 2002.

Academic criticism of the classic capital asset pricing model (CAPM) performance measures is not new. In particular, several authors have pointed out the shortcomings of using both the Sharpe ratio for performance evaluation and the mean-variance framework for portfolio construction when the underlying investments have highly non-symmetric distributions.

A number of hedge-fund strategies have asymmetric outcomes. This can be because they either explicitly use derivatives or because their return profile involves taking on some implicit short options risk.

Until recently it was fine to use the Sharpe ratio as a way of summarizing the attractiveness of an investment. This ratio is the investment's excess return over T-bills divided by the investment's standard deviation. The reason for the measure's acceptance is that, given the persistence of superior stock market returns, the predominant investment has been portfolios of equities. And research since the 1970s has shown that diversified portfolios of equities have symmetric outcomes.

But, given the ongoing stock market downdraft since March 2000, US mutual-fund inflows have dramatically slowed down while hedge-fund investing has exploded. As a matter of fact, according to Galbraith and Viviano (2002) of Morgan Stanley, net hedge-fund inflows grew to the same size as net US mutual-fund inflows in 2001.

Therefore, only now have the shortcomings of using traditional performance measures to evaluate all manner of strategies become relevant to investors.

In this article, I will briefly touch on the problems with using traditional performance evaluation methods and later I will summarize the state-of-the-art in alternative performance evaluation techniques.

Traditional performance evaluation

Two CAPM performance measures are the *Sharpe ratio* and *alpha*. Alpha measures an investment's excess return beyond taking on market risk. These metrics are appropriate if:

- investors choose portfolios using a mean-variance framework; and
- market risk is the only source of risk for which investors are rewarded.

Investors choose portfolios using a mean-variance framework

The first assumption is not appropriate in investments that have highly asymmetric outcomes as with option strategies.

As a matter of fact, four Yale professors (Goetzmann *et al* 2002) have derived an optimal strategy for maximizing the Sharpe ratio. This strategy has a distribution that has a truncated right tail and an elongated left tail. By undertaking a maximum Sharpe ratio strategy, an investor may be accepting negatively skewed returns in exchange for improving the mean or variance of the investment.

The problem with this trade-off is that investors are risk averse; they most certainly have a preference for upside risk and an aversion to downside risk: the opposite of the derived maximum Sharpe ratio strategy! The Yale professors show that one can achieve a maximum Sharpe ratio portfolio by selling certain ratios of calls and puts against a core equity market holding. They conclude that:

'expected returns being held constant, high Sharpe ratio strategies are, by definition, strategies that generate modest profits punctuated by occasional crashes.' The experience of the Art Institute of Chicago's endowment provides evidence for this concern. One of the endowment's hedge-fund managers noted in their marketing material that their fund had 'the highest Sharpe ratio in the industry', according to the *Wall Street Journal* (Dugan *et al* 2002). The hedge fund noted it would combine

'cash holdings with stocks and riskier index options' in such a way that they:

'could guarantee profits of 1% to 2% a month in flat or rising markets. The fund ... could lose money only if the stocks to which the options were tied dropped more than 30%.'

This firm's funds were wiped out late last year.

An extreme example of how a superior investment can have a low Sharpe ratio is as follows (Bernardo and Ledoit 2000).

- Take a lottery whose ticket costs one cent today, and where winners pocket fifty billion dollars next year with probability 10%, and nothing otherwise.
- This lottery has a Sharpe ratio of 0.33.

Market risk is the only source of risk for which investors are rewarded

Under this assumption, any return unrelated to the market would be due to superior judgment or inside information. This excess return is *alpha*.

Financial economists now believe that there are multiple sources of risk besides the market factor for which an investor is rewarded for holding. There may be large losses from bearing one of these risk factors, resulting in a short-option-like return profile. But the returns over time are sufficient to make the activity profitable. These returns are called *risk premia*.

Using the Sharpe ratio to evaluate risk-premia strategies will create the same type of problems as with option sellers. A number of alternative investment strategies seem to earn risk premia. These include relative value bond funds, equity risk arbitrage, equity option market-making, the value versus growth equity strategy, and high-yield currency investing.

One problem with evaluating risk-premia strategies is that, while one may be earning a return due to being exposed to an unlikely event, an empirical measure will not show this if the big event hasn't occurred yet.

¹ QWAFEFW is the Quantitative Work Alliance for Applied Finance, Education, and Wisdom. The group has active chapters in New York, Boston and Chicago with a new chapter being formed in London.

Alternative performance evaluation

Asset-based style factors

Being able to model the shape of uncertainty is key to establishing proper risk-adjusted performance measures. The current academic thinking is to use 'asset-based style factors' to characterize an alternative investment. The idea is if an investor can link a hedge fund's returns to its underlying 'style factors', then one can use the style factor's longer history of returns to evaluate the risk of a specific hedge fund.

One practical application of the asset-based style factor approach was noted by Weisman and Abernathy (2000). The authors use an optimization technique to fit a hedge fund's returns to certain underlying assets and options. One particular example came from a mortgage-backed securities manager. This manager had a reported Sharpe ratio of 4.99 prior to August 1998. A decomposition of the fund's returns showed that a similar pattern of returns was achievable using substantial leverage and short options exposure.

After August 1998, the manager reported a very large loss.

The gain–loss ratio

One would like a measure that accounts for an investor's preference for positively skewed outcomes and their avoidance of negatively skewed outcomes.

The Bernardo–Ledoit gain–loss ratio is one such measure. This measure is the ratio of the expectation of the positive part of the returns divided by the expectation of the negative part. This measure would very much reward the lottery mentioned above.

Fat tails

If an investment's returns are not normally distributed, one may want to try to come up with more accurate return distributions in order to understand an investment's return-to-risk trade-off. For example, the returns of relative-value hedge-fund strategies exhibit negative skewness while the returns of commodity trading advisors have positive skewness (see Schmidhuber and Moix 2001).

Nonlinear relationships to stock and bond portfolios

Alternative investments are frequently marketed based on their lack of correlation to stock and bond portfolios. Performance measures that accurately capture this correlation are therefore needed.

One extreme example would be a fund that has convex payoffs with respect to the market (through long calls and puts.) Say its payoff is $Y = a + b * X^2$, where X is the market return, and a and b are constants. The correlation of the strategy to the market is zero, even though it is entirely determined by the market's return. This is because there is absolutely no linear relationship between X and Y , but only a positive quadratic relationship.

Favre and Galeano (2002) recommend using nonlinear regressions to estimate the relationship between a hedge-fund strategy and a portfolio of traditional assets. For example, the equity non-hedge strategy appears to be equivalent to a long position in a traditional portfolio combined with long out-of-the-money calls and short out-of-the-money puts.

Most hedge-fund categories have concave payoffs on the downside. Further, diversification benefits disappear at extreme negative levels of traditional asset returns with several exceptions.

Scenario-driven risk visualization (see Johnson et al 2002)

An investor frequently uses the normal distribution to represent returns of a diversified portfolio since one assumes that it is acceptable to use the Central Limit Theorem.

Under this theorem, as the number of randomly distributed independent variables becomes large, the distribution of the collection's mean approaches normality.

This would be fine for a portfolio's return if its individual strategies were never influenced by a dominant event. But in practice this does not happen, as seen during the October 1987 stock market crash, the Fall of 1998 bond debacle, and during the aftermath of September 11, 2001.

One way to address this problem is to represent an investment's distribution as a combination of two distributions: one for peaceful times and one for eventful times.

The distribution during eventful times would not just include higher volatility, but also the greater correlation among strategies that occurs during crises. A risk manager would explicitly determine the proportion of crisis returns in the combined distribution.

Conclusion

One can expect that the type of alternative

performance measurement techniques discussed here will become prevalent as investors look outside the realm of diversified baskets of equities for returns.

If indeed it is the case that those strategies that have above-average returns involve taking on some implicit short option risk, then measures that go beyond the trade-off between mean and variance will need to come to the forefront.

Bibliography

- Bernardo A and Ledoit O 2000 Gain, loss and asset pricing *J. Political Economy* **8** 144–72
- Dugan I, Burton T and Mollenkamp C 2002 Chicago Art Institute's hedge-fund loss paints cautionary portrait for investors *Wall Street Journal* 1 February 2002
- Favre L and Galeano J-A 2002 An analysis of hedge fund performance using Loess fit regression *J. Alternative Investments* **4** 8–24
- Galbraith S and Viviano M 2002 Tail or dog: the pond's getting crowded *Morgan Stanley, Strategy and Economics, US Strategy* 30 April 2002
- Goetzmann W, Ingersoll J, Spiegel M and Welch I 2002 Sharpening Sharpe ratios *Yale School of Management Working Paper*
- Johnson D, Macleod N and Thomas C 2002 Modelling the return structure of a fund of hedge funds *AIMA Newsletter* April 2002
- Schmidhuber C and Moix P-Y 2001 Fat-tail risk: the case of hedge funds (part II) *AIMA Newsletter* December 2001
- Weisman A and Abernathy J 2000 The dangers of historical hedge fund data *Risk Budgeting* (London: Risk Books)

Hilary Till, Managing Principal, Premia Capital Management, LLC, Chicago. Premia Capital specializes in detecting pockets of predictability in derivatives markets using statistical techniques. Prior to Premia Capital, Ms. Till was Chief of Derivatives Strategies at Boston-based Putnam Investments. She has a BA in Statistics with general honors from the University of Chicago and an MSc in Statistics from the London School of Economics (LSE). E-mail: till@premiacap.com