MEASURING RISK-ADJUSTED RETURNS IN ALTERNATIVE INVESTMENTS

Quantitative Work Alliance for Applied Finance, Education & Wisdom

QWAFAFEW

Chicago

Hilary Till

Premia Capital Management, LLC

Chicago, IL

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PRESENTATION OUTLINE

I. Traditional Performance Evaluation

- **Sharpe Ratio**
- **Alpha**

II. Alternative Performance Evaluation

- **Asset-Based Style Factors**
- **Gain-Loss Ratio**
- **Fat Tails**
- **Non-Linear Relationships to Asset Markets**
- **Scenario-Driven Risk Visualization**

TRADITIONAL PERFORMANCE EVALUATION

- **Two CAPM performance measures are the *Sharpe ratio* and *alpha.***
- **The *Sharpe ratio* measures an investment's excess return divided by its standard deviation.**
- ***Alpha* measures an investment's excess return beyond taking on market risk.**

TRADITIONAL PERFORMANCE EVALUATION

(Continued)

- **These CAPM metrics are appropriate if:**

  1. **Investors choose portfolios using a mean-variance framework;**

     and

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

TRADITIONAL PERFORMANCE EVALUATION
(Continued)

1. Investors Choose Portfolios Using a Mean-Variance Framework

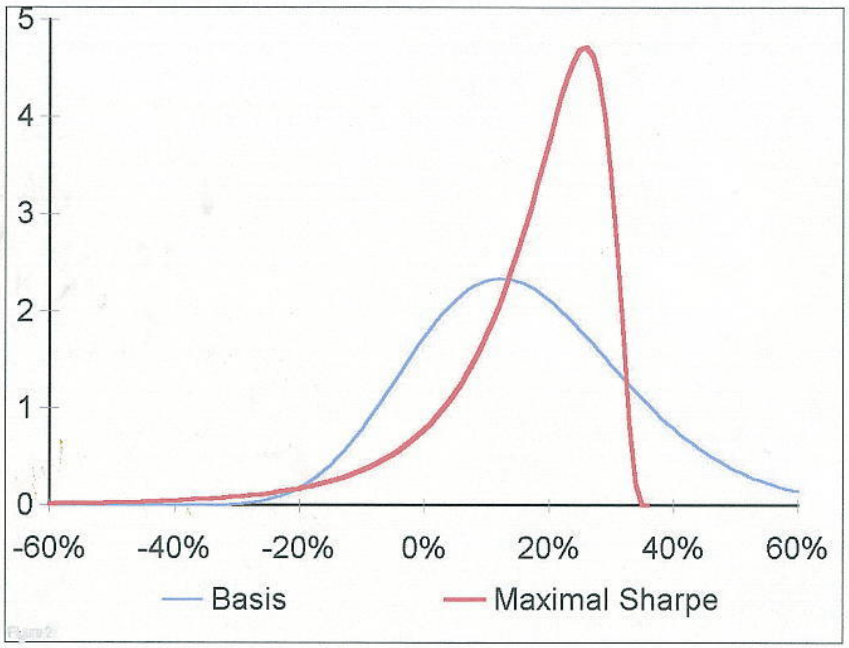
- **The first assumption is not appropriate in investments that have highly asymmetric outcomes as with option strategies.**

- **Four Yale University professors have derived an optimal strategy for maximizing the Sharpe ratio.**

TRADITIONAL PERFORMANCE EVALUATION

(Continued)

- **The optimal strategy has a truncated right tail and fat left tail.**

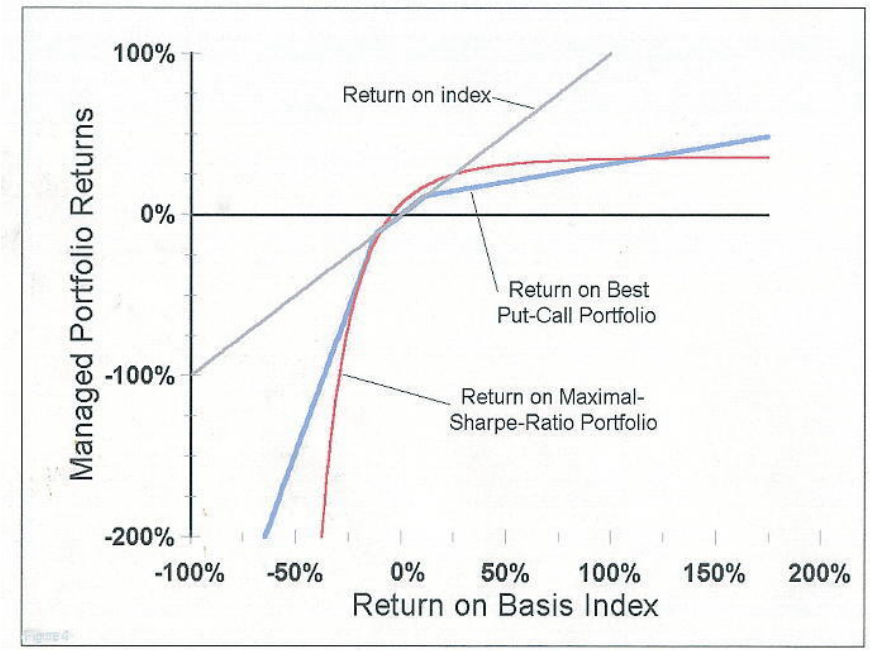


Source: Goetzmann, William, Jonathan Ingersoll, Matthew Spiegel, and Ivo Welch, "Sharpening Sharpe Ratios," Yale School of Management, Working Paper, February 2002.

TRADITIONAL PERFORMANCE EVALUATION

(Continued)

- **This strategy can be achieved by selling certain ratios of calls and puts against a core equity market holding.**



Source: Goetzmann, William, Jonathan Ingersoll, Matthew Spiegel, and Ivo Welch, "Sharpening Sharpe Ratios," Yale School of Management, Working Paper, February 2002.

TRADITIONAL PERFORMANCE EVALUATION
(Continued)

- **The Yale professors conclude that:**

  "expected returns being held constant, high Sharpe ratio strategies are, by definition, strategies that generate modest profits punctuated by occasional crashes."

TRADITIONAL PERFORMANCE EVALUATION
(Continued)

- **The experience of the Art Institute of Chicago's endowment provides evidence for the Yale professors' 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."**

TRADITIONAL PERFORMANCE EVALUATION

(Continued)

- **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.***

Source: Ianthe Dugan, Thomas Burton, and Carrick Mollenkamp, "Chicago Art Institute's Hedge-Fund Loss Paints Cautionary Portrait for Investors," Wall Street Journal, 2/1/02.

TRADITIONAL PERFORMANCE EVALUATION

(Continued)

- **An extreme example of how a superior investment can have a low Sharpe ratio is as follows:**
  - **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.**

Source: Antonio Bernardo and Olivier Ledoit, "Gain, Loss and Asset Pricing," Journal of Political Economy, 2000, Vol. 8, No 1.

TRADITIONAL PERFORMANCE EVALUATION
(Continued)

2. 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.**

TRADITIONAL PERFORMANCE EVALUATION

(Continued)

- **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*.**

TRADITIONAL PERFORMANCE EVALUATION
(Continued)

- **Using the Sharpe ratio to evaluate risk-premia strategies will create the same type of problems as with short-option sellers.**

- **A number of alternative investment strategies seem to earn *risk premia*.**

- **They include: Relative Value Bond Funds, Equity Risk Arbitrage, Equity Option Market-Making, The Value vs. Growth Equity Strategy, and High Yield Currency Investing.**

TRADITIONAL PERFORMANCE EVALUATION
(Continued)

- **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 has not occurred yet.**

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.**

ALTERNATIVE PERFORMANCE EVALUATION: ASSET-BASED STYLE FACTORS

(Continued)

- **One application of the asset-based style factor approach was noted in the book, Risk Budgeting.**

- **The authors use an optimization technique to fit a hedge fund's returns to certain underlying assets and options.**

- **One example is a mortgage-backed securities manager. This manager had a reported Sharpe ratio of 4.99 prior to August 1998.**

ALTERNATIVE PERFORMANCE EVALUATION: ASSET-BASED STYLE FACTORS

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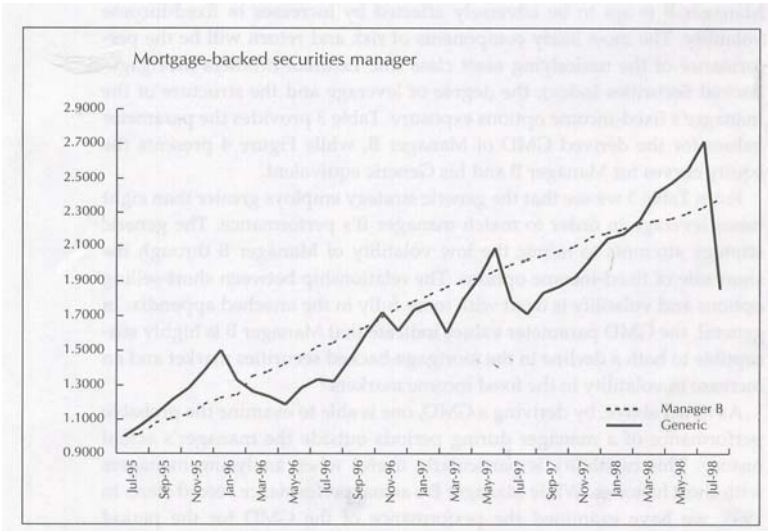
- **A decomposition of the fund's returns showed that a similar pattern of returns was achievable using substantial leverage and short options exposure.**



Source: Weisman, Andrew and Jerome Abernathy, "The Dangers of Historical Hedge Fund Data," Risk Budgeting, Risk Books, 2000.

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

ALTERNATIVE PERFORMANCE EVALUATION: THE GAIN-LOSS RATIO

- **If normality cannot be assumed, 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.**

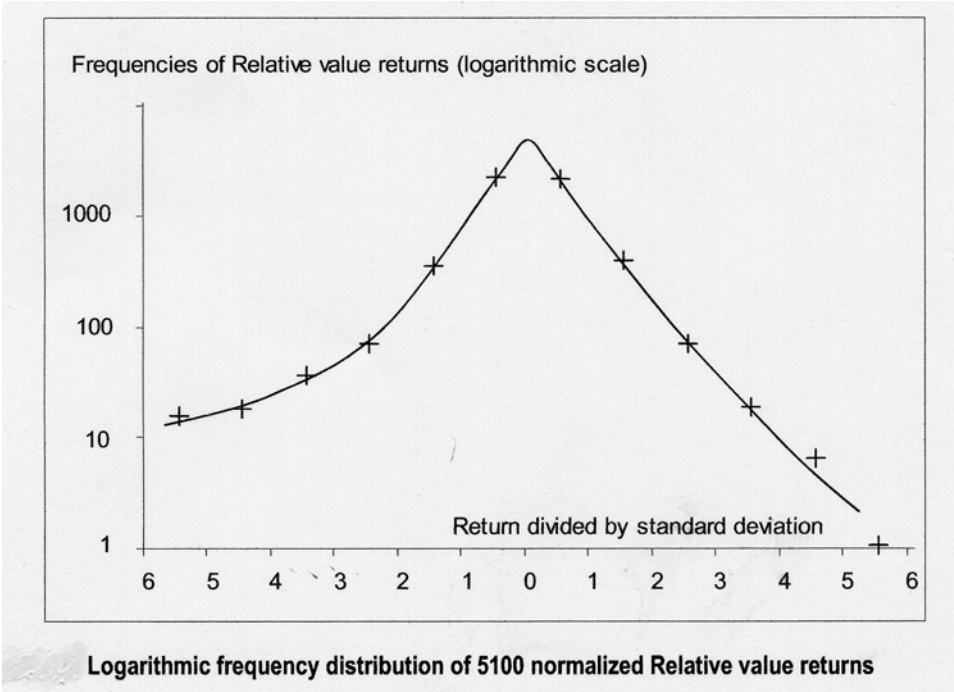
- **It is the ratio of the expectation of the positive part of the returns divided by the expectation of the negative part.**

ALTERNATIVE PERFORMANCE EVALUATION: 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.**

ALTERNATIVE PERFORMANCE EVALUATION: FAT TAILS
(Continued)

- **For example, the returns of relative value hedge fund strategies exhibit negative skewness.**



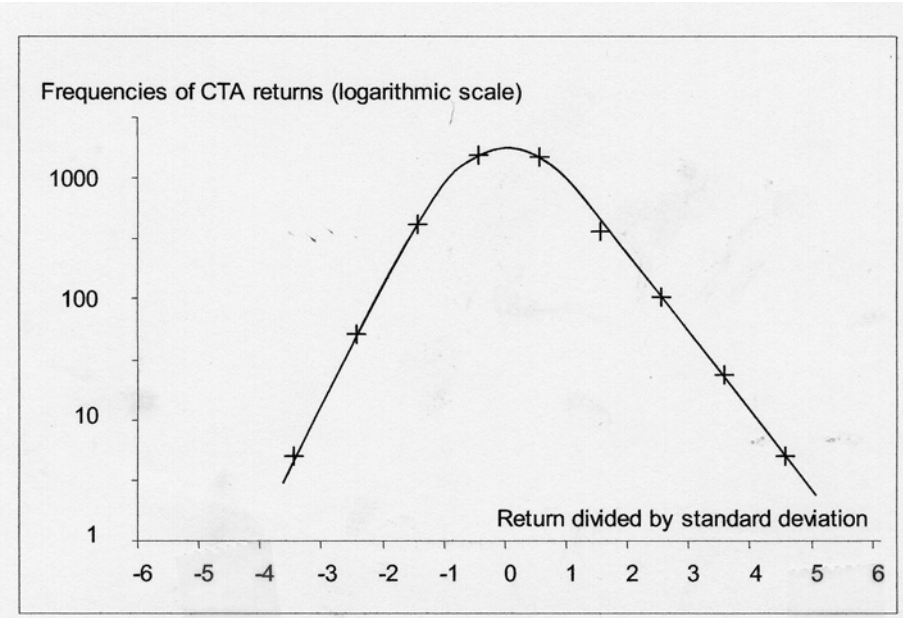
Logarithmic frequency distribution of 5100 normalized Relative value returns

Source: Christof Schmidhuber and Pierre-Yvex Moix, "Fat Tail Risk: The Case of Hedge Funds (Part II)", AIMA Newsletter, December 2001.

ALTERNATIVE PERFORMANCE EVALUATION: FAT TAILS

(Continued)

- **The returns of Commodity Trading Advisors, on the other hand, have positive skewness.**



Logarithmic frequency distribution of 4020 normalized CTA returns.

Source: Christof Schmidhuber and Pierre-Yvex Moix, "Fat Tail Risk: The Case of Hedge Funds (Part II)", AIMA Newsletter, December 2001.

ALTERNATIVE PERFORMANCE EVALUATION: NON-LINEAR 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.**

ALTERNATIVE PERFORMANCE EVALUATION: NON-LINEAR RELATIONSHIPS TO STOCK AND BOND PORTFOLIOS

(Continued)

- **One extreme example would be a fund that had convex payoffs with respect to the market (through long calls and puts.)**

- **Say its payoff is Y = X-squared, where X is the market return.**

- **The correlation of the strategy to the market is zero, even though it is entirely determined by the market's return.**

ALTERNATIVE PERFORMANCE EVALUATION: NON-LINEAR RELATIONSHIPS TO STOCK AND BOND PORTFOLIOS

(Continued)

Let's take an example where the constant correlation is equal to zero and there is a deterministic relationship between X and Y:

$$y = x^2$$

The constant correlation is equal to

$$\rho(x, x^2) = \frac{E(xx^2) - E(x)E(x^2)}{\sqrt{\left(E(x^2) - E(x)^2\right)\left(E(x^4) - E(x^2)^2\right)}} \underset{x \sim N(0,1)}{=} \frac{0 - 0 * 1}{\sqrt{(1-0)(3-1)}} = 0$$

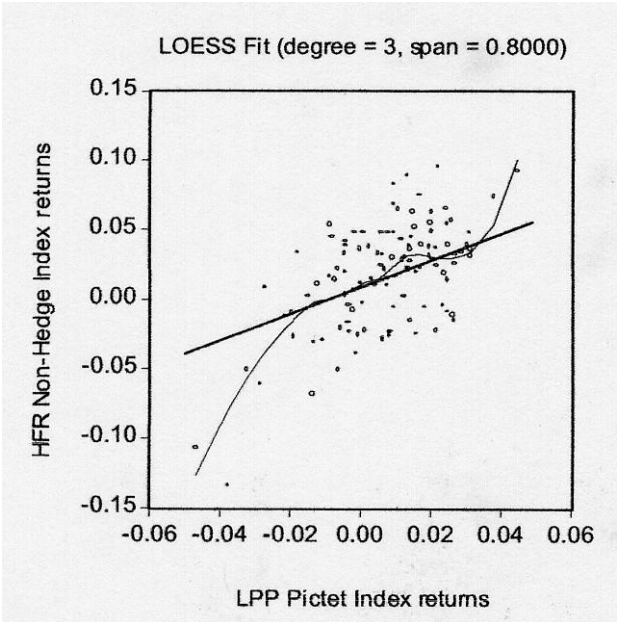
The constant correlation shows no relation between both distribution even though the Y asset is depending on the X asset. This is due to the fact that the constant correlation "tries" to find linear relation between X and Y. In this case, there is absolutely no linear relation between X and Y, but only a positive quadratic relation.

Source: Favre, Laurent and Jose-Antonio Galeano, "An Analysis of Hedge Fund Performance Using Loess Fit Regression," Journal of Alternative Investments, Spring 2002.

ALTERNATIVE PERFORMANCE EVALUATION: NON-LINEAR RELATIONSHIPS TO STOCK AND BOND PORTFOLIOS

(Continued)

- **One can use non-linear regressions to estimate the relationship between a hedge fund strategy and a portfolio of traditional assets.**



Equity Non-Hedge Strategy

Equivalent to long position in traditional portfolio with some long out-of-the-money calls and some short out-of-the-money puts.

Source: Favre, Laurent and Jose-Antonio Galeano, "An Analysis of Hedge Fund Performance Using Loess Fit Regression," Journal of Alternative Investments, Spring 2002.

ALTERNATIVE PERFORMANCE EVALUATION: NON-LINEAR RELATIONSHIPS TO STOCK AND BOND PORTFOLIOS

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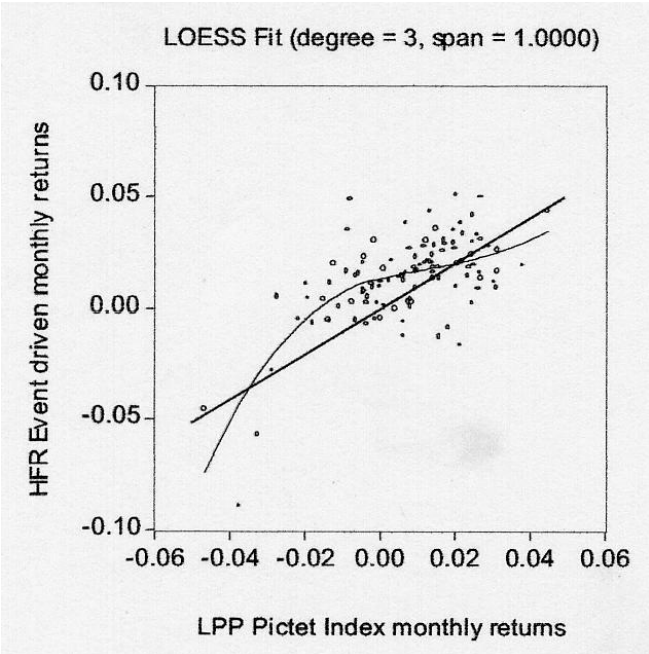
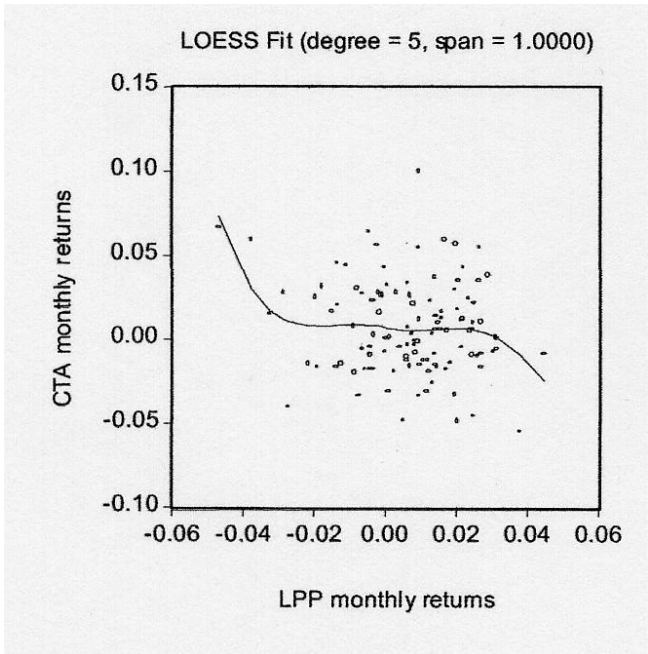
Event-Driven Strategy



Managed Futures



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ALTERNATIVE PERFORMANCE EVALUATION: NON-LINEAR RELATIONSHIPS TO STOCK AND BOND PORTFOLIOS

(Continued)

- **The Favre-Galeano article shows that most hedge fund categories have concave payoffs on the downside.**

- **Diversification benefits disappear at extreme levels of traditional asset returns with several exceptions.**

ALTERNATIVE PERFORMANCE EVALUATION: SCENARIO-DRIVEN RISK VISUALIZATION

- **An investor frequently uses the normal distribution to represent returns of a diversified portfolio since one assumes it is OK 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 OK for a portfolio's return if its strategies would never be influenced by a dominant event.**

ALTERNATIVE PERFORMANCE EVALUATION: SCENARIO-DRIVEN RISK VISUALIZATION

(Continued)

- **One idea is to represent an investment's distribution as a combination of two distributions: one for peaceful times and a second for eventful times.**

- **The distribution during eventful times would not just include higher volatility, but also the greater correlation among strategies that tends to occur during crises.**

- **A risk manager would explicitly determine the proportion of crisis returns in the combined distribution.**

ALTERNATIVE PERFORMANCE EVALUATION: SCENARIO-DRIVEN RISK VISUALIZATION

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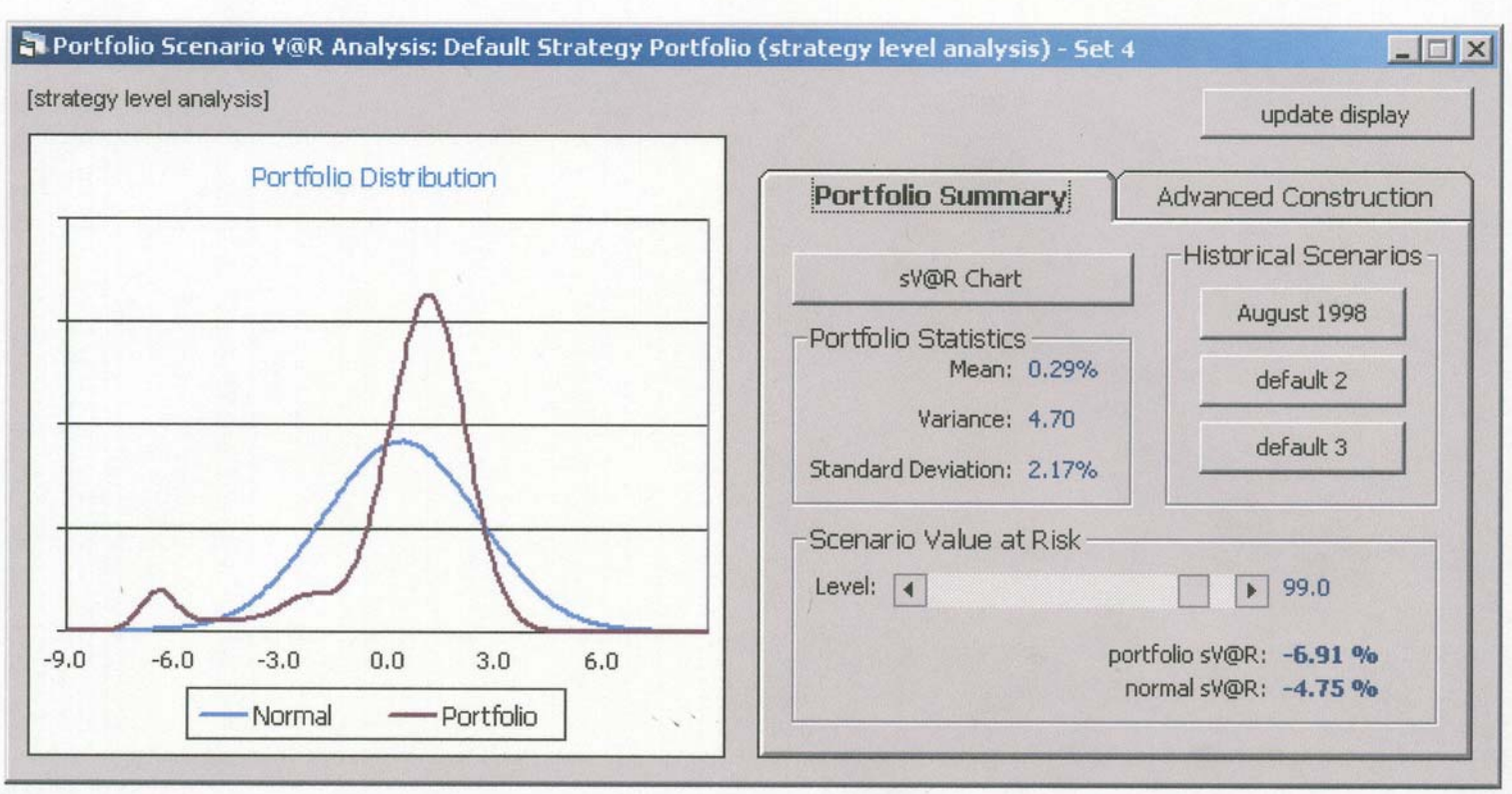

Source: Johnson, Damien, Nick Macleod, and Chris Thomas, "Modelling the Return Structure of a Fund of Hedge Funds, " AIMA Newsletter, April 2002.

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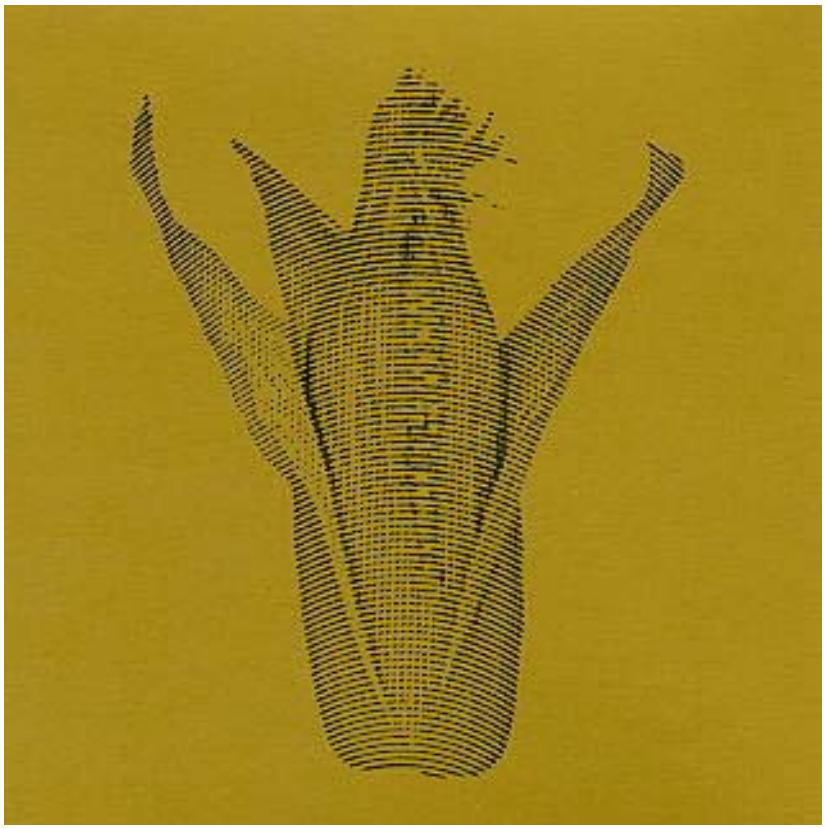

Ms. Hilary Till

Principal

Premia Capital Management, LLC

505 N. Lake Shore Drive

Suite 402

Chicago, IL 60611 USA

Phone: 312-583-1137

E-Fax: 240-414-8933

E-mail: till@premiacap.com