Survey of Recent Hedge Fund Articles

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In this article, we provide the busy reader with a survey of articles that were written over the past four years on hedge funds. Specifically, we review the economic basis for hedge fund returns and then discuss some of the logical consequences of these observations. Next, we summarize the general statistical properties of hedge fund strategies. We then examine what the appropriate performance measurement and risk management techniques are for these investments. And lastly, we briefly cover ways that investors can consider incorporating hedge funds within their overall portfolios.

RETURN SOURCES: INEFFICIENCIES, RISK PREMIA, ILLIQUIDITY, AND EVENTFUL PERIODS

Inefficiencies[1]

Anjilvel *et al.* of Morgan Stanley (2001) emphasize the "alpha advantage" of hedge fund managers. They write, "Our research has shown that a significant proportion of the total return to hedge funds in the past has been *alpha*, in contrast with a small negative total alpha for mutual funds …" (Italics added.)

Alpha is a manager's excess return above and beyond taking on market risk. A manager can only earn a positive alpha if that manager either has an ability to identify mispriced securities or has an ability to time the market. Alpha is a measure of a manager's skill level.

The Morgan Stanley researchers hypothesize that "one possible explanation for an 'alpha advantage' … is that … [hedge fund managers] can forecast expected returns better than others. This means a significant ability to exploit market inefficiencies to outperform their benchmarks, presumably by virtue of skill, knowledge, and insight."

[1] This section is based on Till (2004b).

Capacity

If hedge funds are exploiting market inefficiencies, this means that other investors are supplying those inefficiencies. This means that, unfortunately, we can't all profit from exploiting inefficiencies. Therefore, there is a natural cap on the potential size of the hedge fund industry, assuming that hedge funds are indeed exploiting inefficiencies rather than taking in *risk premiums*.

In *risk premium* strategies (as opposed to strategies with an "alpha advantage"), an investor takes on risks that others would prefer not to hold; in some cases, one can see a direct analogy between particular risk premium strategies and the provision of insurance, as will be covered later.

There are a number of historical examples to point to in showing that superior investment strategies have historically been fleeting, which is why one should be cautious in predicting the potential size of the (alpha-generating portion of the) hedge fund industry. To provide a broad historical perspective, one can quote Siegel (2003): "High-beta stocks beat low-beta stocks until William Sharpe discovered beta in 1964; small stocks beat large ones until Banz and Reinganum discovered the size effect in 1979."

Gatev *et al.* (1999) provide a more recent example. They simulate the performance of the equity pairs trading strategy. Over the period 1962 to 1997, they "… find average annualized excess returns of up to 12 percent for a number of self-financing portfolios of top pairs."

But Gatev *et al.* (1999) also find, "Pairs trading has declined in profitability dramatically from the 1970's and 1980's to a low point at the end of our sample when the returns were sometimes negative."

They hypothesize that after the strategy's discovery in the early 1980's, "competition has decreased opportunity."

This is very plausible given that the strategy's success was widely publicized in the 1980's, including a report that a Morgan Stanley group made $50 million for the firm in 1987 as well as an article about the strategy in *Institutional Investor* magazine in 1989.

Further evidence of the capacity-constrained nature of the hedge fund industry is provided by Agarwal *et al.* (2003). Using data from January 1994 through December 2000, they note, "… large funds with large inflows display poor future performance and a lower probability of exhibiting persistence. This finding is consistent with decreasing returns to scale in the hedge fund industry."

Mozes and Herzberg (2003) find similar results when examining hedge fund manager data from 1990 through 2001. They find, "… large relative increases in assets under management are strongly predictive of decreases in future performance."

Selecting Alpha Generators

The following discussion summarizes two studies on selecting hedge fund managers whose performance cannot be linked to known risk factors. Therefore, one expects that the returns of these managers are due to skill-based alpha generation rather than being due to bearing hidden risks, as phrased by Feldman (2002).

Chen and Passow (2003) develop a quantitative model to select long-short equity managers who have low exposure to the following four factors: the broad equity market, the two Fama-French equity factors, and the Goldman Sachs Commodity Index (GSCI). The Fama-French factors are the return on small capitalization versus large capitalization stocks and the return on high book-to-market (value) versus low book-to-market (growth) stocks, as described in Fama and French (1992).

Using data from January 1990 to September 2002, Chen and Passow find that "choosing those funds with high exposure to each risk factor gives unstable results." On the other hand in brief out-of-sample testing, the researchers find that choosing funds that have low exposure to their risk factors results in uncovering funds that perform well in both bullish and bearish market environments.

And again, Chen and Passow find evidence that "… outperformance is highly correlated with … [assets under management] growth, with negative impact on subsequent returns."

Mozes and Herzberg (2003) present the results of selecting equity funds that have good returns, lower risk, and lower correlations to the equity market compared to peer group funds. The authors believe these criteria might indicate that superior performance is due to underlying manager skill rather than being due to risk-taking and/or undue exposure to the equity market. They also take into consideration recent asset flows, noting the inverse relationship between increases in assets and later performance. Lastly, they screen out funds whose size and/or age demonstrates a lack of experience in handling large sums of money for long periods of time.

The authors find, "For the period 1996 to 2001, portfolios of such funds generate significantly higher risk-adjusted returns … than portfolios containing all funds …, portfolios constructed solely on the basis of past returns …, and portfolios based on past [risk-adjusted returns]."

What both of these studies cannot answer, though, is at what point would the popularity of such tests lead to the selected managers quickly reaching or exceeding their capacity constraints? As with the equity pairs-trading study, one worries that the identification of superior investment strategies might lead to their profits diminishing.

Risk Premia[2]

Another source of return in certain hedge fund strategies is from earning risk premia. With risk premia strategies, there may be large, infrequent losses from bearing certain risk factors, resulting in a short-option-like return distribution, but the returns over time are sufficient to make the activity profitable.

In the following, we will give several examples of strategies where it appears that the investor earns a risk premium. (Most of these examples are drawn from Cochrane (1999a and 1999b).

Relative-Value Bond Funds

One could argue that a relative-value bond fund earns its returns by taking on the illiquid assets that international banks desire to lay off when in need of reducing risk. The fund hedges this risk by shorting liquid assets. A relative-value bond fund thereby provides a reinsurance function for financial institutions, but it also exposures the fund to liquidity crises. As a result, an examination of empirical data shows that relative-value bond funds have short-option-like returns. An investor in such funds assumes the risk of systemic financial distress and provides other investors with the flexibility of being able to readily liquidate their investments. A relative-value bond fund is in essence providing real options to other investors.

Equity Risk Arbitrage

In this strategy, a merger candidate is bought by a hedge fund at a discount to where its intended buyer has announced it will pay for the company. An investor assumes the risk that a merger deal will fail. This strategy tends to earn consistent returns but sustains very large losses in the event that a deal does not get consummated.

A historical analysis of merger arbitrage deals conducted in Mitchell and Pulvino (2001) shows that this strategy's return is correlated to the overall market during severe market downturns, giving a return profile similar to short index put options.

Given that it appears that one can earn the returns from this strategy in a passive manner and given that one is also assuming the risk of severe market downturns with this strategy, it appears that one is earning a risk premium by entering into this type of investment.

[2] This section is based on Till (2001a), Till (2001b), and Till (2004c).

Value vs. Growth Equity Strategy

One market anomaly identified by Rosenberg *et al*. (1985) was that an investor could earn returns beyond that predicted by CAPM by investing in stocks that have high book-value-to-price ratios. This value-based strategy has historically had twice the Sharpe ratio of the overall market. (The Sharpe ratio is defined as an investment's excess returns over T-bills divided by its standard deviation; it is a measure of risk-adjusted return.)

Cochrane (1999a) notes that value stocks may earn premium returns because of the risk associated with distressed stocks all going bankrupt during a financial panic. This is precisely the time that investors would not like to find their equity portfolio doing poorly. Therefore, investors pursuing a value-based equity strategy may be in effect earning a risk premium for assuming the risk of a "credit crunch, liquidity crunch, flight-to-quality or similar financial event" that other investors would prefer not to take on. By assuming these risks, the value investor may be in effect providing financial-distress insurance to other investors.

To further understand why value investing may require excess returns, we need to emphasize that most individual investors have larger economic worries than just the performance of their investment portfolios. The main source of income is from their jobs. In the event of systemic financial distress, individuals whose jobs are tenuous would not want their portfolios to be particularly at risk. This means avoiding stocks of companies that could be threatened with bankruptcy. One indication of a weak company is one in which its price-to-book ratio is low.

An investor who systematically buys stocks based on "value" considerations such as a low price-to-book ratio and sells stocks based on "growth" considerations may be taking on risks that most individual investors desire to avoid.

Small Capitalization Stocks

Cochrane (1999a) also notes that small-capitalization stocks seem to have abnormally high returns, even after accounting for this style's market "Beta." (Beta provides a measure of how much a portfolio's performance varies with respect to the overall stock market.)

In both Harvey and Siddique (2000) and Low (2000), the authors find that small capitalization stocks do particularly poorly when the stock market does poorly. Investors may require a return premium for taking on this risk. This premium may be a contributing explanation for why, over very long periods of time, small cap stocks have historically had superior returns.

Lux (2002) discusses one of the risks associated with small-capitalization stocks:

"Illiquidity is one of the biggest hazards with investments that are outside the mainstream, such as small capitalization stocks. …small-cap fund managers are betting that liquidity won't dry up in thinly traded stocks, causing their prices to plunge."

Lux notes that "taking such a gamble to earn excess returns is not unreasonable," but investors should take this risk into consideration when investing in small cap stocks.

Whereas most risk modeling solely uses volatility as a measure of risk, Krishnan and Mains (2005) also formally take into consideration long-term recession risk in evaluating proper investor allocations to asset classes that are particularly exposed to recession risk. These investments include small-capitalization stocks and emerging-markets equities. The authors note, "Investors are worried about extreme event or recession risk. In the meantime, investors who are willing to suffer through difficult markets conditions can earn a premium."

High-Yield Currency Investing

In this strategy, one invests in currencies with relatively high interest rates and funds this purchase in a currency with relatively low interest rates. On average this kind of strategy has proven profitable; the forward rate of currencies is not predictive of where future currency spot rates will be. One could argue, particularly in cases where a currency pair has an extreme interest-rate differential that one is taking on devaluation risk with this strategy. This devaluation risk increases with global financial panics.

One example of this strategy concerns investing in the Thai Baht. The Sharpe ratio for investing in Thai Baht deposits that were funded by U.S. dollar denominated loans was 2.55 over the period 1980 to 1996, according to data in Shimko and Reider (1997). Given the unexpected, dramatic devaluation of the Bhat in 1997, it appears that an investment in Baht carried a well-deserved risk premium over this period.

Weather Fear Premia in Futures Markets

In the grain, coffee, and energy futures markets, a futures price will sometimes embed a fear premium due to upcoming, meaningful weather events that can dramatically impact the supply or demand of a commodity.

In this class of trades, a futures price is systematically too high, reflecting the uncertainty of an upcoming weather event. We say the price is too high when an analysis of historical data shows that one can make statistically significant profits from being short the commodity futures contract during the relevant time period. And further that the systematic profits from the strategy are sufficiently high that they compensate for the infrequent large losses that occur when the feared, extreme weather event does in fact occur.

These opportunities appear to occur because the economy cannot tolerate threats to either the food or energy supply so the market adds a premium to the futures price around the

time of potential weather shocks to ration demand. Further, the commercial commodity trade can be well aware of this return opportunity with no danger of it disappearing. This is because in order to take advantage of these positive expected-value opportunities, they would have to absorb volatile price risk that would impair their ability to carry out essential business planning. In other words, the commercial trade has larger business considerations than just the performance of their futures hedges.

Insurance Analogy

As can be seen from the examples above, a number of diverse traditional *and* alternative investment strategies appear to earn their returns due to assuming risk positions in a risk-averse world. In some cases, as noted above, one can see a direct analogy between particular risk premia strategies and the provision of insurance.

Selling insurance is the essence of a short put position. While insurance is socially useful, insurance companies are widely diversified to spread the risk of any one local disaster. Investment managers who follow short put strategies, either explicitly or implicitly, are typically not diversified enough to avoid catastrophic losses. Those who invest with these managers should do so knowingly and with sufficient diversification in other asset classes to withstand the occasional disaster.

Illiquidity[3]

We have thus far covered two sources of return in hedge fund strategies: the exploitation of inefficiencies and the monetization of risk premia. Another way to produce a higher-than-average return is to invest in securities that are illiquid. Naturally the market will demand a liquidity premium when valuing such investments. Investors value flexibility; this is the basis of real option theory. In real options theory, one explicitly values the optionality associated with decision-making flexibility. In essence, with illiquidity, a portfolio is short real options, and the investor gives up the flexibility of being able to readily liquidate their investments.

Illiquidity is a common feature of alternative investments, whether one chooses venture capital, private equity, or hedge funds. For hedge funds, the illiquidity can arise from the contracts an investor enters into, which may have one year or longer lock-ups, or can arise from the type of investments that a hedge fund specializes in. A hedge fund's investments may include over-the-counter derivatives instruments, which may be difficult to value, or small-capitalization stocks, which may trade infrequently, for example.

[3] This section is based on Till (2003) and Till (2004a).

Benefits

Liquidity is Overrated

There isn't anything inherently bad about an illiquid investment. As a matter of fact, David Swensen of Yale University's endowment, has noted that "American investors, particularly those with long time horizons, pay far too much for liquidity," according to an *Economist* (2000) article. With liquidity overpriced, Swensen advocates investments where an institution gets paid for illiquidity. One then uses diversification for risk control rather than paying for liquidity.

Tick-by-Tick Evaluation of a Good Investment is Painful

One seemingly positive feature of a liquid investment is the ability to receive continuous pricing on that investment. But is that really a positive? Taleb (2001) provides an example that makes one reconsider that benefit.

Taleb notes that a 15% return with a 10% volatility per year provides a 93% probability of making money in any given year. But this also translates into a 50% of chance of making money in any given second. Exhibit 1 reproduces his chart of the probability of making money over different time scales, given this investment's return and risk parameters.

The significance of losing money about half the time that one makes money over the very short-term is that the joy of making money is not equivalent to the larger degree of pain one feels in losing money. If an investor is watching their investments tick-by-tick in an eight-hour day, Taleb points out that he or she will have 241 pleasurable minutes versus 239 unpleasurable minutes in this example. If the trader feels the negative effect say 2.5 times more than the magnitude of the positive one, then that trader could easily become emotionally burned out. This would adversely affect the trader's ability to stay with a good investment.

In coming up with this example, Taleb was not advocating illiquid investments. But this example does show one potential disadvantage of a deeply liquid investment if an investor is unable to stand back from its daily movements.

Predictability is at Long Timeframes

Professor John Cochrane of the University of Chicago notes that stock and bond returns have a substantial predictable component at long time horizons. In Cochrane (1999a), the author provides an example of an equity-forecasting model in which month-to-month returns are quite unpredictable. But at a five-year time horizon, the returns seem very predictable.

Cochrane notes that "if daily returns are very slightly predictable by a slow-moving variable, that predictability adds over long horizons."

Given Taleb's observations on an investor's emotional reactions to random fluctuations in the profitability of a good investment strategy, one might wonder how many investors could take advantage of such return predictability if one needs a five-year time horizon to benefit from it. Perhaps it would be easier to do so if the investment were illiquid.

Buy-and-Hold Strategies Have Provided Superior Returns

During the long equity bull market of the 1980's through 2000, a number of researchers have shown that it is *unlikely* that the average equity mutual fund investor earned the market's double-digit passive returns.

Instead, one finds in examining flows into and out of mutual funds that investors typically put their money into the S&P 500 after it rose and pulled money out after the market fell.

A natural response to research findings like this is to advocate buy-and-hold strategies. But one wonders how realistic that advice is for investments that are packaged in vehicles that offer daily liquidity like mutual funds.

Knapp (2002) provides an example concerning the track record of a futures trading fund whose results were exceptionally volatile. The futures trader reported impressive, compounded annualized returns. The reported returns were *technically* accurate. But they did not reflect the actual experience of the fund's investors who, like mutual fund investors, fled the fund after it had large draw-downs and flew into the fund after it posted large gains. When Knapp calculated the internal rate of return of the fund based on the fund's average money under management, he came up with sub-Treasury returns. He concluded that an investor would need to be "contra-human" in order to be able to actually experience the fund's impressive annualized returns.

Costs

An Investor Cannot Rebalance His or Her Portfolio

In evaluating illiquid alternative investments, an investor should understand that one loses the ability to rebalance a portfolio should other superior investment opportunities arise. Terhaar *et al.* of UBS (2003) also point out that when one establishes a policy portfolio, which includes allocations to illiquid investments, the actual weightings can deviate from the policy's weightings because of liquidity constraints in entering and exiting investments.

When one chooses to invest in illiquid investments such as venture capital, real estate, and hedge funds, an investor needs to ensure that the range of allocations that may occur over time is acceptable.

The UBS researchers conclude that an investor must have a sufficiently high tolerance for risk to accept the "periodically elevated risk levels." That investor must also have a long enough time horizon to ensure that they are able to benefit from the expected higher returns of the illiquid investments.

An Investor is Short a Put Option

That an investor lacks rebalancing flexibility when owning illiquid investments can also be thought of in option terms. A holder of illiquid investments is short put options while a holder of liquid assets is long put options. Presumably a holder of liquid assets would be successful in implementing a dynamic stop-loss policy. This dynamic stop-loss policy can be modeled as a put option, according to Myron Scholes of Oak Hill Capital Management. Scholes (2000) explains:

"A put option provides the equivalent of a dynamic liquidity cushion. A put-protected position self-liquidates as money is lost and markets become more illiquid. The cost of this protection is the value of liquidity."

Default and Liquidation Risk

One source of illiquidity in hedge fund investments arises from the nature of the contract that investors enter into with hedge fund managers. Krishnan of Morgan Stanley and Nelken of Super Computer Consulting (2003) note that:

"If a hedge fund has a one-year lockup, funds can typically only be taken out at the end of a calendar year following the year of investment. Thus, an investor who allocates money in January 2002 can only take the money out in December of 2003, and the effective lockup period is two years."

During the lockup period, the hedge fund manager may alter the hedge fund's leverage level according to the manager's interests, which may not coincide with what is optimal for the investor. Krishnan and Nelken note that anecdotally a manager will alter their leverage policy according to how the hedge fund is performing with respect to its previous high watermark. Typically a hedge fund needs to outperform a previous high watermark before receiving an incentive fee.

The manager's leverage policy (or behavior) can have a meaningful impact on an investment's performance. Say an investor believes in the underlying investment process that a hedge fund is pursuing. Say those returns have a certain mean return and standard deviation. The returns that the investor will actually receive will be very path-dependent since the hedge fund manager will likely alter their leverage level according to how performance compares to the previous equity high.

Krishnan and Nelken note that if a hedge fund reaches a certain loss threshold, the manager may substantially decrease leverage in order to prevent redemptions and

therefore lose an ongoing management fee stream. They note that once redemptions occur, there may be a further sharp and quickly accelerating decline in the value of the hedge fund's investments due to concentrated liquidation pressure. (One hedge fund manager, whose $450 million global macro fund was recently liquidated, "expressed surprise at the speed with which investors withdrew their money," wrote Chong (2005) in *The Times*.)

On the other end of the performance spectrum, once a hedge fund earns a certain amount in a year, the hedge fund manager may also decrease leverage in order to "coast." Perhaps earning greater than expected returns would alarm clients about the risks being taken so that there would be limited benefit in posting extraordinary returns. Finally, if a hedge fund's returns are in the neighborhood of the previous high watermark then the manager may use maximum leverage to increase their future expected incentive compensation.

An interesting consequence of the path-dependent nature of hedge fund returns, under this model of hedge fund manager behavior, is that if one had another investment that had the same underlying return process but did not have lock-ups (and incentive fees), then one would expect a different return stream to accrue to the end investor. This is because the dynamic leverage scheme outlined in the previous paragraph would likely not occur.

Based on Krishnan and Nelken's framework, one can figure out the *cost* of the illiquid nature of hedge fund contracts as follows. Create a well-specified underlying return generating process; come up with a model of a hedge fund manager's leverage policy; and figure out the threshold level of losses at which investors will attempt en masse to liquidate their investments. Calculate the risk-adjusted returns of the underlying return generating process absent dynamic leverage and forced liquidation pressure. Next calculate the risk-adjusted returns of the hedge fund investment, complete with the manager's and investors' behaviors factored in. The difference in these two risk-adjusted returns provides one with a measure of the cost of this form of illiquidity.

Stale Pricing

1. Inaccurate Relationship Between Investments

Another signature aspect of investing in illiquid investments is that these investments may be marked based on old (or "stale") prices. If one uses unadjusted historical data to compare liquid and illiquid investments, one may not be getting a true picture of the underlying economic relationship between these investments.

In Asness *et al.* (2001), the principals of AQR Capital Management have built a convincing argument that the lack of relationship of hedge fund indices to the S&P 500 is largely due to the reporting of stale prices for hedge fund positions. The authors use the CSFB/Tremont hedge fund indices in their research.

When the authors regress the CSFB/Tremont Aggregate Hedge Fund Index's returns versus lagged returns of the equity market, they find a strong relationship between the

hedge fund index and the S&P using data from January 1994 to September 2000. Because there is such a strong relationship once they compare the hedge fund index's returns to dated returns in the stock market, they infer that hedge funds making up the index may have been using stale pricing in evaluating their holdings.

2. Real Economic Impact

Getmansky *et al.* (2003) note that the economic impact of stale pricing "can be quite real." In a timely analogy, the authors note that the "spurious serial correlation [induced by illiquidity] can lead to wealth transfers between new, existing, and departing investors, in much the same way that using stale prices for individual securities to compute mutual-fund net-asset-values can lead to wealth transfers between buy-and-hold investors and day-traders."

Valuation Risk

If a fund manager elects to imperfectly value a portfolio of illiquid securities, that manager risks the dire consequences of violating investor trust. Specifically, if a manager mismarks his or her portfolio beyond some threshold level above its true liquidation value, then that manager risks investors losing faith in that manager. The result can be that a massive liquidation occurs, causing the terminal value of the portfolio to plummet to a level beyond a more reasonable liquidation value. The market extracts a penalty for the fund's breach of trust. Weisman (2003) provides a methodology for evaluating what the premium should be for taking on this valuation risk.

Eventful Periods[4]

One example of an alternative investment strategy that does not rely on risk premia or illiquidity for generating returns is trend-following managed futures programs.

Trend-followers will scan the markets with quantitative screens designed to detect a trend. Once the model signals a trend, a trade will be implemented. A successful trend-follower will curb losses on losing trades and let the winners ride. That is, false trends are quickly exited and real trends are levered into. In a sense this is the distinguishing feature amongst trend-following managed futures programs.

Feldman (2005) finds that "in general, there is a consistent short profile between the performance of [managed futures] strategies and large-growth [equity] performance." In other words, managed futures strategies appear to be negatively correlated with the performance of large-capitalization stocks that are also categorized as growth stocks.

Rulle (2003) provides an intuitive rationale for why this has been the case historically:

[4] This section is based on Till and Eagleeye (2005).

"(Trend-following) … has a high negative correlation to equity markets during periods of perceived crisis in those markets. We believe this occurs because a global consensus emerges about macroeconomic conditions, which causes various markets, particularly currencies, interest rates and equities to move in tandem. When this consensus is further confronted by an 'event,' such as a major country default, the 'event' will reinforce the crisis mentality already in place and drive those trends toward their final conclusion."

Another way of characterizing Rulle's argument is that trend-following futures programs have historically benefited from "event risk."

PROPERTIES OF RETURNS[5]

We will now review some very general statistical properties of various hedge fund strategies.

Short-Options-Like Strategies

It appears that a number of fixed income and equity arbitrage strategies have payoffs that resemble those that can be obtained by writing put options on traditional assets.

For example, Favre and Galeano (2002) illustrate the non-linear relationship of a number of hedge fund styles to an equity-and-bond benchmark of interest to Swiss institutions, the LPP Pictet index. They use non-linear regression techniques to estimate the relationship between a hedge fund style and a portfolio of traditional assets. Exhibit 2 illustrates a best-fit relationship between the returns of the Event Driven hedge fund style and an equity-and-bond benchmark. This equity arbitrage strategy is equivalent to a long position in a traditional portfolio combined with short out-of-the-money puts.

When investors choose strategies that are implicitly short options, due care must be exercised in choosing appropriate performance metrics to evaluate these strategies.

In Goetzmann *et al.* (2002), four Yale University professors have derived an optimal strategy for maximizing the Sharpe ratio, a common performance metric. The optimal strategy is one that can be very nearly achieved by selling certain ratios of fairly valued calls and puts against a core equity market holding, as illustrated in Exhibit 3. One would instead prefer a performance metric that would not be so easily gamed. The subject of performance metrics will be discussed later in this article.

Long-Option-Like Strategies

It was the researchers, William Fung of the Center for Hedge Fund Research and Education, London Business School, and David Hsieh of Duke University, who first

[5] This section is based on Till (2002a) and Till and Eagleeye (2003a).

linked the returns of both the Commodity Trading Advisors (CTA's) and Global Macro hedge fund styles to long option-like profiles.

For example, Fung and Hsieh (2001) found high explanatory power in modeling the return profile of CTA's as equivalent to look-back option straddles on currencies, commodities, and fixed income. In addition, by focusing on extreme events to detect non-linear correlations between hedge fund strategies and risk factors, Fung and Hsieh (1997) also showed how the global macro style behaves like a straddle on the U.S. dollar, as shown in Exhibit 4. (A straddle is the combination of being long a call option and long a put option.)

PERFORMANCE MEASUREMENT[6]

As discussed in the previous section, some hedge fund strategies have *highly asymmetric outcomes*. This is of concern because traditional performance measures were designed for diversified baskets of equities, which in turn largely have symmetric outcomes. Therefore, standard performance measures are frequently inappropriate for the evaluation of hedge funds.

Sharpe Ratio

One issue with the Sharpe ratio as a performance metric results from its identification of risk as the standard deviation of returns around the investment's mean. This is appropriate if the investment's return distribution is symmetric. Because empirical studies from the 1970's showed that diversified portfolios of equities have returns that appear to be distributed in a symmetric fashion, the use of the Sharpe ratio has become widespread in investment evaluation.

But if an investment's returns are highly skewed as with option strategies, the use of the Sharpe ratio is inappropriate. One can increase the Sharpe ratio of an investment by selling fairly valued options: in this case, an investor is accepting the possibility of negatively skewed outcomes in exchange for improving the investment's average return, as pointed out by Leland (1998).

The fact that investors have a preference for positively skewed outcomes and an aversion to negatively skewed outcomes is not captured by a risk measure that equally weights the two types of outcomes.

To be fair to the Sharpe ratio's namesake, one should note that Nobel-prizing economist Dr. William Sharpe has stated, "I never named it the Sharpe ratio. I called it the Reward-to-Variability ratio," as Dr. Sharpe is quoted in Dugan (2005). Further, Dr. Sharpe has stated, "Anybody can game this. I could think of a way to have an infinite Sharpe ratio."

[6] This section is based on Till (2001a), Till (2001b), and Till (2004c).

Alternative Metrics

Basically there are two fundamentally different ways to address the shortcomings of the Sharpe ratio (or, as it should be known, the Reward-to-Variability ratio.) One way is to come up with a better summary risk-adjusted return number, given the demand for having just one number with which to compare all kinds of diverse investments. The second way is to summarize an investment by deriving its primary "asset-based style factors." If one is allowed more than one number to summarize an investment, this is the preferred approach.

Alternative Risk-Adjusted Measures

1. *Stutzer Index*. As described in Stutzer (2000), the main concern for investors is the probability of underperforming a benchmark on average. Therefore the Stutzer Index rewards those portfolios that have a lower likelihood of underperforming a specified benchmark on average.

2. *Bernardo-Ledoit Gain-Loss Ratio.* As described in Bernardo-Ledoit (2000), this measure is the ratio of the expectation of the positive part of the returns divided by the expectation of the negative part. If an investment's expected returns are large, and the potential loss is low, then this measure would reward such an investment in a way that the Sharpe Ratio would not.

3. *Excess Downside Deviation as an Adjustment to the Sharpe Ratio.* Johnson *et al*. (2002b) point out many hedge fund strategies appear to be in effect "short option" strategies that bear overpriced risks associated with rare events. Since these strategies exhibit asymmetric outcomes, the Sharpe Ratio is inadequate; however, given the prevalence of the measure, the authors suggest an adjustment to include downside deviation. Their "adjusted Sharpe ratio" is defined as "the Sharpe ratio that would be implied by the fund's observed downside deviation if returns were distributed normally."

4. *Bavar (Beta and Volatility Adjusted Returns) Ratio.* In Goodman *et al.* (2002), researchers from Kenmar propose that investors use the Bavar ratio. This ratio "adjusts the beta of various investments to be equivalent, so that a fund that has a lower return but is uncorrelated to the market can be appropriately compared with a fund that achieves a higher return but is highly correlated with the market."

Asset-Based Style Factors

The current academic thinking on how to evaluate alternative investment strategies, which may have short-option-like risk and brief track records, is to use "asset-based style factors" to characterize an investment.

Ideally, financial economists would prefer to come up with the universe of fundamental risk factors that can explain the time-series behavior of an investment's returns rather than just explain an investment's return based on other asset's returns. In other words, if

an investment's return cannot be entirely explained by its exposure to the market, what are the additional underlying risk factors of special concern to investors (that give rise to the investment's excess return)? But that effort has not been fruitful as yet. Instead, linking a portfolio, whether it is a fiduciary account, mutual fund, or a hedge fund, to a limited set of investment styles has been a lot more successful empirically.

Sharpe (1992) originally used this approach to model mutual fund risk. A current effort by academics is to extend this approach to hedge funds. In addition to including various asset classes and rule-based investment styles, researchers are also explicitly including options as explanatory factors for a hedge fund's returns.

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 specific hedge fund. Presumably the return history of the style factor would be long enough so that if the hedge fund incorporates a short-event-risk-type strategy, the magnitude of the losses that have occurred (and perhaps could occur) would be apparent from the long-term data.

The asset-based style factor approach arguably provides more useful information about alternative investments and their unique risk exposures than purely relying on the summary metrics covered above.

RISK MANAGEMENT[7]

We had previously noted that a number of hedge fund strategies appear to be earning risk premia. In other words, they earn returns because they are performing an economic function, which involves some form of risk transfer. One consequence is that they have short-option-like return profiles. The following section discusses two risk metrics for strategies that have asymmetric outcomes.

Conditional Value-at-Risk

Agarwal and Naik (2004) recommend applying the Conditional Value-at-Risk (CVaR) framework to hedge funds. They advocate replacing Value-at-Risk (VaR), which has been popular among traditional asset managers. The authors explain that "[whereas] VaR measures the maximum loss for a given confidence interval, … CVaR corresponds to the expected loss conditional on the loss being greater than or equal to the VaR."

By using CVaR, the authors are able to capture the left-tail risk of those hedge fund strategies that have short put option-like exposures.

They additionally show that the application of the mean-variance framework in the case of some hedge fund strategies can result in underestimation of tail risk by as much as 50%.

[7] This section is based on Till (2002b), Till (2002c), and Till and Eagleeye (2003b).

The authors conclude that if an investor's goal is to create portfolios for which the magnitude of extreme losses is kept under control, then that investor should consider using CVaR as their risk constraint.

Modified Value-at-Risk

When one cannot assume that an investment's returns are distributed normally (or at least symmetrically distributed), Signer and Favre (2002) propose a risk measure that takes into consideration the third and fourth moments of an investment's distribution. Skewness is the third moment, which describes how asymmetric a distribution is; and kurtosis is the fourth moment, which is linked to the existence of extreme returns. They describe a statistical method for adjusting VaR to incorporate skewness and kurtosis; they refer to this new measure as "modified VaR."

The authors advocate using modified VaR as the risk constraint for portfolios that include hedge funds because "nearly all hedge fund strategies show negatively skewed return distributions with positive excess kurtosis."

The authors provide an example that shows how the efficient frontier is changed when using modified VaR rather than VaR as the risk constraint. Exhibit 5 "shows the degree to which [a] … sample portfolio with a hedge fund portion of maximum 10% is represented too positively (in the sense of returns being too favorably risk-adjusted) by not taking account of the skewness and kurtosis of the return distributions."

One should add that not all hedge fund strategies can be characterized as exhibiting negative skewness. For example, the equity market neutral strategy has typically been found to have advantageous skewness and kurtosis properties. Instead, it is mainly the event driven and fixed income arbitrage strategies that have been characterized as having the most disadvantageous skewness and kurtosis properties.

Exhibit 6 illustrates the skewness and kurtosis properties for different hedge fund strategies. Signer (2002) calculates these statistics using time series collected from the following three hedge fund databases, TASS, HFR, and Zurich Capital Markets during the time period, January 1994 through December 2000.

Event Risk: Individual Managers

Since it is unacceptable for a hedge fund manager to have large losses, individual hedge fund managers pay particular attention to event risks. An example of an "event risk" analysis for a total-return portfolio is as follows.

This example portfolio consists of a long Russell 2000 (small-cap equity index) vs. short S&P 500 (large-cap equity index) futures trade *and* a long Municipal Bond vs. short Long Treasury Bond futures trade. These trades are normally unrelated. During a

scenario test of the portfolio's sensitivity to event risk, one finds that the combination of these two strategies results in an exposure to a liquidity shock, as shown in Exhibit 7.

The short legs of each spread are the more liquid of the pair. As a result, both of these trades are at risk to a flight-to-quality event as happened in the Fall of 1998. The scenario tests also show that the Fall of 1998 scenario is the worst case.

One response to a concentrated risk to a liquidity shock has been to purchase out-of-the-money fixed-income calls. These hedges would be expected to cushion the portfolio in the event of another liquidity crisis.

Event Risk: Funds of Hedge Funds

Similarly, fund of hedge fund managers attempt to model their portfolio's return distribution when all the strategies are influenced by a dominant event.

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 would never be 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, the September 11th, 2001 terrorist attacks, and during the aftermath of Hurricane Katrina in 2005.

Johnson *et al.* (2002a) recommend addressing this problem by representing 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.

Transparency and the Limitations to Quantitative Techniques[8]

Because many hedge fund managers provide minimal transparency to their investors, the burden is on the investor to understand the economic basis of their manager's returns.

Bismarck's Advice

A hedge fund manager who now has over five billion dollars under management once told the lead author of this article that his prospective investors were only interested in receiving a one-page summary of performance numbers. The ensuing discussions would

[8] This section is based on Till (2004c).

then focus on the nuances of how the performance numbers were calculated. There was no interest in discussing the underpinnings of the investment process, he said.

It was as if hedge fund investors were applying Baron von Bismarck's advice on sausages and legislation to their investments. ("Anyone who likes legislation or sausage should watch neither one being made," as Bismarck has been quoted.)

Cautionary Example

Anson (2002) provides an informative example of the importance of understanding the economic basis for a manager's returns. In Anson's hypothetical example, an investment manager leverages his or her initial investment capital by selling out-of-the-money puts and calls on the S&P 500 to achieve a certain performance objective above T-bills.

Exhibit 8 illustrates the superior performance of the strategy until a "volatility event" or large move occurs in the stock market. What is striking about Anson's simulated examples is that on average, it takes about seven years for the volatility event to occur and leave the investor with sub-T-bill returns. This event could occur in one month, or it could take as long as twenty years.

INVESTOR PREFERENCES AND CHOICES

Types of Products[9]

One promising area of research in hedge funds is focusing on coming up with better models of investor preferences in order to determine whether the unique returns and risks of various hedge fund strategies provide a better match for various classes of investors.

Not only are investors risk averse, but a better model of investor preferences also includes that they are loss averse. As discussed by Chen *et al.* (2002):

"Risk aversion is a measure of a general tendency to avoid risk. Loss aversion is a specific measure of how much more weight an investor accords to a loss of a given magnitude in comparison to an equivalent gain."

The researchers explicitly model the distributional characteristics of each hedge style, including their skewness and kurtosis properties. They then determine the optimal combination of traditional and alternative investments, given different levels of investor risk and loss aversion.

For certain levels of risk and loss aversion, the researchers find that the most attractive hedge fund styles are the equity market-neutral and global macro styles. The equity market-neutral style has historically sacrificed returns in exchange for dramatically lower

[9] This section is based on Till (2002b).

volatility. The global macro style has a return pattern, which historically has sacrificed upside return in the U.S. equity market in return for protection on the downside. These trade-offs are obviously appropriate for "loss averse" investors.

The researchers also note that there is no reason to assume that the levels of risk aversion and loss aversion are common to all investors, which means that portfolios would need to be customized for each class of investor.

Alternatively, Siegmann and Lucas (2002) hypothesize that the optimal behavior of a loss-averse investor depends on whether an investor is in a situation of surplus. If one is in the happy condition of surplus, then the optimal investment strategies are ones that have long option payoffs (with particular strike prices.) If the investor is in the opposite situation, then the optimal investment strategies are ones that have income-producing, short option-like payoffs (again with particular strike prices.)

Siegmann further notes that the optimal strategy also depends on the available options (or achievable dynamic strategies). This will determine whether the long call or the straddle pay-off is optimal in the case of a positive surplus. And similarly for negative surplus and the short put and short straddle pay-off. The author also notes that it is a matter of ongoing research to interpret the properties of dynamic strategies in terms of specific option strategies.

Anecdotally, the very wealthy clients of European fund-of-funds prefer strategies that have a lot of optionality, including the global macro strategy and Commodity Trading Advisors (CTA's). These European funds have at times gravitated to managers who are in the midst of large drawdowns, figuring that with such a large dispersion of results, there is an increased chance of a large upside.

If Siegmann and Lucas' model is correct, though, for everyone else, the appropriate hedge fund strategies are arbitrage strategies, which for the most part deliver consistent returns with the small chance of large losses, the essence of a short-option profile.

How to Incorporate Hedge Funds in an Investor's Overall Portfolio[10]

Surveying the extensive hedge fund literature, it appears that there are six competing conceptual frameworks for considering how hedge funds should be incorporated into an investor's portfolio.

[10] This section is based on Till (2004b) and Till (2004d).

These frameworks are briefly discussed below.

1. Equity Proxies

In this framework, investors would replace their equity allocation with equity hedge funds to benefit from the equity premium but with truncated downside risk.

2. Alternative Betas

Alternative *betas* are defined as "systematic and fairly well-known strategies that generally provide liquidity to those wanting more and take risk from those wanting less, something the hedge fund investor gets compensated for doing," as discussed in Asness (2004).

Similarly, Fung (2003) refers to hedge funds delivering "alternative risk premia for bearing risk in factors different from traditional assets."

In this framework, an investor could decide to only invest with those managers that provide "style-pure" exposures to defined "hedge fund betas." The investor would then need to be careful to not pay high "alpha fees" for what is actually a type of beta, as recommended by Siegel (2004).

3. Pure Alpha Generators

Again, alpha is defined as those returns that cannot be attributed to taking on various types of market risk. It is a measure of how skillful a manager is.

In this framework, an investor would choose to invest in those managers whose performance cannot be linked to major risk factors.

It should be noted that it is still a matter of vigorous debate to comprehensively define the universe of risk factors that a hedge fund manager may be exposing its investments to. The universe of risk factors, which are used in a particular analysis, is known as a "factor model." For example, in Alexander and Dimitriu (2004) the researchers consider four factor models.

There is evidence that selecting hedge fund managers whose performance cannot be attributed to taking on various types of risks provides superior future performance. That said, one wonders at what point would the popularity of such screens lead to the selected managers quickly reaching their capacity constraints.

4. Derive Extra Returns from Both Risk Premia and Liquidity Premia

In Terhaar *et al.* of UBS (2003), the researchers model *all* investments, including hedge funds, as some combination of systematic risk factors plus a risk premium, resulting from the investment's level of market segmentation, and illiquidity.

To make the UBS researchers' point clearer, one can refer to Jaeger's (2002) discussion of several hedge funds strategies in which risk premia and liquidity premia are earned:

"Often, the typical equity investor doesn't like to hold stocks that become involved in mergers and acquisitions. The equity investor already has a large gain and may achieve a slight, incremental gain if the transaction is consummated on schedule. However, the investor runs the risk of losses if the transaction is repriced, delayed, or cancelled. The risk arbitrageur assumes the risks that the equity investor prefers to avoid. Similarly, the distressed debt investor buys debt that traditional fixed income investors may be forced to sell in order to maintain portfolio yield or comply with investment guidelines. The convertible hedger provides liquidity to an 'orphan' asset class that is neither pure equity nor pure debt."

In this framework, an investor's hedge fund managers would be benchmarked against the returns of traditional assets classes plus the assumed extra returns arising from various types of risk premia and liquidity premia.

5. Total Return from Fund of Funds

A defining feature of hedge funds is their boutique nature. A hedge fund may only have one or two key decision-makers, for example. This does not give a lot of comfort to prospective investors who require a deep team of analysts and managers carrying out a disciplined and repeatable investment process that does not rely on any one individual for its continued success.

Fund-of-funds can provide the type of structure that can potentially offset this concern. A fund-of-funds diversifies away the idiosyncratic, operational risk of an individual hedge fund. In this framework, one should not compare individual hedge funds to mutual funds, but instead one should see fund-of-funds as the analog to mutual funds.

Because an investor expects absolute returns from a diversified fund-of-hedge-funds, an appropriate benchmark for this investment vehicle would be the performance of a traditional balanced portfolio, which is 60% invested in U.S. equities and 40% invested in U.S. bonds. One should note that historically the 60/40 benchmark has been a very difficult bogey for fund-of-hedge-funds to beat.

6. Unstable Factor Exposures

Funds of hedge funds have historically had varying exposures to asset classes over time. See, for example, Exhibit 9.

If investors are uncomfortable with not having control over their portfolio's exposure to various asset classes, then it may not be advisable to include hedge funds in their portfolio. In fact, the consulting firm Ennis Knupp + Associates state that their "standard advisory position is … *not* [to] advocate hedge funds[;] … most clients with well-

designed investment policies are better off without them," as stated in Bennett *et al.* (2002). (Italics added.)

Conclusion on Six Conceptual Frameworks

One can logically argue the merits of each of the six conceptual frameworks presented in this section as long as they are consistently applied. That said, our own view is that those unique investors who are *not* constrained by market segmentation issues and liquidity concerns can take advantage of the niche opportunities offered by hedge funds.

CONCLUSION

In this article, we reviewed leading-edge academic and practitioner research on hedge funds.

We would summarize the key conclusions of this article as follows:

- If hedge funds are exploiting inefficiencies, this means that other investors are supplying those inefficiencies. And unfortunately, we can't all profit from exploiting inefficiencies since in that case, nobody would be supplying inefficiencies. Therefore, all hedge fund strategies, which exploit inefficiencies, are by definition capacity-constrained.

- If instead hedge funds are exploiting non-obvious risk premia, then an investor must make use of enhanced risk measurement techniques.

- If hedge funds are at least partly earning above-market returns due to earning an illiquidity premium, a hedge fund investor must decide whether that premium is sufficient compensation for the added default, liquidation, and valuation risks that he or she is assuming.

- Finally, because we cannot all be exploiters of inefficiencies, providers of insurance, and suppliers of liquidity, will need to accept that most investors' long-term performance will be due to an appropriately designed and executed asset allocation policy.

ENDNOTES

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EXHIBITS

Exhibit 1

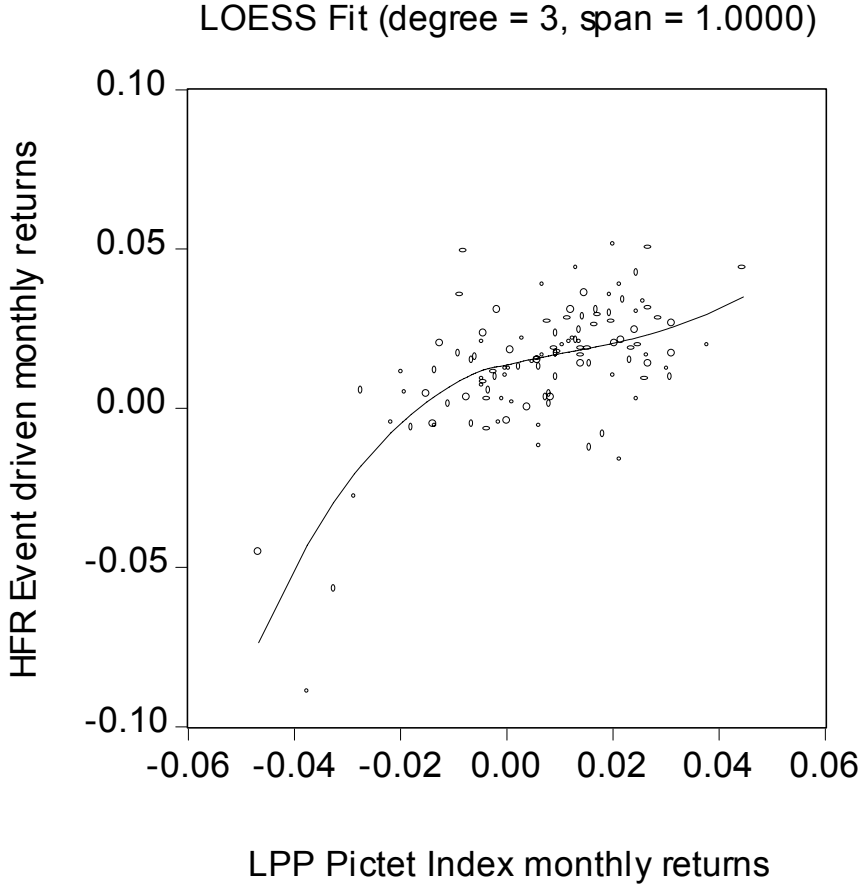
Probability of Making Money at Different Scales

Scale	Probability
1 year	93%
1 quarter	77%
1 month	67%
1 day	54%
1 hour	51.3%
1 minute	50.17%
1 second	50.02%

Source: Taleb (2001), Table 3.1.

Exhibit 2

HFR Event Driven Returns vs. Traditional Portfolio Returns



Source: Favre and Galeano (2002), Exhibit 8.

HFR: Hedge Fund Research, Inc.

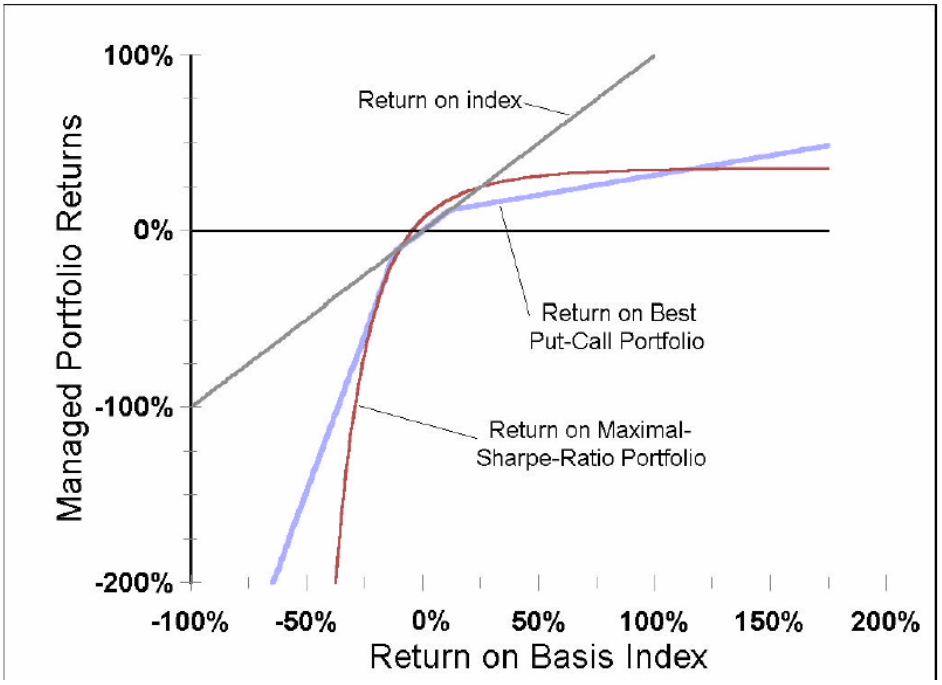
Event Driven (Strategy): also known as "corporate life cycle investing."

LPP Pictet Index: a benchmark index for Swiss institutional investors, which includes Swiss equities, global equities, and global bonds.

LOESS Fit (Regression): a type of regression used to fit non-linear relationships. Here, the researchers fit the relationship between hedge fund returns and market returns. Market returns, in turn, are represented here by the LPP Pictet Index.

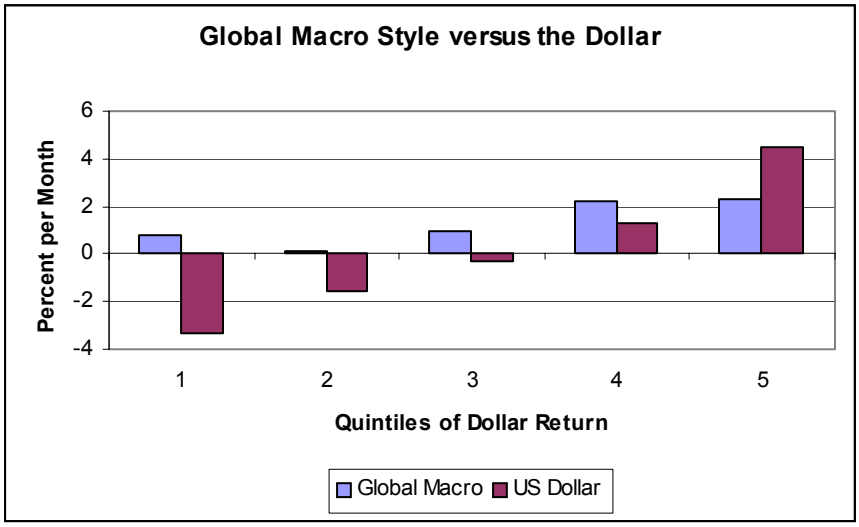
Exhibit 3

Returns of an Options-Based Index Strategy that Maximizes the Sharpe Ratio vs. an Index



Source: Goetzmann et al. (2002), Figure 4.

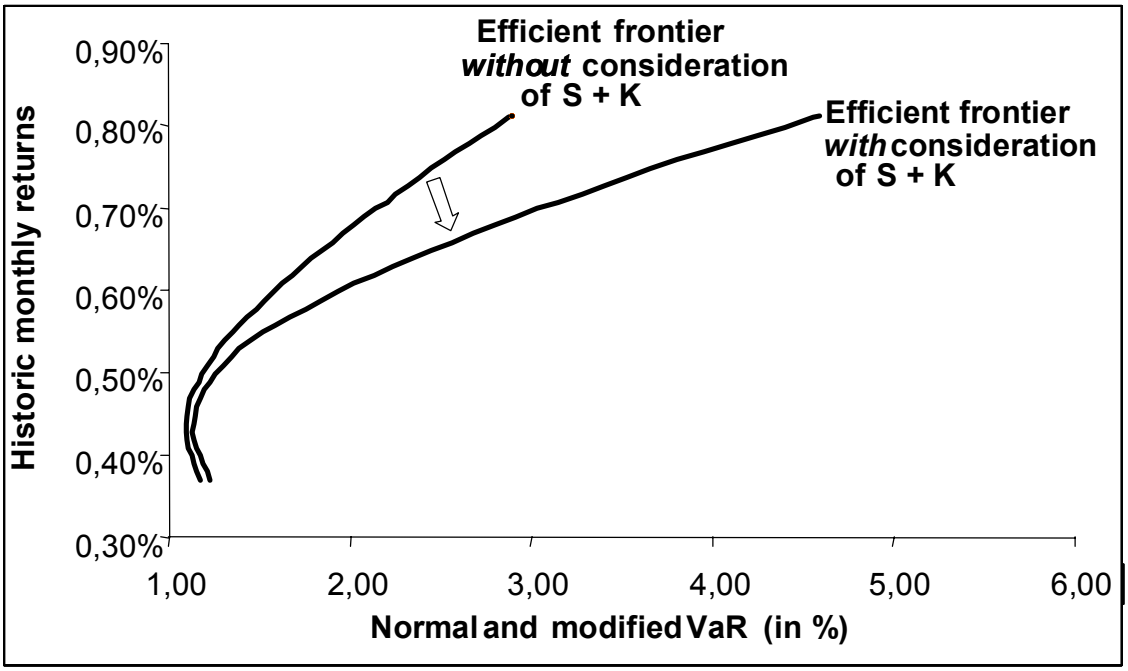
Exhibit 4



Source: Fung and Hsieh (1997), Figure 5.

Exhibit 5

Sample Portfolio with a Maximum Investment in Hedge Funds of 10%

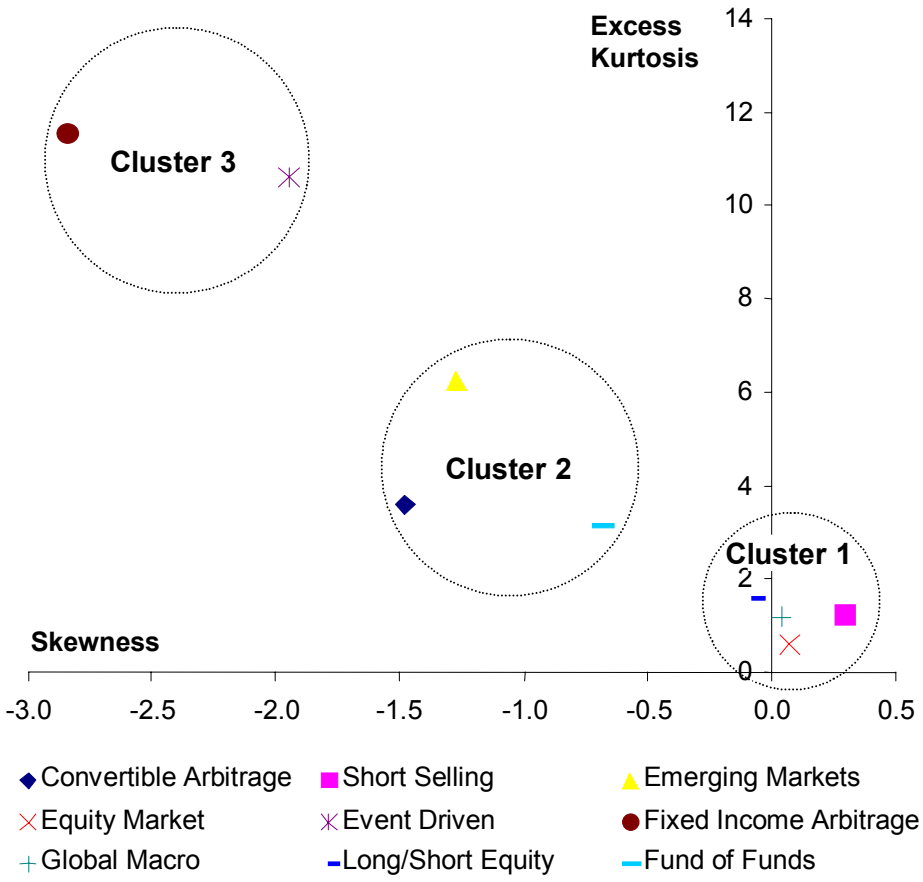


Source: Signer and Favre (2002), Exhibit 6.

(S refers to skewness, and K refers to kurtosis.)

Exhibit 6

The Skewness and Kurtosis of Hedge Fund Styles



Source: Signer (2002).

Exhibit 7

A Derivatives Portfolio's Exposure to Severe Events

Event	Maximum Loss
October 1987 stock market crash	-4.11%
Gulf War in 1990	-4.12%
Fall 1998 bond market debacle	**-6.42%**
Aftermath of 9/11/01 attacks	-3.95%

Worst-Case Event	Maximum Loss
Fall 1998 bond market debacle	-6.42%

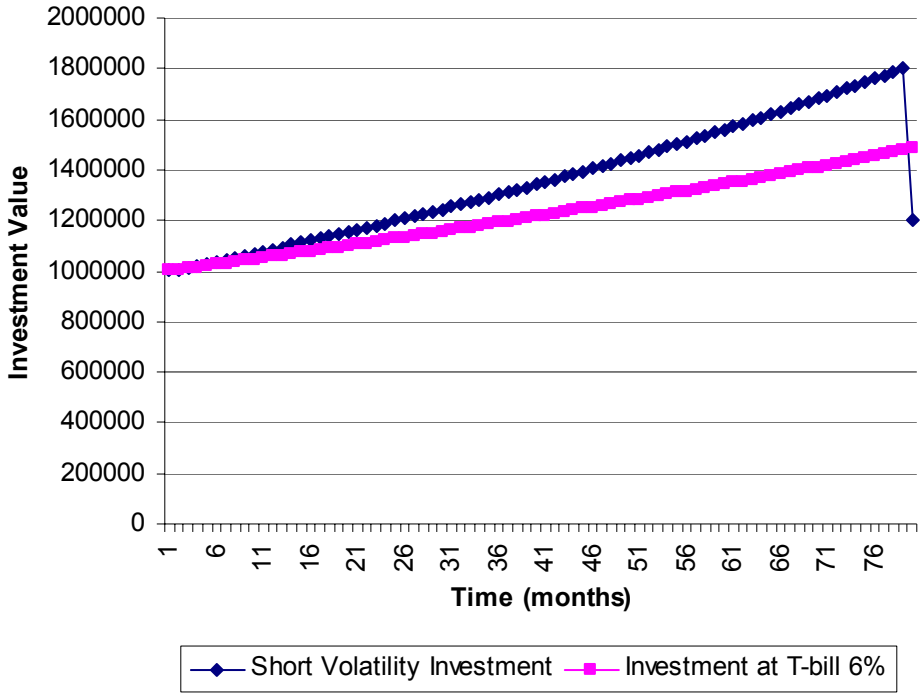
Value-at-Risk based on recent volatility and correlations

3.67%

Source: Risk Report from Premia Capital Management, LLC as cited in Till and Eagleeye (2003b).

Exhibit 8

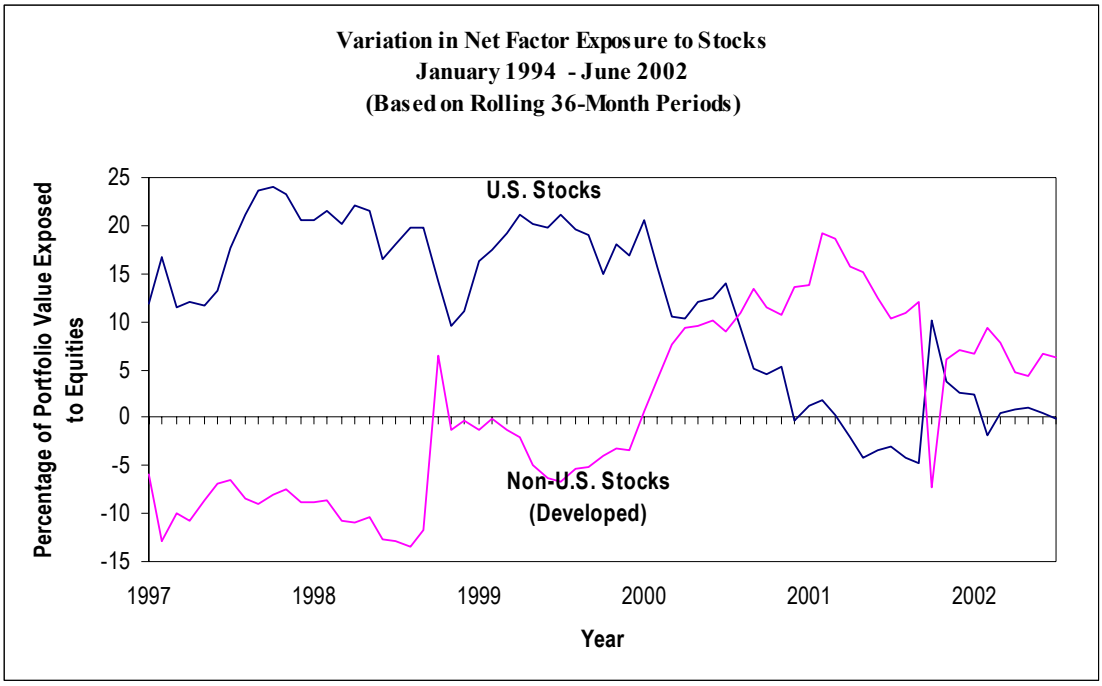
Simulated Short Volatility Investment Strategy



Source: Anson (2002), Exhibit 1. (This chart was created by Professor J. Clay Singleton of Rollins College using the algorithm in Anson's article.)

Exhibit 9

Effective Equity Exposure of the HFR Fund-of-Fund Index Through Time



Source: Bennett et al. (2002), Exhibit 8.