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MARKETS AND INDUSTRY

AN EVALUATION OF HEDGE FUNDS: RISK, RETURN AND PITFALLS

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Hedge funds are collective investment vehicles fast becoming popular with high net worth individuals as well as institutional investors. These are funds that are often established with a special legal status that allows their investment managers a free hand to use derivatives, short sell and exploit leverage to raise returns and cushion risk. Given that they have substantial latitude to invest, it is instructive to examine the performance of hedge funds as compared to other forms of managed funds. This paper provides an overview of hedge funds and discusses their empirical risk and return profiles. It also poses some concerns regarding the empirical measurements. Given the complexity of hedge fund investments, meaningful analytical methods are required to provide greater risk transparency and performance reporting. Hedge fund performance is also beset by a number of practical issues generating "practical risks". These risks are not fully addressed by the usual risk-adjusted performance measures in the literature. A penalty function to discount these extraneous risk dimensions is proposed. The paper concludes that further empirical work is required to provide informative statistics about the risk and return of hedge funds.

Keywords: Hedge funds; Risk management; Performance measurement; Nonnormal distribution; Hurst Ratio; Risk penalty function.

1. Background

Since the early 1990s, there has been a growing interest in the use of hedge funds amongst both institutional and high net worth individuals. Due to its private nature, it is difficult to obtain adequate information about the

operations of individual hedge funds and reliable summary statistics about the industry as a whole.

Hedge funds are known to be growing in size and diversity. As at the end of 1997, the MAR/Hedge database recorded a total of more than 700 hedge fund managing assets of US$90 billion (see Table 1). This is only a partial picture of the industry, as many funds are not listed with MAR/Hedge. In practical terms, it is not easy to estimate the current size of the hedge fund industry unless all funds are regulated or obligated to register their operations with a common authority. Brooks and Kat (2001) estimated that, as at April 2001, there are around 6000 hedge funds with an estimated US$400 billion in capital under management and US$1 trillion in total assets.

While hedge funds are well established in the US and Europe, they have only begun to grow aggressively in Asia. In the week ending April 30, 2002 alone, 8 new funds were introduced or launched. These were funds initiated by familiar names like Merrill Lynch, Lazard, Morley, Societe Generale, HSBC and Crosby. In year 2000, there were some 30 funds that were established. They attracted about US$600 million in capital. Another 20 hedge funds were set up in 2001. Many of these were start-ups and founded by talents who were previously employed by large institutional fund management companies. In 1999, HedgeFund Intelligence launched a new publication, AsiaHedge. Recently, AsiaHedge has also set up 4 Asia-Pacific Hedge Fund Indices, covering

Table 1. MAR Hedge Fund Categories: December 1997 Mean and Standard Deviation of Returns (1990–1997)

		1990–1997			
Category	Number	Assets (US$ billion)	Mean Return (%)	Standard Deviation (%)	Risk-adjusted Returns
Event-driven	120	8.6	18.9	5.9	3.2
Global	334	30.9	17.7	9.4	1.9
Global/macro	61	29.8	28.1	16.3	1.7
Market neutral	201	18.0	8.6	2.1	4.1
Sectors	40	1.8	29.6	15.9	1.9
Short-sellers	12	0.5	7.0	15.2	0.5
Long-only	15	0.4	27.3	15.4	1.8

Source: Eichengreen *et al.* (1998, p. 37)
Note:

(a) The mean returns are annually compounded returns over the period 1990 to 1997, except for the Long-only Funds, which were computed from 1994 to 1997.

(b) The annualized standard deviations were computed from the standard deviation of monthly returns for each investment style.

(c) Risk-adjusted returns are obtained by dividing the mean return by the standard deviation.

funds in four geographic areas: Japan, Asia ex-Japan, Asia inclusive of Japan and Australia.

AsiaHedge currently has reported data of about 150 hedge funds operating in Asia and Australia and/or investing in the Asia-Pacific markets. These hedge funds, like their counterparts in the U.S. use long/short, global/macro and event-driven strategies.

Three interesting features differentiate hedge funds from other forms of managed funds. Most of them are small and organized around a few experienced investment professionals. In fact, more than half of U.S Hedge Funds manage amounts of less than US$25 million. Moreover, most hedge funds are leveraged. It is estimated that 70 per cent of hedge funds use leverage and about 18% borrowed more than one dollar for every dollar of capital.[1] Another peculiar feature is the short life span of hedge funds. Hedge funds have an average life span of about 3.5 years.[2] Very few have a track record of more than 10 years. These features lead many to view hedge funds as "risky" and "opportunistic".

2. What Are Hedge Funds?

"Hedge Funds" is a term coined by a journalist, Carol Loomis, to describe an innovative investment structure first created by Alfred Winslow Jones. Jones had established a fund with unique features: (a) He set up "hedges" by investing in securities that he determined as undervalued and funding these positions partly by taking short positions in overvalued securities, creating a "market neutral" position; (b) He also designed an incentive fee compensation arrangement in which he was paid a percentage of the profits realized from his clients' assets; and (c) He invested his own investment capital in the fund, ensuring that his incentives and those of his investors were aligned and forming an investment "partnership".

Currently, most hedge funds retain these features. They are set up as limited partnerships with a lucrative incentive-fee structure. Hedge fund managers often also have a significant portion of their own capital invested in the partnerships.

However, the term "hedge fund" has also been generalized to describe investment strategies that range from the original "market-neutral" style of Jones to many other strategies and opportunistic situations, including global/macro investing, such as the Quantum Fund of George Soros. Soros is famous for his "attack" on Sterling in September 1992, when he was reported to have a US$10 billion short position. He made $1 billion when the British Pound subsequently devalued. Soros shorted the Pound but was long the Yen.

[1] See Eichengreen and Mathieson, p. 7.
[2] Stefano Lavinio, p. 128.

Due to the diversity of the industry, there is no standard method to classify hedge funds neatly. In the industry, there are at least 8 major databases set up by data vendors and fund advisors. We follow the classification used by Eichengreen and Mathieson (1998), who relied on the MAR/Hedge database. Under this classification, there are 8 categories of hedge funds with 7 differentiated styles and a fund-of-funds category:

(a) **Event driven funds.** These are funds that take positions on corporate events, taking an arbitraged position when companies are undergoing re-structuring or mergers. For example, hedge funds would purchase bank debt or high yield corporate bonds of companies undergoing reorganization (often referred to as 'distressed securities'). Another event-driven strategy is merger arbitrage. These funds seize the opportunity to invest just after a takeover has been announced. They purchase the shares of the target companies and short the shares of the acquiring companies. Occasionally, they carried out the reverse if the deal would likely fail.

(b) **Global funds** is a catchall category of funds that invest in non-US stocks and bonds with no specific strategy reference. It has the largest number of hedge funds. It includes funds that specialize on the emerging markets.

(c) **Global/Macro funds** refer to funds that rely on macroeconomic analysis to take bets on major risk factors, such as currencies, interest rates, stock indices and commodities.

(d) **Market neutral funds** refer to funds that bet on relative price movements utilizing strategies such as long-short equity, stock index arbitrage, convertible bond arbitrage and fixed income arbitrage. Long-short equity funds use the strategy of Jones by taking long positions in selective stocks and going short on other stocks to limit their exposure to the stock market. Stock index arbitrage funds trade on the spread between index futures contracts and the underlying basket of equities. Convertible bond arbitrage funds typically capitalize on the embedded option in these bonds by purchasing them and shorting the equities. Fixed income arbitrage bet on the convergence of prices of bonds from the same issuer but with different maturities over time. This is the second largest grouping of hedge funds after the Global category.

(e) **Sector funds** concentrate on selective sectors of the economy. For example, they may focus on technology stocks if these are over-priced and rotate across to other sectors.

(f) **Short-sellers** focus on engineering short positions in stocks with or without matching long positions. They play on markets that have risen too fast and on mean reversion strategies.

(g) **Long-only funds** take long equity positions typically with leverage. Emerging market funds that do not have short-selling opportunities also fall under this category.
(h) **Fund of funds** refer to funds that invests in a pool of hedge funds. They specialize in identifying fund managers with good performance and rely on their good industry relationships to gain entry into hedge funds with good track records.

Table 1 presents statistics about the various categories of hedge funds and past performance. The sectoral hedge funds provided the best mean return over the period studied, while the "market-neutral" funds had the lowest standard deviation of returns. On a risk-adjusted basis (dividing the mean return by the standard deviation), the category of fund that ranks highest is the market neutral funds followed by event-driven funds. But, before this conclusion is valid, more discussion follows on the empirical problems using the data obtained from incomplete databases.

3. Why Invest in Hedge Funds?

Traditional asset allocation optimizes the use of equities, bonds, real estate and private equity to invest in a portfolio that maximizes returns and minimizes the portfolio risk. With this objective, hedge funds become a natural candidate for consideration. Firstly, it is commonly believed that hedge funds may have superior returns. There are many anecdotal stories about the stunning success of hedge fund managers and their skills. Soros was reported to have obtained returns in excess of 30% p.a for a good number of years. From Table 1, there is also apparent evidence that hedge funds, as a group, have returns that are impressive. For example, over the period 1990–1997, all the hedge funds had positive absolute returns. Global/Macro funds obtained mean returns of 28.1% p.a. with a standard deviation that is comparable to equity funds.

Secondly, hedge funds have returns that are generally believed to be uncorrelated to the traditional asset classes and may even have a lower risk profile. For example, Morgan Stanley Dean Witter (November 2000, p. 1) reported that hedge funds "exhibit a low correlation with traditional asset classes, suggesting that hedge funds should play an important role in strategic asset allocation". Table 2 shows a common presentation of the underlying relationships between hedge funds and the other assets.

Thirdly, in a bear market, many investment mangers find it uninteresting to merely beat the market index, which may have negative returns. They would have preferred to go short or avoid long positions to have positive returns. Investing in appropriately chosen hedge funds may provide the possibility of obtaining positive "absolute returns".

Table 2. Performance Measures For Hedge Fund Indices (Jan 1990–April 2000)

	Annualized Return (%)	Annualized Std Dev (%)	Correlation with S&P 500	Correlation with Lehman Bro Gov/Corp
EACM 100[1]	15.2	4.4	0.37	0.19
Eq Mkt Neutral	9.1	3.2	−0.11	0.15
Eq Hedged	20.6	10.3	0.20	0.00
Event	13.7	5.4	0.48	0.09
Global/Intl	20.8	11.5	0.61	0.15

Source: Lehman Brothers (2000)
Note: 1. The EACM 100 is an index of hedge funds representing a wide range of strategies.

The foregoing provides persuasive reasons to consider hedge funds as "alternative investments". However, relying on statistics culled from public databases is fraught with data biases. An uninformed investor may be misled into common misperceptions about the return and risk of hedge funds. There is now recent and definitive work by a number of authors that have provided fascinating revelations about the risk and return profiles of hedge funds which are discussed below.

4. Commercial Databases and Statistical Inferences

4.1. *Data collation issues*

Organized as private limited partnerships, and frequently as offshore investment vehicles, hedge funds generally do not disclose their activities to the public. This has resulted in frequent complaints about the lack of transparency. Fortunately, many funds do release selective information to publicize themselves and their performance to attract new investors. These data are collected by a small number of data vendors and fund advisors. A few large advisors and vendors are currently publishing performance data and indices/subindices periodically corresponding to the various investment strategies. A listing of Hedge Funds Databases and some descriptive details is provided in the Appendix.

However, voluntary participation in performance reporting leads to incompleteness of information regarding the hedge fund population as a whole. Thus, sampling biases are present whenever an investor analyses a hedge fund database on a stand-alone basis. Some of theses biases are briefly discussed below.

4.2. *Survivorship bias*

Databases obviously only include hedge funds that submit information. Funds that perform poorly often choose not to submit their performance. Thus,

poorly performing funds are likely to be missing in a database. A "survivorship bias" arises when a database includes only the performance of funds that are alive and present at the end of the sample period. A subset of survivorship bias, called liquidation bias, occurs when disappearing funds may not report final periods leading up to and including their liquidation. If funds cease operation due to poor performance, the historical returns of surviving funds in the database is biased upward with risk biased downward relative to the population of hedge funds.

Hedge funds may exit a database for reasons other than poor performance. Database vendors often delist funds that do not provide reliable information. Some popular funds also stop reporting their performance when they have reached a desired size, and do not need to further solicit "new" money. Omissions of these funds would also severely bias a database.

Brooks and Kat (2001) stated that around 30% of newly established funds do not survive the first three years, primarily due to poor performance. Thus, not including defunct funds is likely to lead to over-estimation of the returns and profile of the hedge fund industry. Fung and Hsieh (2001a) found that estimates of survivorship biases differed across two commonly used databases, HFR and TASS. The survivorship bias (and attrition rate) was much higher in TASS than that in HFR. They estimated that survivorship bias would over-report hedge fund mean returns by about 1.5% to 3% per annum.

4.3. *Selection bias*

Database vendors impose their own criteria before a hedge fund may enter their database. The criteria would include the type of fund involved, track record and assets under management. Databases may also exclude types of hedge funds whose trading activities or instruments do not meet their criteria. Again, the result is a likely *upward* bias in the database, which has become a biased sample belonging to the larger population.[3]

Data collation and statistical biases present problems when generalizations have to be made about the returns and risk across the different categories of hedge funds. These biases also affect the computation of hedge fund indices. Since this is so, statistical inferences about the performance of hedge fund returns and the returns on hedge fund indices may not be reliable.

Brooks and Kat (2001) provided evidence to support this view. They showed that different databases have different sample statistics for similar categories of funds. Table 3 shows that the mean return for macro hedge

[3]Park (1995) analyzes a subset of selection bias termed "instant history bias". This bias arises because when a new fund is first included, database managers often "back-fill" its performance history. Up to a year or more of data may be added to the database. Again, another sampling bias is added onto the database.

Table 3. Hedge Fund Indices from Different Databases Mean and Standard Deviation of Returns (Jan 1995–Apr 2001)

Category/Database	Mean (%)	Standard Deviation (%)
Risk Arbitrage[1]	14.1[3]	
Zurich[2]	13.2	12.8
Hennesse	13.0	11.8
Tuna	14.9	12.4
Altvest	15.6	13.4
HFR	13.6	12.7
Macro	13.3	
Zurich	10.2	19.3
Hennesse	10.4	30.6
HFR	13.2	28.1
CSFB/Tremont	17.2	50.2
Tuna	15.6	33.8
Altvest	17.0	32.6
Van	9.4	41.8
Equity Market Neutral	12.8	
Zurich	11.9	6.5
Hennesse	8.5	10.4
HFR	10.9	13.3
CSFB/Tremont	13.7	10.8
Tuna	15.2	19.2
HFR	16.8	17.2
Market Indices		
S&P 500	18.6	54.4
DJIA	18.1	54.7
Russell 2000	13.7	69.1
NASDAQ	21.6	106.9
Lehman Government Bond	7.4	10.3

Source: Brooks & Kat (2001)
Note:

1. The major databases are explained in the Appendix
2. Zurich Capital Markets compute the indices using the MAR/Hedge database that it acquired in March 2001.
3. Simple Average of returns estimated using the different databases.

funds computed by the various databases ranges from 10.2% to 17.2%. Yet, this is a statistic for a common class of hedge funds over the same time-period. More interestingly, the standard deviation ranges from 19.3% to 50.2%. This is compelling evidence for the investor to be wary about obtaining statistics from hedge fund databases and making statistical inferences.

5. Nature of Hedge Funds, Trading Strategies and Performance Measurements

5.1. *Mean, variance, skewness and kurtosis*

It is clear that because of the method of collection and reporting of the hedge fund databases, there are biases in the data collected. Some of the returns can be viewed as the upper bound and the averages are likely to be smaller than actually reported. The wide range in returns and dispersion indicates that the mean and variance may not capture the full picture regarding the activities of hedge funds. Indeed, the organizational structure of hedge funds, their investment objectives, trading strategies and managerial compensation differentiate them significantly from the usual mutual fund. Most mutual funds are generally engaged in "buy-and-hold activities" — acquiring and managing stocks and bonds over a longer period of time. Although some mutual funds would engage in activities like leverage or short-sell, most do not.

There is now increasing evidence that hedge fund returns and hedge fund indices returns are not normally distributed. And, it is the strategies of hedge fund investments that have directly contributed to this situation. Typically, hedge fund investments are based on absolute return strategies. They are expected to deliver performance regardless of market conditions. To do so, hedge fund managers use two main approaches to achieve absolute return targets: (a) *directional* (or market timing) and (b) *non-directional* approaches.

The directional approach dynamically bets on the expected directions of the markets. Funds will invest long or sell-short securities to capture gains from their advance and decline. In contrast, the non-directional approach attempts to extract value from a set of embedded arbitrage opportunities within and across securities. The non-directional approach typically exploits structural anomalies in the financial market.

Mean-variance analysis is appropriate when returns are normally distributed or investors' preferences are quadratic. The reliability of mean-variance analysis therefore depends on the degree of non-normality of the returns data and the nature of the (non-quadratic) utility function. While the utility function may not be a serious problem, the non-normal distribution of returns presents an issue.

According to Fung and Hsieh (1999a), "... when returns are not normally distributed (as it is the case for hedge funds), the first two moments (i.e. mean and standard deviation) are not sufficient to give an accurate probability." Fung and Hsieh found that hedge fund returns are leptokurtic or fat-tailed. One likely explanation is that net returns include spreads that are distributed with fat tails.

Brooks and Kat (2001) found that hedge fund index returns are also not normally distributed. Many hedge fund indices exhibit relatively low skewness

and high kurtosis, especially in the case of funds investing in convertible arbitrage, risk arbitrage and distressed securities. These are non-normal profiles. Brooks and Kat argued that, while hedge funds may offer relatively high means and low variances, such funds give investors third and fourth moment attributes that are exactly the opposite to those that are desirable. Investors obtained a better mean and a lower variance in return for more *negative skewness* and *higher kurtosis*. There is no free lunch. These issues complicate a clear conclusion on the return and risk of hedge funds as an asset class for investment by even the most experienced investors.

Generally, the dynamic trading strategies of hedge funds render traditional mean-variance measures relatively meaningless. While some hedge funds may have low standard deviations, this does not mean they are relatively "riskless". In fact, they harbor skewness and kurtosis, which may be overwhelmingly "risky".

5.2. *Correlations of returns*

Fung and Hsieh (1997) examined the returns of hedge funds and commodity trading advisers. They confirmed that hedge fund managers and commodity trading advisers generate returns that have low correlations to the returns of mutual funds and standard asset classes. This is the benefit often cited by portfolio managers in their choice of hedge funds as an "alternative investment". Having an additional asset with a low or negative correlation permits the diversification of risk in a means-variance environment.

However, there are complications that arise in the case of hedge funds where correlation-based diversification may not be valid. Lavino (2000, p. 177) argued that many hedge funds are not *consistently* and *continuously* negatively or poorly correlated with other asset classes over time. Hedge funds may also not have meaningful standard deviations. In fact, many hedge funds have distributions with fat-tails, that is, exceptional events are more frequent than those which would have been predicted based on normality assumptions. This negates the use of correlation as a gauge to execute portfolio diversification.

Fung and Hsieh (2001) stated that "... Risk management in the presence of dynamic trading strategies is also more complex." Hedge fund managers have a great deal of freedom to generate returns that are uncorrelated with those of other asset classes. But, this freedom comes at a price. Dynamic trading strategies predispose hedge funds to extreme or tail events. Thus, correlations may come at a cost. They cautioned that "periodically the portfolio can become overly concentrated in a small number of markets" and market exposures converge. This would lead to an "implosion" due to diversification.

Andrew Lo (2001) reinforced this view. He explained that many investors participate in hedge funds to diversify their returns, as hedge fund returns

seem uncorrelated with market indexes such as S&P 500. However, uncorrelated events can become synchronized in a crisis, with correlation changing from 0 to 1 overnight. These situations are examples of "phase-locking" behavior encountered in physical and natural science.

We conclude that using means and standard deviations to report the returns and risks of hedge funds is not adequate. Providing skewness and kurtosis statistics would be helpful. Relying on simple correlation measures to diversify portfolio risks is not appropriate when deciding to add hedge funds to a portfolio of other assets.

6. Some Suggested Measures to Measure Risk and Return

Frank Sortino and Lee Price (1994) have proposed evaluating downside risks rather than total risks. They defined a new measure and termed it the Sortino Ratio. This is similar to the Sharpe Ratio, except that it uses 'downside deviation' instead of using standard deviation as the denominator.

The Sortino Ratio was developed to differentiate between deviations on the upside and on the downside and is more consistent with the investors' concern over risk of losses in their investments. The Sortino ratio also allows for the setting of a user-defined return benchmark where the numerator is the difference between the return on the portfolio and the Minimum Acceptable Return (MAR). The MAR is usually the risk free rate, zero or user-defined (for example, 5%).

We have earlier highlighted that the high skewness of a hedge fund's returns may be connected to the hedge fund manager's selection of high-reward and low variance opportunities. Lavinio (1999) has defined another measure to capture this, as follows:

$$\boldsymbol{d}\ \textbf{Ratio} = \mathrm{Abs}(d/U)$$

where,

$$d = \text{number of returns less than zero times their value}$$

$$U = \text{number of returns greater than zero times their value}$$

$$\mathrm{Abs} = \text{absolute value}\,.$$

The d Ratio compares the value and frequency of a manager's winners to losers to capture the skewness in returns. This statistic, which does not require any assumption of the underlying distribution, may be used as a proxy for a fund's risk, with $d = 0$ representing a distribution with no downside, and $d =$ infinity representing one in which the manager does not make any positive returns.

In analyzing the performance of hedge fund managers, we also need to gain insights into the permanence of a manager's skill. One way to examine

if good performance is merely transitory is to see if it is mean-reverting (i.e. whether the performance will reverse and converge toward some predictable long-term value). We can capture this with the Hurst Ratio,[4] which is defined as follows:

$$\textbf{Hurst Ratio} = \log M/(\log N - \log a)$$

where

$$\begin{aligned} M(t) &= (\max(t) - \min(t))/S(t) \\ N &= \text{length of shorter sub-periods into which a manager}'\text{s return record has been sub-divided} \\ t &= \text{number of sub-periods into which a manager}'\text{s return record has been sub-divided} \\ S(t) &= \text{standard deviation of data over sub-period } t \\ a &= \text{constant term that is negligible if track record is five years or less}. \end{aligned}$$

A Hurst Ratio between 0 and 0.5 means that a manager's return will tend to fluctuate randomly, but converge to a stable value over time. With a Hurst Ratio around 0.5, a hedge fund manager's track performance will be regarded as totally random, i.e. returns in one period are not affected by returns in another period. Such hedge funds are deemed to be "risky" as any stellar short-term gains may be accompanied by substantial losses in another time period.

Hurst Ratios, which are between 0.5 and 1, describe returns that are persistent. These fund managers have "hot" hands. We should, however, interpret such findings with care, as there is a need to examine whether the same manager can maintain his fund's Hurst Ratio in future time-periods that are beyond the chosen sampling periods. More rigorous testing is required with out-of-sample data to provide meaningful conclusions.

Though the Sortino, d and Hurst Ratios would provide additional insights to the performance and risk of hedge fund investing, further work is needed before these analytical methods can be used to report on the risk and return performance of hedge funds. In the next section, we examine some practical issues that complicate hedge fund performance.

[4]Lo (1991) applied the Hurst Ratio to stock returns and found that short-range dependence adequately captured the time series behavior of stock returns.

7. Practical Issues

We have seen that data issues may unwittingly lead to meaningless comparisons of hedge fund performance. However, even if one possesses a set of clean and reliable data, it is unlikely that there will be a statistically computed measure of risk-adjusted return, which would satisfy a sophisticated investor. Hedge funds performance measures are beset by many practical business issues, which make it extremely difficult to have a simple measure to fully convey risk and return.

Specifically, hedge funds face many practical issues that increase their "riskiness". For ease of exposition, we have identified at least 6 types of practical issues that confound risk and return measurements: style purity, consistency, fund size, use of leverage, liquidity and asset concentration. We note that some of these problems are closely linked to one another and create extraneous risks, which may not be correctly priced by the usual risk- adjusted return measures.

Firstly, many hedge funds are assumed to have a pure and consistent style. This is rarely the case. Many funds may be opportunistic and operate with more than one style. Thus, many hedge funds do not always function exactly as their self-reported classifications indicate. From the outside looking in, it is almost impossible to classify hedge funds neatly.

A hedge fund's style purity over time is definitely less consistent when compared to Unit Trusts (and mutual funds), which by nature are "buy-and-hold" accounts. Fung and Hsieh (2001b) and others have suggested using factor analysis to discern the underlying dimensions or "factors" that drive the returns for funds. This may, then, go below the surface to determine unique hedge fund strategies that differentiate one fund from another. Hopefully, this would enable an investor to detect style purity, style consistency and most importantly, style deviations.

Hillary Till (2001a and 2001b) suggested that a number of hedge fund strategies might appear to "earn their returns due to assuming risk positions in a risk-averse financial world, rather than from inefficiencies in the market place". In this sense, returns are made from a "risk transfer", and not due to managerial abilities per se. If indeed this is the case, then the skill of selecting the appropriate hedge fund styles and the type of managers who can execute the styles consistently, and how to allocate funds across these managers become important to achieve superior returns. Viewed from this standpoint, style purity and consistency are important attributes to measure exposure to hedge fund risks rather than statistical measures like variance and skewness.

A hedge fund's asset under management ("AUM") growth may be (a) internally generated through performance, (b) externally induced because of

inflows, or (c) magnified through use of higher leverage. Hedge fund size is a dimension that has significant implications for risk and return. A hedge fund's risks increases proportionately with its AUM. This is because the use of specialized strategies naturally limits a hedge fund to some "optimal size" beyond which it becomes increasingly difficult to keep the same strategy or have the opportunities for execution (often with leverage). We observe that hedge fund managers are inclined to close their funds for further investments as soon as a target size is reached. This is evidence that many managers understand the trade-offs between size and performance. Yet, many often neglect to focus on the relationship between size and risks.

Hedge fund managers are drawn to the use of leverage to magnify potential returns from small arbitrage opportunities. They are also inclined to *concentrate* their investable funds in a small subset of potentially "rich" opportunities. Weisman and Abernathy (2000) demonstrated the importance of guarding against excessive *leverage*, which is compounded by a lack of *liquidity* when a disastrous event strikes. They pointed out that if one were to construct a non-diversified, illiquid and/or leveraged portfolio and let it grow over time, it would eventually lead to bankruptcy of the fund, if a misfortune strikes. The potential risk is very high employing these strategies. The *perceived risk* may be low, as a well-constructed, downside-oriented measure using past data may not reveal the potential risks from the occurrence of a future disastrous event. *This is because a misfortune has not yet struck.* But the potential risks, which are usually unforeseen, are large and threaten the eventual survival of the fund.

8. Accounting for Various Sources of Risk

Assume that we have two hedge funds with similar statistical attributes: the same average holding period returns adjusted by its standard deviation. We want to know which fund has a better "risk-adjusted" return. Let us further assume that the *first fund* (compared to the second) is less leveraged, invests in more liquid assets, is less concentrated/ more diversified, and more disciplined in its application of investment styles. We are, most likely, very inclined to prefer the *first fund* to the second. That is because the second fund, although it has the same average return adjusted by its standard deviation, has taken extraneous risk to achieve the same results. This is especially more obvious if analyzed in the context of possible disastrous events. Thus, depending on the strategy employed, it is generally correct to say that a non-leveraged, more liquid, more diversified and more disciplined fund has a better chance of survival in the long term.

Perhaps, the crucial question has now become more obvious: how to modify "risk-adjusted returns" to account for the many other forms of risks not captured statistically. Generally, "risk-adjusted return" is defined as:

$$\frac{\text{Observed Returns} - \text{Benchmark Returns}}{\text{Indicated Risk Measure}}$$

This measure assumes that all the named variables are observable, measurable and reliable. The benchmark return may be a stock index, a contrived peer measure or the 90- day Treasury Bill rate of interest. The risk measure may be the "tracking error", "standard deviation", or some other measure.

From the foregoing, we are sanguine that this risk-adjusted measure will be able to tell the whole story. We propose, instead, a new metric to account for the numerous risks faced by a hedge fund investor. We define:

$$\text{Risk Adjusted Return} = \frac{(\text{Observed Returns} - \text{Benchmark Returns}) \times \text{Penalty Function}}{\text{Indicated Risk Measure}}$$

Without delving into the statistical properties in this paper, we postulate that the Penalty Function is a discount factor that takes into account various dimensions such as hedge fund style (purity and consistency), size, leverage, liquidity and asset concentration. These dimensions penalize the statistically measured risk-adjusted returns of hedge funds. Table 4 itemizes the risk dimensions and suggests avenues to discount them in the penalty function.

It should be noted that the leverage, liquidity and concentration measures require additional data supplied by hedge fund managers. This calls for more disclosure and transparency from the hedge fund managers.

While no single performance measure can be complete, we argue that a properly constructed "risk-adjusted return with penalty" that has accounted for practical business risks is more meaningful to an investor. A return that is merely adjusted by standard deviations cannot alert an investor to such risks as leverage or liquidity, which had been undertaken (to achieve the returns). Using a penalty function would provide a handle to scale the observed return for the many practical risks that had been assumed by the hedge fund manager. Even identifying the components that will constitute the penalty function would be a worthwhile exercise to avoid the pitfalls of investing in hedge funds.

9. Conclusions

This paper presented an overview of hedge funds, describing their development and characteristics. It also surveys some of the pitfalls that investors face when they try to make investment decisions using hedge fund data from commercial sources. Given the dynamic trading strategies and the complexity of hedge fund investments, commonly used statistics such as the mean, standard deviation and correlations are not meaningful. These statistics must be used with extreme caution as the underlying distribution of hedge fund returns (and also the returns of hedge fund indices) is not normally distributed.

Table 4.

Discount to Risk-Adjusted Returns to Account for Various Types of Practical Risk

Sources Of Risks	To Penalise for	Suggested Measurement method	Predicted Discount to Returns
Style Purity	Deviation from Self-reported Investment Style	Deviation from Style Benchmark	The higher the style "impurity" the higher the discount
Asset Growth	Unexpected increases in Fund Size (and Assets Under Management)	Change in Fund Size	The higher the increase in fund size in the period under review, the higher the discount
Leverage	Excessive Leverage	(a) Average gross exposure, (b) Active Use of Leverage (Computed from a comparison of returns with and without the use of leverage following the standards recommended by the Association for Investment Management and Research)	The higher the use of leverage the higher the discount
Liquidity	Low Asset Liquidity	(a) Average Day to Complete Sales, (b) Ratio of Position to Trading Volume	The higher the threat of "illiquidity" the higher the discount
Asset concentration	(a) Single Security Exposure, (b) Erratic Returns	(a) Average Percentage of 10 Largest Holding over reporting period, (b) Fractal Dimension or Inverse of Hurst Coefficient	The higher the asset concentration the higher the discount

This paper has suggested 3 other metrics that may be useful: Sortino, d, and the Hurst Ratios. However, more empirical work is needed before they are used. A future paper will provide some empirical results relating to these measures.

Without specifying the mathematical form, we venture further to account for various other sources of risk such as style purity, style consistency, size, leverage, liquidity, and asset concentration. We also suggested a "penalty function" for the risks from these sources. The statistical properties of this penalty as well as illustrations using real data are left for future work.

We conclude by noting that many authors have pointed to the limited use of statistical measures and have suggested option-based analytical approaches to evaluate hedge fund performance. In particular, the works by Hsieh and Fung (1997, 1999b) and Agarwal and Naik (1999) have discussed these avenues to provide insights into these complex but crucial issues in hedge funds investing. In this paper, we have also suggested using more dimensions to alert investors to the numerous sources of unseen risks when they invest in hedge funds. This is a promising direction for more research.

Appendix

List of Commercial Hedge Fund Databases

Name	Description	Features of Indices
HFR (www.hfr.com)	Hedge Fund Research (HFR) is a hedge fund research and consulting firm that has collected data on around 4,000 different hedge funds.	Around 1,500 funds are used to calculate 33 indices that reflect the monthly net of fee returns on equally weighted baskets of funds.
Zurich Capital Markets (www.marhedge.com)	Originally developed by Managed Accounts Reports (MAR) but it was sold to Zurich Capital Markets in Mar 2001.	Database contains 1,500 hedge funds, which are used to calculate 19 indices that reflect median monthly net of fee returns.
CSFB/Tremont (www.hedgeindex.com)	The TASS database tracks around 2,600 funds. There are strict rules for fund selection. The universe consists only of funds with a minimum of USD 10m under management and a current audited financial statement. Funds are reselected quarterly as necessary.	Using a subset of around 650 funds, CSFB/Tremont calculates 10 indices that the monthly net of fee returns on an asset-weighted basket of funds. Large fund have a larger influence in these indices.

List of Commercial Hedge Fund Databases (continued)

Name	Description	Features of Indices
Hennesse (www.henessegroup.com)	The Hennesse Group is a hedge fund advisory firm that maintains a database of around 3000 funds.	Based of subset of about 500 funds, Hennessee calculates 23 indices that reflect the monthly net of fee returns on equally weighted basket of funds.
Van (www.vanhedge.com)	Van Hedge Fund Advisors is a hedge fund advisory firm with a database of about 3,400 funds.	Using a subset of around 500 funds, Van calculates 15 indices that reflect the monthly net of fees returns on equally-weighted baskets of funds.
Altvest (www.altvest.com)	Altvest is hedge fund website that provides information on alternative investments. The Altvest database contains information on around 2000 hedge funds.	Altvest calculates 14 equally weighted indices from the monthly net of fee returns of the funds in its database.
TUNA (www.hedgefund.net)	Hedgefund.net is a website providing free hedge fund information and performance data. Its database covers 1,800 hedge funds.	Hedgefund.net calculates 35 equally weighted indices from the monthly net of fee returns of the funds in its database. In Tuna's case, if a fund shuts down, it is completely removed from the indices.[5]
AsiaHedge (www.hedgefundintelligence.com)	AsiaHedge is a subscription database that provides information on hedge fund industry in the Asia Pacific Region. Publishes a league table of 156 funds.	AsiaHedge establish the Bank of Bermuda AsiaHedge indices. There are 4 indices to measure the performance of hedge funds in 4 geographies based on the median net of fee returns of funds in its league table.

Source: Brooks and Kat (2001), Hedge Fund Intelligence

[5]Estimated returns may suffer from survivor bias (ranging from 1.5–3%). Around 30% of newly established funds do not survive beyond 3 years. Most data vendors (with the exception of TUNA) do incorporate funds that have ceased to exist in their index to avoid this.

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