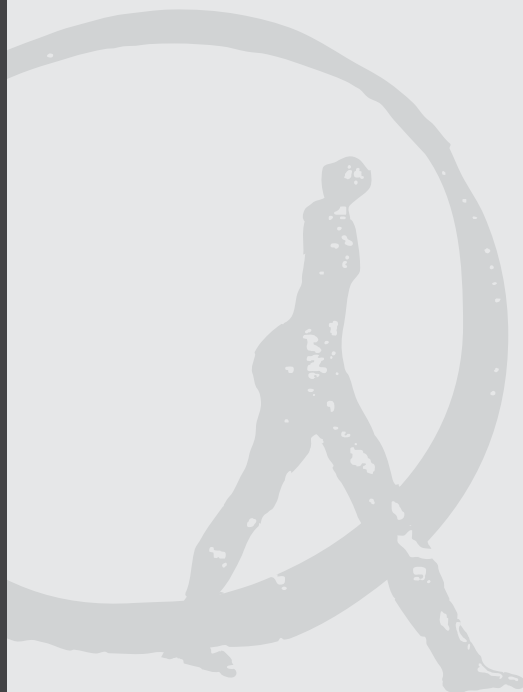


The Difficulties of Measuring the Benefits of Hedge Funds

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Abstract

In this paper, the use mean-variance approach for the determination of the benefits of allocations to hedge funds is critically evaluated. The advantages of investing in hedge funds are often explained and demonstrated with reference to a shift in the efficiency frontier of traditional portfolios. The added value of hedge funds is almost always indicated in a mean-standard deviation environment and should in our view be reconsidered. The estimated risk exposure can be quantified by the introduction of Value-at-risk analysis corrected according to higher moments of distribution. With this new risk measure, we are able to obtain a corrected value.

This special part is added in order to explain in more easy words the new concept proposed in the "Difficulties of measuring the benefits of hedge funds". The conclusion after having read this paper could be:

- Assume a lottery. Consider one person willing to buy a lottery ticket A for 1\$ and having a certain low probability of gaining \$1 million. Consider a lottery B where the person receives 1\$ but has to pay with a certain low probability \$1 million. Which lottery do you prefer ? If it is lottery A, you are risk averse and you do not like positive skewness. If it is lottery B, you are not risk averse and you like negative skewness.

Lottery A faces an almost certain loss of a trivial amount in exchange for a trivial probability of a very large gain. The expected return of lottery A is of course negative since the government extracts a significant portion of the revenues. Lottery players thus pay a premium in exchange for positive skewness.

This is what we proposed in this paper. We measure the value of this premium with the risk measure developed in this paper. As hedge fund has often negative skewness (ie. they receive this premium), they have this certain low probability to pay \$1 million. our measure take that into account and combine optimally the hedge funds in order to diminish the amount to pay with a low probability.

- Volatility will not ranked the risk of the hedge fund as soon as they have this skewness characteristic.
- A hedge fund portfolio constructed with the volatility only will underestimate the risk of loss of the portfolio.

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Introduction

The hedge fund industry is in the midst of a boom. According to TASS,¹ the industry reported record inflows of more than USD 8 billion in the second quarter of 2001, the highest quarterly figure since records began at the beginning of 1994. In the first quarter of 2001 year, the money invested in the hedge fund sector (approx. USD 7 billion) was almost equal to the amount invested throughout the whole of last year.

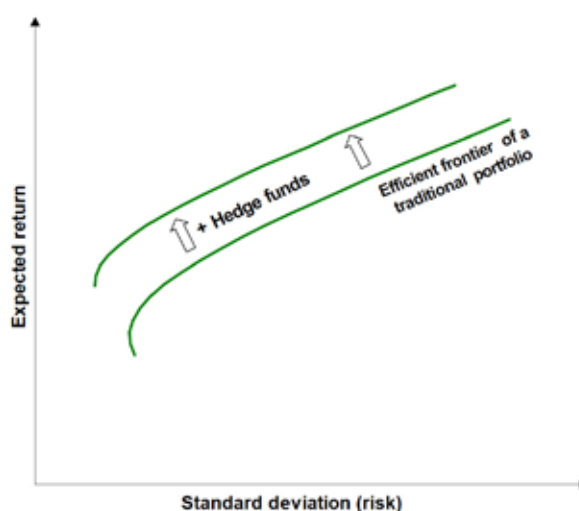
Banks are increasing the proportion of alternative investments in their asset allocation, and even pensions funds are taking a more positive view of this investment instrument. The fashionable nature of hedge funds is also reflected in financial publications, which have devoted a great deal of copy to this investment category over the past few months.

State-of-the-art

The arguments used for showing the superiority of hedge funds over traditional investments, such as bonds and equities, is that they offer better risk-adjusted returns and they have a low correlation with events on financial markets.

A risk/return diagram is generally used to show how a higher efficiency line can be achieved by including hedge funds in a traditional portfolio (Exhibit 1). This means that a greater return can be generated for the same risk, or a lower risk accepted for the same return. Risk is measured as the fluctuation in returns around the mean value, the so-called standard deviation. This diagram is also known as the mean-variance diagram.

Exhibit 1: Diagram illustrating the benefit of hedge funds in a traditional portfolio



The benefits hedge funds bring to a traditional portfolio are almost always explained and justified by a shift in the efficiency line in a mean-variance environment. This is now the standard procedure in theory and practice and can be described as a 'state-of-the-art' way of highlighting the benefits of hedge funds in a traditional portfolio and is repeatedly rolled out at most conferences and in many works about hedge funds.

Below is a rundown of academic works which show how, in a mean-variance environment, hedge funds shift the efficiency line of a traditional portfolio to the top left towards better risk-adjusted returns.

Exhibit 2: Academic literature and shift in efficiency line

Authors	Source	Hedge fund data	Period examined	Results
AGARWAL, Vikas / NAIK, Narayan Y.	On Taking the "Alternative" Route: Risks, Rewards, Style and Performance Persistence of Hedge Funds. <i>Journal of Alternative Investments</i> , Spring 2000, Vol. 2, No. 4, p. 6-23	HFR (Hedge Fund Research) as well as TASS and Altvest	January 1994 - Sep. 1998	A mean variance analysis carried out shows that a combination of alternative investments and passive investing generates significantly better risk-adjusted returns than just passive indexing.
EDWARDS, Franklin R. / LIEW, Jimmy	Hedge Funds versus Managed Futures as Asset Classes. <i>The Journal of Derivatives</i> , Summer 1999, p. 45-61	MAR (Managed Account Reports)	January 1982 - Dec. 1996	Passive investing in equity and commodity indices is no substitute for investing in hedge funds and managed futures. With passive index strategies, the efficiency line of a traditional portfolio can be shifted northwest, but this effect is accentuated by including hedge funds and managed funds. The various efficiency lines are shown in a standard deviation/return environment.
INEICHEN, Alexander M.	In Search of Alpha. Global Equity Research UBS Warburg, London, October 2000, p. 149-150	TASS (CSFB/Tremont HF Indices) and HFR	January 1990 - April 2000	Long/short equity strategies are ideal for equity investors in order to minimize risk (standard deviation) without incurring substantial losses at the expected return.
LAMM, R. McFall	Portfolios of Alternative Assets: Why not 100% Hedge Funds? <i>The Journal of Investing</i> , Winter 1999, p. 87-97	EACM 100 (Evaluation Associates Capital Markets) and TASS (CSFB/Tremont HF Indices)	January 1991 - Dec. 1997	Hedge funds represent a conservative investment, primarily to replace investments in bonds and cash. This statement contradicts the widely held view that hedge funds are risky investments. Both aggressive and conservative investors can improve the risk-adjusted return of their traditional portfolio by including hedge funds.
MODIGLIANI, Leah	Quantitative aspects of analyzing risk – are hedge funds worth it? in: LAKE, Ronald A. (ed.): <i>Evaluating and Implementing Hedge Fund Strategies</i> , 2nd edition, London 1999, p. 326-329	HFR (Hedge Fund Research)	2nd quarter 1992 - 2nd quarter 1997	Specific selected hedge funds are combined with the S&P 500. The resultant Sharpe ratio is higher in all these combinations than that of the benchmark (S&P 500).
LIANG, Bing	On the Performance of Hedge Funds. <i>Financial Analysts Journal</i> , July/August 1999, Vol. 55, No. 4, p. 72-85	HFR (Hedge Fund Research)	January 1994 - Dec. 1996	The efficiency line of hedge funds is way above that of mutual funds. The monthly standard deviation is used as the measurement of risk. Compared with mutual funds, hedge funds show a better risk/return trade-off. Higher Sharpe ratios and higher abnormal returns.

Authors	Source	Hedge fund data	Period examined	Results
SCHNEEWEIS, Thomas / MARTIN, George	The Benefits of Hedge Funds: Asset Allocation for the Institutional Investor. <i>Center for International Securities and Derivatives Markets</i> , University of Massachusetts, Amherst, September 2000, p. 11-15, 24, 36-38	EACM 100 (Evaluation Associates Capital Markets) and HFR (Hedge Fund Research)	January 1990 - April 2000	Increase in the Sharpe ratio (as measurement of the risk-adjusted return) of 57% if hedge funds (EACM 100) are added to make up 20% of a traditional portfolio (50% S&P 500; 50% Lehman Brothers gov/corp. bonds). Markowitz return/risk optimization shows a shift in the efficiency line as a result of including hedge funds.
SCHNEEWEIS, Thomas / SPURGIN, Richard / KARAVAS, Vassilios N.	Alternative Investments in the Institutional Portfolio. <i>Alternative Investment Management Association (AIMA)</i> , August 2000	EACM 100 (Evaluation Associates Capital Markets)	January 1990 - Dec. 1998	The risk-adjusted return of a traditional portfolio can be increased by adding hedge funds and managed futures. In extreme market conditions, i.e. extremely low or high returns in the traditional portfolio, the risk-lowering and return-increasing effect of the hedge fund and managed futures portfolio is even greater.
Tremont Partners Inc. / TASS Investment Research	The Case for Hedge Funds. <i>The Journal of Alternative Investments</i> , Winter 1999, Vol. 2, No. 3, p. 71-72	TASS (CSFB/Tremont Hedge Fund Indices)	January 1990 - March 1999	Three hedge fund sub-indices (long/short US equities, long/short European equities and long/short global equities) are added to a pension fund index at 5, 10, 15 and 20%. The greater the proportion of hedge fund sub-indices, the greater the risk-adjusted return. Standard deviation is taken as the measurement of risk.

Critique

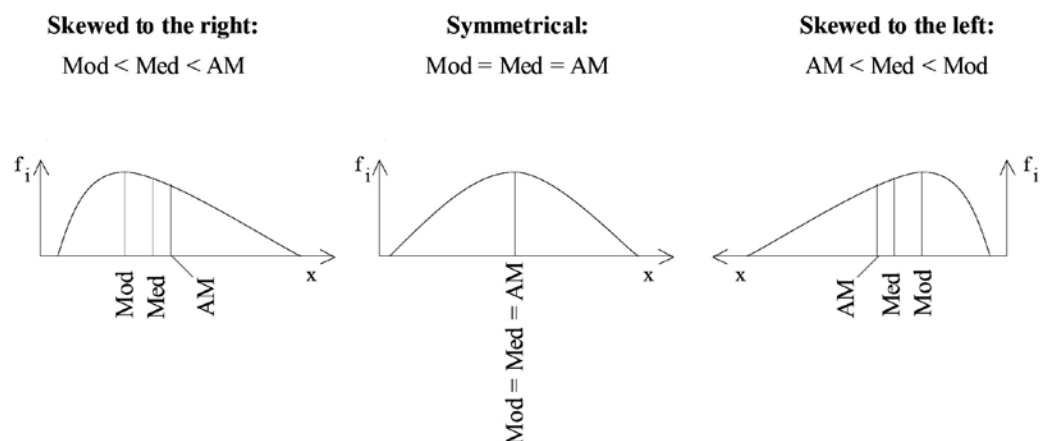
If, however, risk is only defined as standard deviation or variation of a return distribution, the investor is faced with two main problems with this risk measurement.

First, the negative and positive deviations from the mean value are incorporated in the standard deviation calculation, but investors see the positive deviations more as an opportunity rather than a risk. Second, other parameters that could be crucial for investor are ignored by just concentrating on the first two moments of the distribution (average return and standard deviation).

The return distributions of hedge funds cannot be characterised by the mean return and standard deviation alone. Nearly all strategies demonstrate negatively skewed (i.e. skewed to the left) return distributions, skewness being the third moment of a distribution. This is an unwelcome characteristic for the risk-averse investor, as he obviously has a clear preference for a positively skewed (i.e. skewed to the right) portfolio, which offers much greater protection against losses by comparison and also promises greater earnings opportunities in the form of higher returns. Most hedge fund strategies can also show positive 'excess kurtosis' (fourth moment of a distribution), where earnings occur with above-average frequency at both ends of the distribution. This is also known as 'fat tails'.

The assumption behind the mean-variance world is that the returns are normally distributed. This assumption is not valid when returns are skewed. Exhibit 3 shows how the skewness of a distribution affects its shape: unlike the negatively skewed distribution, the positively skewed one has a comparatively greater tendency towards high positive returns and better protection against losses. However, the probability of achieving returns under the arithmetic mean is greater with the positively skewed distribution, while the negatively skewed returns tend to produce more positive returns.

Exhibit 3: Skewness of a distribution



where:

Mod = Modus; the most frequently occurring value;

Med = Median; the median or central value is a value that divides into two the variable values that are arranged by size (both left and right sides of the median each feature 50% of the values arranged by size)

AM = Arithmetic mean; sum total of the values weighted with relative frequencies

f_i = Frequency; frequency with which a specific value x occurs

Negative skewness and positive excess kurtosis are unwelcome distribution features for the investor, but these are not taken into account in a mean variance world.

The mean-variance approach will classify distributions as equally beneficial if they show the same mean values and standard deviations. If the distribution of returns does not move far from the normal distribution and therefore skewness and kurtosis show negligible values, the mean variance concept produces correct results. It is conceivable, however, that the shift in the efficiency line in a mean-variance world is exaggerated if strategies have negatively skewed return distributions and fat tails. The same applies to mean variance-based performance figures, such as Sharpe ratio (expected return minus risk-free interest rate divided by standard deviation). The deviation from the normal distribution is obvious in hedge funds in particular, as these vehicles use mostly dynamic strategies and options with asymmetric pay-off profiles.

The next section proposes a new risk measure, called Modified Value-at-Risk when returns are not normally distributed. After that this measure is applied to a Swiss pension fund portfolio where a maximum of 10% of hedge fund strategies are added.

Modified VaR

The usual approach in the mean-variance concept does not go far enough for hedge funds because various risks are ignored that are specific to hedge funds. One potential solution would be to adjust the return or the risk. As the previous discussion shows since standard deviation is not a suitable method for measuring hedge fund risk, adjusting the risk is an obvious answer. A risk

measure has to be found, in which third and fourth order moments are taken into account, and positive deviations from the mean value are not regarded as risk.

One very promising method is to use Value at Risk (VaR), which is a one-sided loss-oriented measurement of risk and can therefore meet the latter requirement mentioned above. Unlike the two-sided fluctuation risk, which can be measured through a distribution measure such as variance or standard deviation, the VaR attempts to quantify the risk of losses, ignoring the earnings opportunities that contrast with the potential losses. The VaR is normally regarded at a probability or confidence level of 95% or 99%. The basic idea of the VaR at the 99% probability level is only to include the 99% smallest losses and determine the VaR as the maximum of these losses. By doing so, the major losses that occur with only a probability of 1% or less are disregarded. This means that the VaR is not a maximum loss, but a loss barrier that at most will be exceeded by a probability of 1%.

If the returns are distributed normally, the VaR is defined as follows:

$$VaR = W(\mu\Delta t - n\sigma\sqrt{\Delta t}) \quad (1)$$

where:

μ = portfolio historic mean return

W = current value of the portfolio

n = number of standard deviations (depending on confidence level)

σ = standard deviation for a specific time period²

Δ_t = time window

If the returns are distributed normally, there is essentially no difference between the two measurements, i.e. VaR and standard deviation, as the VaR is simply a multiple of standard deviation (factor depending on probability level). For example, if the confidence level is 99%, the VaR is simply standard deviation multiplied by 2.33, this result being deducted from the expected return or historical mean value of returns. This form of VaR is hereinafter referred to as 'normal VaR' (as opposed to 'modified VaR' which is described below).

The 'Critique' section pointed out that nearly all hedge fund strategies show negatively skewed return distributions with positive excess kurtosis. It is, therefore, not realistic to assume that hedge funds returns are distributed normally, as implied in a mean variance environment and when calculating the above-mentioned 'normal' VaR values. Replacing standard deviation with normal VaR values brings an improvement only if negative deviations from the mean value are regarded as risk, but this is not a satisfactory solution if hedge fund returns are not distributed normally.

If returns are not distributed normally, a simple VaR model can no longer be used, so another method is required to calculate the VaR. One option is the so-called Cornish-Fisher expansion, which can adjust the VaR in terms of asymmetric distribution (skewness) and above-average frequency of earnings at both ends of the distribution (kurtosis).³ This method of calculating the VaR is hereinafter referred to as modified VaR.

The Cornish-Fisher⁴ expansion is defined as follows:

$$z_{CF} = z_C + \frac{1}{6}(z_C^2 - 1)S + \frac{1}{24}(z_C^3 - 3z_C)K - \frac{1}{36}(2z_C^3 - 5z_C)S^2 \quad (2)$$

2 - Standard deviation for a specific time period is annualized by the root of the time. For example, monthly standard deviation can be calculated using monthly returns (if available). Annual standard deviation is obtained by multiplying the monthly values by the root of the time, i.e. here by the root of 12. This technique is valid only when returns are normally distributed.

3 - See MINA/ULMER (1999). Mina and Ulmer give four methods of calculating the VaR for values not distributed normally. These are: Partielle Monte-Carlo, Fourier method, Johnson transformation and the Cornish-Fisher expansion. According to their research, Cornish-Fisher is quick and easy to follow, but not always accurate depending on the distribution. This method is entirely adequate for our purposes of showing how standard deviation is an unsuitable measurement of hedge fund risk.

4 - See CORNISH/FISHER (1937)

where:

z_C = critical value for the probability $(1-\alpha)$ with a standard normal distribution (-2.33 at 99%)

S = skewness

K = excess kurtosis

where the skewness and kurtosis of a distribution are defined as follows:

$$S = \frac{1}{T} \sum_{t=1}^T \left(\frac{R_t - \bar{R}}{\sigma} \right)^3 \quad (3)$$

$$K = \frac{1}{T} \sum_{t=1}^T \left(\frac{R_t - \bar{R}}{\sigma} \right)^4 - 3 \quad (4)$$

The modified VaR therefore comes to:

$$VaR = W(\mu - z_{CF}\sigma) \quad (5)$$

The Cornish-Fisher expansion means that the VaR can be calculated for asymmetric distributions. In a normal distribution, S and excess K are both zero and z_{CF} is the same as z_C in the above equation. Using modified VaR values produces startling and revealing results for hedge funds.

The sample portfolio

The sample portfolio is made up of hedge funds, Swiss equities, international equities as well as domestic and foreign bonds. The investor is assumed to be a conservative one who thinks in Swiss francs, so the currency risk is hedged. The Swiss equities asset category is represented by the Swiss Performance Index, the hedge funds by indices of a well-known hedge fund database (TASS) and the remaining asset categories by MSCI indices.

Exhibit 4: Proxies for the various asset classes

Asset class	Proxy
Hedge funds	Indices from the TASS database selected according to specific criteria
Swiss equities	Swiss Performance Index (SPI)
International equities	MSCI World
Swiss bonds	MSCI Fixed Income Switzerland
International bonds	MSCI Fixed Income World

* The survivorship bias is only diminished in TASS; see Liang (2000)

The period under review was taken as 1 January 1994 – 31 December 2000. An earlier starting date was not used as the hedge fund sector only began to take off at that time.

It was also only from 1994 that the major data providers started leaving in their databases the performance figures that 'dead' funds achieved in their 'lifetime', thus significantly helping alleviate the so-called 'survivorship bias' problem.⁵ If a database only includes existing hedge funds, the performance of the individual indices will be automatically too high. As mentioned above, the major data providers first started doing this from 1994 onwards.

5 - See also LIANG (2000)

The individual asset classes can vary within specific limits. As a result, a relatively conservative asset allocation was deliberately chosen to match the allocations of conservative investors, pension funds and institutions.

Exhibit 5: Upper and lower limits for individual asset classes

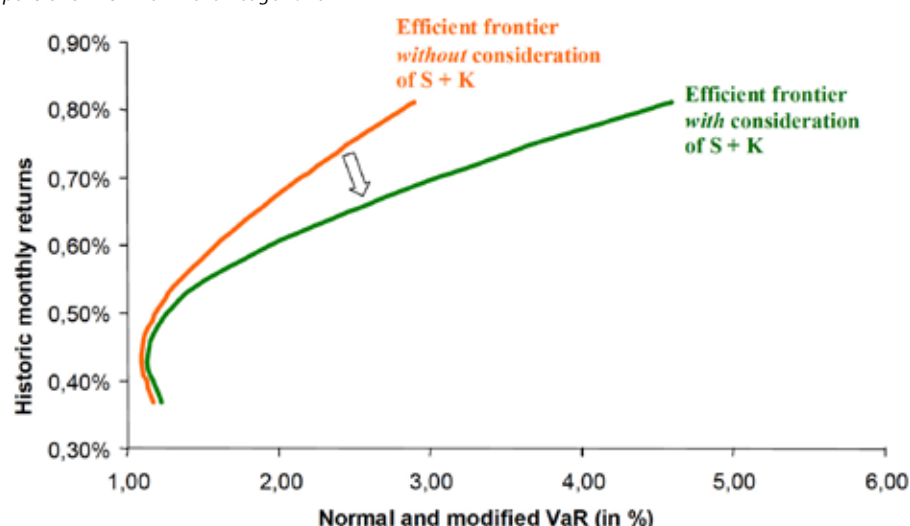
Asset class	Min.	Max.
Hedge funds	0%	10%
Swiss equities	0%	30%
International equities	0%	25%
Swiss bonds	0%	100%
International bonds	0%	20%
Total of hedge funds and equities	0%	55%

The weightings of the individual asset classes are then changed within the permitted margins so as to minimise the normal VaR.⁶ This is enough to minimize the standard deviation or variance in the mean-variance concept and therefore enough for the standard procedure of demonstrating the effect of including a hedge fund in a traditional portfolio. In a second step, modified VaR values are calculated as a more precise measurement of risk.

Calculations based on monthly returns also produce monthly standard deviations or VaR values. If, for example, a VaR of -5% is calculated with these values, this means there is a 1% chance that the loss will be greater than 5% next month (or a 99% chance that it will be lower or the same).

The following graph shows the degree to which the sample portfolio with a hedge fund portion of maximum 10% is represented too positively (in the sense of returns being too favourably risk-adjusted) by not taking account of the skewness and kurtosis of the return distributions. The TASS Composite Index is used to give an overall picture of hedge funds, as it covers the entire sector and all strategies on a capital-weighted basis.

Exhibit 6: Sample portfolio with max. 10% hedge fund



It is assumed that the investor is seeking an annual return of 7.5% with this sample portfolio (equivalent to 0.625% per month; pension funds must achieve a minimum return of 4% per annum). This means that he/she will *underestimate* the risk by 28% if he/she is looking to achieve this with standard deviation or normal VaR. The error rapidly increases the higher the required return. Thus, without skewness and kurtosis, one would underestimate the risk.

6 - The optimisation process works as follows: the different asset classes are given various weightings, starting for example, with 100% Swiss bonds, the weighting is systematically reduced. Ultimately, only those combinations are taken into account that can deliver the lowest VaR at the given return. Around 80 different efficient portfolios are normally used, with the five asset classes each having differing weightings. The monthly returns are then calculated for every efficient portfolio for the last seven years, producing a matrix of more than 6,000 return figures (84 monthly returns time 80 different weightings). For the individual efficient weightings or portfolios, the VaR (normal and modified) and four moments of distribution, i.e. skewness and kurtosis, standard deviation and average return, are calculated on a monthly basis.

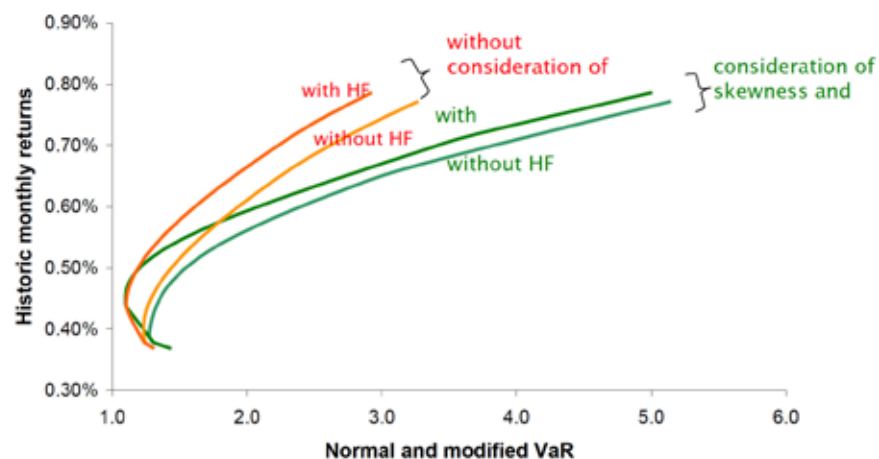
More comprehensive assessment including the traditional portfolio

Ultimately, the investor is not interested in whether hedge funds are represented too favourably in a mean-variance concept or not. The crucial question for him/her is whether including hedge funds makes sense for his/her portfolio. In order to assess this, the traditional portfolio must also be examined for skewness and kurtosis values and adjusted accordingly.

If the hedge fund portfolio shows less favourable skewness and kurtosis values than the traditional one (as it normally should), then in the mean-variance concept, the effect of including hedge funds is shown too positively, and the shifting of the efficient frontier to the top left⁷ is too great. Such a condition occurs if the hedge fund portfolio comprises event driven strategies, which typically show high negative S and K values.

The arrows in the graph in Exhibit 7 show the shift in efficiency lines, or rather the positive effect of including event driven strategies in a traditional portfolio. The added value of hedge funds is much lower if skewness and kurtosis are taken into account (e.g. by using modified VaR as a risk measurement), which includes higher moments of a distribution. The two upper efficiency lines the classic picture, as can be seen in a mean variance diagram.

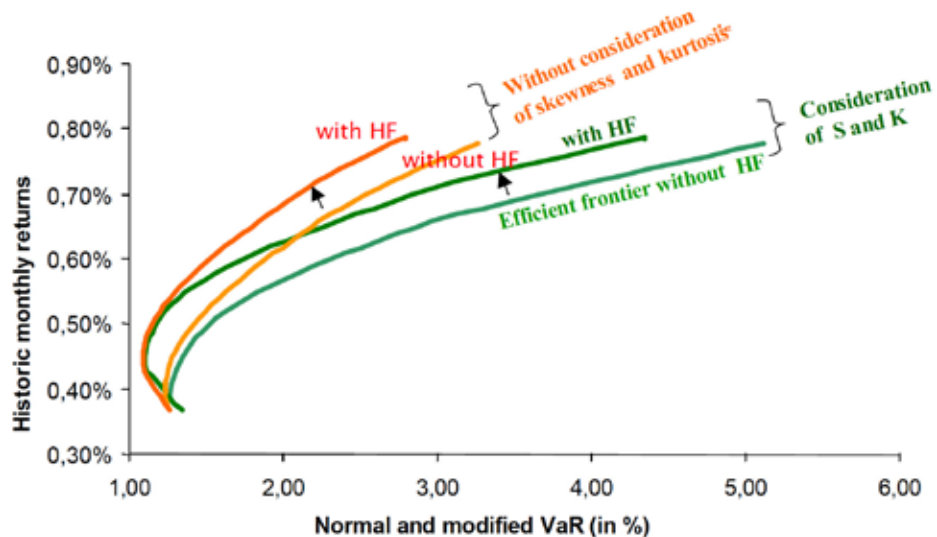
Exhibit 7: Pension fund portfolio with 10% Event-Driven strategy



The other less common scenario is also possible of course, where the hedge fund portfolio shows similar or better skewness and kurtosis values than a traditional portfolio. This can occur if the investor chooses a hedge fund strategy with low S and K values, or if the traditional portfolio is defined by high S and K values.

The first scenario can be realised if the hedge fund portfolio is made up of equity market-neutral strategies, which typically show low S and K values. In this situation, the positive effect of including hedge funds would be similar or even greater than demonstrated in a mean variance environment.

Exhibit 8: Pension fund portfolio with 10% equity market neutral strategies:



Conclusion

The mean-variance concept normally shows hedge funds too positively (in the sense of better risk-adjusted returns), as it does not take account of certain risk factors, but it would be wrong to conclude that there is no justification for including hedge funds in a portfolio. Ultimately, the investor is only interested in whether he/she will derive a benefit from adding hedge funds to his/her portfolio. In order to assess this, other aspects have to be examined, such as higher moments of the hedge fund portfolios and the traditional portfolio. Including hedge fund strategies with high negative skewness and kurtosis values in a portfolio does bring a benefit in the sense of better risk-adjusted returns, but not to the extent that the mean variance concept seeks to maintain. To gain a further perspective, other criteria have to be taken into account in addition to first- to fourth-order moments, notably liquidity risks and survivorship biases. In our opinion, however, a great deal would be achieved if more skewness and kurtosis values were taken into account when assessing the benefits such instruments bring.

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