An Empirical Study Of Hedge Funds

by

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Submitted to Sloan School of Management
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Abstract

Hedge Funds are one of the fastest growing, yet least understood, category of alternate investment vehicles. They are pooled investment vehicles that use leverage, short-selling, dynamic hedging and derivatives to implement investment strategies significantly different from the non-leveraged, long-only approach traditionally followed by investors.

This Thesis explores and validates characteristics, attributes and behavior of the generic category of Hedge Funds by researching academic and empirical studies available in the public domain. It traces the dramatic growth of the Hedge Fund industry in recent times as well as the regulatory environment governing the industry. The findings of this study assess a variety of Hedging styles and strategies that have proliferated in recent years by building on practitioner and academic research. We further examine the risk return profile of Hedge Funds, effective diversification and portfolio allocation decisions. The results of our study offer a thorough explanation of issues essential to Hedge Fund investment and their usefulness as an alternative asset class in both institutional and private portfolios.

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Thesis Title: An Empirical Study of Hedge Funds
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Section 1. Introduction

Over the past few years, Hedge Funds have become more prominent and more popular. Sources have estimated that there are close to 5700 Hedge Funds operating in the United States today with approximately $600 billion under management. In 1990, it is estimated that only $50 billion was under management in Hedge Funds, demonstrating the rapid increase in a relatively short period of time. Hedge Funds have been around in some form since the establishment of the Jones Hedge Fund in 1949. The term "Hedge Fund" is undefined, including in the federal securities laws. Indeed, there is no commonly accepted universal meaning. As Hedge Funds have gained stature and prominence, though, "Hedge Fund" has developed into a catch-all classification for many unregistered privately managed pools of capital. These pools of capital may or may not utilize the sophisticated hedging and arbitrage strategies that traditional Hedge Funds employ, and many appear to engage in relatively simple equity strategies. Basically, many "Hedge Funds" are not actually hedged, and the term has become a misnomer in many cases.

This Thesis explores and validates characteristics, attributes and behavior of the generic category of Hedge Funds by exploring academic research and empirical studies available in the public domain. It avoids excessive detail on very specific aspects of Hedge Funds and instead explores the validity of widely held beliefs, myths and premises that surround this industry.

In doing so, the Thesis is presented in the following sections:

In section two, a brief introduction to the history and current situation is covered.

In section three, regulatory issues applicable to Hedge Funds are discussed.

In section four, the advanced strategies and techniques used by Hedge Funds are addressed.

In section five, issues essential to arrive at an accurate understanding of the Hedge Fund returns are discussed.

Section six addresses risk characteristics of Hedge Funds.

Section seven discusses the issues related to Hedge Fund diversification and portfolio asset allocation decisions.
Section 2. Hedge Fund: History and Background

A Hedge Fund, in essence, is an investment structure for managing a private, loosely regulated investment pool that can invest in both cash (physical securities) and derivative markets on a leveraged basis.[2] Legally, it may take the form of a limited partnership, corporation, trust or Mutual Fund depending on where the Fund is domiciled and the type of investors it seeks to attract. The domicile or legal location of the Hedge Fund determines the structure. Most U.S.-based Hedge Funds are structured as limited partnerships while Hedge Funds outside the U.S., or “offshore” Funds, are typically structured as limited liability companies.

Today, the institutional investment universe consists of traditional investments and a growing list of alternative investments. Figure 1 illustrates where Hedge Funds fall within the universe of investment opportunities with respect to their composition versus more traditional investments [3]:

![Diagram of Investment Opportunities]

Figure 1
The Evolution of the Hedge Fund Industry
Hedge Funds trace their origins back to 1949 and the establishment of a private investment partnership by Alfred W Jones. He discreetly ran his Hedge Fund for nearly ten years, generating profits through superior stock picking, hedging out market risk by short selling, while applying leverage to magnify the returns of these hedged positions. He also introduced a performance-based compensation arrangement, earning a percentage of the profits generated by the Fund, similar to performance fees seen throughout the industry today. The Hedge Fund industry continued to grow steadily throughout the 1960s, largely on the back of the success of Jones. In 1969 the first Fund of Hedge Funds, Leveraged Capital Holdings, was established. Growth slowed during the early 1970s following the oil crises, before resuming a steady pace throughout the 1980s. As Figure 2 shows, growth during the 1990s has been somewhat dramatic.

Figure 2:
The major milestones of Hedge Fund history are summarized as:

1949  First hedge fund established by Alfred W. Jones
1968  140 hedge funds are recognised by SEC
1969  Leveraged Capital launches first Fund of Hedge Funds. George Soros launches the Quantum Fund.
1970  Hedge funds enter their first crisis as equity markets fall. Industry studies estimate that hedge fund assets under management fell by 70%.
1986  Julian Robertson established the Jaquar Fund. The first global macro fund. The growth of the sector continues.
1992  Hedge funds attract widespread media attention as the British pound is forced out of the ERM.
1994  Many hedge funds suffer heavy losses as the Fed unexpectedly increases US interest rates.
1995-98 With strong equity markets, hedge funds achieve spectacular returns, thereby attracting hundreds of new managers to the industry
1997  Hedge funds blamed for triggering the Asian currency crisis. In Europe, the number of funds grows at a rapid pace. The major investment banks establish prime brokerage services.
1998  The hedge fund boom comes to an end as market liquidity drives up and equity markets correct. The Fed negotiates a bailout of Long-Term Capital Management.
1999  Despite generating strong returns, the industry remains out of favour. Growth, however, continues apace.
2000  On the basis of industry studies, we estimate that there are currently around 6,000 hedge funds, with assets approaching $450 billion.

Source: Deutsche Bank
Hedge Funds vs. Mutual Funds (Open End)

For traditional investments, Mutual Funds are apparently the most popular investment vehicles. An open-ended Mutual Fund is operated by an investment company that raises money from shareholders and invests in a group of assets, in accordance with a stated set of objectives. As an alternative investment tool, Hedge Funds are fundamentally different from Mutual Funds, although on some surface aspects they do have some similarities.

<table>
<thead>
<tr>
<th>HEDGE FUNDS</th>
<th>MUTUAL FUNDS (open end)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &quot;pool&quot; of private investment capital; structured as a limited partnership to invest in a portfolio made up of a variety of securities.</td>
<td>A portfolio made up of numerous Stocks (or Bonds) but regulated by percentages in accordance with charter.</td>
</tr>
<tr>
<td>Managed by a General Partner, who makes fees based only on investors' profits NOT losses.</td>
<td>Managed by a Fund Manager, who gets paid regardless whether investors profit or lose.</td>
</tr>
<tr>
<td>The General Partner's assets are more likely to be a significant percentage of the Fund.</td>
<td>The Fund Manager's assets are less likely invested in the Fund.</td>
</tr>
<tr>
<td>Available only to Accredited Investors, high-net worth individuals and institutions by a Confidential Offering Memorandum and Partnership Agreement</td>
<td>Available to the general public by prospectus.</td>
</tr>
<tr>
<td>Not allowed to advertise</td>
<td>Can advertise, and charge 12B-1 fees.</td>
</tr>
<tr>
<td>Are limited by the SEC to 99 &quot;limited partners&quot; investing in a Fund.</td>
<td>Are not limited in the number of investors who can invest in the Fund</td>
</tr>
<tr>
<td>Are not limited by the SEC in the securities or strategies used to be profitable</td>
<td>Are limited by the SEC in the securities or strategies used to be profitable</td>
</tr>
<tr>
<td>General Partners can liquidate a position before it drops in value and shift focus to another issue.</td>
<td>Regulatory requirements often do not allow the Funds to liquidate a dropping Stock</td>
</tr>
<tr>
<td>Entry is significant - $100K-250K to $1MM+</td>
<td>Entry is usually from $1,000 to $3,000.</td>
</tr>
<tr>
<td>Low expenses and fees are a percentage of the profits.</td>
<td>Higher expenses, but no fees from profits - the Fund Manager makes money regardless of whether the investor makes money.</td>
</tr>
<tr>
<td>Illiquid, may not be able to redeem at any time.</td>
<td>Traded daily on the open markets.</td>
</tr>
<tr>
<td>Usually a lock-in period to prevent aborting any strategies.</td>
<td>Small fee to redeem within six months; traded daily.</td>
</tr>
<tr>
<td>About 3-6000 Funds</td>
<td>Over 10,000 Funds</td>
</tr>
</tbody>
</table>

Besides the difference listed in the table above, Hedge Funds also lack the transparency the Mutual Funds have. As inherently private investment vehicles, Hedge Funds have not met traditional institutional levels of transparency and accountability. In recent years, institutional investors and Funds of Hedge Funds have exerted enormous pressure on Hedge Funds to provide greater transparency. The reason is simple: fiduciaries find it difficult to justify investing in a Fund with unknown risks and exposures. Hedge Fund managers must further develop investment processes and infrastructure in order to meet these institutional requirements. As knowledge increases, institutional investors may be more willing to accept "risk transparency"; i.e. sufficient information to measure risks, rather than total transparency of holdings. For their part, Hedge Funds may be more willing to accommodate higher levels of transparency in order to attract institutional assets. Until that happens growth in the Hedge Fund Industry is likely to continue to trail the Mutual Fund Industry.

**Fee structure of Hedge Funds**

Hedge Fund managers receive a share of the annual percentage gain of the Fund in addition to an annual management fee. Currently, most Hedge Fund managers charge a fixed annual fee of 1 to 2% and an incentive fee of 20%, calculated on the return over a year, or less commonly, over a quarter. The incentive fee is a percentage of profit above a base, typically, the asset value at the beginning of the year. This incentive fee is generally subject to a high water mark provision. If the Fund loses money, then the manager must make up the loss in the next year before the incentive fee becomes applicable. This is sometimes cited as a cause for Hedge Funds going out of business after short sustained periods of suboptimal performance.

Strong rewards can thus be linked to Fund performance. Unlike many Mutual Fund managers, Hedge Fund managers are usually heavily invested in a significant portion of their Funds and share the rewards as well as risks with the investors. The "incentive fee" remunerates Hedge Fund managers only when returns are above certain benchmark, whereas Mutual Funds pay their
financial managers according to the volume of assets attracted, regardless of performance. The compensation is effectively an at-the-money call option on up to a portion of the portfolio every year, plus a fixed fee to cover operating expenses. Clearly, Hedge Fund operators are paid to take risks, and the further implication is that investors believe that these managers have the skills to offset the high cost of the option.
Section 3: Regulations of the Hedge Fund industry

Historically, the offer and sale of securities within the United States has been subject to concurrent federal and state regulation under the Securities Act of 1933 (the "Securities Act") and state blue sky laws. In order to avoid the registration and prospectus delivery requirements of the Securities Act, securities of Hedge Funds and offshore funds are typically offered in private placement transactions which rely on the private placement "safe harbor" provisions of Regulation D or the safe harbor for offerings outside the United States contained in Regulation S.

The exclusions from registration under the federal securities laws that apply to Hedge Funds and their securities offerings are central to the questions that currently surround Hedge Funds. The exclusions define the investment strategies that Hedge Funds may pursue, the types of investors who generally may invest in Hedge Funds, and how Hedge Fund securities may be sold. Hedge Funds are able to avoid regulation by meeting criteria that are laid out in four general exclusions or exceptions: (1) the exclusion from registration of the fund under the Investment Company Act of 1940, (2) the exemption from registration of the fund's securities under the Securities Act of 1933 (3) the exception from registration of the Hedge Fund manager under the Investment Advisers Act of 1940, and (4) the exception from reporting requirements under the Securities Exchange Act of 1934. (http://www.sec.gov/)

Exclusion from Registration under the Investment Company Act of 1940

Hedge Funds typically do not register with the SEC. They rely on one of two exclusions under the Investment Company Act of 1940 to avoid registration. The first exclusion under Section 3(c)(1) of the Investment Company Act limits investors in the Hedge Fund to 100 persons, while the second exclusion under Section 3(c)(7) of the Investment Company Act, which was added to the Investment Company Act in 1996, imposes no numerical limit on the number of investors. Instead, it generally looks to the size and nature of the investments of an individual. Thus, investors in funds that utilize the 3(c)(7) exemption generally must be "qualified purchasers." Qualified purchasers are defined to include high net worth individuals (generally individuals who own certain specified investments worth at least $5 million) and certain companies. The theory is that wealthy investors do not need the full protections of the registration provisions of the federal securities laws. Although there is no specific numeric limitation on the number of investors in a
Section 3(c)(7) fund, the federal securities laws generally require any issuer with 500 or more investors and $10 million of assets to register its securities and to file public reports with the Commission. Most Hedge Funds do not wish to register their securities, and therefore they stay below the 500 investor level.

Exemption from Registration under the Securities Act of 1933
Importantly, both of these exclusions require Hedge Funds to sell their securities in non-public offerings. Thus, most Hedge Funds rely on one of a handful of exemptions under the Securities Act in order to avoid making a public offering. In order to be classified as a non-public offering, the Hedge Fund securities may not be offered for sale using general solicitation or advertising. Additionally, Hedge Funds generally sell their securities only to those who qualify as "accredited investors." The term "accredited investor" includes individuals with a minimum of $200,000 in annual income or $300,000 in annual income with their spouses, or a minimum of $1,000,000 in net assets. It also includes most organized entities with over $5,000,000 in assets, including registered investment companies.

Because these limitations under the Securities Act apply at lower levels than the "qualified purchaser" exemption for 3(c)(7) funds, these 3(c)(7) funds may only be offered or sold to investors who are qualified purchasers as well as accredited investors. Other Hedge Funds, which do not qualify as 3(c)(7) funds, may be offered and sold to accredited investors, whether or not they are also qualified purchasers. Finally, a fast-growing group of funds of Hedge Funds are registered under the Securities Act and may be publicly offered and sold.

Exception from Registration under the Investment Advisers Act of 1940
Managers of Hedge Funds meet the definition of "investment adviser" under the Investment Advisers Act of 1940 because they are in the business of providing investment advice about securities to others. Under this Act, an investment adviser with fewer than 15 clients that does not publicize itself generally as an investment adviser is not required to register with the Commission. Because Commission regulations count each Hedge Fund, rather than each investor in the Hedge Fund, as one client, some Hedge Fund managers may not be required to register with the Commission. Unregistered advisers are not directly subject to the Commission's examination and inspection program. But, it is important to note that all Hedge Fund managers
— whether registered as investment advisers or not — are subject to the antifraud provisions of the Investment Advisers Act.

Exception from Reporting Requirements under the Securities Exchange Act of 1934

Hedge Funds generally are not subject to the reporting requirements of the Securities Exchange Act because they are operated so as not to trigger registration of their securities under that statute. However, if a Hedge Fund holds large public equity positions, the manager, like any other large institutional manager, must publicly disclose those positions. This disclosure, however, does not necessarily provide significant insight into any particular Hedge Fund's portfolios or strategies because the manager is permitted to aggregate all clients' holdings into one report. In addition, disclosure is not required of short and debt positions.

In order to make sensible investment decisions, it is essential to understand the general Hedge Fund strategies and issues related to performance and risk measurement. This will be the focus of the Thesis over the remaining sections.
Section 4. Hedge Fund Types and Strategies

Hedge Fund investment strategies tend to be quite different from the strategies followed by traditional money managers. Moreover, in principle every fund follows its own proprietary strategy. This means that Hedge Funds are a very heterogeneous group. There are, however, a number of ideal types to be distinguished, comprising broad categories as described below:

![Hedge Fund Diagram]

There are no conclusive studies on how the global allocation of Hedge Fund investments are made though a study by HFR seems to suggest that Equity Hedge dominates, as described:
Percent Assets by HFR Hedge Fund Category (December 1999)

- Fund of Funds Index: 11%
- Convertible Arbitrage Index: 4%
- Statistical Arbitrage Index: 2%
- Distressed Securities Index: 3%
- Sector (Total): 7%
- Emerging Markets (Total): 6%
- Relative Value Arbitrage Index: 2%
- Merger Arbitrage Index: 2%
- Market Timing Index: 0%
- Macro Index: 4%
- Fixed Income (Total): 7%
- Event-Driven Index: 6%
- Equity Non-Hedge Index: 9%
- Equity Market Neutral Index: 5%
- Equity Hedge Index: 32%

We examine these major types of Funds with reference to their investing strategies in the next section:

**Market Neutral or Relative Value Strategies**

**Convertible Arbitrage**

This strategy is identified by hedge-investing in the convertible securities of a company. A typical investment is to long the convertible Bond and short the common Stock of the same company. Positions are designed to generate profits from the fixed income security as well as the short sale of Stock, while protecting principal from market moves. Current income is generated by combining the yield of the convertible security with the interest income on the proceeds from the short positions, less any dividends on the shares sold short. As seen from the literature, most managers employ some degree of leverage, ranging from zero to 6:1. The equity hedge ratio may range from 30 to 100 percent. The average grade of Bond in a typical portfolio is BB-, with individual ratings ranging from AA to CCC. However, as the default risk of the company is hedged by shorting the underlying common Stock, the risk is considerably better than the rating the un-hedged Bond indicates.
Convertible arbitrage Hedge Funds focus on the mispricing of convertible bonds. Their rationale is that:

a) Since convertibles are hybrid in nature, they do not attract pure bond and pure stock investors, so that price discrepancies are frequent

b) Convertible securities often contain several call, put, or exercise-date options that are often neglected by the market. Credit risk and interest rate risk of the convertible position may also be hedged using adequate instruments.

This strategy is based on the fact that convertible Bonds/warrants have embedded options in them. They grant the holder of a Bond the right to convert the Bond into common shares of the issuer. The number of shares into which each Bond is convertible, also known as conversion ratio is pre-specified in the Bond indenture and is used to calculate the conversion price. So basically it has an inherent warrant with the strike price as the conversion price. When the Stock price increases, the value of the inherent call option increases as well.

A hypothetical example clarifies this: suppose a convert's price is $1000 and the company's current Stock price is $50 with a 50% conversion premium, so the value of the Stock price conversion premium is $75. Option delta is the movement in the price of the option for every 1% increase in the Stock- suppose an option on this Stock has a delta (hedge ratio) of 0.65. The amount of shares to short is then: ($1000/$75)*0.65=8.6667. During small price movements in the Stock this short position will act as an effective hedge against a decrease in the price of the Bond, since part of the price component of a convertible is conversion value. This helps create a market neutral position with returns solely dependent upon the coupon the Bond is paying. During volatile markets this hedge breaks down and a large decrease in the price of the Stock will result in a profit because the short position becomes more profitable then the losses from holding the Bond. Conversely a large increase in the price of the Stock results in a profit because the rise in the price of the convertible Bond is greater then the loss from the short position. The central component of convertible arbitrage is the current income derived from a position. That is, the income if the price of the Stock remains more or less constant. If the coupon on company X's Bonds is 7%, their current price $50, and in turn their current yield just under 14%, say 13.5%. Then the current income in establishing a convertible arbitrage position
would be 13.5% + the interest received on the proceeds received from the short sale of company X's Stock. [5]

Convertible arbitrage has been among the top-performing Hedge Fund strategies, gaining 25% in 2000 and 14% in 2001 (while the S&P dipped 12%), according to the CSFB/Tremont Hedge Fund Index. Now, seven of every ten convertible buyers are cash-laden Hedge Funds, which revel in the chance to arbitrage their convertible positions by shorting the Bonds' underlying Stocks or options. But its success depends on high volatility in equities and the accompanying credit-spread[6], which was exactly what happened during the past couple of years as the economy was in recession. With the recovery of the economy, the volatility will decrease, the intrinsic call value will be worth less as well. So it is quite possible that in such a scenario convertible arbitrage will fall out of the favor of some Hedge Fund mangers.[7]

Cumulative Returns:

![Diagram](image)

**Equity Market Neutral**

This investment strategy is designed to exploit equity market inefficiencies and usually involves being simultaneously long and short matched equity portfolios of the same size within a country. Market neutral portfolios are designed to be either beta or currency neutral, or both. Well-
designed portfolios typically control for industry, sector, market capitalization, and other exposures. Leverage is often applied to enhance returns.

The main objective of market-neutral style of investment is to minimize market and sector risk by buying Stocks, which are expected to outperform the market, and selling Stocks short, which are expected to underperform the market. For example, a Hedge Fund manager will long the 10 biotech Stocks that are expected to outperform and short the 10 biotech Stocks that are expected to underperform. Therefore what the actual market does won’t matter (much) because the gain/loss is offset by each other. This style offers the chance to make positive investment returns in a down market as well as in up market. Theoretically, when long and short positions are equally weighted and securities are paired for each sector then the market-neutral style should render the portfolio insensitive to market risk. The goal of market-neutral investment style is to keep market exposure as little as possible. Market exposure of a portfolio can be measured by the following formula:

\[
\text{Market exposure} = \frac{\text{Long exposure} - \text{Short exposure}}{\text{Capital}}
\]

Market neutral strategies suffer less from cyclical patterns than the majority of other Hedge Fund strategies. Evidence clearly indicates that this strategy is a very powerful risk management tool in periods of market dislocation, e.g., August-September 1998 or September 2001. The only element of cyclical that academic studies have found in equity market neutral strategy is a general tendency to be positively correlated with high equity market volatility, and negatively correlated with spikes in equity volatility. It also suffers less from capacity constraints than many of the purely arbitrage-based strategies as the investment process is based on a variety of principles, including but not exclusively arbitrage.

In practice there are always some uncovered risks, mainly Stock selection risk, trade execution risk and market risk of unhedged positions. In addition, hedge positions may not completely eliminate market or sector risk. Therefore, active management is required to adjust positions regularly and keep portfolio in line with acceptable market exposure. Managers use tactics such as pair arbitrage etc.

In order to reach the goal of reducing market risk, it is often essential to find new ways of capturing relative valuation differences in equities due to fundamental or statistical factors. The
'superior' return depends on the discovery of genuine mispricing between equities in the same sector. So a manager's Stock-Picking skill is vital for the success of this strategy. On the one hand, many Fund managers are looking for the mispricing opportunities, so it is important to identify these mispriced opportunities swiftly and execute the trade efficiently. On the other hand, because of the existence of market inefficiency, prices are often driven by external news or determined by investor's (irrational) behavior or by noise traders with little relation to known reference points. As a result, the mispricing may not be corrected for a long time and the Fund may not be able to cash in the profit from it. At times, the use of heavy leverage and margin maintenance requirements may force Fund managers to close their positions before the prices converge to the expected value (if the managers' expectation is correct), which will cause losses to the Fund. Liquidity is an important issue to be considered in the equity market-neutral strategy.

Cumulative Returns:

- Equity Mkt Ntrl
- CSFB/Tremont Hedge Fund Index
- MSCI World $
- S&P 500 Total Return
**Fixed Income arbitrage**

Fixed income arbitrage Hedge Funds tend to profit from price anomalies between related securities and/or bet on the evolution of interest rates spread. Typical trading strategies are butterfly-like structures e.g., sell expensive three-year and five-year bonds while buying a cheap four-year bond), cash/futures basis trading strategies (the cheapest to deliver often trades either rich or cheap to the fitted yield curve), or relative swap spread trades (e.g., buy a government bond and short a strip of euro-dollar contracts to buy the Treasury/Euro-Dollar spread).

Most managers trade globally with a goal of generating steady returns with low volatility. This category includes interest rate swap arbitrage, US and non-US government Bond arbitrage, forward yield curve arbitrage and mortgage-backed securities arbitrage. The mortgage-backed market is primarily US-based, over-the-counter and particularly complex. Mortgage-Backed Securities Arbitrage generally involves the purchase of the mortgage-backed securities and the short sale of other fixed income securities such as government Bonds of the same term.

Basis Trading involves the purchase of a government Bond and the sale of a futures contract on that Bond. The downside of this strategy is limited to the difference between the price paid for the Bond and the proceeds from the sale of the futures contract. Traders look for price movements in both instruments over the holding period to determine if an arbitrage opportunity arises to realize a profit before final delivery of the Bond in satisfaction of the futures contract.

The arbitrage opportunities used by this style are generally not 'riskless arbitrage', which consists of purchasing a portfolio at one price and simultaneously selling that same portfolio at a higher price, generating a profit on the difference. The managers exploit the price differences in related short-term Bonds. Since the underlying assets are not exactly the same, there is residue risk and sometimes it can have a huge impact on the returns.

An example: After the 1987 Stock market crash, traders and many investors rushed to buy newly issued United States Treasury in expect of soaring Bond market. The overall boom in the Bond market did not happen, but that did drive up the on-the-run Treasuries (newly issued Treasury Bonds change hands more frequently than older ones). So they acquire what is called a "liquidity premium," which is to say that professional Bond traders pay a bit more for them because they are more liquid and thus easier to resell. But in the panic, the premium on the 30-year Bond became grotesquely large, which presented an arbitrage opportunity. A young trader, John
Meriwether, and his partners at Saloman Brothers seized the opportunities, laid a bet that the premium would shrink when the panic subsided. So they purchased the off the run Bond and shorted the on-the-run Bond with the same or similar maturity. When the prices finally converged, they made $50 million for their company. This has become a paradigm of successfully taking advantage of fixed income arbitrage opportunity.[9] In contrast 11 years later, the same John Meriwether (then the manager of LTCM) and his team, lost more than $2 billion on the interest rate swap arbitrage they designed because the ‘similar’ assets’ prices didn’t converge as they anticipated. The loss significantly contributed to the final debacle of LTCM.

Cumulative Returns:

![Graph showing cumulative returns over time](image)

- Fixed Inc Arb
- CSFB/Tremont Hedge Fund Index
- MSCI World $
- S&P 500 Total Return

**Commodity Arbitrage**

A typical investment is to be long one commodity and short another commodity which is temporarily distorted from their historical, mathematical, or fundamental pricing relationship. The manager identifies the distorted relationship and buys the “cheap” one and sells short the “expensive” one. By being long and short at the same time, the manager takes out the directional risk of an unfavorable price move. [10]
Credit Arbitrage

A typical investment is to be long one debt instrument and short another of similar credit quality. The manager will identify a mispricing between similar credit quality debt instruments and sell the “expensive” one and buy the “cheap” one. By being long and short at the same time, the manager takes out the directional risk of an unfavorable interest rate move. This strategy uses a similar approach as fixed income arbitrage and therefore, in the TASS Hedge Fund index, is listed under fixed income arbitrage.

Event-driven Strategies

Event-driven Hedge Funds focus on price movements generated by an anticipated corporate event, such as a merger, an acquisition, a bankruptcy, etc. The funds in this category cover a wide range of strategies. The most popular ones are distressed securities (bets on the likelihood of a bankruptcy and the estimation of the recovery rate) and merger arbitrage (bets on the completion of announced mergers). In the latter category, some of the funds get involved in the restructuring process and are at the frontier of private equity, while others only invest in the most liquid and senior part of the debt.

Investment returns of event-driven Hedge Funds have low correlation with market returns. Theoretically, they can offer returns under any market circumstances. However, different events are more likely to happen at different stages of the economic cycle. For example, M&A usually occur in times of economic upturns and bullish markets where high Stock prices make Stock-for-Stock acquisitions favorable. Whereas economic downturns offer investors great opportunities to invest in good businesses that have balance sheet issues. As a result, these strategies have a modest degree of market exposure or directional risk. Because of this they are less dependent on overall Stock market direction. Managers rely heavily on fundamental research to identify events and shape their strategies accordingly.
M&A Arbitrage/Risk Arbitrage

M&A arbitrage Funds invest in companies involved in a M&A effort. Specialists invest simultaneously in long and short positions in both companies involved in a Merger or Acquisition. M&A Arbitrage/Risk arbitrageurs typically long the Stock of the company being acquired. They also often short the Stocks of the acquiring company in Stock-swap deals. The principal risk in such events is ‘deal risk’—should the M&A deal fail to close.

The stock of the company being acquired will in general trade at a discount since all acquisitions take time and there always is risk that the acquisition will not be completed. M&A arbitrage Funds make investment profits when they successfully anticipate the outcome of an announced M&A and capture the spread between the current market price and the price at which the stock trades after the M&A is completed.

When a M&A is pending, uncertainty about the outcome creates a pricing disparity between the price of the acquiring company’s Stock and the price of the target company’s Stock. M&A arbitrage managers evaluate announced M&A and if they find favorable risk/return
characteristics they will go long the target company's Stock and sell the acquiring company's Stock. If the deal is completed in the way the manager anticipates, profits will be made from the long position. Since traditional investment Funds are limited to their use of short selling, the M&A arbitrage strategy cannot be found in a traditional Mutual Fund. M&A arbitrage Hedge Fund managers, often, do not attempt to anticipate possible M&As. Instead, they analyze already announced M&A to identify favorable risk/return characteristics.

Example: Consider a hypothetical Stock-for-Stock transaction in which Company A [11], with Stock trading at $105, offers one share of its Stock for each share of Company B Stock, currently trading at $80. An investor looking to create an arbitrage profit would buy Company B Stock at, say, $100, the price to which it climbed immediately after the M&A announcement, and sell short Company A Stock at $105 in an amount equal to the exchange ratio - in this case 1-to-1. (Actually, in some instances, particularly in mega - M&As, the acquirer's Stock price usually drops somewhat immediately after the announcement, as shorting pressure pulls down the price; but for this example we will keep it at $105.) As the M&A date draws nearer, this $5 spread will narrow as the prices of Company B and Company A Stocks converge. When the spread narrows, the investor's returns grow - for example, if Company B Stock rises to $101 and Company A falls to $104, the investor earns $1 on the long investment and $1 on the short. Once the M&A is consummated and Company B Stock is converted to Company A shares, the investor locks in the $5 gain regardless of the current price of Company A Stock. (His Company B shares are converted into Company A shares, which he delivers to cover his short sale of Company A shares at $105.) If during the interim the market has tumbled, sending Company A Stock down to $80, the investor makes $25 on the short sale of Company A Stock at $105 minus the loss of $20 on the Company B shares for which he paid $100. (Though if a market downturn causes Company A Stock to fall significantly before the M&A closes, Company B might back out of the deal; as a cover against a market downturn, some Fund managers supplement their M&A arbitrage investments with Put options on the S&P Index, which enable the manager to lock in a sell price in the event the index craters.) In this way, the investment is buffered from violent market swings.

The principal risk is deal risk, should the deal fail to close. Any superior return should be from the extra information the M&A Arbitrage Hedge Fund managers can get through due diligence, normally either by quantitative analysis or fundamental research. So naturally, M&A
arbitrageurs care only about the probability of the deal being approved and how long it will take
the deal to close. Prior empirical evidence as in Larcker and Lys [12] does suggest that the
abnormal returns are partially due to the fact that arbitrageurs are better informed than the market
about the probability of deal success. Recent theories further suggest that not only are
arbitrageurs active participants in takeover contests, but they may also exert significant impact
on the takeover process. [13] Their decision to enter the market for corporate control will, by
itself, influence takeover results regardless of arbitrageurs' superior ability to predict the
takeover outcome. For instance, Cornelli and Li [14] develop an information-based model in
which the information advantage that an arbitrageur possesses arises from his own position
rather than from his capability of predicting outcomes. The arbitrageur has incentives to
accumulate target shares as long as the expected profit is positive. His purchase of shares helps
overcome the free-rider problem and consequently, facilitates the takeover process. Gomes [15]
further shows that arbitrageurs are capable of attaining hold-out power derived from
accumulating large blocks of target shares. This potential threat will force bidders to offer higher
takeover premiums.

Historically the vast majority of friendly acquisition offers that have been announced are
completed. Only about 3 percent of "good" transactions "break." In addition, through
diversification across many such deals, Fund managers are able to minimize the impact of one
deal falling through. Still, as a hedge against collapsed deals, some Fund managers supplement
their long positions in the target company with Puts on the company's Stock - but only when the
spread is such that the potential profit well offsets the cost of the buying the Put. But as
previously mentioned, M&A usually occur in times of economic upturns. The years 1996-1999
was a golden age for M&A arbitrage Funds, but for the past couple of years, the index based on
M&A arbitrage offered a small negative return. The current market for M&A arbitrage is no
better because M&A investing depends on one crucial resource that is currently (2003) running
low -- an ample supply of new deals. The wave of corporate scandals and the fact that investors
have been penalizing the shares of overly complicated companies have caused CEOs to think
twice about M&A's and takeovers. Also, the government is taking longer, closer looks at
pending deals, inhibiting fresh M&A activity. Even the announced M&A had lower successful
rate or took much longer than expected, which increased the risk of M&A arbitrage. The result
was fewer and smaller deals. In the first nine months of 2002, companies announced 5,054
transactions worth $356 billion, according to Thomson Financial. That is down from 8,622 deals, worth $1.4 trillion, in the same period of 2000. [16] In the first 5 months of 2002, the aggregate value of U.S. M&A (including cross-border deals) is down more than 50% relative to 2001 on an annualized basis. With a small universe of deals to play, the potential for good risk-adjusted returns is concentrated in relatively few situations. So until the next economic upturn happens, M&A arbitrage Funds may continue to shrink.

Cumulative Returns:

![Cumulative Returns Graph]

- Event Driven
- CSFB/Tremont Hedge Fund Index
- MSCI World $^
- S&P 500 Total Return

**Distressed Securities**

Fund managers invest in the debt, equity or trade claims of companies in financial distress and bankruptcy. The securities of companies in need of legal action or restructuring to revive financial stability typically trade at substantial discounts to par value and thereby attract investments when managers perceive a turn-around will materialize. Managers may also take arbitrage positions within a company's capital structure, typically by purchasing a senior debt tier and short-selling common Stock, in the hopes of realizing returns from shifts in the spread between the two tiers.
In today's volatile business climate, with increasing numbers of Bond defaults and Chapter 11 bankruptcy filings, the market for distressed companies' debt and equity securities continues to capture the interest and imagination of the investment community. The profit-making potential of securities selling at discount prices makes distressed securities very attractive to the educated and aggressive investor. [17] When a company is facing bankruptcy, even if it is because of temporary liquidity problem instead of long-term insolvency, investors demand a huge credit premium. And since the company is forced to close many positions under extremely unfavorable circumstances (i.e. it may not be able to meet a margin call), they have to settle for lower prices for liquidity. Distressed securities' return is a combination of the risk premium from holding low-grade securities and the liquidity premium from holding less liquid securities. The distressed securities market is also called 'vulture-capital' market. Distressed securities are usually considered risky because the company might not recover. If that happens, the Fund may lose part or even all of the money it invested in corporate Bonds.

Cumulative Returns:
Event-driven Multi-strategies

This subset refers to a variety of Hedge Funds that draw upon multiple themes, including risk arbitrage, distressed securities, and occasionally others such as investments in micro and small capitalization public companies that are raising money in private capital markets. Fund managers often shift assets between strategies in response to market opportunities.

The investments in micro and small capitalization public companies by raising money in private capital markets are regulated by Rule 506 of Regulation D, The Securities Act of 1933. So, this is therefore also called Regulation D strategy. Companies do not have to register their securities and usually do not have to file reports with the SEC. They can use it to raise unlimited amount of money. Investments usually take the form of a convertible security with an exercise price that floats or is subject to a look-back provision that insulates the investor from a decline in the price of the underlying Stock. Another component of it is high yield Bond. It generally refers to investing in low-graded fixed-income securities of companies that show significant upside potential. Managers generally buy and hold high yield debt.

Cumulative Returns:
Opportunistic Strategies

These strategies have the highest degree of market exposure or directional risk. There are several strategies that fit within this category.

Emerging Market

This strategy involves equity or fixed income investing in emerging markets around the world. Because many emerging markets do not allow short selling, nor offer viable futures or other derivative products with which to hedge, emerging market investing often employs a long-only strategy. Due to different international trading patterns of individual countries, growth rates of economies, monetary policy and fiscal (taxation and spending) policy, securities from different countries have different risk/return characteristics and low correlation. Statistics data showed that there is only a low correlation (about 0.40) between emerging country Bonds and US Treasuries. International diversification improve a portfolio’s risk-return characteristics by shifting the efficient frontier to the upper-left.

When Emerging Markets are added, the new frontier offers a better return for the same risk, or the same return for lower risk. Therefore, both Hedge Funds and Mutual Funds have begun to look at emerging financial markets for new opportunities. This strategy is simply based on traditional Markowitz portfolio theory: as long as the two portfolio’s correlation is less than one, we can combine them together to increase diversification, and as the result of that, get a better efficient frontier.

But to invest in global market has never been easy. Investors need to pay special attention to country risks, including political uncertainty, imperfect fundamental data and research information, non-standard and reduced disclosure requirements, possible enforcement difficulties and limited remedies in the event of default etc. In 1997, a global financial crisis started In Asia. By the middle of 1998, it spread to Russia. The Russian restructuring led to large losses, changed perceptions of default and convertibility risk, and affected the balance of risks and returns in international portfolios. It challenged fundamental assumptions about emerging market finance, particularly the belief that countries would not unilaterally restructure sovereign debt, and led investors to question the balance of risks in portfolios. Ultimately, the Russian restructuring triggered capital outflows from many emerging markets, a sharp widening of emerging market
spreads, and a drying up of liquidity in international capital markets. LTCM was not the only one that suffered. Many other Hedge Funds, and even some commercial banks suffered huge loss as well. All in all, it made a gloomy year for Hedge Funds and gave many investors the wrong impression about Hedge Funds. Also some papers began to argue whether it is a sensible choice to invest globally. Soon the market offered an answer. From March 5th 1999 through March 9th 2001, in dollar terms, the Morgan Stanley Emerging Markets Index returned positive 13.76%. In comparison the Nasdaq Composite Index returned negative 11.75%; the S&P returned negative 2.44%; and the Bloomberg European 500 Index returned positive 1.17%.

Another risk, which is unique to international investment, is exchange rate risk. It is the risk that an investment’s value will be affected by changes in exchange rates. For example, if money must be converted into a different currency to make a certain investment, changes in the value of the currency relative to the American dollar will affect the total loss or gain on the investment when the money is converted back. It has a huge impact on the dollar-denominated return on investors who make international investments.

In the end, regardless of the short-term higher returns or losses, most investors have reached an agreement that international diversification does increase a portfolio’s return to risk ratio.

Cumulative Returns:
Global Macro

Managers carry long and short positions in many of the world's major capital or derivative markets. These positions reflect their views on overall market direction as influenced by major economic trends and or events. The portfolios of these Funds can include stocks, bonds, currencies and commodities in the form of cash or derivatives instruments. Most Global Macro Funds are large and invest globally in both developed and emerging markets.

Macro Hedge Funds aim to generate high total returns by having the flexibility to invest in any asset class, in any geographical area, using any available instrument. Macro portfolios hold positions that reflect not only views on the fortunes of individual companies and/or sectors but also positions on broader world economic trends at the country level. Positions need not be concentrated, and typically will cover a wide range of equity markets, interest rate, currencies and commodities.

Global Macro Funds may be based on fundamental views or Technical Trading Systems, or a combination of both. Fundamental analysts believe that changes in market prices are due to changes in supply and demand caused by changing economic conditions and that the most appropriate approach to investments decision-making is to focus on these economic Factors. Technical traders generally believe that market prices are the key aggregator of information necessary to make investment decisions. Global Macro investing has traditionally been seen as dominated by a small number of huge players.

Global Macro also exhibits a low correlation with equity markets (approx +0.3). This suggests their effective role as a diversification for equity portfolios.
**Dedicated Short Bias**

Short Selling involves the sale of a security not owned by the seller; a technique used to take advantage of an anticipated price decline. To execute a short sale, the seller borrows securities from a third party in order to make delivery to the purchaser. The seller returns the borrowed securities to the lender by purchasing the securities in the open market. If the seller can buy that Stock back at a lower price, a profit results. If the price rises, however, a loss results. Dedicated short sellers were once a robust category of Hedge Funds before the long bull market rendered the strategy difficult to implement. A new category, short biased, has emerged. The strategy is to maintain net short as opposed to pure short exposure. Short biased managers take short positions in mostly equities and derivatives. The short bias of a manager's portfolio must be constantly greater than zero to be classified in this category.

Cumulative returns:

![Graph showing cumulative returns for Ded Short Bias, CSFB/Tremont Hedge Fund Index, MSCI World $, and Russell 2000.](image)

**Long/Short Equity**

This directional strategy involves equity-oriented investing on both the long and short sides of the market. The objective is not to be market neutral. Managers have the ability to shift from value to growth, from small to medium to large capitalization stocks, and from a net long
position to a net short position. Managers may use Futures & Options to hedge. The focus may be regional, such as long/short US or European equity, or sector specific, such as long and short technology or healthcare stocks. Long/short equity Funds tend to build and hold portfolios that are substantially more concentrated than those of traditional stock Funds.

This category is emerging into two subclasses- High Directional Long/Short Equity where managers can be greater than 10-15% net long or net short and Low Directional Long/Short Equity where managers can not be greater than 10-15% net long or net short. Low Directional managers could be included in the Relative Value Category because of how close they are to Equity Market Neutral. This is a strategy mainly based on fundamental research. This strategy combines bottom-up fundamental research with secular trend evaluation to create the optimal portfolio of long and short positions. The process often utilizes small, medium and large capitalization companies to maintain maximum flexibility.

Cumulative returns:

- Long/Short
- CSFB/Tremont Hedge Fund Index
- MSCI World $}
- S&P 500 Total Return
Managed Futures

This strategy invests in listed financial and commodity futures markets and currency markets around the world. The managers are usually referred to as Commodity Trading Advisors, or CTAs. Trading disciplines are generally systematic or discretionary. Systematic traders tend to use price and market specific information (often technical) to make trading decisions, while discretionary managers use a judgmental approach.

Cumulative returns:

![Graph of cumulative returns]

- Managed Futures
- CSFB/Tremont Hedge Fund Index
- MSCI World $)
- S&P 500 Total Return

General Techniques used in Hedge Funds

We can also summarize some of the popular techniques that Hedge Funds often use as leveraging, short selling, hedging and arbitrage:

Leveraging

This involves borrowing money, either to increase the effective size of the portfolio, or in the form of margin purchasing of, for example, futures contracts or Bonds. For traditional Mutual Funds, leverage is generally not allowed. But Hedge Fund returns often rely heavily on leverage. When the return of the underlying asset is higher than the borrowing rate, leverage offers much
higher return than the underlying asset. But leverage also amplifies the risk of the Hedge Fund. When the return of the underlying asset is lower than the borrowing rate, investors suffer a loss on the leverage position.

A common misconception is that Hedge Funds involved significant leverage. The levels of 40 times leverage seen in LTCM were an aberration and not the norm. Since some Hedge Fund strategies don’t use leverage at all, the average leverage is only about 2 times. When the market is hard to predict or when managers cannot locate enough investment opportunities of a certain strategy, they are more inclined to take conservative positions in investing, namely, increase the cash (money market instruments) reserve and decrease the leverage level. For example, in 2001 and 2002, the average leverage for convertible arbitrage Funds was less than half of the 2000’s level.

Estimated Portfolio Leverage of an Anecdotal Sample of Convertible Arbitrage Funds

![Graph showing estimated average leverage employed by arbitrageurs](image)

Source: Goldman Sachs Convertible Research.

**Short selling**

This involves the sale of borrowed securities considered overvalued in the anticipation of purchasing them later for a profit at lower prices. It is an inherently risky strategy since the most one can make is the amount received when the securities are sold short, yet the loss potential is unlimited. But in Hedge Funds, a short position is sometimes used to reduce the risk of long position with similar underlying assets. So for Hedge Funds, short selling can be used as a hedging technique or for speculation.
Hedging

Utilization of a defensive strategy to mitigate risk, at a fraction of the cost to capital of the risk itself. Hedging can be likened to purchasing insurance against the likelihood of an unfavorable event. Depending on the type of risk exposure created by the investment strategy, different types of risk must be hedged, for example currency risk, interest rate risk, political risk, market risk, company risk. For each type of risk, certain hedging techniques and instruments are appropriate. The talented manager is the one who properly analyzes risk and hedges it most efficiently.

Arbitrage

Arbitrage strategies attempt to exploit temporary price inefficiencies or discrepancies between securities or markets. The investment manager uses historical relationships between instruments in different markets to predict future trends or movements in price. An example from risk arbitrage is the purchase of equity instruments from a company that is to be acquired by another, and offsetting this with a short sale of the equity instruments of the acquiring company.
Section 5. Understanding Hedge Fund Returns

The main reasons why Hedge Funds have attracted investors were superior absolute returns. Although claims of superior performance by a few managers are cited in the financial press, the question of whether the industry as a whole performs well is still open. One can think of Hedge Fund returns as a combination of exposure to macro factors (economic exposure), microelements of fund structure (e.g., fees, fund size) as well as manager skill in processing security or market specific information. Objective and accurate performance measurements are essential to evaluate whether a Fund really offers superior return in the long run. Therefore, this section is dedicated to a discussion of the relevant issues for better understanding Hedge Fund returns and risks.

It would be worthwhile to recognize that surveys have shown that primary investor fears about investing in Hedge Funds accrue out of concerns and perceptions as captured below:

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Return Characteristics of Hedge Funds:

Unconditional distribution:

Many Hedge Fund index return distributions are not normal and exhibit negative skewness and positive excess kurtosis. This is especially true for the convertible arbitrage, risk arbitrage, and distressed securities indices. Indices in the categories macro and equity market neutral are the most noteworthy exceptions.
**Time series behavior:**

The monthly returns of many Hedge Fund indices exhibit highly significant positive first order autocorrelation. The phenomenon is most apparent in the convertible arbitrage, distressed securities, and emerging markets indices, which confirms that this is primarily a reflection of delays in the marking-to-market of illiquid and OTC securities.

**Correlation with other asset classes:**

With the exception of the convertible arbitrage and equity market neutral indices, monthly Hedge Fund index returns exhibit a high positive correlation with the stock market. Correlation with the bond market is low, however, except for the macro and equity market neutral indices.

**Correlation between different categories:**

With the exception of equity market neutral, the monthly returns of the various categories of indices appear to be highly correlated, suggesting that different types of strategies partly share the same systematic factors. This is not only true for strategies that are somewhat alike but also for strategies that a priori have little in common.

**Differences between indices of the same type:**

There is considerable heterogeneity between indices that aim to reflect the same type of strategy. This is especially true for the macro and equity market neutral indices. As a result, investors’ perceptions of Hedge Fund performance and value added will heavily depend on the indices studied.

These findings have several implications for those investing in or considering to invest in Hedge Funds. The most important are:

**Overestimation of the Sharpe ratio and the benefits of Hedge Funds:**

Excess smoothness of the available monthly return data will lead to underestimation of true return volatility and significant overestimation of the Sharpe ratio. Similarly, straightforward application of mean-variance analysis will overestimate the attainable improvement in expected return at a given level of standard deviation and lead to over-allocation to Hedge Funds.
Unsuitability of the Sharpe ratio and mean-variance analysis:

Since they look only at the mean and the standard deviation, the Sharpe ratio and mean-variance analysis are not suitable for the evaluation of the performance of (portfolios containing) Hedge Funds. With many Hedge Fund indices offering skewness and kurtosis properties that are exactly opposite to what investors desire, the Sharpe ratio may seriously overstate true performance. Likewise, improved mean-variance characteristics may be accompanied by deteriorating skewness and kurtosis.

Potential Biases

Most data of Hedge Funds available to investors are offered by a few prominent commercial Hedge Fund database information providers. Not all the Hedge Funds are included in these databases and the performance return information is often fraught with bias. Due to lack of regulation requirements, many Funds don’t disclose their financial statements to the public. So to get a full objective picture of the whole Hedge Fund industries, academic researchers are cautious about the potential biases in the databases being used. There are four major potential biases:

Selection Bias:

Database vendors are not able to include the entire universe of Hedge Funds when calculating returns. Because Hedge Funds are not required to disclose their results, only Funds with significant excess returns or Funds that want to market their results to raise capital, are likely to report their results to the data base vendors. These vendors require the consent of Fund managers to publish their returns. Since Hedge Funds are not allowed to advertise publicly, these data vendors serve as an important advertisement and distribution channel. Thus, self-selection bias exists either because under performers would not wish to make their performance known or because Funds that performed well have less incentive to report to data vendors to attract potential investor. Sometimes Funds prefer not to publish their returns for they do not wish intervention in case SEC interprets reporting as illegal advertising. For example, George Soros’ Quantum Funds are not included in some databases because the Funds are closed and they do not need to raise additional capital. While the exclusion of these top-performing Funds may underestimate the industry’s returns, the bias is greater that exclusion of poor performing Funds will overestimate returns.
Survivorship Bias

Another caution against simply taking the average results from different Hedge Fund database as the representation of the whole Hedge Fund industry is because of strong survivorship bias in those data. Hedge Funds frequently disappear. The rate of attrition of Hedge Funds is relatively high. Few Funds -- or Fund managers -- survive more than a few years. The high water mark provision in the compensation structure contributes significantly to the Funds’ low survivor rate. Managers using the simple high water mark calculation may not accept new money, and may rationally adjust their strategy depending on how far they are from the high water mark. The more the manager is “out of the money,” the more he or she may increase volatility. In addition, the more the manager is out of the money, the less the incentive to accept new capital, and the less the willingness of new investors to invest. This suggests that Funds with a year or two of poor performance may have a high probability of going out of business, or at least decreasing in size sufficiently to no longer be included in Hedge Fund data bases. For example, Funds are removed from the CSFB/Tremont Hedge Fund Index when they are liquidated or fail to meet the financial reporting requirements.

If Fund survival (directly or indirectly) depends upon historical performance, it is well known that standard methods of analysis may lead to biased results [24]. The database vendors only calculate returns for Funds that are still “surviving,” and excludes those Funds that have gone out of business due to poor results or other reasons. Academic research by David Hsieh at The Fuqua School of Business (Duke University) describes this bias as the difference between an “observable portfolio” or the Funds at the beginning of a period and the “surviving portfolio” or the returns of the Funds still in the database at the end of a period. According to Hsieh’s estimate, the survivorship bias adds 3% per year to returns.

Global Pension Group estimates that survivorship bias overstates annual returns by 1.3%-3.1%, depending on the Hedge Fund strategy. Furthermore, additional Morgan Stanley research on Hedge Fund performance using a different data series (the MAR indices, which are less susceptible to survivorship bias) confirms these performance results. While most academic studies attempt to eliminate survivorship bias by taking Fund returns into account until the moment of disappearance, a second ex-post conditioning bias, the so-called look-ahead bias, is
usually not accounted for. This bias arises because the employed methodology implicitly or explicitly conditions upon survival over a number of consecutive periods.

**Instant History Bias**

Hedge Funds normally go through an “incubation period” of 24-36 months where Hedge Fund managers trade with limited resources. After this period ends, the money manager markets the returns to the database vendor. A database vendor typically will “back fill” the results to the start of the Fund, giving the Fund a so-called “instant history.” Again, the Fund is likely to report its results to the vendor only if they are significantly positive. Hsieh estimates this “instant history” bias inflates returns by about 1.4% per year.

**Stale Pricing Bias**

Another commonly discussed bias in Hedge Fund performance data is related to the possible existence of stale pricing in the underlying assets of a Hedge Fund.

In traditional markets, lack of liquidity and not marking to market may lead to what is called stale price bias. For securities with stale prices, estimated beta may be lower than the actual beta and, depending on the time period chosen measured, standard deviation may be higher or lower than would exist if actual prices existed. Even in traditional markets, prices are often computed using benchmark lattice, appraisal values, etc., such that reported prices do not reflect current market prices. In fact, for CTAs and many Hedge Fund strategies, prices reflect market-traded prices to a greater extent than that in many traditional asset portfolios. [25]

Moreover, research on stale price effects in Hedge Funds that use traditional academic research methodologies may fail to represent or reflect the actual existence of stale prices. Many Hedge Funds do not contain equity issues so that evidence of a correlation with lagged equity returns is not necessarily indicative of stale prices. Moreover, unlike tests of stale prices in traditional markets which may use daily data, most research in Hedge Funds used monthly data. It is unlikely that monthly data would capture stale price effects over such a lengthy time period especially since for many Hedge Fund strategies the underlying holdings are relatively liquid compared to many traditional assets (e.g., real estate) or traditional alternatives such as private equity for which appraisal values are used.
Stale pricing can lead to smoother return distributions that result in lower volatility, a phenomenon called serial correlation. The Morgan Stanley Global Pension Group has adjusted volatility data based on its estimates for stale pricing. These upward volatility adjustments range from 2.9 for the relative value strategies to 4.3 for the stock selection strategies. Clearly, serial correlation can have fairly significant impacts on Hedge Fund volatility, particularly for Fund strategies that take positions in illiquid asset classes.

### Performance and Volatility Adjustments for Survivorship Bias and Serial Correlation

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*Source: Morgan Stanley, FRM.*

While many Hedge Fund strategies have been shown to provide unique risk/return opportunities, it is important to note that, as for traditional assets, academic research has reviewed a series of fund based or micro issues in determining fund performance including:

- Performance Persistence
- Use of Historical Benchmark Data
- Survivor Bias
- Stale Price Bias
- Fees/Lockup Period
- Fund Size
- Fund Age

As shown below considerable published research has addressed each of the above issues. The prominent studies include:
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<td>Schneeweis and Spurgin</td>
<td>Sharpe style based factors on hedge fund returns</td>
<td>Various databases, 1990-2001</td>
<td>Market factors (long volatility and short volatility) explain hedge fund index returns</td>
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<tr>
<td>[1999]</td>
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<td>Authors</td>
<td>Subject</td>
<td>Data, Model, and Tested Hypotheses</td>
<td>Results &amp; Supporting Hypothesis</td>
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<td>Attes, Krul, Liew</td>
<td>Stale prices</td>
<td>CSFB/Tremont, 1994-2000; Regression on lagged S&amp;P returns</td>
<td>Non-synchronous return data can lead to understated estimates of actual market exposure; after adjusting for increased market exposure a broad universe of hedge funds does not add value (most of these are hedge equity funds).</td>
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<td>[JPM, 2001]</td>
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<td>Ackermann, McEnally, and Ravenscraft [JF, 1999]</td>
<td>Sources of hedge fund performance (e.g., size, fees, etc.)</td>
<td>MAR and HFR, 1990-1995, restrict funds to at least 24 of data</td>
<td>Hedge fund size and incentive fees are critical determinants of superior risk-adjusted performance</td>
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<td>Agarwal and Naik (JAI, 2000)</td>
<td>Performance persistence of hedge funds</td>
<td>HFR 1994-1998; style factors and persistence</td>
<td>Reasonable degree of persistence attributable to loser persistence</td>
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<td>Brown and Goetzmann</td>
<td>Offshore funds: survival and performance</td>
<td>Bernheim Offshore</td>
<td>Differences in survivor bias, and return history</td>
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<td>[JOB, 1999]</td>
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<tr>
<td>Fung and Hsieh (FAJ, 2000a)</td>
<td>Benchmark issues</td>
<td>Various indices</td>
<td>Index Universe is momentum bet and Individual Index is style bet</td>
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<td>Goetzmann, Ingersoll, and Ross [NBER, 1998]</td>
<td>Fee performance impacts</td>
<td></td>
<td>Impact of high water marks on performance</td>
</tr>
<tr>
<td>Liang (JFQA, 2000)</td>
<td>Characteristics of alternative hedge fund databases</td>
<td>TASS and HFR databases</td>
<td>Differences in survivor bias, and return history</td>
</tr>
</tbody>
</table>
Performance Persistence

Performance persistence usually means identifying winners and losers within a particular industry. Moreover, it means identifying winners that follow winners or losers that follow losers. From a practical point of view the interest is to determine if some Funds have consistently higher returns than others. The importance of finding performance persistence rests on the fact that it would enable investors to beat the market average. The winners and losers within an industry are determined by evaluating them based on a given benchmark or an index for the industry.

For Mutual Funds, academic researchers usually use indexes like S&P 500 as benchmarks. However, the S&P500 index cannot be used as a benchmark for the Hedge Fund industry given the diversity of Hedge Fund strategies and their exposure to different security markets. One approach is to compare the return of the Hedge Fund with its corresponding Hedge Fund sub indices. But in contrast to Mutual Funds, Hedge Funds are not required to register with the SEC and disclose their asset holdings. The inclusion in a certain sub category completely depends on the voluntary disclosure of the Hedge Funds and the issues of ‘bias’, as discussed earlier, creep in. Moreover, Hedge Funds can use leverage. So two Funds using the same strategy or even investing in the same assets, if using different leverage levels, can have very different risk-return profiles.

In a simplistic setting, performance attribution and evaluation involve disintegrating a Fund’s returns into the parts that can be replicated by standard asset baskets, or market indices, and the residual that is attributed to the Fund manager’s “skill.” The purpose of this disintegration rests on the assumption that investors are only willing to reward a manager for superior performance that cannot be easily replicated.

So do Hedge Funds offer superior returns? If using the Sharpe Ratio alone, the answer is clearly yes. Most Hedge Fund strategies have a statistically significant higher Sharpe Ratio than S&P 500 index. But some argue that a simple mean-variance approach is not applicable considering that the distribution of Hedge Fund returns doesn’t obey normal distribution. It is a legitimate argument for each individual Hedge Fund. If the investors are well diversified within the Hedge Fund realm, the impact of non-normality will be much smaller.
While the historical risk and return benefits of Hedge Funds are attractive at an aggregate level, the calculations are based on historical data and the question of whether their performance is sustainable is an issue. Intuition suggests that Hedge Funds’ ability to generate alpha should fall as the market for Hedge Funds grows (beyond the growth of capital markets). Are we near that point yet or is there a lot of growth that can happen before these problems occur? The positive argument is that Hedge Funds are innovative, so they will steer away from saturated markets with limited opportunities in favor of new opportunities in the desire to generate alpha. Another way to look at this is to quantify the growth of market inefficiencies, as this is a source of alpha generation. Global Pension Group [26] believes that structural inefficiencies in global capital markets will grow. Among the inefficiencies they identify include the captive nature of Mutual Fund investors, growth of 401(k) plans, and manager selection based on administrative Factors. Furthermore, most Fund managers are benchmarked to a passive index, which results in a large anchor part of the portfolio that may never see liquidity. Typically, Fund managers cannot go short a Stock; they can only underweight relative to the benchmark. So unless there is an overhaul in the regulations of Fund managements, the inefficiency will exist in the near future. These inefficiencies represent opportunities that allow for skill based performance persistence.
Section 6. Understanding Hedge Fund Risks

There are many different Hedge Fund strategies, some of which are riskier than others. However, the key differences between Hedge Funds and "traditional" managed funds lie in the use of short-selling, leverage and derivatives, all of which ring warning bells on their own.

Investors in single Hedge Funds also face other types of risk that traditional asset investors do not. Hedge Fund managers are usually small operations, managing limited amounts of money. Disclosure is limited, and sometimes non-existent. The industry is largely unregulated unlike the mutual funds industry. Cases of fraud or mismanagement are not uncommon. Public information is scarce and research is costly. Single Hedge Funds have an average life span of only 3.5 years, with many new funds closing within their first 2 or 3 years due to poor performance.

Mean-Variance vs. VaR Approach

As with traditional investments, a major source of risk for Hedge Funds is market risk – that is, the risk that the value of a Fund’s assets declines because of adverse movements in market variables such as interest rates, exchange rates, or security prices. This risk can be increased by leverage, or reduced by hedging strategies. In addition, each Fund has its own investment style and specific risk – that is, a risk that is independent of what the market is doing. Also, many investors do not have the tools required to gauge the risk of these positions, so that simple disclosure of positions is not necessarily the best option. The solution would be of course to disclose standardized risk information, so that investors could understand precisely what risk reports contain. [32]

Mean-variance analysis developed by Markowitz has been the framework traditionally used for risk-return profile analysis. It critically relies on two assumptions: either the investors have quadratic utility or the asset returns are jointly normally distributed. Both assumptions are not required, just one or the other. In 1997 Fung and Hsieh’s working papers, the result indicated that the mean-variance analysis of Hedge Funds approximately preserves the ranking of preferences in standard utility functions.

But after a series of Hedge Fund debacles in 1998, many organizations leading by US Congress called for Hedge Funds to draft and publish sound practices for their risk management and internal controls. As a result, “Sound practices for Hedge Fund managers” report was issued in
February 2000, which developed some innovative recommendations for the Hedge Fund industry. In particular, it suggested that Hedge Fund managers should employ a VaR model for measuring and communicating the risk of loss for their portfolios.

Values at Risk (VaR) and scenario analysis have progressively become best practices for assessing the total market risk exposure of any Funds. They are well accepted within leading financial institutions and corporations, and are supported by the Bank for International Settlements, Group of Thirty and the European Union. VaR aims to measure the magnitude of the likely maximum loss that a portfolio could experience over a finite time horizon at some specific confidence level. The time horizon typically corresponds to a holding period hypothesis, which should reflect the features of the portfolio on which the risk is being measured. The confidence level indicates the frequency of the maximum loss. The user sets the confidence level according to the purpose at hand (risk management, regulatory reporting, etc.) and within the limits of what is considered as "normal" market conditions. For example, VaR with a confidence level of 99 percent implies that the loss should not exceed the VaR in 99 cases out of 100.

There are two main reasons why VaR instead of simply standard deviation has become popular in investments. First, managers think of risk in terms of dollars of loss, whereas standard deviation defines risk in terms of deviations, either above or below, expected return and is therefore not intuitive. 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."

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. It is conceivable 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 the Sharpe ratio (expected return minus risk free interest rate divided by standard
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 or she will derive a benefit from adding Hedge Funds to his or 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 my 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.
Sample Portfolio with Maximum 10% Hedge Fund

Figure: The skewness and kurtosis shift the efficient frontier to the bottom-left.

Second, in trading portfolios deviations of a given amount below expected return do not occur with the same likelihood as deviations above, as a result of positions in options and option-like instruments, whereas the use of standard deviation for risk management assumes symmetry. In other words, for a portfolio, its distribution is not normal distribution. Often it has fat tails (skewness) and as a result the probability of extreme values is far beyond the probability predicted by normal distribution.

There are three major approaches to calculate VaR.

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

\[ \text{VaR} = W(\mu \Delta t - n\sigma\sqrt{\Delta t}) \]

\( \mu \) = portfolio historic mean return

W = current value of the portfolio

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

\( \sigma \) = standard deviation for a specific time period

\( t \) = time window
2. 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). This method of calculating the VaR is hereinafter referred to as modified VaR.

\[ z_{CF} = z_c + \frac{1}{6}(z_c^2 - 1)S + \frac{1}{24}(z_c^3 - 3z_c)K - \frac{1}{36}(2z_c^3 - 5z_c)S^2 \]

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

\( S = \) skewness

\( K = \) excess kurtosis

\[ S = \frac{1}{T} \sum_{t=1}^{T} \left( \frac{R_t - \overline{R}}{\sigma} \right)^3 \quad K = \frac{1}{T} \sum_{t=1}^{T} \left( \frac{R_t - \overline{R}}{\sigma} \right)^4 - 3 \]

The modified VaR therefore comes to:

\[ VaR = \mu - z_{CF}\sigma \]

3. As an empirical approach, Monte Carlo simulation and Historical simulation can be used to estimate VaR.

Historical simulation, like Monte Carlo, is a simulation technique, but it skips the step of making assumptions about the distribution of changes in market prices and rates (usually). Instead, it assumes that whatever the realizations of those changes in prices and rates were in the past is what they can be over the forecast horizon. For Monte Carlo simulation, the manager first makes some assumptions about the distribution of changes in market prices and rates (for example, by assuming they are normally distributed), then collecting data to estimate the parameters of the distribution. Monte Carlo then uses those assumptions to give successive sets of possible future realizations of changes in those rates. For each set, the portfolio is revalued. When done, the
manager has a set of portfolio revaluations corresponding to the set of possible realizations of rates. From that distribution, the 99th percentile loss is the VaR.

**Risk-Return Profile – Multivariate Model Approach**

For legal and competitive reasons, Hedge Fund managers have traditionally been very reluctant to disclose specifics about their operation or risks even to their own investors, resulting in frequent criticism. In addition, positions are often proprietary - external knowledge of the positions could directly impact anticipated returns.

Style analysis can play a role in performance evaluation. It is often also used to estimate expected returns of a Hedge Fund based on its identified strategic and tactical asset allocations, assuming the Fund doesn’t change its styles significantly. Obviously, if two managers use similar location choices and trading strategies, their returns should be correlated. Academic studies also use Factor Analysis to extract the dominant common styles, whether or not they are correlated to the asset classes.

Unlike Mutual Funds, the regression works very poorly for Hedge Funds because the $R^2$ values with the traditional asset classes are very low. In the present context this would imply that Mutual Fund returns are generated primarily from static asset allocation decisions, while Hedge Fund returns are generated primarily from “skill.” The Factors underlying Hedge Fund returns have not been fully identified yet in previous research. Considering that many Hedge Fund strategies are market-neutral and Hedge Fund managers seek out and exploit mispricing of securities using a variety of financial instruments to sustain hedge’s returns, the lack of strong correlation didn’t come as a surprise to investors.

Since most Mutual Funds are limited in their use of short sales and leverage, a manager that depends critically on the right location decision will have a slow-moving ? within a limited range. In contrast, a Hedge Fund manager can and will have deltas in orders of magnitude greater that can shift dramatically over very short intervals of time. So most of the Hedge Fund returns were thought of as nearly pure “bets” on manager skill.

An example: it is well known that Quantum gained 25.5% in September 1992 by betting on the devaluation of the British pound. Using monthly returns, the regression of Quantum against the pound has an $R^2$ of only 23%. Using daily returns for the month of September 1992, the $R^2$ is only 10%! The bet appeared to have been put on around September 11 and taken off around
September 22. This can be seen from Figure 6, which plots Quantum’s daily net asset value per share versus the British pound/U.S. dollar exchange rate (measured in pounds per U.S. dollar). The inability of simple statistical procedures in picking up the correlation between Quantum and the pound means that the number of proxies needed to pick up very short-term dynamic trading strategies is virtually infinite.

![Figure 6](quantum_graph.png)

*Figure 6*  
Quantum net asset value versus GBP/USD exchange rate, September 1992

Application of return-based style analysis has proven to be beneficial, but its results must be carefully interpreted. It is often incorrectly stated that the Factor loadings correspond to the effective allocation of the Fund’s portfolio among the asset classes. In actuality, the most one can say is that the Fund behaves “as if” it was invested using these Factor loadings.

A drawback of return-based style analysis is that it assumes style consistency through time, at least over the period of return measurement. A time series of data is used to perform a single constrained regression, providing a single style for the entire period. It is therefore common practice to use moving window regressions to incorporate new information and evaluate a manager’s style shifting through time. Normally researchers set no upward restriction on beta coefficients. The economic justification is the possibility of leverage. However, one should be cautious in interpreting a high beta, since this beta is relative to the average leverage of the certain index. In a sense, it is a relative indicator of leverage, but not an absolute one.

Three Examples of Multivariate Models to Explain Returns
Harri & Brorsen Model [27]:

In order to examine the performance persistence and uncover the source of returns for Hedge Funds, Harri and Brorsen developed the style analysis similar to Sharpe’s (1992) [28] and Fung and Hsieh (1997) [29] style Regressions. Style here is determined based on the strategy followed by a particular Hedge Fund. The regression to be estimated is:

\[ r_{it} = \alpha_i + \sum_{k=1}^{K} \beta_{ik} F_{kt} + \epsilon_{it}; \quad i = 1, \ldots, n; \quad t = 1, \ldots, T; \quad \epsilon_{it} \sim N(0, \sigma_{\epsilon}^2) \]

where, \( r_{it} \) is the return of Fund \( i \) in month \( t \), the Factor loading is the return on the \( k \)th \( F_k \) asset class Factor in month \( t \). Eight asset classes are used. These are three equity classes: S&P500, Morgan Stanley Capital International (MSCI) world equities excluding U.S. equities (Wexus), and MSCI emerging markets equities (Em); two Bond indices: a government Bond index (Govbd) and a corporate Bond index (Corpbd); the 1-month eurodollar deposit for cash (Edmth); the price of gold for commodities (Gold); and the Federal Reserve’s Trade Weighted Dollar Index for currencies (Trdwtgtd). The regression allows for different intercepts for each Fund within a particular style.

The results for the Style Regressions of Hedge Fund Returns on Eight Asset Classes are shown in the following table. (t-statistics are given in parentheses).
<table>
<thead>
<tr>
<th>Variable</th>
<th>All</th>
<th>Global</th>
<th>Sector</th>
<th>Market Neutral</th>
<th>Global Macroe</th>
<th>Short Sales</th>
<th>Event Driven</th>
<th>Long Only</th>
<th>FOF-U.S.</th>
<th>FOF Non-U.S.</th>
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</thead>
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<tr>
<td></td>
<td>(-9.47)</td>
<td>(-7.74)</td>
<td>(-1.59)</td>
<td>(-2.12)</td>
<td>(-1.06)</td>
<td>(0.90)</td>
<td>(-3.65)</td>
<td>(2.6)</td>
<td>(-4.48)</td>
<td>(-3.04)</td>
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<td>S&amp;P500</td>
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<td>0.014</td>
<td>0.021</td>
<td>0.006</td>
<td>0.011</td>
<td>-0.005</td>
<td>0.009</td>
<td>0.023</td>
<td>0.018</td>
<td>0.013</td>
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<tr>
<td></td>
<td>(21.44)</td>
<td>(12.75)</td>
<td>(4.81)</td>
<td>(7.79)</td>
<td>(5.93)</td>
<td>(-1.0)</td>
<td>(6.35)</td>
<td>(2.99)</td>
<td>(10.04)</td>
<td>(11.23)</td>
</tr>
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<td>Wezas</td>
<td>-0.0055</td>
<td>-0.006</td>
<td>-0.005</td>
<td>-0.003</td>
<td>-0.006</td>
<td>0.0008</td>
<td>-0.005</td>
<td>-0.005</td>
<td>-0.004</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(-20.33)</td>
<td>(-11.59)</td>
<td>(-2.74)</td>
<td>(-7.61)</td>
<td>(-6.51)</td>
<td>(0.34)</td>
<td>(-6.45)</td>
<td>(-1.65)</td>
<td>(-9.85)</td>
<td>(-10.38)</td>
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<td>Eta</td>
<td>0.014</td>
<td>0.02</td>
<td>0.017</td>
<td>0.006</td>
<td>0.01</td>
<td>-0.018</td>
<td>0.011</td>
<td>0.073</td>
<td>0.01</td>
<td>0.014</td>
</tr>
<tr>
<td>Gold</td>
<td>0.028</td>
<td>0.037</td>
<td>0.018</td>
<td>0.013</td>
<td>0.028</td>
<td>0.006</td>
<td>0.023</td>
<td>-0.057</td>
<td>0.018</td>
<td>0.027</td>
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<tr>
<td></td>
<td>(21.92)</td>
<td>(14.36)</td>
<td>(1.21)</td>
<td>(7.07)</td>
<td>(6.39)</td>
<td>(0.41)</td>
<td>(7.31)</td>
<td>(1.88)</td>
<td>(9.10)</td>
<td>(8.21)</td>
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<tr>
<td>Tnbwgl</td>
<td>-0.006</td>
<td>-0.019</td>
<td>-0.287</td>
<td>-0.007</td>
<td>0.015</td>
<td>0.188</td>
<td>0.0008</td>
<td>-0.092</td>
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<td>(-1.25)</td>
<td>(-1.83)</td>
<td>(-4.69)</td>
<td>(-0.88)</td>
<td>(0.83)</td>
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<td>Edmnth</td>
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<td>-0.946</td>
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<td>-3.582</td>
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<td>(-3.26)</td>
<td>(0.92)</td>
<td>(3.15)</td>
<td>(0.72)</td>
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<td>(-5.32)</td>
<td>(2.0)</td>
<td>(0.86)</td>
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<td>Govbond</td>
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<td>-0.937</td>
<td>-13.131</td>
<td>-0.417</td>
<td>-2.068</td>
<td>11.525</td>
<td>-1.015</td>
<td>-15.908</td>
<td>-0.80</td>
<td>-0.720</td>
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<tr>
<td></td>
<td>(-3.29)</td>
<td>(-2.7)</td>
<td>(-4.07)</td>
<td>(-1.5)</td>
<td>(-3.16)</td>
<td>(4.09)</td>
<td>(-2.32)</td>
<td>(-2.48)</td>
<td>(-3.15)</td>
<td>(-1.57)</td>
</tr>
<tr>
<td>Corpbd</td>
<td>1.09</td>
<td>1.47</td>
<td>16.132</td>
<td>0.449</td>
<td>1.302</td>
<td>-13.498</td>
<td>1.043</td>
<td>16.773</td>
<td>0.769</td>
<td>0.735</td>
</tr>
<tr>
<td></td>
<td>(5.79)</td>
<td>(3.82)</td>
<td>(4.35)</td>
<td>(1.48)</td>
<td>(1.79)</td>
<td>(-4.16)</td>
<td>(2.28)</td>
<td>(2.3)</td>
<td>(2.80)</td>
<td>(1.42)</td>
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<td>F-value *</td>
<td>1.61</td>
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<td>1.01</td>
<td>2.08</td>
<td>2.03</td>
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<td>1.01</td>
<td>0.97</td>
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<td>Df</td>
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<td>139</td>
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<tr>
<td>P-value</td>
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<td>0.0001</td>
<td>0.4546</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.2423</td>
<td>0.4384</td>
<td>0.4956</td>
<td>0.0018</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Note: * The null hypothesis being tested is the hypothesis of no performance persistence.

The results are reported for all styles and for each style separately. The last three rows of the Table report the F-value, the degrees of freedom, and the p-value for the null hypothesis that the intercepts for all Funds within a style are equal. The rejection of this hypothesis implies that performance persistence exists. The hypothesis is rejected for five styles, the Global, Market Neutral, Global Macroe, FOF-U.S., and FOF offshore styles. The hypothesis of no performance persistence is also rejected when the estimation is performed with all styles. Out-of-sample testing also indicated the persistence of the returns.

The concept of "style" should be thought of in two dimensions: location choice and trading strategy. Location choice refers to the asset classes, that is, the Fs in Equation used by the managers to generate returns. Trading strategy refers to the direction (long/short) and quantity (leverage), that is, the Fs in Equation applied to the assets to generate returns. The actual returns are therefore the products of location choice and trading strategy.
Example: To illustrate this point, consider a manager trading S&P futures contracts. Without leverage, a fully invested position of being consistently long one futures contract (i.e., buy and hold) will result in the style regression showing a coefficient of one on the S&P 500 index. If the manager leverages up to two futures contract, the regression coefficient will be two. Conversely, if he is short one futures contract, the regression coefficient will be -1. However, if he alternates between long and short each month, the regression coefficient will be close to zero.

This example illustrates how return is a function of the location choice as well as trading strategy. Hedge Fund managers' trading strategies have F that are not constrained to be between zero and one. In principal, the Fs can be between negative infinity and positive infinity. In practice, the Fs are usually between -10 and +10. In addition, the managers can be opportunistic, so that the Fs can and do change quickly. Their returns are not likely to be correlated to the asset class returns. These are dynamic trading strategies. This helps to explain why Sharpe's style regression which is better suited to buy and hold returns on asset classes, is not appropriate for performance attribution when applied to Hedge Fund managers who use dynamic trading strategies.

As we can see from Harri and Brorsen's table, the absolute value of loading Factors of traditional indexes like S&P 500 is quite small; some are not significantly different from zero. That indicates the low correlation between some Hedge Fund strategies and market returns. Indeed, the lack of dominant style Factors attests to the wealth of performance diversity available among these managers. For example, truly market neutral Funds should not have excessive exposures to traditional asset classes in extreme moves.

Since Hedge Funds can short-sell and can use leverage, unlike while doing a Sharpe style analysis, no constraints were imposed on style weights. So the loading Factor can be much higher than 1.

Unlike Mutual Funds, Hedge Fund's return can be nonlinear. Considering that Hedge Fund returns exhibit non-linear option-like exposures to standard asset classes traditional linear Factor models offer limited help in evaluating the performance of Hedge Funds. Agarwal and Naik [30] propose a general asset class Factor model comprising of excess returns on passive option-based strategies and on buy-and-hold strategies to benchmark the performance of Hedge Funds.
Agarwal & Naik Model:

\[ R_i^t = \alpha^t + \sum_{k=1}^{K} b_k^i F_k^t + u_i^t \]

where, \( R_i^t \) = net-of-fees excess return (in excess of the risk free rate of interest) on an individual Hedge Fund \( i \) for month \( t \),

\( a^i \) = value added by a Hedge Fund \( i \) over the regression time period,

\( b_k^i \) = average Factor loading of an individual Hedge Fund \( i \) on kth Factor during the regression period,

\( F_k^t \) = excess return (in excess of the risk free rate of interest) on kth Factor for month \( t \),

\( (k=1, \ldots, K) \) where the Factor could be a Trading Strategy Factor (an option-based strategy) or a Location Factor (Long position in an index), and

\( u_i^t \) = error term.

This equation may look similar to Harri & Borsen Model. That is because all of these models are based on APT models; what makes them different are the different Factors used by different models to capture returns.

Agarwal and Naik used Passive Option-based Strategies and Buy-and-Hold Strategies as the Factor classes. In order to examine the value added by Hedge Funds, they regress the net-of-fee monthly excess return (in excess of the risk free rate of interest) on a Hedge Fund on the excess return earned by passive option-based strategies (Trading Strategy Factors) and that earned by traditional buy-and-hold strategies (Location Factors). To conserve degrees of freedom and to mitigate potential multi-collinearity problems, they use a stepwise regression approach where the independent variables are entered into the discriminant function one at a time, based on their discriminating power. The single best variable is chosen first; the initial variable is then paired with each of the other independent variables, one at a time, and a second variable with maximum incremental explanatory power is chosen, and so on.

The special characteristic of the model is the inclusion of option strategies as Factors. Four option strategies, S&P 500 at-the-money call, out-of-the-money call, at-the-money Put & out-of-
the-money Put are included in the model. For calls (Puts), they select the option with next higher (lower) strike price to be the out-of-the-money option. They denote at-the-money call (Put) option on the S&P 500 Index by SPCa (SPPa) and out-of-the-money call (Put) option by SPCo (SPPo).

Besides those Factors, in the style regression, the buy-and-hold-strategy Factors consist of indices representing equities (Russell 3000 index, MSCI World excluding USA index and MSCI Emerging Markets index), Bonds (SB Government and Corporate Bond index, SB World Government Bond index and Lehman High Yield index), Federal Reserve Bank Competitiveness-Weighted Dollar index and the Goldman Sachs Commodity index. They also include three zero-investment strategies representing Fama-French’s “Size” Factor (Small-minus-Big or SMB), “Book-to-Market” Factor (High-minus-Low or HML) and Carhart’s [31] “Momentum” Factor (Winners-minus-Losers). Finally, to capture credit risk, they include the change in the default-spread (the difference between the yield on the BAA-rated corporate Bonds and the ten-year Treasury Bonds) as an additional Factor.

François-Serge Lhabitant Model:

By adapting the Sharpe (1988) return-based style analysis model and using as asset classes the nine CSFB/Tremont sub-indices, Lhabitant developed an intuitive model. For a given Hedge Fund, the model can be written as:

\[ R_t = \alpha + \sum_{i=1}^{y} \beta_i \cdot I_{tt} + \epsilon_t \]

where

I1,t = return on the CSFB Tremont Convertible Arbitrage index at time t
I2,t = return on the CSFB Tremont Short Bias index at time t
I3,t = return on the CSFB Tremont Event Driven index at time t
I4,t = return on the CSFB Tremont Global Macro index at time t
I5,t = return on the CSFB Tremont Long Short Equity index at time t
I6,t = return on the CSFB Tremont Emerging Markets index at time t
I7, t = return on the CSFB Tremont Fixed Income Arbitrage index at time t

I8, t = return on the CSFB Tremont Market Neutral index at time t

I9, t = return on the CSFB Tremont Managed Futures index at time t

It is the only model I found which does not include any passive traditional-asset indices. They simply use alternative asset styles represented by indices of active Funds. Therefore, for a given Hedge Fund, the beta coefficients can then be seen as exposures to the different CSFB/Tremont styles. The idea behind it was that CSFB/Tremont index is an all-inclusive Hedge Fund index, so any Fund using multiple strategies should be captured by the linear combination of individual strategies. The alpha coefficient is the excess return generated by the Hedge Fund manager, taking into account its investment style. For beta, they keep the lower boundary constraint. Although Hedge Funds may take short positions, their underlying indices are style indices, not standard asset class indices. Therefore, having a negative exposure to a particular style could be hard to justify economically.

Unlike other models, the return-based style analysis of Lhabitant Model can be directly used to monitor a Hedge Fund manager’s investment style, regardless of claimed exposure or categorization and without necessitating periodic disclosure of the Funds’ assets. This provides a useful indication as to the economic environment in which a given manager is likely to do well or poorly. It can also provide some evidence of both the probability and extent to which a particular Hedge Fund performance will diverge from any performance benchmarks it is measured against.

Application of VaR to Multivariate Models

The multivariate models can be used for VaR analysis as well. Lhabitant was one of the pioneers who developed its application in Hedge Funds’ risk analysis. Based on style exposure of a Hedge Fund of his 9-Factor model, he applied a two-step procedure to obtain its value at risk, that is, its maximum loss during a specified period of time at a given level of probability. The first step estimates systematic risk. Once the Hedge Fund is mapped on the nine indices, we can “push” the price of each individual risk Factor in the most disadvantageous direction and estimate the overall impact on the Fund, accounting for risk Factor correlation. This will give us the VaR due to market moves (i.e. style return moves). We call this first part the “value at market risk”. In a
second step, we will add up the VaR due to the specific characteristics of the Fund, that we will call "value at specific risk".

Assume that we want a confidence level of 99% for the one-month VaR. Denoting by $F_i^*$ the one percentile extreme move of index $i$ returns over one month, the value at market risk for a Fund $P$ over one month is given by

$$\text{Value at Market Risk}_{P,1M} = \sqrt{\sum_{i=1}^{9} \sum_{j=1}^{9} \rho_{i,j} \cdot \beta_i \cdot F_i^* \cdot \beta_j \cdot F_j^*}$$

Table. Correlation, extreme moves and volatility figures for Hedge Fund indices

<table>
<thead>
<tr>
<th></th>
<th>Convertible Arbitrage</th>
<th>Dedicated Short Bias</th>
<th>Event Driven</th>
<th>Global Macro</th>
<th>Long Short Equity</th>
<th>Emerging Markets</th>
<th>Fixed Income Arbitrage</th>
<th>Market Neutral</th>
<th>Managed Futures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convertible Arbitrage</td>
<td>1.00</td>
<td>-0.30</td>
<td>0.60</td>
<td>0.36</td>
<td>0.21</td>
<td>0.45</td>
<td>0.75</td>
<td>0.31</td>
<td>-0.61</td>
</tr>
<tr>
<td>Dedicated Short Bias</td>
<td>-0.30</td>
<td>1.00</td>
<td>-0.73</td>
<td>-0.14</td>
<td>-0.77</td>
<td>-0.72</td>
<td>-0.06</td>
<td>-0.56</td>
<td>0.30</td>
</tr>
<tr>
<td>Event Driven</td>
<td>0.60</td>
<td>-0.73</td>
<td>1.00</td>
<td>0.40</td>
<td>0.66</td>
<td>0.80</td>
<td>0.41</td>
<td>0.52</td>
<td>-0.53</td>
</tr>
<tr>
<td>Global Macro</td>
<td>0.36</td>
<td>-0.14</td>
<td>0.40</td>
<td>1.00</td>
<td>0.52</td>
<td>0.46</td>
<td>0.58</td>
<td>-0.05</td>
<td>-0.04</td>
</tr>
<tr>
<td>Long Short Equity</td>
<td>0.21</td>
<td>-0.77</td>
<td>0.66</td>
<td>0.52</td>
<td>1.00</td>
<td>0.75</td>
<td>0.23</td>
<td>0.30</td>
<td>-0.15</td>
</tr>
<tr>
<td>Emerging</td>
<td>0.45</td>
<td>-0.72</td>
<td>0.80</td>
<td>0.46</td>
<td>0.75</td>
<td>1.00</td>
<td>0.35</td>
<td>0.46</td>
<td>-0.38</td>
</tr>
<tr>
<td>Fixed Income arbitrage</td>
<td>0.75</td>
<td>-0.06</td>
<td>0.41</td>
<td>0.58</td>
<td>0.23</td>
<td>0.35</td>
<td>1.00</td>
<td>-0.01</td>
<td>-0.32</td>
</tr>
<tr>
<td>Market neutral</td>
<td>0.31</td>
<td>-0.56</td>
<td>0.52</td>
<td>-0.05</td>
<td>0.30</td>
<td>0.46</td>
<td>-0.01</td>
<td>1.00</td>
<td>-0.17</td>
</tr>
<tr>
<td>Managed Futures</td>
<td>-0.61</td>
<td>0.30</td>
<td>-0.53</td>
<td>-0.04</td>
<td>-0.15</td>
<td>-0.38</td>
<td>-0.32</td>
<td>-0.17</td>
<td>1.00</td>
</tr>
<tr>
<td>Volatility</td>
<td>1.83</td>
<td>6.41</td>
<td>2.54</td>
<td>4.20</td>
<td>4.76</td>
<td>6.67</td>
<td>1.66</td>
<td>0.76</td>
<td>2.89</td>
</tr>
</tbody>
</table>

This table shows the correlation, volatility and extreme move figures for the hedge funds style indices at the end of September 2000. All values are computed from a historical sample of 36 months. Volatility and Extreme moves are expressed on a monthly basis.

where $\rho_{i,j}$ is the correlation between monthly returns of Hedge Fund indices $i$ and $j$. This formula is inspired by the one used in the variance/covariance method (e.g. Riskmetrics). The procedure to estimate extreme moves is based on extreme value theory and detailed in the table.

To estimate specific risk, simply define specific risk ($s_e^2$) as the difference between total risk (observed Fund variance $s_p^2$) and systematic risk (variance due to the market, i.e. the Hedge Fund style). We have:

$$\sigma_e^2 = \sigma_p^2 - \sum_{i=1}^{9} \sum_{j=1}^{9} \rho_{i,j} \beta_i \cdot \sigma_i \cdot \beta_j \cdot \sigma_j$$
The error terms $\varepsilon_{t}$ are non-correlated with the systematic risk, and distributed with zero mean and variance $s_{e}^{2}$. If we want to compute the one-percentile of the error term distribution, we can be done numerically, or parametrically if we assume a particular distribution for these error terms. For instance, if we assume a normal distribution, we can apply a Factor push of 2.33 times se (corresponding to a 99% confidence level for a normal variable) to obtain the specific risk of a Hedge Fund assuming $s_{e}$ is normally distributed.

\[
\text{Value at Specific risk}_{p,1M} = 2.33 \times \sigma_{e}
\]

So the total VaR over a period is obtained by adding up market and specific risk figures, accounting for their zero correlation:

\[
\text{VaR}_{p,1M} = \sqrt{\left(\text{Value at Market Risk}_{p,1M}\right)^{2} + \left(\text{Value at Specific Risk}_{p,1M}\right)^{2}}
\]

**Limitations of multivariate models:**

1. Hedge Fund managers change their strategies based on the opportunities in the market constantly, so when researchers test on back-testing months or forward-testing months, the result often show significant discrepancy between the market result and the result predicted by the models. But an alternative explanation can be that the model fails to capture the Factors and their coefficient in the first place. A moving-window approach may partly help resolve this problem.

2. No model could simply take all the Funds within a database. They each have more specific requirements, which can introduce more selection bias. So we cannot simply take a model and apply it on a random chosen Hedge Fund, we have to be cautious to make sure that the Fund fits the model’s requirements.

3. As with all linear models, the regression result can be greatly influenced by outliers. The researchers may decide to remove the outliers from the data. But that creates a serious problem for estimate the VaR, which was created exactly to take the outliers and nonnormal distribution into consideration.
Section 7. Hedge Fund Diversification and Asset Allocation

Hedge Fund Diversification

Portfolio diversification—the practice of spreading one’s money among many different investments—is a commonsense concept that has many parallels in popular language and culture. Its theoretical foundations were introduced in the normative work of Harry Markowitz [18] and later confirmed by the work of William Sharpe. [19]

Since choosing a ‘bad’ manager may easily wipe out all the benefits of a Hedge Fund allocation, investing in only one Hedge Fund is likely to be suboptimal. The reasons are threefold.[20] Firstly, dramatic performance differentials between competing Funds raise the issue of whether a single investment instrument can deliver consistent returns close to those of the broad hedge-Fund indices that are used at the strategic asset-allocation level. Secondly, a number of individual Hedge Funds have collapsed under the weight of spectacular frauds or investment debacles (Manhattan Capital Management, Maricopa Investment Corporation, Lipper Convertible Arbitrage, etc.). This has raised concerns among investors, who often lack sufficient information to evaluate comparative Hedge Fund performance and to perform the necessary exhaustive on-site due diligence checks. Finally, investing only with managers who have a good reputation and an established track record does not provide a complete hedge, as illustrated by the debacle of the brain trust that was Long Term Capital Management.

Consequently, risk-conscious investors are coming back to the central tenet of modern portfolio theory, namely, diversification. By combining several Hedge Funds with differing return distributions and risk profiles in a portfolio, investors are able to diversify specific risk away and ensure a more disciplined exposure to the overall Hedge Fund asset class. This is likely to result in better long-term risk-adjusted returns.

Intuitively, the existence of Hedge Fund diversification benefits will depend on the number of Hedge Funds in a portfolio. Beyond the agreement that holding only a few Funds may imply under-diversification, exposure concentration and, therefore, too much risk, while holding too many Funds may result in over-diversification, the dilution of each Fund’s contribution, and the neutralization of most diversification benefits, there seems to be no consensus on the optimal
number of Funds. On the academic side, the literature suggests that approximately 8 to 10 managers should be sufficient to significantly reduce the overall risk of the portfolio [21]. However, Amin and Kat [22] show that one has to hold at least 20 Funds to fully realize the diversification potential in Hedge Funds. From the practitioner's perspective, the consensus seems to be that at least 20 to 30 managers are necessary to diversify effectively, as shown by studies on Funds of Hedge Funds. The short note by Ruddick [2002] evidences that the maximum benefits of diversification are reached with around 20 Funds, and that it is still possible to have them at around 40 Funds if the quality of new additions can be maintained.

Most investors are naive investors. For example, very few investors effectively take correlations (that is, the non-linearity of risk) into account when making complex portfolio decisions. Rather, they prefer to allocate assets using simpler rules, such as dividing allocations evenly among the assets available. So naive diversification is a protection against ignorance. It aims to spread assets evenly in the portfolio in order to reduce overall risk, while at the same time ignoring the mathematical complexities underlying modern portfolio theory. According to the latter, naive diversification does not give proper consideration to the correlations among the assets and should therefore result in suboptimal portfolios. However, in practice, naive diversification usually results in reasonably diversified portfolios that are surprisingly close to some point on the efficient frontier. The implementation of a naive diversification strategy, however, is likely to revolve around transaction and portfolio management costs. There are diminishing marginal returns and, eventually, absolute returns when increasing portfolio size, since transaction costs remain relatively constant while incremental reductions in portfolio risk get smaller. Therefore, the question of the number of optimal securities necessary in a naively diversified portfolio is still open.

I believe there is no rule of the thumb or a magic number for diversification. For well-informed investors, the number of Hedge Funds needed is probably fewer than those for naive investors. Conceivably Hedge Funds belonging to the same strategy have higher correlation coefficients, so within the same group it is more important to pick the Funds which perform better than the rest instead of using the rest for diversification. Hedge Fund strategies have moderate to low correlations with each other, so it would improve the efficiency of diversification by choosing best performing Funds from different categories.
The following table shows the historic correlation between different Hedge Fund strategies:

**Correlation Matrix — 10 Years Ending March 2001**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conv. Arb</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Stat Arb</td>
<td>0.251</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>M&amp;A Arb</td>
<td>0.250</td>
<td>0.519</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eq. Distressed</td>
<td>0.406</td>
<td>0.211</td>
<td>0.200</td>
<td>0.431</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market Macro</td>
<td>0.634</td>
<td>0.268</td>
<td>0.188</td>
<td>0.266</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Eq Neutral</td>
<td>0.207</td>
<td>0.421</td>
<td>0.578</td>
<td>0.564</td>
<td>0.349</td>
<td>1.000</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short Hedge</td>
<td>-0.165</td>
<td>-0.329</td>
<td>-0.502</td>
<td>-0.399</td>
<td>-0.192</td>
<td>-0.859</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fund Selling</td>
<td>0.212</td>
<td>0.432</td>
<td>0.652</td>
<td>0.762</td>
<td>0.292</td>
<td>0.792</td>
<td>-0.604</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>0.479</td>
<td>0.365</td>
<td>0.361</td>
<td>0.389</td>
<td>0.200</td>
<td>0.641</td>
<td>-0.648</td>
<td>0.509</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>MSCI EAFE</td>
<td>0.236</td>
<td>0.270</td>
<td>0.385</td>
<td>0.399</td>
<td>0.179</td>
<td>0.560</td>
<td>-0.519</td>
<td>0.490</td>
<td>0.615</td>
<td>1.000</td>
<td></td>
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<tr>
<td>MSCI EMF</td>
<td>0.099</td>
<td>0.468</td>
<td>0.573</td>
<td>0.501</td>
<td>-0.013</td>
<td>0.620</td>
<td>-0.577</td>
<td>0.687</td>
<td>0.613</td>
<td>0.542</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LB Agg</td>
<td>0.388</td>
<td>0.033</td>
<td>0.024</td>
<td>0.364</td>
<td>0.244</td>
<td>0.124</td>
<td>-0.079</td>
<td>0.134</td>
<td>0.307</td>
<td>0.144</td>
<td>-0.025</td>
<td>1.000</td>
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<tr>
<td>90-Day T-bill</td>
<td>0.106</td>
<td>0.101</td>
<td>-0.146</td>
<td>-0.041</td>
<td>0.162</td>
<td>0.015</td>
<td>0.053</td>
<td>-0.072</td>
<td>0.074</td>
<td>-0.08</td>
<td>-0.153</td>
<td>0.344</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Source: BARRA RogersCasey 2001

Example: There are many studies on the effect of diversification and optimum Hedge Fund portfolio construction. Based on the historical return data and simple principles about correlations, Noel and his colleagues presented a special portfolio - Minimum Variance Portfolio, which characterized a well-informed diversification approach [23].

There is a general consensus that expected returns are difficult to obtain with a reasonable estimation error. On the other hand, there is a common impression that return variances and covariances are much easier to estimate from historical data. Since early work by Merton [1980] or Jorion [1985, 1986], it has been argued that the optimal estimator of the expected return is noisy with a finite sample size, while the estimator of the variance converges to the true value as
the data sampling frequency is increased. As a result, they approach the question of optimal strategic asset allocation in the alternative investment universe.

The data they used were from CSFB/Tremont Hedge Fund indices. 48 months of observations (beginning of 1994 to end of 1998) were used to estimate the covariance matrix of the returns of the nine Hedge Fund sub indexes. They then form a global minimum variance portfolio. The portfolio is held for six months, their monthly returns are recorded, and the same process is repeated again. So, minimum variance portfolios have ex-post monthly returns from early 1999 to the end of 2000. The means and variances of these portfolios are used to assess the performance of optimal diversification.

The exhibit reports ex-post means, standard deviations, and other characteristics of the global minimum variance portfolio. In addition to the global minimum variance portfolio, they also consider the following two portfolios: the value-weighted Tremont global index and the equally weighted portfolio of the various indices.

<table>
<thead>
<tr>
<th>Ex-Post Mean, Standard Deviation, and Other Characteristics of the Minimum Variance Portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Retum</td>
</tr>
<tr>
<td>Minimum variance portfolio</td>
</tr>
<tr>
<td>Equally weighted index</td>
</tr>
<tr>
<td>Tremont global index</td>
</tr>
</tbody>
</table>

Mean and standard deviations are expressed in percentage per year, and obtained from monthly data through a multiplicative factor of 12 and square root of 12, respectively.

The ex-post volatility of minimum variance portfolios is almost three times lower than that of a naively diversified equally weighted portfolio, and almost seven times lower than that of the value-weighted Tremont global index. Interestingly, the mean return on the minimum variance portfolio tends to dominate that of the equally weighted. The annual mean return on the minimum variance portfolio is 12.16%, which compares to 9.13% and 12.50% for the equally weighted and value-weighted portfolios, respectively.

As an illustration, they then use an exhibition to display the evolution of $100 invested in January 1999 in the Tremont global index, an equally weighted portfolio of Tremont indexes, and the minimum variance portfolio obtained from an implicit Factor-based variance-covariance matrix estimate. As can be seen from the exhibit, the minimum variance portfolio has a much smoother path than its equally weighted and value-weighted counterparts.
Performance of Minimum Variance Portfolio in the Alternative Investment Universe

Graph displays the evolution of $100 invested in January 1999 in the Tremont global index, an equally weighted portfolio of Tremont indexes, and the minimum variance portfolio obtained from an implicit factor-based variance-covariance matrix estimator, where all factors with eigenvalues lower than \( \lambda_{\text{min}} \) are treated as noise.

This article is perhaps the first to evaluate the out-of-sample performance of an improved estimator of the covariance structure of Hedge Fund index returns, focusing on its use for optimal portfolio selection. This strongly indicates that optimal inclusion of Hedge Funds in an investor portfolio can potentially generate a dramatic decrease in the portfolio volatility on an out-of-sample basis. Differences in mean returns, on the other hand, are not statistically significant, suggesting that the improvement in terms of risk control does not necessarily come at the cost of lower expected returns.

**Fund of Funds**

An alternative way for Hedge Fund diversification is to invest in Fund of Funds. Since self-managed diversification is unrealistic for most investors (primarily on the basis of due diligence), investment in a Fund of Funds is the choice for many small to medium-sized investors. Funds of Funds offer the investor exposure to a wide range of alternative investment styles and strategies which, combined in a portfolio, can produce consistent absolute returns with low levels of risks. The Fund of Funds structure can also provide a more transparent and liquid platform than direct Hedge Fund investment and can relieve the investor of many potential problems such as the process of due diligence and Fund selection. Fund of Funds allows exposure to Hedge Funds through a relatively low minimum investment, sometimes as a listed share, and can provide higher levels of disclosure. It can also give investors access to multiple Hedge Funds with a
much smaller investment than the minimum required by individual Hedge Funds. So those investors who wish to avoid the logistical problems and record-keeping headaches of tracking several Hedge Funds can delegate the portfolio construction and monitoring activities to a Fund of Hedge Funds. This has become a preferred investment structure for most institutional investors, since it gives them instant diversification and frees them from the responsibility of monitoring managers. Certainly these advantages come at a price. Fees are charged by both the Fund of Funds manager and the underlying Hedge Funds. Investors have to consider the level of both the annual management fee and any additional performance fees charged by the Fund of Funds and the fees paid to the managers of underlying Hedge Funds. Fortunately, some Fund of Funds managers are able to mitigate these fees by obtaining fee rebates from the underlying managers, taking advantage of the substantial allocations they can make to the manager. Typical Fund of Funds fee may be 1%-2% management fee per annum, plus another 0.5% for custodian and other professional services. Performance fees can be up to 20% of NAV performance, some subject to a benchmark-related hurdle rate.

Estimated Global Fund of Hedge Funds Market Size (July 2001)

<table>
<thead>
<tr>
<th>Buyer segment</th>
<th>United States</th>
<th>Europe</th>
<th>Japan and Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hedge Funds</td>
<td>Hedge Funds</td>
<td>Hedge Funds</td>
</tr>
<tr>
<td>Institutional market</td>
<td>NHF FOHF NHF FOHF NHF FOHF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corporate pensions</td>
<td>35</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Public pensions</td>
<td>28</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Endowments/ foundations</td>
<td>21</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Insurance companies</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>High net worth</td>
<td>281</td>
<td>50</td>
<td>80</td>
</tr>
<tr>
<td>Totals</td>
<td>350</td>
<td>67</td>
<td>75</td>
</tr>
</tbody>
</table>


Funds of Hedge Funds (FOHFs) oversee about $100 billion. The majority of the current global demand is from affluent individuals—less than 25% is from institutions. Over 70% of FOHF assets are managed for American investors, 15% for pan-European, and 10% for Japanese. Demand will remain strong, but are there natural limits? Investors will show continued interest in FOHFs, buoyed by the broader mainstreaming of alternative investments. This secular shift of
money, however, will suppress returns if market inefficiencies become more fully arbitraged, thus potentially dampening future demand. Many strategies may already be reaching such capacity constraints. The market for FOHFs is maturing rapidly. To date, the professional standards for investment process, marketing, and client service are still in a developmental stage. As traditional investors gain more experience with FOHFs and as additional sophisticated clients (e.g., institutional investors) enter the market, these standards will be raised significantly. The industry will likely enter a phase of consolidation. Over the next few years, the FOHF business will become significantly more resource intensive. Large investments are required in client service, risk management systems, and the due diligence and monitoring of managers. The scale required to support these activities is increasing. Established firms are best positioned for success. Significant advantage goes to firms that are already developing an advanced infrastructure and performance record. Scale requirements, coupled with a scarcity of experienced FOHF professionals, may make gaining substantial market share difficult for future entrants. Going forward, larger financial institutions will likely approach this market through acquisition or alliance.
<table>
<thead>
<tr>
<th>Task</th>
<th>Sub Task</th>
<th>Direct Investing Issues</th>
<th>Advantage of Fund of Funds</th>
<th>Disadvantage of Fund of Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fund Selection &amp; Management</td>
<td>Search</td>
<td>Over 5,000 funds to consider</td>
<td>FoF manager knows the market, knows where to search</td>
<td>FoF manager could miss something, e.g., a new fund that is very good at what it is doing</td>
</tr>
<tr>
<td></td>
<td>Screen</td>
<td>Many funds to interview</td>
<td>FoF manager interviews funds as part of his or her business</td>
<td>Screening process may be too restrictive</td>
</tr>
<tr>
<td></td>
<td>Select</td>
<td>Documentation process could be cumbersome</td>
<td>Documentation part of his or her normal business operations. One agreement for the end investor</td>
<td>May not structure the best investment position for the investor (e.g., L.P.)</td>
</tr>
<tr>
<td></td>
<td>Monitor</td>
<td>Many different levels of disclosure, reporting styles, inconsistencies in methodology</td>
<td>FoF will report fund exposure and performance in a consistently computed manner</td>
<td>May not report fund-specific information that is relevant to evaluating a specific fund</td>
</tr>
<tr>
<td>Operational Aspects</td>
<td>Accounting,</td>
<td>Manage individually, cumbersome</td>
<td>FoF will consolidate</td>
<td>Cash flows may not get fully invested immediately</td>
</tr>
<tr>
<td></td>
<td>cash flow management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimum fund investment</td>
<td>Must meet minimum investment requirement for each fund</td>
<td>Must meet only minimum investment requirement for FoF. thereby permitting smaller overall</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>levels</td>
<td></td>
<td>investment</td>
<td></td>
</tr>
<tr>
<td>Efficiency of Investment</td>
<td>Risk</td>
<td>Risk of selecting a high volatility fund</td>
<td>Risks are averaged and diversified, economies of scale</td>
<td>Diluting the risk benefits of the best players in the market</td>
</tr>
<tr>
<td></td>
<td>Return</td>
<td>Opportunity to find the best performer</td>
<td>Average performance of many managers, styles, funds, forced diversification</td>
<td>Diluting the returns of the best performer (likelihood of positive tail of distribution reduced)</td>
</tr>
<tr>
<td></td>
<td>Diversification</td>
<td>Requires multiple investments, ramp-up time</td>
<td>Instant diversification, single point of entry</td>
<td>No control over asset allocation, fund allocation</td>
</tr>
<tr>
<td></td>
<td>(Correlation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs/Fees</td>
<td>Senior management fees</td>
<td>Fees for individual funds only</td>
<td>Possibly better (negotiated) treatment in fees and other terms for individual hedge funds</td>
<td>Double fees: FoF fee on top of individual fund fees</td>
</tr>
<tr>
<td></td>
<td>and performance based-fees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(carried interest)</td>
<td></td>
<td></td>
<td></td>
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</table>

Source: Morgan Stanley.
Hedge Fund Index Investing

There is a strong emerging interest in Hedge Fund index investing rather than Fund of Funds. Hedge Fund indices typically provide greater diversification than funds of funds: whereas a FOF may use around 25 Hedge Funds chosen by its management team, an index typically has 100 or more that are chosen according to size or other objective criteria. Index product fees also tend to be lower, with consequences for the return distribution: while a typical index product charges no performance fee, a typical FOF may charge a 10% performance fee (on top of the 20% charged by its constituent funds), effectively increasing the negative skew of expected returns by yielding all of the net downside but only 90% of the net upside. Hedge Fund index investing also offers targeted exposure. Asset allocators increasingly often prefer the objective market exposure of an index to the standalone perspective of a fund of funds. As the institutional community broadens its interest in Hedge Funds, there is reason to believe that much of this interest will be channeled into index products.

With the industry still in its infancy and Hedge Funds under no formal obligation to disclose their results, gaining insight into the performance characteristics of Hedge Funds not straightforward. Fortunately, many funds release performance as well as other administrative information attract new and to accommodate existing investors. These data are collected by a small number of data vendors and fund advisors, some of which make their data available to qualifying investors and have indexes that track performance according to investment styles.

There are a variety of Hedge Fund indices and the popular ones include:


Zurich Hedge Fund Indices http://www1.zindex.com/zindex/action/main


Altvest Hedge Fund Indices: http://www.investorforce.com/av/index/index_rets.asp

Altvest is a Hedge Fund website that aims to provide investors with real-time information on alternative investments. The Altvest database contains information on around 2,000 Hedge Funds. From the monthly net of fee returns of these funds, Altvest calculates 14 equally weighted indices.

Credit Suisse First Boston/Tremont Indices: http://www.hedgeindex.com
The CSFB/Tremont indices are based on the TASS database which tracks around 2,600 funds. Using a subset of around 650 funds, CSFB/Tremont calculates 10 indices. Contrary to other indices, the CSFB/Tremont indices reflect the monthly net of fee return on an asset-weighted basket of funds. Large funds therefore have a larger influence on the index than smaller funds. There are strict rules for fund selection. The universe consists only of funds with a minimum of USD 10 million under management and a current audited financial statement. Funds are re-selected quarterly as necessary.

Deutsche Bank 100: http://www.eacmalternative.com

HFR Hedge Fund Indices: http://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. HFR uses a subset around 1,500 funds to calculate 33 indices. These indices reflect the monthly net of fee returns on equally weighted baskets of funds.

Zurich Capital Markets http://www.marhedge.com

The Zurich Capital Markets database and the indices calculated from it were originally developed and compiled by Managed Accounts Reports (MAR) but were sold to Zurich Capital Markets in March 2001. The database contains information on around 1,500 Hedge Funds, which are used to calculate 19 indices. The latter reflect the median monthly net of fee returns on the funds the indices.

Hennessee Hedge Fund Indices: http://www.hennesseegroup.com

The Hennessee Group is a Hedge Fund advisory firm that maintains a database of around 3,000 funds. Based on a subset of about 500 funds, Hennessee calculates 23 indices that reflect the monthly net of fee returns on equally-weighted baskets of funds.

LJH Hedge Fund Indices: http://www.ljh.com

TUNA Hedge Fund Indices: http://www.hedgefund.net

Hedgefund.net is a Hedge Fund website that offers investors free Hedge Fund information and performance data. The database covers around 1,800 Hedge Funds and forms the basis for the
calculation of 35 indices. The latter reflect the monthly net of fee returns on equally weighted baskets of funds.

VAN Hedge Fund Indices: http://www.hedgefund.com

Van Hedge Fund Advisors is a Hedge Fund advisory firm that has collected data on about 3,400 funds. Using a subset of around 500 funds, Van calculates 15 indices. These indices reflect the monthly net of fee returns on equally-weighted baskets of funds.

**Asset Allocation Decisions**

Although researchers do not agree that Hedge Funds offer a superior net-fee return as a standing-alone investment instrument, it is well established that Hedge Fund can play an essential role in portfolio diversification for both institutional and private investors.

All the fundamental arguments for diversification within the Hedge Funds apply to portfolio diversification within all available assets as well. As we can see from the table, Hedge Funds have low correlation with the traditional investment asset classes like Stocks and Bonds. Adding Hedge Fund as an asset class moves the efficient frontier to the upper-left. For the same level of risk, the expected return will be higher; or for the same expected return, the risk level will be lower. An optimized asset allocation calls for a high allocation to Hedge Funds even with conservative return assumptions.

![Asset Allocation Diagram](chart.png)

Source: Tremont Investment Management Inc. and Scotia Capital.
Robert Parnell examined the risk-return profile of different asset classes for the past 8 years. He estimated that a 30% allocation to Hedge Funds would have increased the annualized return by 0.8 percentage points and decreased the annualized volatility by 1.4 percentage points. It is noteworthy that volatility is reduced as return is increased. The benefits increase along with allocation. The allocation to Hedge Funds based on the optimization approach varies depending on the portfolio's risk and return objectives. For example, for a return target of 9%, an optimizer would allocate 40.2% to equities, 30.4% to Bonds and 29.4% to Hedge Funds. For a 10% return requirement, the Hedge Fund allocation jumps to 33.3%. While the analysis is dependent on input assumptions, it does illustrate how attractive Hedge Funds can be as an asset class in a diversified portfolio.
Conclusion

All in all, different researches have indicated that well-managed Hedge Funds do offer superior returns. The most attractive feature of the Hedge Fund is that it has low systematic risk (low β), it should be included in a diversified institutional portfolio (10-30% from different research results). As I have discussed at length, this superior return is mainly because Hedge Fund managers could take advantage of the market inefficiency. Considering that there are more market inefficiency opportunities to be exploited, I believe that Hedge Fund as an alternative investment tool is still at its early growth stage. So in the next few years, we should expect to see a persistent increase in investors’ focus on Hedge Funds. For Hedge Funds to grow as an investment alternative, individuals need to increase their knowledge and comfort level as to their use in investment portfolios. Hedge Funds offer unique opportunities to:

Reduce overall portfolio volatility risk

Enhance portfolio returns in economic environments in which traditional stock and bond investments offer limited opportunities and in which even other alternative investment vehicles do not provide similar returns

Participate in a wide variety of new financial products and markets not available in traditional investor products

The logical extension of using investment managers with specialized knowledge of traditional markets to obtain maximum return/risk tradeoffs is to add specialized Hedge Fund managers who can obtain the unique returns in market conditions and types of securities not generally available to traditional asset managers.
References


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6. Jolly, R.L., Scott ; Seidler, Charles ; Sommers, Dan ; Um, Christina ; Williams, James, (Case Study: Convertible Arbitrage-U.S. Market Trends and Global Position Winners and losers. Fall 2002.


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