The Risk in the Long/Short Hedge Fund Strategies

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Executive Summary

A hedge fund is a private partnership that is known for the alternative methods of investment strategies being used producing excessive return and low risk, compared to other asset classes. Hedge funds come in higher cost, in terms of fees paid by investors. The use of leverage, short-selling and derivative products are mostly responsible for the outcome of the hedge fund strategies. However, measuring the return and identifying the risk factor of each and every strategy confronts with the available data biases that all hedge funds are subject to.

The long/short equity strategy answers to more than 40% of the reported hedge funds, in terms of asset under management, mainly due to the lower market exposure and the better relative performance when compared to other hedge funds or the equity mutual funds. By providing descriptive statistical analysis, the results drawn highlight the view that the long/short equity strategy delivers significant return while includes lower risk exposures when compared to other hedge fund strategies. Moreover, five different portfolios with different asset allocation are constructed in order to study the contribution of the long/short equity hedge funds when included in an investment portfolio. Finally, two key papers describing the risk factors of the long/short strategy, employing a linear and a non-linear approach are presented.

Section 1: Introduction

a) What is a Hedge Fund?

Although there is no clear definition, a hedge fund can be defined as a private partnership that invests in heterogeneous types of financial instruments in an attempt to increase expected return while reducing risk. Hedge funds are subject to less limitation with respect to investments selection, while are not subject to the information disclosure requirements that are established for other investment vehicles. A distinctive characteristic of hedge funds is the active strategy adopted by the fund manager who tries to obtain the best result from investment opportunities using instruments that are not available to other fund managers. Apart from the use of traditional assets, such as stocks and bonds, which are used by mutual funds, pension funds et cetera, hedge funds have the flexibility of using both alternative asset classes such as subordinated debt and derivatives and alternative investment techniques such as are Short – Selling, Leverage and the use of derivates.

Hedge funds do not have to register neither with the U.S. Securities and Exchange Commission (SEC) nor with the National Association of Securities Dealers (NASD) or the Commodity Futures Trading Commission, the major self – regulatory bodies in the investment industry. The same applies for funds that are based either in Europe or in Asia, while the majority of the funds are domiciled in the U.S. However, there have been reported cases that many funds register with the above mentioned bodies in order to provide protection to their investors.

In order to invest in a hedge fund, an individual should meet the "high – net – worth" requirement meaning that only accredited or qualified investors are allowed. An investor is considered *accredited,* if he or she meets any of the following criteria:

- Has a net worth of more than $1 million, owned alone or jointly with a spouse.
- Has earned $200.000 in each of the past two years.
- Has earned $300.000 in each of the past two years when combined with a spouse.
- Has a reasonable expectation of making the same amount in the future.

For investment institutions, such as pension funds, endowments and trust, the primary qualification is having $5 million in assets.[1]

Another factor that distinguishes hedge funds from other types of collective investment vehicles is the fund's management compensation structures. Many hedge funds are structured under the '*2 and 20'* arrangement, meaning that the fund manager receives an annual fee equal to 2 percent of the assets in the fund and an additional success fee equal to 20 percent of the year's profits. It is mentioned that U.S. Securities and Exchange Commission regulations forbid mutual funds, for example, from charging performance fees. The performance fee plus the success fee structure, although may differ between hedge funds, rarely change. In addition, performance fees come with a downside for the fund managers: The fund sets a *high water mark,* which means that the fund starts charge performance fees only if the fund's assets return to the investment amount before starting writing losses. As a result, it is a powerful incentive for the manager to take under consideration the strategies she uses. Thus, due to high water marks, the loss of the performance fee for more than a year might be the cause for disbanding the fund, in order to follow a different investment vehicle to recoup the losses. Furthermore, redemption fees are charged as well, in order to preserve the investment capital for a certain amount of time. By charging this extra fee, it is well defined that hedge funds is a long – term investment proposition that require a significant amount of time to meet the desired return by the investors. The lock-in period vary for each hedge fund and can range from 3 to 24 months providing the fund managers with the freedom and the required investment capital to devise a particular investment strategy without worrying about the fluctuations that restrictions and the amount of capital can cause.

The hedge fund industry traces its beginning back to 1949, when Alfred Winslow Jones established the first hedge fund in the U.S. Jones used two techniques, considered speculative, to protect his portfolio from a declining market – leverage and short selling. Jones believed that stock selection was the key to performance regardless of market direction. He established a portfolio of long stocks which he believed would outperform the market and simultaneously sold short stocks expected to underperform,

[1] The Security and Exchange Commission defines the term *accredited investor* under the Rule 501 of Regulation D.

using leverage to magnify profits. In this way, his portfolio was positioned to make money in both rising and falling markets. Jones also established the performance fee structure for hedge funds by keeping 20 percent of the fund's net profits for himself. As news of Jones' success spread throughout Wall Street and the high-net-worth investor community, other money managers launched similar funds to reap the high performance allocations. Unfortunately, many of these managers strayed from Jones' original concept and used leverage without short selling to reduce the market risk. As a result, when the markets began to fall, many of these hedge funds declined dramatically in value and gave hedge funds the reputation of being high-risk investments.

In the late 1970s, hedge funds began to attract more positive attention as exceptional hedge fund managers like Julian Robertson and George Soros posted extraordinary returns over long periods of time. However, the "macro" strategy of these two high-profile managers led to short-term volatility. As these funds attracted considerable media coverage, the public's general perception was that all hedge funds were volatile; ironically, a large proportion of hedge funds had greater-than-market steadiness of returns as their mandate. Furthermore, hedge funds' success brought about huge changes in the way people thought about finance and investing. As a result, a significant number of academic professors tried to benefit from their knowledge and experience. Long Term Capital Management (LTCM) was an infamous hedge fund that was formed by an experienced bond trader at Solomon Brothers firm, John Meriwether, joined by the famous professors Robert Merton and Myron Scholes, who in 1997, shared the Nobel price in Economics. LTCM's primary strategy included speculating strategies with high levels of leverage, earning significant returns while maintaining a low level of risk. However, during the Russian government bonds' default in 1998, the fund lost $4.6 billion, highlighting the significant amount of risk that hedge fund are exposed to.

Over the last decade hedge funds have become more and more popular with institutional investors and high – net – worth individuals. As a result, the amount of assets under management has grown from around $40 billion in 1990 to an estimated

$1.5 trillion, today, according to Hedge Fund Research firm[2]. In line with this, the number of hedge funds worldwide has grown to around 9.700, with $111 million in assets under management on average.

b) Return Characteristics

Despite the ambiguities involved in describing hedge funds, we can sort them out in two categories based in their return / risk characteristics: absolute return funds and directional funds, outlined below.

Absolute – return funds: The goal of an absolute – return fund, or pure - alpha fund, is to generate a reasonable percentage return, regardless the state of the financial markets. This type of funds, rarely aim to beat the equity indexes, they target a positive return with relatively low risk. The fund manager aims to remove all market risk, that is beta risk, in order to create a fund that doesn't vary with market performance. Thus, the fund's performance depends entirely on the manager's skill, which in academic terms, is called *alpha.* Of course, much hedging of risk is required to generate a steady, low – risk return, justifying the absolute – return funds as the purest example of hedge funds. These funds are also referred to as 'bond – like investments', because a bond that the holder maintains to maturity generates a steady return from the interest. This category is most appropriate for conservative investors who prefer low risk and are willing to give up some return in exchange. It must be highlighted, though, that the return target is higher than the long – term rate of return on bonds and lower than the long – term return target on stocks, ranging from 8% - 10%.

Directional funds: Managers design this type of funds, also called beta funds, to generate the maximum return possible. Directional funds maintain some exposure to the market, but they tend to generate higher – than – expected returns, for the specific

[2] visit www.hfr.com

amount of risk that they take. The return may be disproportionately larger than its risk and because of this significant beta exposure, are considered to have equity – like returns. Although these returns may vary from year to year, they are likely to be higher long-term, than the returns generated from an absolute – return hedge fund. A directional strategy is appropriate for aggressive investors willing to take a significant amount of risk in exchange for potentially higher returns, usually double or triple returns compared to those of the stock market.

In any case the specific investment techniques used by hedge funds, such as leverage, short selling and the use of derivatives contribute in the return earned, but at the same time are responsible for the magnification of the amount of risk taken.

Measuring the performance of hedge funds, arises another important issue concerning data vendors. The limited available data, caused by the fact that most data vendors started collecting data around 1994, cover a very small period of time, which included a very special period: the bull market during the 1990s and the various crises that followed, including the present one. On the other hand, this fact contrasts with the situation for the traditional asset classes, such as stocks and bonds, where can be found return data that extend beyond a business cycle. Thus, the – generating process behind hedge funds returns is still considered to be unknown and so far there is little evidence or idea what constitutes normal behavior and what not.

The debate on the sources of hedge fund returns seems to split the industry in two camps: the proponents on the one side claim that the essential part of hedge funds returns comes from the funds' exposure to systematic risk, the betas, while the other side, the 'alpha protagonists' argue that hedge fund returns depend mostly on the specific skill of the hedge fund manager. Empirical evidence shows hedge fund returns as a mixture of both systematic risk (beta) exposure and skill – based absolute returns (alpha). However, the fundamental question that needs further analysis is how much beta and how much alpha.

One answer is to identify the different systematic risk factors of hedge funds and thus give us more precise insights into the return sources[3]. In a sense, the hedge fund returns can be 'broken down 'to traditional betas' (using long – only investing strategies), 'alternative betas' (using nonconventional investment techniques) and the portion that cannot be specified by a systematic process, there is more likely to be 'real alpha'. Fung and Hsieh extended Sharpe's model to hedge funds in 1997[4] by introducing short selling, leverage and derivatives into their model. They resulted in a factor equation that accounts for all hedge fund return variation that derives from risk exposures to risk factors of various asset classes. According to the preceding argument, the formula on hedge fund returns can be written as follows:

Hedge fund return =

$$Manager's\ Alpha + \sum(\beta_{i*} Factor_{i(\text{modeled})}) + \sum(\beta_{i*} Factor_{i(\text{unmodelled})}) + random\ fluctuations.$$

[3] "Factor Modeling and Benchmarking of hedge funds: Can Passive Investments in hedge funds strategies deliver alpha?", Lars Laeger and Christian Wagner (2005).
[4] Fung and Hsieh (1997)

c) Risk Characteristics

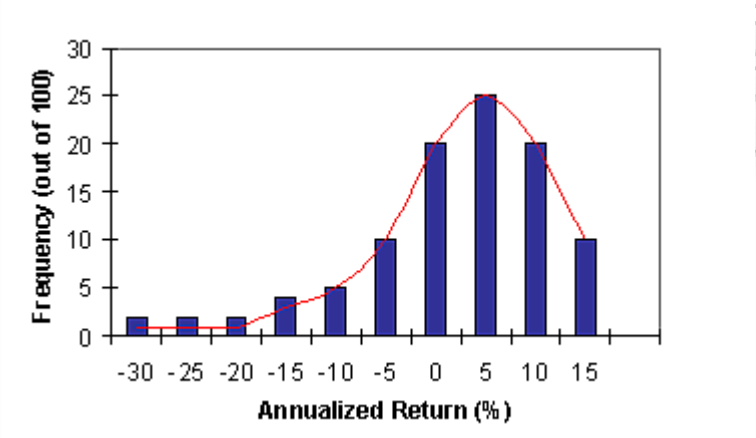
In contrast to traditional investment vehicles such as stocks, bonds and mutual funds, hedge funds have different risk exposures, meaning that most investors expect high return in exchange for the corresponding risk that they are expected to bear. Because hedge funds are typically organized as private investment vehicles for wealthy individuals and institutional investors, they do not disclose their activities publicly, hence, little is known about the risk in hedge fund strategies. As documented in Fung and Hsieh (1997a), hedge fund managers typically employ dynamic trading strategies that include derivative and 'over the counter' securities delivering option - like returns with apparently no systematic risk.

Linear – factor models of investment styles using standard asset benchmarks, as in Sharpe (1992), are not designed to capture the non – linear return features commonly found among hedge funds. This may lead investors to conclude that there is no systematic risk. Confronted with non – normal distributions, it is no longer appropriate to use the standard deviation as the sole measure of risk. In such cases investors should also look at the degree of symmetry of the distribution, as measured by skewness and the probability of extreme positive or negative outcomes, as measured by the distribution's kurtosis. Kurtosis measures the size of the tails of the returns distribution, while high kurtosis indicates that the distribution has 'fat' tails.

Hedge fund investors are exposed to multiple risks, and each strategy has its own unique risks. For example, long/short funds are exposed to the short-squeeze.

The traditional measure of risk is volatility, or the annualized standard deviation of returns. Surprisingly, most academic studies demonstrate that hedge funds, on average, are less volatile than the market. For example, over the period from 1994 to 2010 (present) we referred to earlier, volatility (annualized standard deviation) of the S&P 500 was about 21% while volatility of the long/short equity hedge funds was about 15%. In risk-adjusted terms, as measured by the Sharpe ratio (unit of excess return per unit of risk), some strategies outperformed the S&P 500 Index over the bull and the bear market period mentioned earlier.

The problem is that hedge fund returns do not follow the symmetrical return paths implied by traditional volatility. Instead, hedge fund returns tend to be skewed. Specifically, they tend to be negatively skewed, which means they bear the fat tails mentioned above, which are mostly characterized by positive returns but a few cases of extreme losses. For this reason, measures of downside risk can be more useful than volatility or Sharpe ratio. Downside risk measures, such as value at risk (VAR), focus only on the left side of the return distribution curve where losses occur. They answer questions such as, "What are the odds that I lose 15% of the principal in one year?"



What's more, the lack of public disclosure makes it difficult to link hedge fund styles to asset markets. Hedge fund returns tend to be far from normally distributed and exhibit significant negative skewness as well as substantial kurtosis. On a different note, hedge fund returns, may exhibit relative low standard deviations, but they also tend to exhibit skewness and kurtosis attributes that are exactly opposite to what investors' desire. For the reasons mentioned above, hedge funds risks, undeniably, do not consist only by the standard deviation. For example, Brooks and Kat (2002) found that the published hedge fund indices exhibit *low skewness and high kurtosis.* Moreover, Scott and Horvath (1980) showed that investors will prefer high mean and skewness and at the same time low standard deviation and kurtosis which measure the risk of a hedge fund.

This task is further complicated by the fact that hedge fund managers generally diversify their fund's performance across a variety of strategies - which are described in the following section – each having different risk exposures. Thus, many institutional investors are not yet convinced that hedge funds is a distinct asset class,

i.e. a collection of investments with a reasonably homogenous risk and return characteristics, that are stable over time.

Another widely used risk measure is the Sortino Ratio. The Sortino ratio measures the risk-adjusted return of each hedge fund strategy. It is a modification of the Sharpe ratio but penalizes only those returns falling below a user-specified target, or required rate of return, while the Sharpe ratio penalizes both upside and downside volatility equally. It is thus a measure of risk-adjusted returns that treats risk more realistically than the Sharpe ratio.
It is calculated as follows:

$$Sortino\ Ratio = \frac{R - R_f}{\sigma_d}$$

Where R is the expected return for the hedge fund, R_f is the return of the risk- free asset and σ_d is the standard deviation of the negative asset returns.Thus, the ratio is the actual rate of return in excess of the investor's target rate of return, per unit of downside risk. The ratio was created by Brian M. Rom in 1986 as an element of Investment Technologies' Post-Modern Portfolio theory portfolio optimization software.

Another popular risk measure of hedge funds returns being used is the Omega Ratio. The Omega ratio is the probability-adjusted ratio of gains to losses relative to a given threshold return r. The higher Omega the better, meaning that there is more density return on the right of the threshold return than on the left side:

$$\mathrm{OmegaRatio}(r) = \frac{\int_r^{+\infty} (1 - F(x))\, dx}{\int_{-\infty}^{r} (F(x))\, dx}$$

The Omega ratio uses all the information contained within the historical (or simulated) returns series of the hedge fund. It is especially adapted to asymmetric distributions where risk is not captured by the sole volatility, which is the case of hedge funds. As pointed out by Kazemi, Schneeweis, Gupta (2003), the Omega ratio can be formulated as a call-put ratio: it is the ratio of the call price to the put price for the chosen threshold. The Omega ratio was introduced by Keating and Shadwick in 2002. It derives its power from its universality: it takes into account all the moments of the

distribution, hence it is valid to deal with non-normal returns, while it selects the assets with the lowest density below the threshold return without altering the upside part of the distribution.

We notice some differences between Omega ratio, Sharpe ratio and Sortino ratio. On the one hand, the Sharpe and Sortino ratios are computed based on the sole knowledge of the two first moments of the distribution. The Sharpe ratio measures the excess return to volatility ratio while the Sortino ratio estimates the excess return to "bad" volatility ratio (also called semi-volatility or downside volatility, which is a truncated version of the second-order moment).
On the other hand, the Omega ratio takes into account all the moments of the distribution (mean return, volatility, skewness, kurtosis and higher moments). As a consequence, it is valid for non-normal returns and suitable for the asymmetric nature of hedge fund returns.

d) Hedge fund strategies

There are a vast number of different hedge fund strategies which in some cases use the same or similar techniques and asset classes, with the differences spotted in minor issues. After a thorough investigation in the recent bibliography, a detailed analysis of the hedge fund strategies is presented below:

- *Market Neutral Group*

►Equity Market Neutral - The manager invests similar amounts of capital in securities both long and short, maintaining a portfolio with low net market exposure (low beta). Long positions are taken in securities expected to rise in value while short positions are taken in securities expected to fall in value. These securities may be identified on various bases, such as the underlying company's fundamental value, its rate of growth, or the security's pattern of price movement. Due to the portfolio's low net market exposure, performance is insulated from market volatility.

►Event-Driven - The manager focuses investment decisions on significant catalyst-type events, such as spin-offs, mergers and acquisitions, bankruptcy reorganizations, recapitalizations and share buybacks. Some managers who employ Event-Driven trading strategies may shift the majority weighting between Merger Arbitrage and Distressed Securities, while others may take a broader scope. Typical trades and instruments used may include long and short common and preferred stocks, debt securities, options and credit default swaps. Leverage may be employed by some managers.

►Distressed Securities - The manager invests in the debt and/or equity of companies having financial difficulty. Such companies are generally in bankruptcy reorganization or are emerging from bankruptcy or appear likely to declare bankruptcy in the near future. Because of their distressed situations, the manager can buy such companies' securities at deeply discounted prices. The manager stands to make money on such a position should the company successfully reorganize and return to profitability. Also, the manager could realize a profit if the company is liquidated, provided that the manager had bought senior debt in the company for less than its liquidation value. "Orphan equity" issued by newly reorganized companies emerging from bankruptcy may be included in the manager's portfolio. The manager may take short positions in companies whose situations he deems will worsen, rather than improve, in the short term.

►Merger Arbitrage - The manager will take positions in companies undergoing “special situations”; for example, when one firm is to be acquired by another, or is preparing for a reorganization or spin-off. A frequent trade is “long the acquiree, short the acquirer.”

►Special Situations - The manager invests both long and short, in stocks and/or bonds which are expected to change in price over a short period of time due to an unusual event. Such events include corporate restructurings (e.g. spin-offs, acquisitions), stock buybacks, bond upgrades, and earnings surprises. This strategy is also known as event-driven investing.

►Arbitrage - The manager seeks to exploit specific inefficiencies in the market by trading a carefully hedged portfolio of offsetting long and short positions. By pairing individual long positions with related short positions, market-level risk is greatly reduced, resulting in a portfolio that bears a low correlation and low beta to the market. The manager may focus on one or several kinds of arbitrage, such as convertible arbitrage, risk (merger) arbitrage, capital structure arbitrage or statistical arbitrage. The paired long and short securities are related in different ways in each of these different kinds of arbitrage but in each case, the manager attempts to take advantage of pricing discrepancies and/or projected price volatility involving the paired long and short security.

►Convertible Arbitrage - This strategy typically involves buying and selling different securities of the same issuer (e.g. the common stock and convertibles) and "working the spread" between them. The manager buys one form of security he believes to be undervalued (usually the convertible bond) and sells short another security (usually the stock) of the same company.

►Fixed Income Arbitrage - The manager takes offsetting positions in fixed income securities and their derivatives in order to exploit interest rate-related opportunities. These fixed income securities are often backed by residential mortgages; i.e., mortgage-backed securities.

►Other Arbitrage - may include managers utilizing various arbitrage strategies, including but not limited to capital structure arbitrage, credit arbitrage, multi strategy arbitrage, options arbitrage.

►Statistical Arbitrage - The manager uses quantitative criteria to choose a long portfolio of temporarily undervalued stocks and a roughly equal-sized short portfolio of temporarily overvalued stocks. Trades tend to be short-term and the overall portfolio is usually neutral in terms of various risk characteristics (beta, sector exposure, etc.). "Pairs trading" is a common form of statistical arbitrage.

- *Long/Short Equity Group*

►Growth - A primarily equity-based strategy whereby the manager invests in companies experiencing or expected to experience strong growth in earnings per share. The manager may consider a company's business fundamentals when investing and/or may invest in stocks on the basis of technical factors, such as stock price momentum. Companies in which the manager invests tend to be micro, small, or mid-capitalization in size rather than mature large-capitalization companies. These companies are often listed on (but are not limited to) the NASDAQ. Managers employing this strategy generally utilize short selling to some extent, although a substantial long bias is common.

►Opportunistic- Rather than consistently selecting securities according to the same strategy, the manager's investment approach changes over time to better take advantage of current market conditions and investment opportunities. Characteristics of the portfolio, such as asset classes, market capitalization, etc., are likely to vary significantly from time to time. The manager may also employ a combination of different approaches at a given time.

►Short Selling- The manager maintains a consistent net short exposure in his portfolio, meaning that significantly more capital supports short positions than is invested in long positions (if any is invested in long positions at all). Unlike long positions, which one expects to increase in value, short positions are taken in those securities the manager anticipates will decrease in value. In order to short sell, the manager borrows securities from a prime broker and immediately sells them on the market. The manager later repurchases these securities, ideally at a lower price than he sold them for, and returns them to the broker. In this way, the manager is able to profit from a fall in a security's value. Short selling managers typically target overvalued stocks; characterized by prices they believe are too high given the fundamentals of the underlying companies.

►Value - A primarily equity-based strategy whereby the manager focuses on the price of a security relative to the intrinsic worth of the underlying business. The manager takes long positions in stocks that he believes are undervalued, i.e. the stock price is low given company fundamentals such as high earnings per share, good cash flow, strong management, etc. Possible reasons that a stock may sell at a perceived discount could be that the company is out of favor with investors or that its future prospects are not correctly judged by Wall Street analysts. The manager takes short positions in stocks he believes are overvalued, i.e. the stock price is too high given the level of the company's fundamentals. As the market comes to better understand the true value of these companies, the manager anticipates the prices of undervalued stocks in his portfolio will rise while the prices of overvalued stocks will fall. The manager often selects stocks for which he can identify a potential upcoming event that will result in the stock price changing to more accurately reflect the company's intrinsic worth.

- *Directional Trading Group*

►Futures - Futures managers strive to be profitable in any type of economic climate since the trading advisors have the flexibility to go long (buy in anticipation of rising prices) or "short" (sell in anticipation of declining prices). They can be classified as systematic, discretionary or a combination of the two. Collectively, the performance of Futures managers has a relatively low correlation to many other hedge fund strategies.

►Macro - The manager constructs his portfolio based on a top-down view of global economic trends, considering factors such as interest rates, economic policies, inflation, etc. Rather than considering how individual corporate securities may fare, the manager seeks to profit from changes in the value of entire asset classes. For example, the manager may hold long positions in the U.S. dollar and Japanese equity indices while shorting the Euro and U.S. treasury bills.

►Market Timing - The manager attempts to predict the short-term movements of various markets (or market segments) and, based on those predictions, moves capital from one segment to another in order to capture market gains and avoid market losses. While a variety of investment vehicles may be used, the most typical ones are various

mutual funds and money market funds. Market timing managers focusing on these mutual funds are sometimes referred to as mutual fund switchers.

- *Specialty Strategies Group*

►Emerging Markets- The manager invests in securities issued by businesses and/or governments of countries with less developed economies (as measured by per capita Gross National Product) that have the potential for significant future growth. Examples include Brazil, China, India, and Russia. Most emerging markets are located in Latin America, Eastern Europe, Asia and the Middle East. This strategy is defined purely by geography; the manager may invest in any asset class (e.g., equities, bonds, currencies) and may construct his portfolio on any basis (e.g. value, growth, and arbitrage).

►Fixed Income- The manager invests primarily in yield-producing securities, such as bonds, with a focus on current income. Other strategies (e.g. distressed securities, market neutral arbitrage, and macro) may heavily involve fixed-income securities trading as well.

►Multi-Strategy- The manager typically utilizes two or three specific, pre-determined investment strategies, e.g., Value, Aggressive Growth, and Special Situations. Although the relative weighting of the chosen strategies may vary over time, each strategy plays a significant role in portfolio construction. Managers may choose to employ a multi-strategy approach in order to better diversify their portfolios and/or to more fully use their range of portfolio management skills and philosophies

e) <u>Hedge funds performance during the recent credit crunch</u>

Based in recent studies and data extracted from the recent bibliography it is presented below, the performance and the behavior of the hedge fund industry during the recent credit crunch.

After a decade of robust growth, global hedge fund assets under management declined sharply in 2008 due to conditions brought about by the global economic downturn. Assets under management of the hedge fund industry fell by nearly 30 percent in 2008 from $2,000bn to $1,500bn (See chart 1 and chart 1a). It is noted that assets under management in 2009 reached $1.480bn, according to a recent survey by Eurekahedge[5], a data provider company.

Chart 1 - Global Hedge Funds

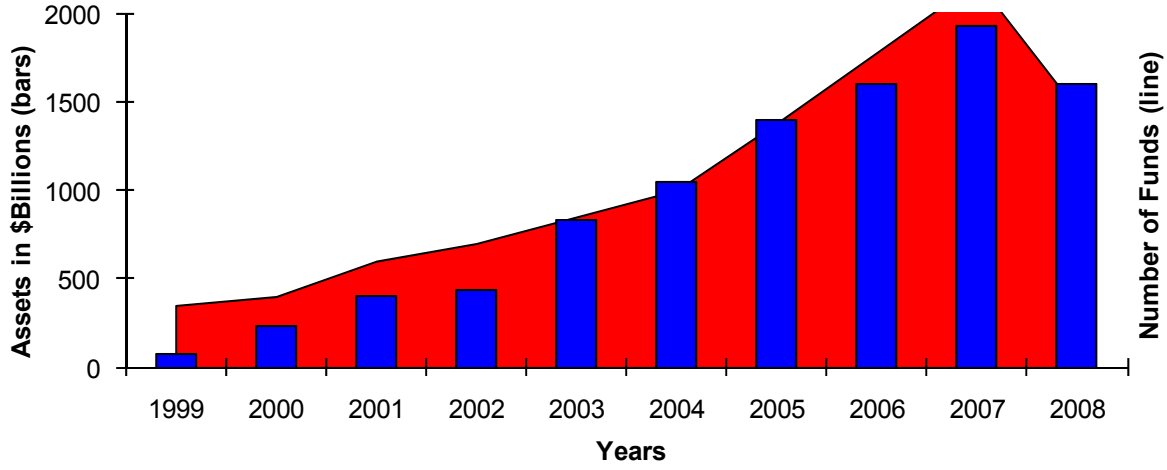
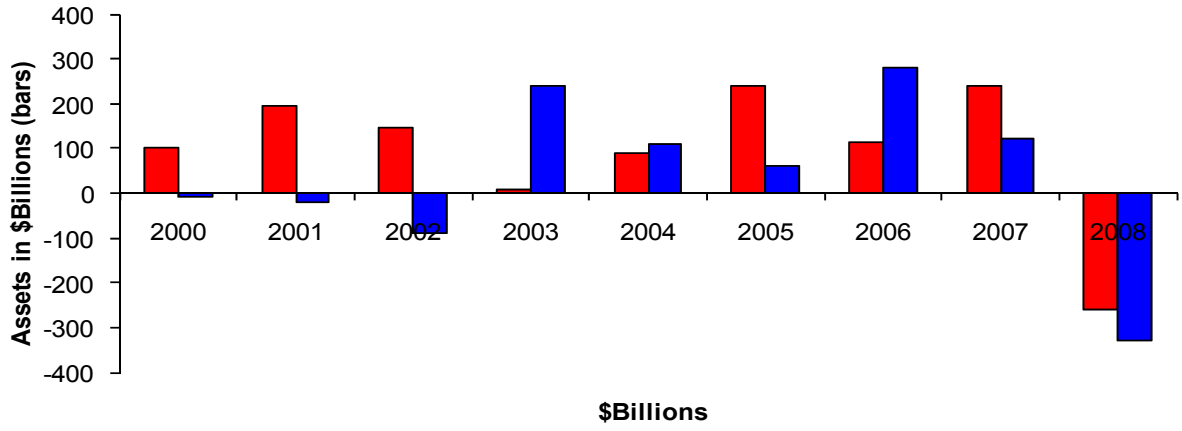


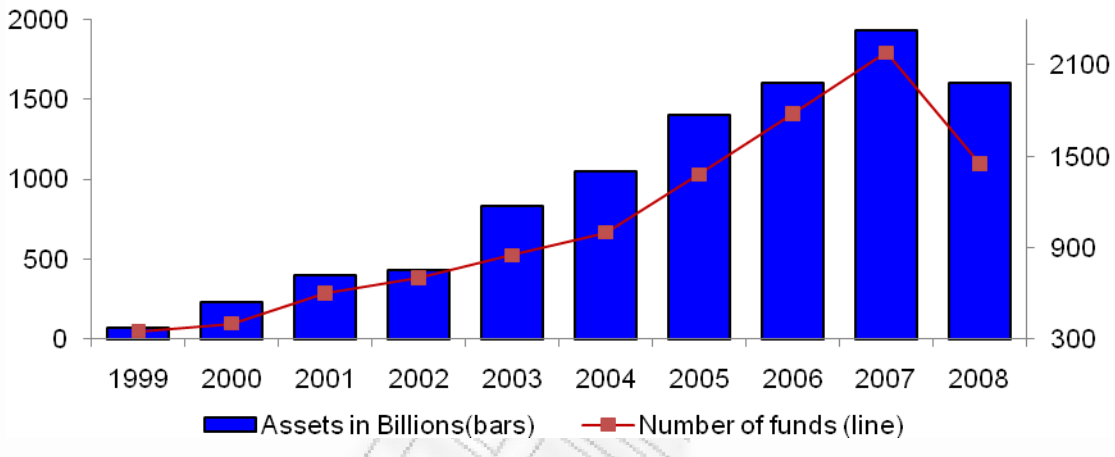
Chart 1a - Global Hedge Funds



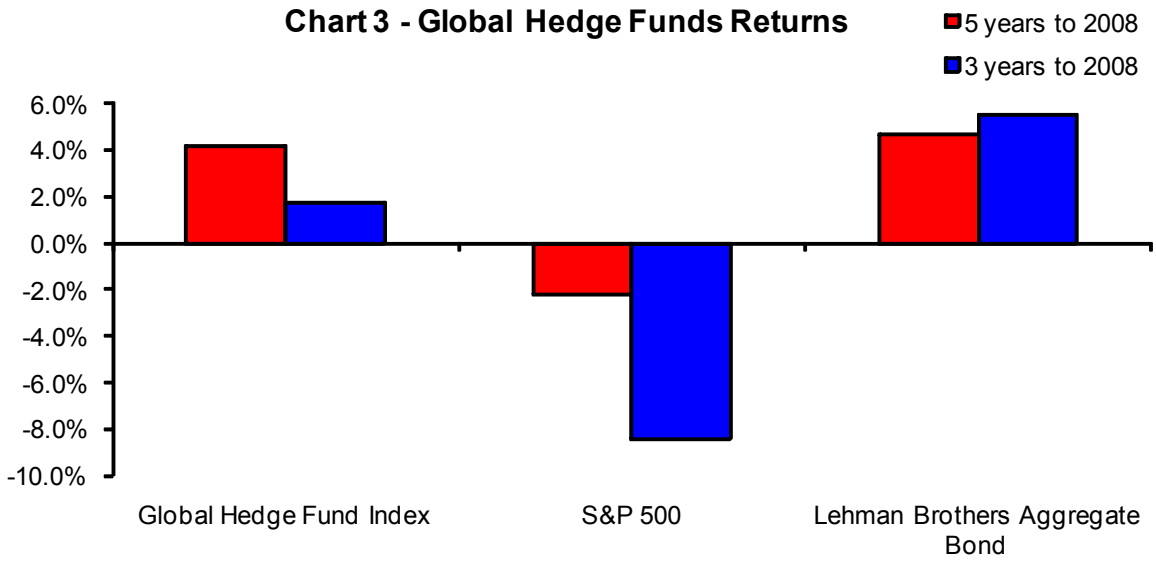
[5] Visit www.eurekahedge.com

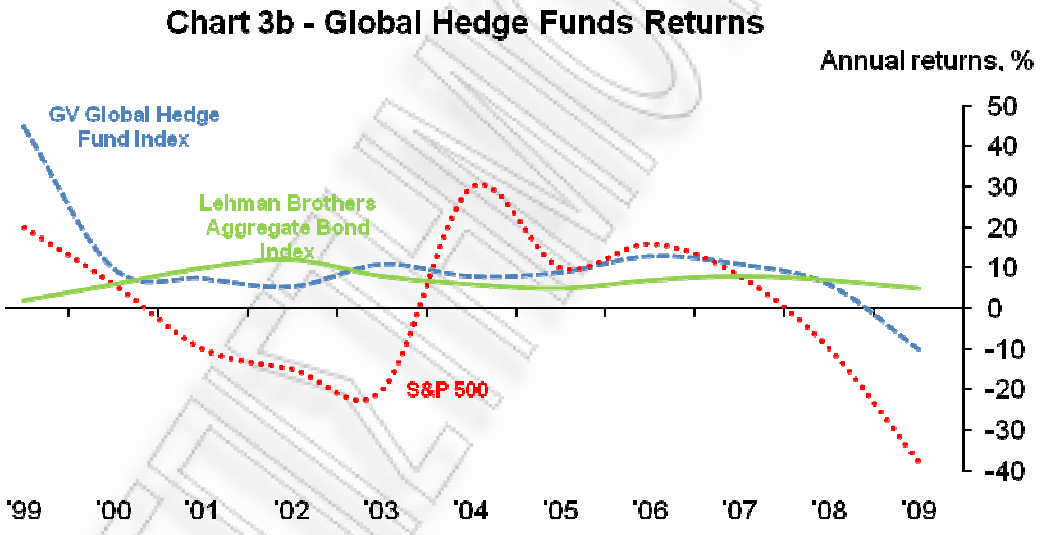
The decline, the biggest on record, was due to a combination of negative performance, surge in redemptions and liquidations of funds. The decline in assets during 2008 was split relatively equally between negative performance and asset outflows (See chart 2). On a regional level, redemptions were more responsible for a fall in assets in Europe and emerging markets, while in the US and Japan, losses on investments accounted for a bigger proportion of the decline. Asia witnessed the highest rate of liquidations.

Chart 2 - Net Asset Flow and Return



The average hedge fund lost 15.7 percent of its value in 2008, one of the worst performances on the historical record (See charts 3 and 3b). Hedge fund losses were widespread, with nearly three-quarters of funds making losses. Nevertheless hedge funds outperformed many of the underlying markets, such as the S&P index which saw a 38 percent drop. The bulk of losses came between September and November 2008, as mark of the recent credit crunch - the bankruptcy of Lehman Brothers - led investors to withdraw significant amounts from the markets. This trend deteriorated the following months, resulting in the big losses described above.





Main contributors to these losses included the collapse of banks in the US and Europe, many of which were service providers to the hedge fund industry; falls in equity markets; a ban on short-selling; and pressure to liquidate positions to meet margin and redemption calls. Hedge funds returned 13.2 percent of investors' assets in 2008. The surge in redemptions was due to losses, risk aversion and the reputational damage inflicted by the Madoff fraud[6]. This is only the second time over the past two decades that the industry has suffered an annual net outflow of funds. The positive inflows

[6] Bernard Lawrence "Bernie" Madoff : a former stock broker, investment adviser, non-executive chairman of the NASDAQ stock market, and the admitted operator of what has been described as the largest Ponzi scheme in history reaching $65bn.

during the first half of the year were more than offset by outflows in the second half. Q3 and Q4 of 2008 set consecutive records in the value of quarterly redemptions. Data for the first two months of 2009 show that investors have continued to pull money out of hedge funds with a further $115bn returned during this period. Firms more oriented towards institutional investors have fared better in this environment. Withdrawal requests were widespread across fund strategies, regions and asset sizes. Some hedge funds were forced to suspend redemptions towards the end of 2008 because selling illiquid assets would have exposed remaining investors to even bigger potential losses.

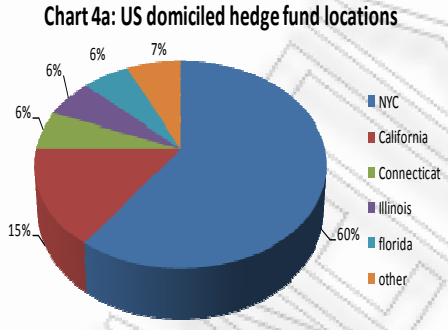
The number of hedge funds fell by 10 percent in 2008 to around 10,000 with most closures coming in the latter part of the year. The fall was caused by funds closing due to losses, lack of liquidity and redemptions as investors looked for safer investments. Around three-quarters of funds in the hedge fund industry are single manager hedge funds and the remainder fund of hedge funds.

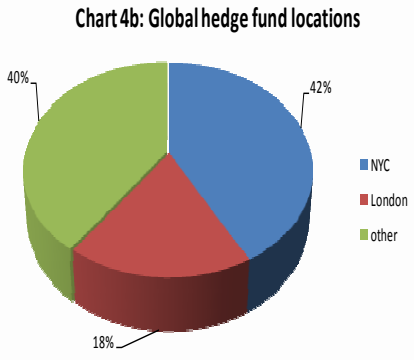
According to the Alternative Investment Management Association (AIMA)[7], the UK hedge fund industry employs around 40,000 people. Around 10,000 of these are directly employed by hedge funds and the remainder among the industry's advisers and service providers. The industry employed some 150,000 people worldwide at the end of 2008, about 6 percent down on the previous year.

Evidence report changes in the geographical distribution as well. At the end of 2008 around a half of the number of hedge funds were registered offshore. Offshore funds saw asset reductions at a faster rate during 2008 than onshore funds. The most popular offshore location was the Cayman Islands (67 percent of number of offshore funds), followed by British Virgin Islands (11 percent) and Bermuda (7 percent). The US was the most popular onshore location in 2008 accounting for nearly two-thirds of the number of onshore funds, with European countries accounting for most of the remainder.

Changes are reported at the location of management of hedge funds as well. Most of them are predominantly managed from onshore locations. The US is by far the leading location for management of hedge fund assets with over two-thirds of the global total

having increased its share slightly in 2008 due to bigger redemptions in Europe. Its share, however, was still well below its 82 percent share six years earlier. Europe and Asia gained in importance in the six years up to 2008. New York is the world's leading centre for hedge fund management, followed by London. Around 60 percent of US domiciled hedge funds are managed from New York. Other important centres in the US include California with 15 percent, and Connecticut, Illinois and Florida with around 6 percent each. According to recent data by HFR, around 42 percent of global hedge fund assets were managed in New York in 2008, down from 50 percent in 2002 but slightly up on 2007. London was the second largest global centre for hedge fund managers with 18 percent of global hedge fund assets managed there in 2008. Its share was slightly down on the previous year due to a bigger fall in hedge fund assets in Europe than in the US. London is much the largest centre in Europe for the management of hedge funds. At the end of 2008, AIMA reported that four-fifths of European hedge fund assets totalling around $300bn were managed out of the UK, the vast majority from London. Other important locations for hedge fund managers in Europe include France, Spain and Switzerland.





[7] For further information visit www.aima.org

Concerning 2009, hedge fund managers had one of their best years following one of the worst. 2009 marked a major recovery of the hedge fund industry with investors returning to funds and good, consistent performance by funds. In the first 11 months of this year hedge funds returned 19 percent on average according to HFR. For hedge funds, 2009 will be remembered as one of the industry's best ever - a year when managers delivered strong gains after 2008's drubbing and investors returned to the fray with new money. In particular, managers specializing in convertible arbitrage strategies fared much better. Through November, funds that exploit price discrepancies between corporate convertible debt and equity surged by an average 55 percent according to HFR data.

As expected, 2008 winners -- the funds that bet exclusively on falling stock prices -- suffered double digit losses. HFR reported they were down 20 percent through November 2009. Strong gains prompted investors to put $150bn into hedge funds during the first nine months of the year. Still, last year's problems continue to weigh on many managers, who cannot begin collecting their performance fees of 20 percent or more until after they recoup last year's losses and pass their high water marks.

SECTION 2: Hedge fund data

a)Hedge fund performance data

With the industry still in its infancy, compared to the other asset classes and under no formal obligation to disclose their results, gaining insight into the performance characteristics of hedge funds is not straightforward. Fortunately, many funds release performance, as well as other administrative data to attract new and 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 researchers. However, the available data are not without problems. We address the following:

- Most databases are of relatively low quality as most data vendors simply pass on the data supplied by the fund managers and their administrators without any independent verification.
- Most hedge funds report into only one or two databases. As a result, every database covers a different subject of the hedge fund universe and different researchers may arrive at quite different conclusions simply because different databases were used.
- Most data vendors only supply data on funds that are still in operation. Since disappointing performance is a major reason for hedge funds to close down, this means that the data available to investors will overestimate the returns that investors can realistically expect from investing in hedge funds by 2 percent – 4 percent per annum. In addition, concentrating on survivors only will lead investors to underestimate the risk of hedge funds by 10 – 20 percent.
- Since many hedge funds invest in illiquid assets, their administrators have great difficulty generating up-to-date valuations of their positions. When confronted with this problem, administrators use the last reported transaction price, which creates artificial lags in the evolution of these funds' net asset values.
- Since most data vendors only started collecting data on hedge funds around 1994, the available data set on hedge funds is very limited. Apart from spanning a very short

period of time, the available data set on hedge funds also span a very special period: the bull market of the 1990s and the various crises that followed. This sharply contrasts with the situation for stocks and bonds, where not only do we have a return data over differencing intervals much shorter than one month; we also have data available over a period that extends over many business cycles. This has allowed to gain insight into the main factors behind stock and bond returns and also allowed researchers to distinguish between normal and abnormal market behavior. The return-generating process behind hedge funds on the other hand is still in embryo form and we have little idea what constitutes normal behavior and what not.

b) Biases in reported hedge fund returns

The lack of transparency and uniform reporting standards in the hedge fund industry is a disreputable source of measurement errors that plague any hedge fund performance analysis. Several biases can exist in published indices of hedge fund returns. The most significant are the following:

Backfill bias. Unlike mutual funds, which report their periodic audited returns to regulators and investors, hedge funds provide information to the database publishers only if they desire to do so. Managers often establish a hedge fund with seed capital and begin reporting their results on a later date and only if the initial results are favorable. Moreover, the most favorable of the early results are then "filled back" into the database together with reports of contemporaneous results. This first source of backfill bias is often called "*incubation bias*". A fund may have previously reported to another database, and when reports to another database, it may to report all the previous data that were given to the other service. It may provide to the new database only the data it would like potential investors to see. In principal, incubation bias can be removed by deleting the returns during the incubation period. Since the incubation period is unknown, it must be estimated. Fung and Hsieh (2000), find that the median length of backfilled periods for hedge funds was 12 months. It is clear that running an experimental fund is costly for the manager, not only in terms of out-of-pocket expenses, but also in terms of the opportunity cost in forgoing income working as a trader for a proprietary trading desk or an established hedge fund.

Survivorship bias. Another important bias in the published hedge fund return indices is survivorship bias. Databases available at any point in time tend to reflect the returns earned by currently existing hedge funds. They do not include the returns from hedge funds that existed at some time in the past but are presently not in existence (i.e. the truly "dead" funds) or exist but no longer report their results (the defunct funds). Unsuccessful hedge funds have difficulties obtaining new assets. Hence, they tend to close, leaving only the more successful funds in the database. But some funds stop reporting not because they are unsuccessful but they do not want to attract new investment. Estimates of survivorship bias by Brown, Goetzmann and Ibbotson (1999), Brown, Goetzmann and Park (2001), Liang (2000, 2001) and Fung and Hsieh (1997) range from 60bps to 360bps a year for various hedge fund types. In a study covering data for a sample period, Amin and Kat (2003) estimated survivorship bias at about 200bps a year. In another study, covering a previous period of time, Ackerman, McEnally and Ravenscraft (1999) found estimates of survivorship bias that were small and insignificant. Substantial differences can be found between the hedge fund categories and the estimation method that is used. The consensus view on the studies on this subject is that this effect accounts for at least 3 percent – 4 percent of the reported hedge fund performance.

Selection. Unlike public information used to compose equity and bond indices, hedge fund index providers often rely on hedge fund managers to submit return data on their funds voluntarily and correctly. Since hedge funds are privately held investment vehicles and thus are not required to make public disclosure of their activities, this 'self-selection' bias causes significant distortions in the construction of the index and often skews the index towards a certain set of managers and strategies on a going-forward basis. Hedge fund indices draw their data from different providers that surprisingly have few funds in common, as most hedge funds report their data only to a certain subset of databases. Counting data have shown that less than one out of three hedge funds in any one database contributes to the reported returns of all major hedge fund indices.[8]

[8] See the study by W. Fung and D. Hsieh, 'Hedge Fund Benchmarks: A Risk Based Approach' (2004)

Autocorrelation. Time lags in the valuation of securities held by hedge funds may induce a smoothening of monthly returns, which leads to volatility and correlation being significant underestimated. Statistically this event is expressed by significant autocorrelation in hedge fund returns.

SECTION 3: Long/Short Equity Hedge Funds risk - return factors

a)The Long/Short equity strategy – Bibliography

According to the Lipper -TASS[9] database, one of the most comprehensive reporting services for hedge fund data, there are more than 5.000 hedge funds reported in their (excluding funds of hedge funds) database. Roughly 40% are classified as having long/short equity as their primary investment style capturing a similar percent of the hedge fund industry's total asset under management. By way of contrast, according to the same database, the next largest style, *Managed Futures,* accounts for 13% of the funds.

Theory suggests that long/short equity hedge funds' returns come from directional as well as spread bets on the stock market. Historical empirical analysis in recent bibliography finds persistent net exposures to the spread between the small versus large cap stocks in addition to the overall market. These factors, put together, account for more than 80% of the return variation. Additional factors are price momentum and market activity. Fung and Hsieh, using a comprehensive dataset compiled from three major database sources, found that among 3000 hedge funds with similar style classification, less than 20% of long/short equity hedge funds delivered significant, persistent, stable positive nonfactor related returns. These non factor related returns are positively correlated to the market activity and negatively correlated to aggregated short interest. In contrast, they continue, equity mutual funds and long-bias equity hedge funds have no significant, persistent, nonfactor related return.

In terms of risk characteristics, long/short equity hedge funds have a lower market exposure than their brethren in the long only world – equity mutual funds. In that sense, this strategy attracts more assets under management due to the less risky profile. According to Fung and Hsieh (2004), the average Long/Short equity hedge fund has in the Lipper -TASS database has a beta of 0.50 with respect to the Standard and Poor's

[9] Visit www.lipperweb.com

500 index, while the average equity mutual fund in the Morningstar[10] database has a beta of 0.96. Since hedge funds carry a substantial higher fee compared to equity mutual funds the search focuses on whether long/short equity hedge funds can deliver value to their investors on a risk-adjusted and cost-adjusted basis[11].

The search following in the next section by Fung and Hsieh focuses on the issue of whether long/short equity hedge funds have similar risk factor exposure as equity mutual funds and indicates the reported evidence of the excess performance found in long/short equity strategy, beyond compensation, for bearing systematic risk.

b) Common risk factor exposures and expected return decomposition – two approaches

In order to identify the common risk factors being used by the long/short equity hedge funds two key papers are being reported that each represents a different approach to the subject.

Jasmina Hasanhodsic and Andrew W. Law (2007), use six common factors in order to replicate hedge fund returns by using passive replicating portfolios, *'linear clones',* using liquid exchange-traded instruments that provide similar risk exposures at lower cost and with grater transparency. In contrast to other studies employing more complex factor-based models of hedge fund returns, they used six factors that correspond to basic sources of risk and consequently expected return: *the stock market, the bond market, currencies, commodities, credit* and *volatility*. These factors, with the exception of volatility, are chosen because each of them is tradable via liquid exchange-traded securities such as futures or forward contracts.

Using standard regression analysis they decomposed the expected returns of a sample of 520 individual hedge funds from the Lipper - TASS hedge fund live database into factor-based risk premia and manager specific alpha, and they found that for certain

[10] Visit corporate.morningstar.com

[11] Hints of excess returns from equity-related hedge funds indices have been reported in Agarwal and Naik (2004) and Fung and Hsieh (2004b) as empirical regularities without a theoretical foundation.

hedge fund style categories, a significant fraction of the funds' expected return is due to those risk premia. While estimates of manager specific alpha are also quite significant in most cases, these results suggest that at least a portion of a hedge fund's expected return can be obtained by bearing risk factors.

More specifically, the long/short equity hedge funds, are replicated by constructing linear clones using five of the six factors (volatility is omitted) and compare their performance to the original funds. The results show that linear clones have comparable performance to their fund counterparts.

To explore the full range of possibilities, Hasanhodsic and Law, investigated the characteristics of a sample of individual long/short equity hedge funds drawn from Lipper - TASS hedge fund database. The focus of the study is on the relative performance of hedge funds versus relative passive portfolios of liquid securities and as long as the cloning process was not selectively applied to a peculiar subset of funds in the Lipper - TASS database, any biases that are found in the sample (survivorship bias, backfill bias, etc.) should impact both funds and clones identically, leaving their relative performance unaffected.

The sample size contained 520 funds returns from February 1986 to September 2005, resulting in being the largest category among the 11 investment styles listed in Lipper - TASS database (the total number of funds responding to the selection of each and every investment style for the specific period is 1610).

To determine the explanatory power of common risk factors for the long/short equity hedge funds, they performed a time-series analysis for each of the 520 individual hedge funds in their sample, regressing the hedge fund's returns on the following six factors: 1) the *US Dollar Index return*, 2) *the return of Lehman Corporate AA Intermediate Bond Index*, 3) *the spread between the Lehman Corporate BAA Corporate Index and the Lehman Treasury Index*, 4) *the S&P500 total return*, 5) *the Goldman Sachs Commodity Index (GSCI) total return* and 6) *the first-difference of the end-of-month value of the CBOE Volatility Index (VIX).* These factors are selected for two reasons: They provided a reasonably broad cross-section of risk exposures for the typical hedge fund (stocks, bonds, currencies, commodities and volatility) and each

factor could be realized through relative liquid instruments so that the returns of the linear clones might be achievable in practice.

The linear regression model provided a simple but useful decomposition of a hedge fund's return Rit into several components:

$E(Ri_t)=\alpha i +\beta i1 E\{\text{Risk Factor}1_t\}+\ldots+\beta iK\{\text{Risk Factor}K_\tau\}$

$VAR(R_{it}) = \beta_{i1}^2 \text{Var}\{\text{RiskFactor}1_t\}+\ldots+\beta_{i\kappa}^2 \text{Var}\{\text{RiskFactor}K_t\}+\text{Covariances}+\text{Var}\{\varepsilon i_t\}$

Where Covariances is the sum of all pairwise covariances between Risk Factor p_t and Risk Factor q_t weighted by the product of their respective beta coefficients $\beta ip + \beta iq$.

This decomposition highlights the fact that a hedge fund can have several sources of risk, each of which should yield some risk premium, that is, risk-based alpha, otherwise investors would not be willing to bear risk. From the statistics summary for the beta coefficients or factor exposures estimated for each of the 520 hedge funds by ordinary least squares they report the following results:
the average manager-specific alpha is positive at 0.82% per month which suggests that managers are indeed contributing value above and beyond the risk premia associated with the six factors mentioned above:

- The average S&P500 beta is 0.38 which is consistent with the fact that long/short equity hedge funds are mandate to provide partially hedged market exposure.
- the average exposure as measured by the beta in the bond market is 0.03
- the average exposure as measured by the beta in the currency market is -0.03
- the average exposure as measured by the beta in the credit market is 0.28
- the average exposure as measured by the beta in the volatility market is 0.07

And finally, the average exposure as measured by the beta in the commodities market is 0.06. Charts 5 and 6 below present the results:

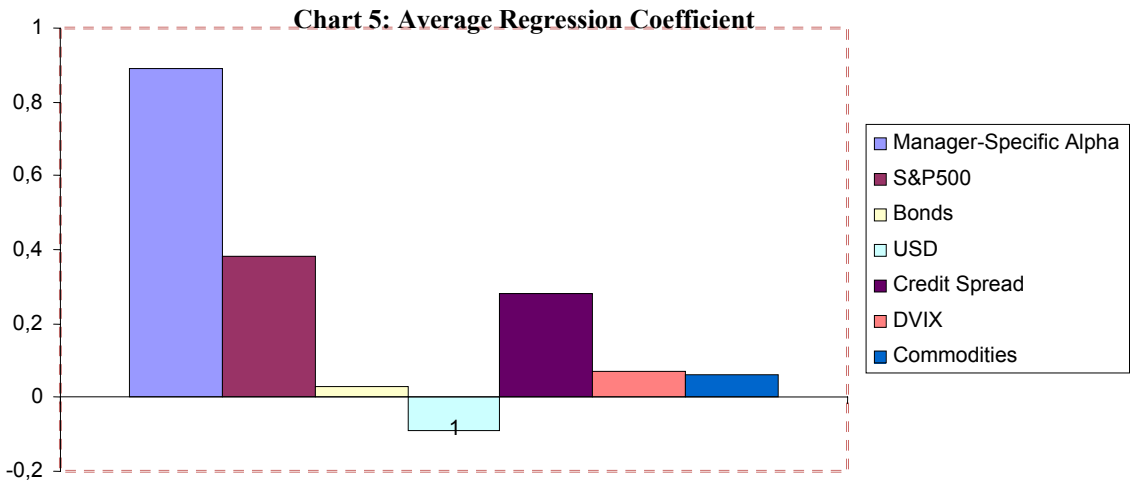


Chart 5: Average (Mean) Regression Coefficients for multivariate linear regressions of monthly returns of hedge funds in the TASS Live Database from February 1986 to September 2005 on the six factors described above.

It is clear, as it can be seen in Chart 5 that Manager-Specific Alpha exposure outline the rest of the risk factors used in the linear regressions.

Using the same parameter estimates for the individual hedge funds in the sample, they answer the question of how much of a long/short hedge fund expected return is due to the risk premia from identifiable factors. Chart 6 shows the average mean total return of a funds and averages of each of the six factors and the manager-specific alpha to that the average total mean return. The average percentage contributions add up to 100 percent. Given the results, the most significant contributors to the average total mean return of 14.6 percent long/short equity hedge funds are managers-specific alpha (70.5 percent) and S&P500 (17.8 percent) which account together for the 88.3 percent of the hedge funds total mean return on average. Moreover, while the remaining risk factors contributes much but positively in the total return of the fund, the volatility index is the only that delivers a negative contribution of -1.8 percent.

Chart 6: Decomposition of total mean return

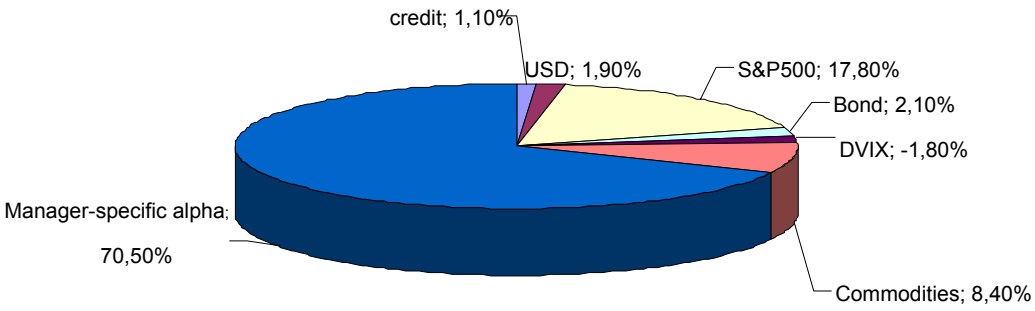


Chart 6: Decomposition of total mean returns of hedge funds in the TASS Live Database according to percentage distributions from six factors and managers-specific alpha, for 520 hedge funds from February 1986 to September 2005.

Hasanhodsic and Law, used these statistical results to perform an empirical test whether hedge funds can be replicated by using linear clones as mentioned above. Despite the promising properties of the linear clones and their empirical conclusions, it is well known that certain hedge funds contain inherent nonlinearities that cannot be captured by linear models. Therefore, more sophisticated methods including non-linear regression may yield more significant benefits in terms of performance. At the same time, the risk factors that are proposed Hasanhodsic and Law are only a small subset of the many liquid instruments that are available to the institutional investors. By expanding the universe of factors to include options and other derivative securities, it should be possible to achieve additional improvements in performance, including the ability to capture the risk of long/short hedge funds in a better sense.

In order to expand the former approach we move on to the second reported paper by *Fung and Hsieh(2005)*, in which they used the priminitive Long/Short equity strategy to observe the returns and the risk factors of long/short equity hedge funds. This strategy is a theoretical model which captures long/short hedge funds returns by taking both long and short positions, or borrowing and lending stocks at the same time, as they express it based on an adaptation as well of *D'Avolio (2002)*.

Typically, as mentioned above, a L/S equity hedge fund holds a portfolio of long and short stock positions. Fung and Hsieh in order to express in simple terms the priminitive Long/Short equity strategy, they assume the following: If the hedge fund has $100 of capital, we suppose $L is used for purchases of long positions and $S is used as cash margin for $2S of short positions. The remaining $100-$L-$S is invested in the risk-free asset. We assume that the long positions are loaned out. In this case, the $L of long position generates a gain of $L (rL + feeL). The short position generates a gain of $2S [-rS + (rffeeS)] + $S rf. Finally, the cash position leads to a gain of ($100-$L-$S) rf. Together, these positions generate a return per $1 of capital that is described as follows:

$$rf + b1\ (rL - rf\ ) + b2\ (rL - rS) + b0$$

where

b1 = ($L-$2S)/$100

b2 = $2S/100

b0 = $L/$100 feeL - $2S/$100 feeS

Fung and Hsieh name this equation *priminitive Long/Short equity strategy*. It is mentioned that, the first term represents the time-value of money. The second term is the return for bearing directional risk. The third term is the return for bearing spread risk—in the sense that the market values of the long and short positions can diverge from each other. The last term represents the net fees earned from lending out stocks over and above the fees paid for borrowing stocks.

In order to apply the strategy to the time interval of their data set, monthly returns, they construct a general form of the equation. In which, rf,t is the return of the risk-free asset, rL,t the return of the long positions, and rS, the return of the short position, during day t. The exposure levels, b1,t and b2,t are constant during day t. b0,t is the net fee for day t. Thus, the equation has the following form:

$$\Sigma t\ \{rf,t + b1,t\ (rL,t - rf,t\ ) + b2,t\ (rL,t - rS,t) + b0,t\ \}$$

where the subscript t is summed over the days of the month, t=1,…,m.

Fung and Hsieh make the assumption that if two hedge funds have the same investment style, in our case the long/short strategy, their returns must be highly correlated. By using principal component analysis they found the common covariances. Additionally, they verified the this main strategy, which they linked to both static and dynamic factors. What's more, they studied the cross section of funds to assess their ability to generate returns after adjusting for the observed risk factors and compared them with the returns of both long only hedge funds and mutual funds.

Due to lack of standardizing reporting format in the hedge fund industry, Fung and Hsieh recommended the use of principal component analysis of fund returns to supplement this commonly used qualitative classification of hedge funds.

Common static risk factors: Fung and Hsieh applied the four-factor model, consisting of the Fama-French (1992) three-factor model, augmented with the Jegadeesh and Tinman (1993) momentum factor. The four factors are:

- *RMRF*: the return of a portfolio that is long stocks/short the risk free asset
- *HML*: the return of long high book-to-market stocks/short low book-to-market stocks
- *SMB*: the return of long small cap stocks/short large cap stocks
- *UMD*: the return of long high momentum stocks/short low momentum stocks

Using regression analysis in two year subperiods of 1994-5, 1996-7, 1998-9 and 2002-3, both the time series characteristics as well as the cross-sectional dispersion of returns were examined. The results found that:

- The median adjusted R^2 is between 0.36 to 0.50
- The median exposure to the market (RMRF) decline over time, from a high of 0.62 in 1994-5 to a low of 0.30 in 2002-3
- The median exposure to SMB remained around 0.30 range in the first three subperiods, dropping to 0.14 in the last sub period
- The median exposure to HML is low, between 0.03 and 0.13

- The median exposure to UMD is even less, between -0.02 to 0.07
- The Durbin-Watson statistic is between 1.84 to 1.95, indicating very low serial correlation in the regression residuals
- The constant term, which represents the monthly alpha, is between 0.20 and 0.37, with the exception of the subperiod 1998-9 when it jumped to 0.79

Fung and Hsieh, compared the results of the regression both with equity mutual funds and long-bias equity hedge funds which reached the following conclusions:

Equity mutual funds have much higher adjusted R^2, greater exposure to the market (RMRF) and roughly the same exposure to the other three factors, SMB, HML and UMD. Interestingly, the median monthly alpha is slightly negative.

Long-bias equity hedge funds tend to fall between L/S hedge funds and equity mutual funds. They have more market exposure than the L/S equity funds and less market exposure than mutual funds. Their median alphas are generally positive but smaller than L/S equity funds. Table 1 below, presents the results of the analysis described above.

Table 1: Regressions of Excess Returns of Equity Hedge Funds and Mutual Funds on the Four Factor Model (1994 - 2004)

	TASS AVG	TASS AVG	TASS AVG	MUTFD LCG	MUTFD MCG	MTUFD SCG	MUTFD LCB	MUTFD MCB	MUTFD SCB	MUTFD LCV	MUTFD MCV	MUTFD SCV
Constant	**0,0062**	**0,0064**	**0,0056**	-0,0006	-0,0009	-0,0011	-0,0006	-0,0001	-0,0014	-0,0007	0	-0,0003
	0,0008	*0,001*	*0,0009*	*0,0007*	*0,00137*	*0,00136*	*0,0034*	*0,0009*	*0,00101*	*0,00076*	*0,00198*	*0,001*
RMRF	**0,04669**	**0,457**	**0,4857**	**1,0001**	**1,1059**	**1,1278**	**0,9496**	**1,0206**	**-0,9996**	**0,9342**	**0,9525**	**0,9244**
	0,0234	*0,027*	*0,247*	*0,0212*	*0,0383*	*0,0395*	*0,0098*	*0,0311*	*0,0323*	*0,0255*	*0,0374*	*0,0323*
SMB	**0,2698**	**0,2604**	**0,2464**	-0,0463	**0,4123**	**0,7214**	**-0,0795**	**0,2743**	**0,6372**	**-0,0626**	**0,1824**	**0,5655**
	0,0372	*0,0352*	*0,0327*	*0,0229*	*0,0508*	*0,0432*	*0,0102*	*0,0347*	*0,0334*	*0,0195*	*0,0386*	*0,0393*
HML		-0,0242	-0,0076	**-0,2638**	**-0,2002**	-0,0728	**0,0598**	**0,3**	**0,5003**	**0,4236**	**0,5869**	**0,6805**
		0,0394	*0,0345*	*0,0282*	*0,0569*	*0,0599*	*0,0126*	*0,0387*	*0,0433*	*0,0328*	*0,043*	*0,0375*
UMD			**0,0689**	**0,0519**	**0,1299**	**0,1073**	-0,0148	-0,0273	-0,0326	**-0,0981**	**-0,1049**	**-0,1012**
			0,0217	*0,0164*	*0,0356*	*0,035*	*0,0075*	*0,0211*	*0,02556*	*0,0185*	*0,0244*	*0,0216*
Adj R2	0,853	0,852	0,868	0,976	0,94	0,953	0,993	0,949	0,946	0,956	0,916	0,927

TASS AVG: Average of TASS L/S Equity Funds
LCG: Average of Morningstar's Large Cap Growth Stocks
MCG: Average of Morningstar's Mid Cap Growth Stocks
SMG: Average of Morningstar's Small Cap Growth Stocks
LCB: Average of Morningstar's Large Cap Blend Funds
MCB: Average of Morningstar's Mid Cap Blend Funds
SCB: Average of Morningstar's Small Cap Blend Funds
LCV: Average of Morningstar's Large Cap Value Funds
MCV: Average of Morningstar's Medium Cap Value Funds
SCV: Average of Morningstar's Small Cap Value Funds

Standard errors in italics. Statistically significant coefficients (1 percent level) in bold.

According to the results, this four-factor model accounted for more than 80 percent of the variation of the returns of the extensive sample of 1.773 equity hedge funds over the period of 1994 – 2004. Moreover, exhausting testing of the data set did not turn up important exposures to dynamic option-like factors. However, slow-moving, time-varying behavior of risk factor exposure was detected.

After adjusting for the risks associated with the four standard risk factors, less than 20 percent of our sample of L/S equity hedge funds exhibit significant, persistent, positive alpha. They showed that this observed excess performance is market-volume related (positively correlated) and more specifically short-sales volume related (negative correlated). After including these non-price variables into the four-factor model, the intercept term in this expanded model is no longer significant. In addition, no discernible serial correlation in the residuals of the expanded model was detected and earlier observed sample break points ere rejected. Therefore, although the delivery of persistent alpha to investors reached on average less than 20 percent of the population of the L/S equity hedge funds, alphas appear to be stable over time at approximately 64 basis points in excess of the risk-free rate.

Further evidence in the research made by Fund and Hsieh showed that neither equity mutual funds nor long-bias equity hedge funds exhibit return sensitivity to short-sales activities, meaning that L/S equity hedge funds do benefit from shorting. This is also a distinguishing feature of L/S equity hedge funds from the long-bias funds.

Section 4: Empirical Tests

a) Historical performance analysis per hedge fund strategy

According to the Bloomberg network, recent data could be found for numerous hedge funds following the most widely used strategies, as provided. The availability though, is rather poor, resulting in a pool of data for a limited period of five years, 2005 – 2010. It is to be highlighted also that, since the data set does not contain the same sample for every hedge fund strategy, some deviations from the theoretical characteristics of each strategy occurred, basically because of the small number of funds under investigation and the limited amount of monthly data as well.

Specifically, the data set contains returns generated by 1.043 hedge funds following 10 different investment strategies. Long/short equity (450 hedge funds), equity market neutral (82 hedge funds), short biased (6 hedge funds), long biased (63 hedge funds), merger arbitrage (13 hedge funds), global macro(100 hedge funds), distressed securities (34 hedge funds), event driven (47 hedge funds), emerging markets (86 hedge funds) and multi strategy (162 hedge funds) were the strategies used in the universe of hedge funds employed to extract statistical results and to assess the impact on asset allocation, as described in the following section.

Table 2 and the charts below show the average total return, standard deviation, Sharpe ratio, VAR (at the 5 percent significance level) and the Sortino ratio for the 5-year data set of each different strategy. A more detailed analysis is described for the long/short equity hedge funds: specifically, the following five charts describe the former ratios for our long/short hedge fund sample (450 funds).

According to descriptive statistical data, the long/short equity delivered the highest total return, in our sample, while negative return is presented in the short biased funds. Given the fact that the market – represented by the S&P 500 index – generated a negative total return during the sample period (2005-2010) of -1.56 percent, it came as a surprise to see short biased hedge funds to generate negative returns. The merger arbitrage funds' returns exhibit the lowest standard deviation, followed by the event driven and market-

neutral funds' returns. On the other hand, emerging market funds produced returns exhibiting the highest standard deviation, just as it was expected. Concerning Sharpe ratios, long/short equity funds had the second highest ratio, falling behind the merger arbitrage funds only, with the long biased and the short biased reaching the poorest results of the sample. Furthermore, with respect to other risk measures, VAR and the Sortino ratio indicated that the the long biased and the short biased strategies provide with the poorest risk-adjusted returns. On the other hand, merger arbitrage, distressed securities and event driven funds provide with better risk-adjusted returns than their peer strategies. This outcome is in line with the reported data from HFR, mentioned in Section 1, indicating that through November 2008, funds that seek to exploit price discrepancies between corporate convertible debt and equity surged by an average 55 percent.

Table 2 and chart 7 summarize the above-discussed results for each hedge fund strategy. Moreover, charts 8-12 show a more detailed representation of the results for each hedge fund strategy. Finally, in order to represent a more detailed view of the long/short strategy, we have constructed graphical representations (charts 13-17) which show the performance of each ratio for the available data set.

Table 2: Hedge fund strategies - Ratios 2005 - 2010

	Total Return	Standard Deviation	Sharpe Ratio	VaR (5%)	Sortino Ratio
long/short equity	7.608030973	13.37665924	0.478977778	-5.369444444	0.492511111
equity market neutral	4.027160494	10.92790123	0.360493827	-4.438395062	0.387777778
global macro	6.2153	15.1133	0.3246	-5.5832	0.3701
event driven	5.114042553	9.552553191	0.426808511	-3.871914894	0.525744681
short biased	-0.792	13.08	-0.338	-4.8	-0.268
long biased	3.287777778	20.84306452	0.125645161	-9.091451613	0.152258065
distressed securities	4.221176471	10.11294118	0.383823529	-4.277352941	0.512647059
emerging markets	6.969418605	24.97453488	0.382906977	-9.837325581	0.359302326
merger arbitrage	7.449230769	8.086923077	0.539230769	-2.811538462	0.56
multi strategy	2.719753086	10.83204969	0.08621118	-4.626459627	0.184223602

Chart 7: Hedge fund strategies

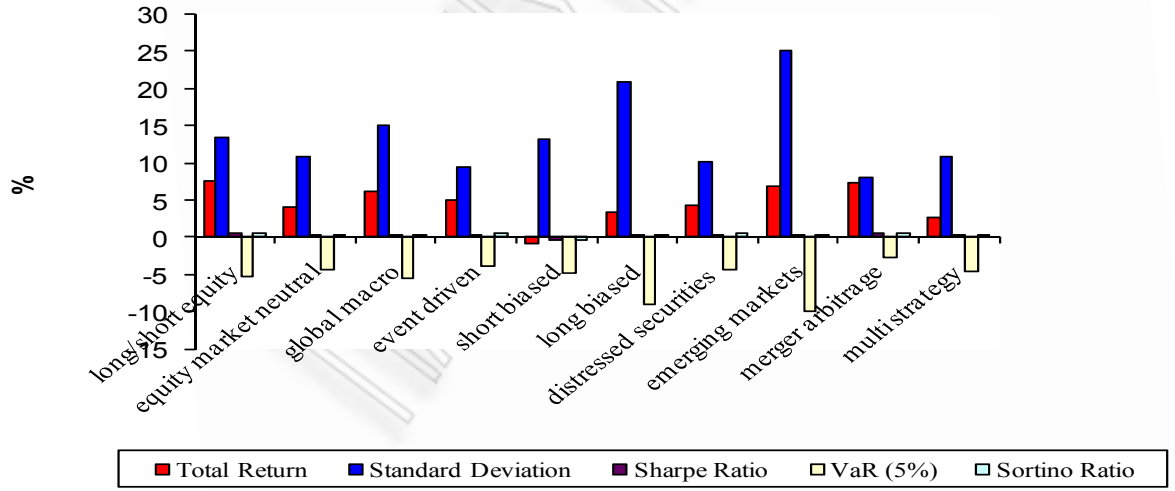


Chart 8:Total Return

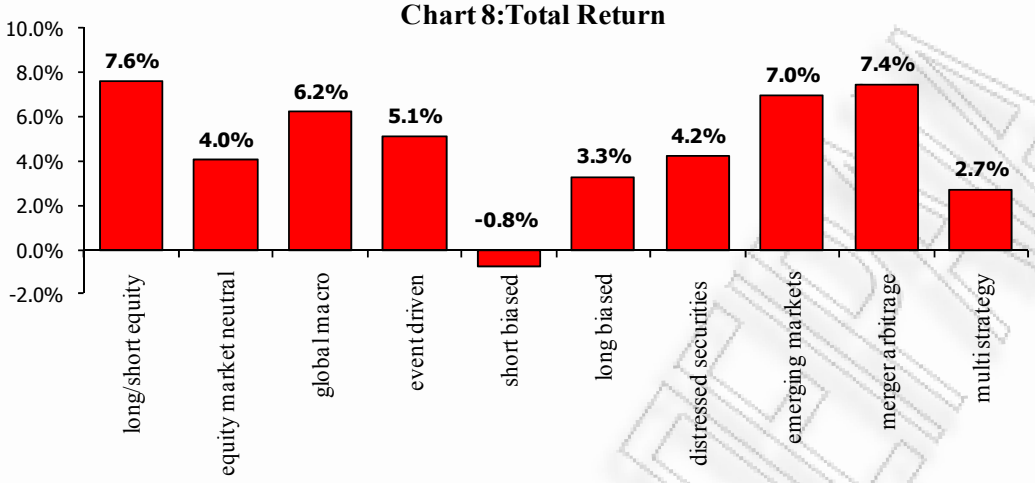


Chart 9: Standard Deviation

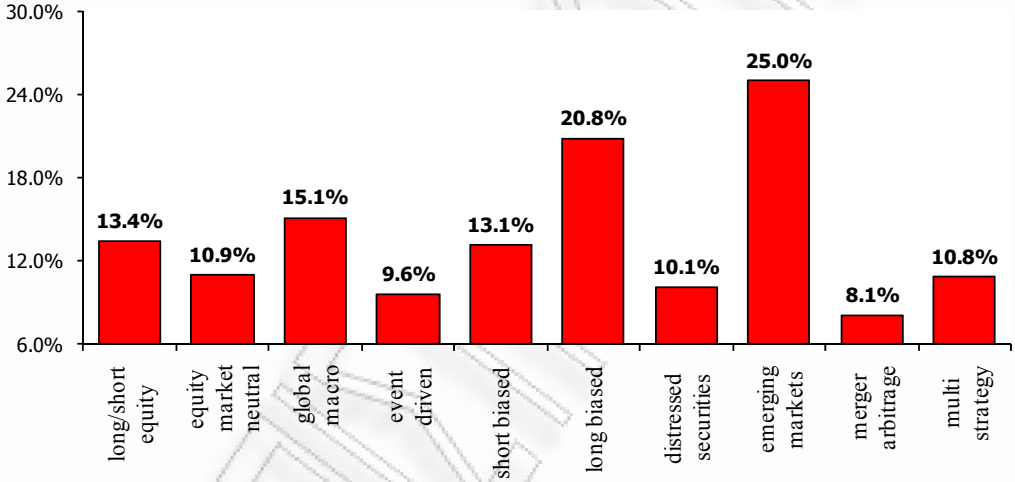


Chart 10: Sharpe Ratio

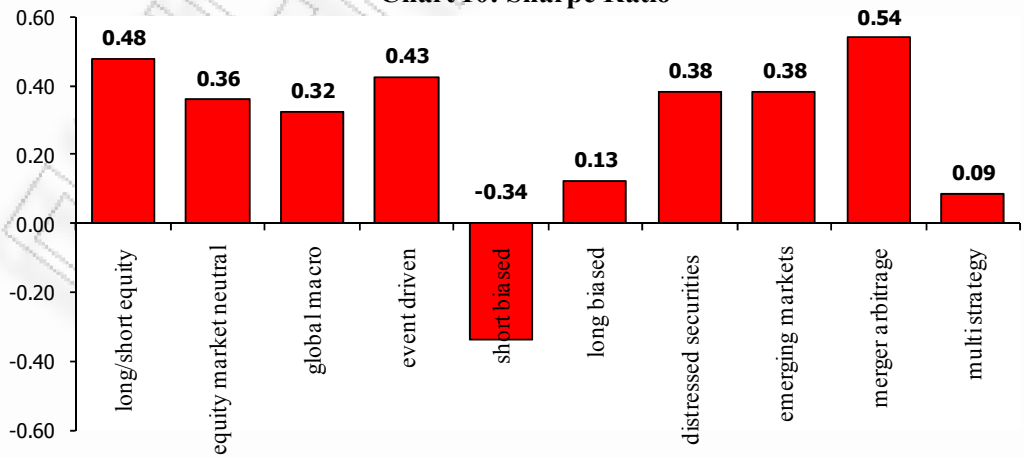


Chart 11: VaR @ 5%

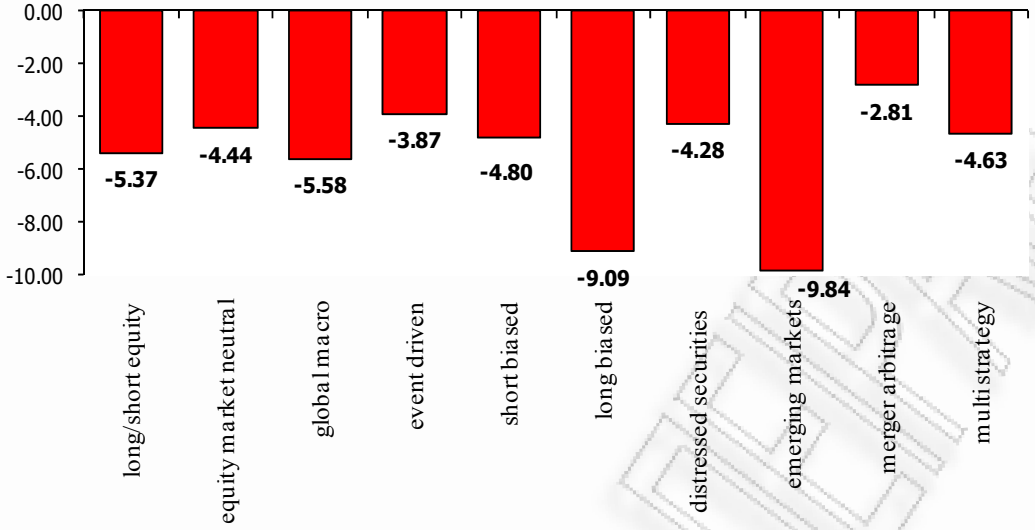
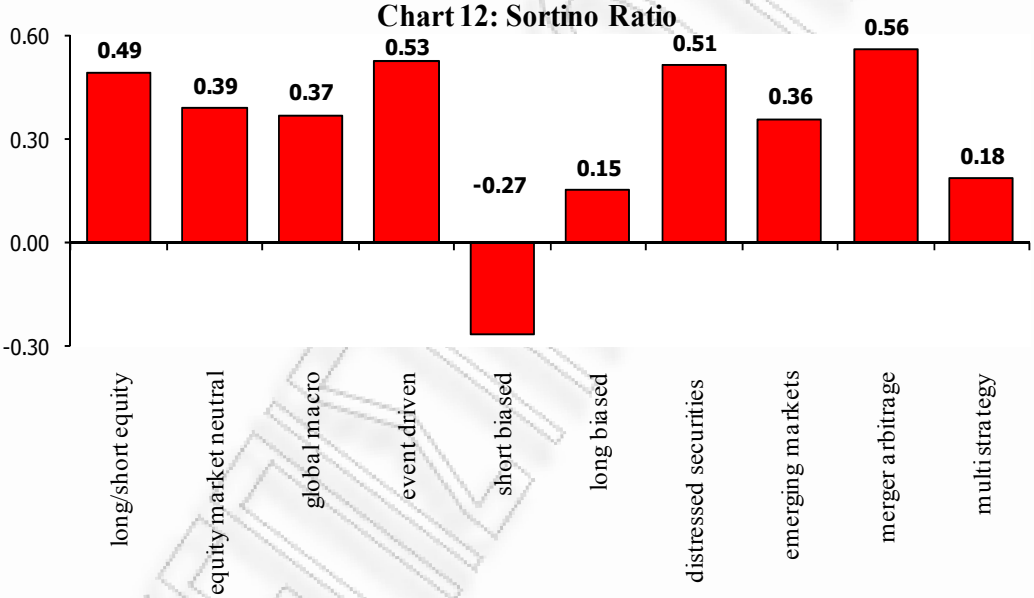


Chart 12: Sortino Ratio



Regarding long/short equity hedge funds, total returns range from -10 percent to 40 percent with the average standing at 7.6 percent, the highest average among the total sample. Moreover, standard deviation ranges from 0.86 to 51.1, averaging at a level of 13.37, supporting the view that this particular strategy implies lower risk when compared with other strategies. However, it is rather surprising that the short biased, multi strategy and merger arbitrage funds delivered returns with lower average standard deviation. This fact is not in line with the theory of the former strategies - since short biased and merger arbitrage hedge funds considered to be more risky – and can be attributed to the data set size, small as it is, which does not capture the last decade

trends. Sharpe ratios of the long/short equity hedge funds delivered favorable results ranging from -1.25 to 2.17 with an average at 0.48 which is the second highest among the sample. Concerning VAR, results range from -21.1 to -0.72 with an average at -5.37, showing a high risk profile as compared to other strategies. Finally, the Sortino ratios indicate that, long/short equity hedge funds performed well, compared to the other strategies on a risk adjusted basis (as described in Section 1), delivering Sortino ratios between -1.22 and 2.8, with average ratio of 0.49. The charts 13 – 17 below show the variation of each ratio among the selected sample of the 450 specific long/short equity hedge funds. The red line indicates each ratio's average:

Chart 13: Long/short equity hedge funds - 5 Years Total Return

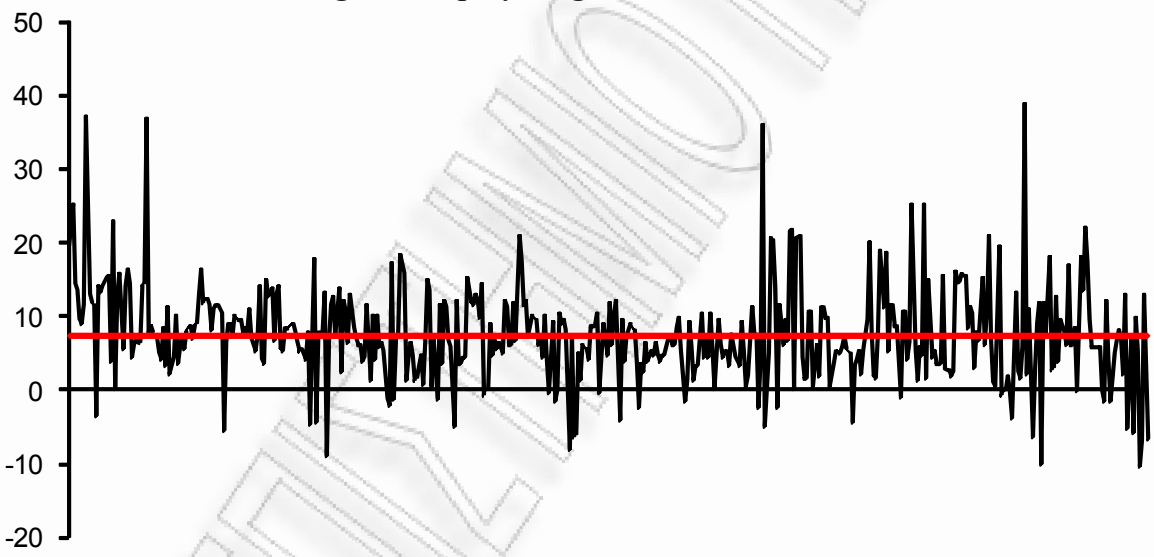


Chart 14: Long/short equity hedge funds - 5 Years Standard Deviation

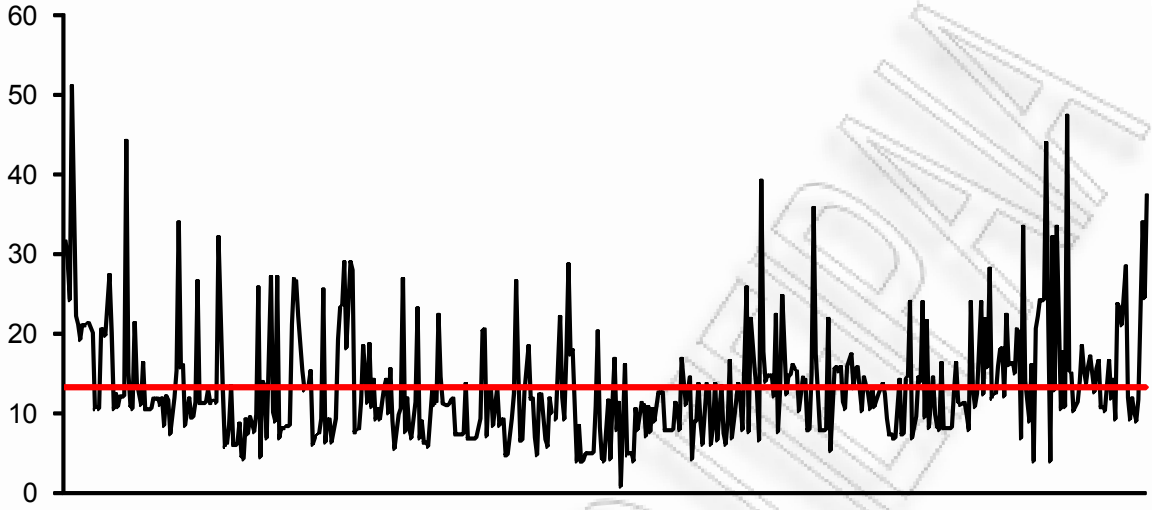


Chart 15: Long/short equity hedge funds - 5 Years Sharpe Ratios

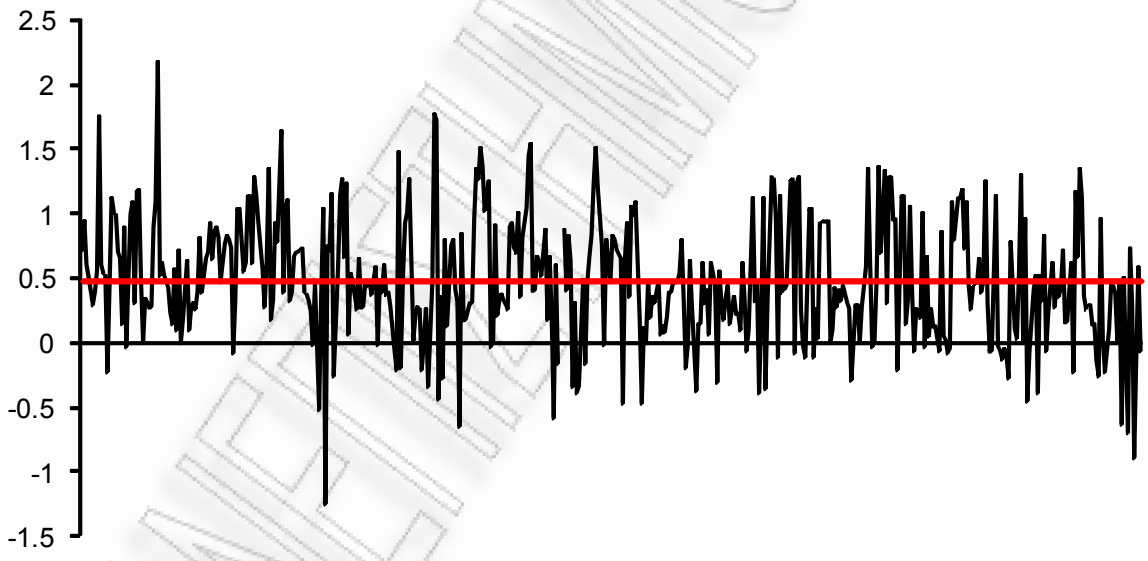


Chart 16: Long/short equtiy hedge funds - 5 Years VaR

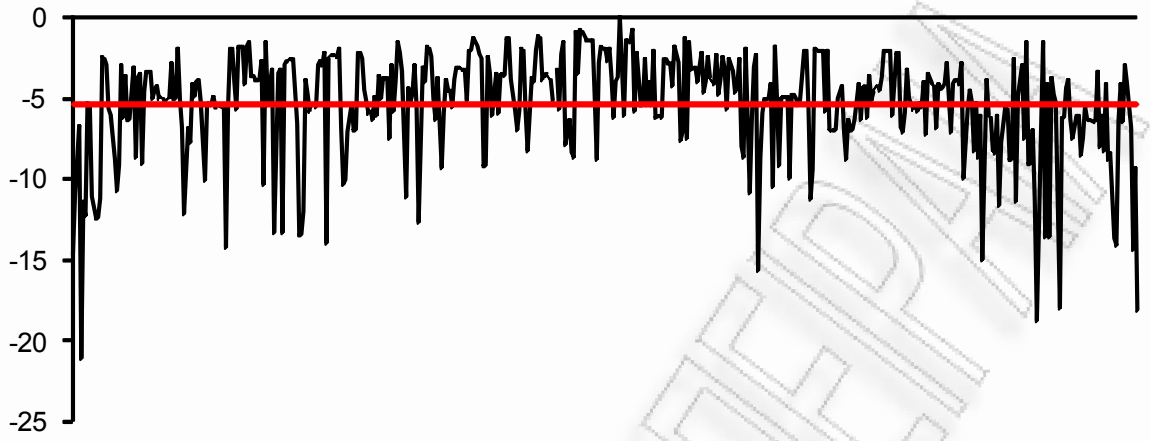
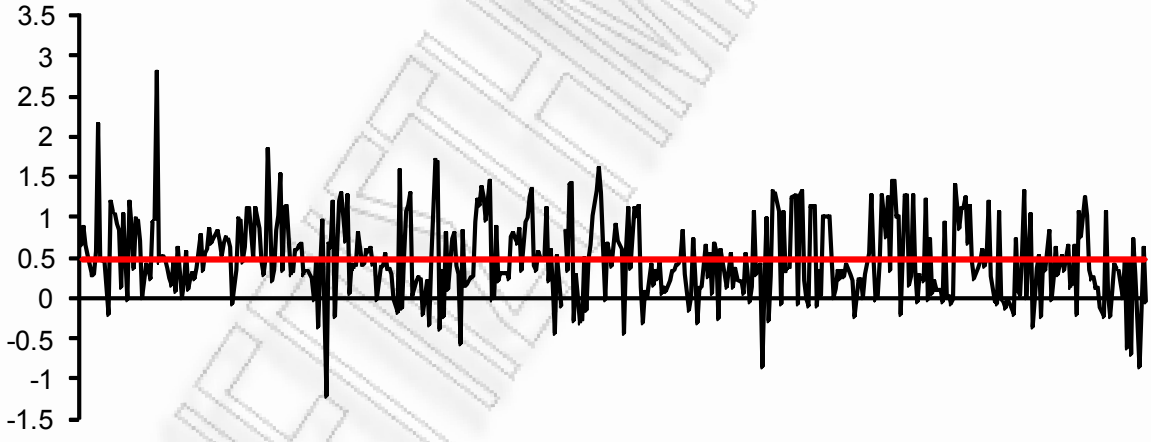


Chart 17: Long/short equity hedge funds - 5 Years Sortino Ratios



b) Portfolio asset allocation: Long/short equity hedge funds impact

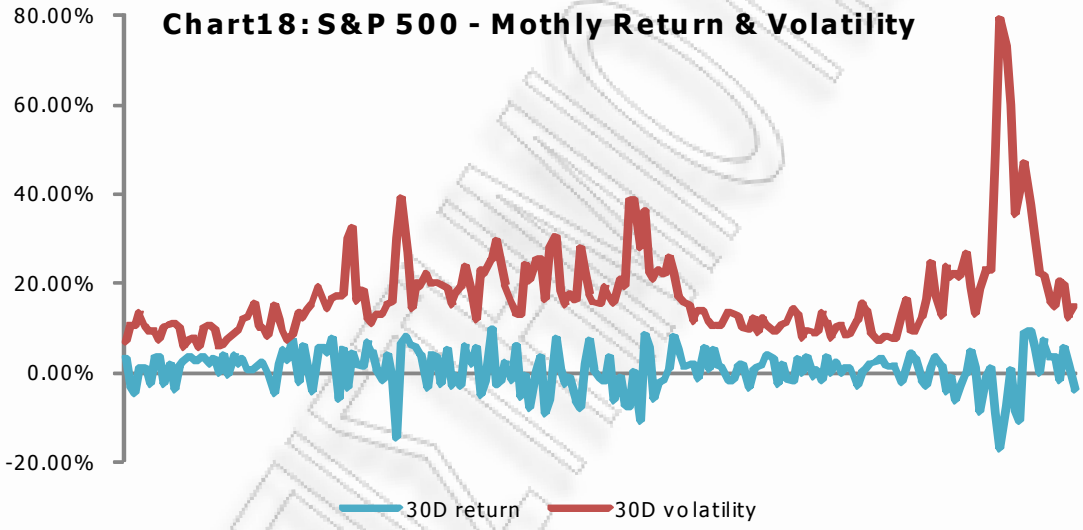
It is of great importance to examine the impact of the long/short equity hedge fund in an investment portfolio with different asset classes. Towards this purpose, we construct five different portfolios with different asset classes: 1) stocks and bonds, 2) stocks and long/short equity hedge funds and 3) stocks, bonds and long/short equity hedge funds, 4) bonds and long/short equity hedge funds and 5) stocks, bonds and long/short equity hedge funds using different weights than the previous portfolio. As a proxy for stocks we use the *S&P 500 index* while for bonds we use the *J.P. Morgan Global Aggregate Bond Index (JPM GABI)* and for long/short equity hedge funds we use the *Credit Suisse-Tremont Long/Short equity hedge fund index*. Our research spans the 16 year period from 1994 to 2010; the time window is chosen on the basis of data availability, but also such that would allow for "normal" and "non-normal" times, such as the 1997 financial crisis in Southeast Asia, the collapse of LTCM in 1998, the dot com bubble in 2000 and the recent crisis post the Lehman Brothers collapse as recently as in 2008. Although some structural changes may have occurred during the 16-year period, we reckon that the use of monthly-reporting indices smoothes out any adverse effect such structural breaks could have on our conclusions' drawing. It is highlighted also that, in order to simplify statistical calculations, the weight of each asset class is known *a priori*. Thus, the portfolios we construct are the following:

- Portfolio 1: 50% S&P 500 + 50% JPM GABI
- Portfolio 2: 50% S&P 500 + 50% Credit Suisse-Tremont long/short equity hedge fund index
- Portfolio 3: 25% S&P 500 + 25% JPM GABI + 50% Credit Suisse long/short equity hedge fund index
- Portfolio 4: 50% JPM GABI + 50% Credit Suisse-Tremont long/short equity hedge fund index
- Portfolio 5: 1/3 S&P 500 + 1/3 JPM GABI + 1/3 Credit Suisse-Tremont long/short equity hedge fund index

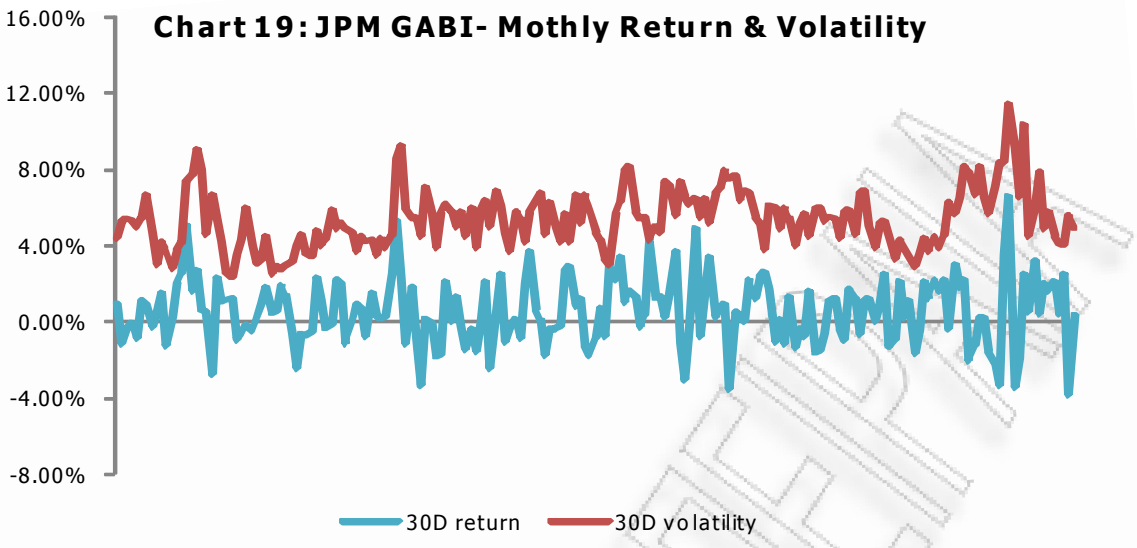
Before moving on to the portfolio construction, we present the risk/return performance of the three asset classes for the available data set:

S&P 500 provided with a positive total return of 123 percent and an annual return of 7.75 percent. During the same period, 30 day volatility, measured by standard deviation, averaged 20.82 percent, reflecting the impact of high-volatility periods in our sample – such as the recent credit crunch.

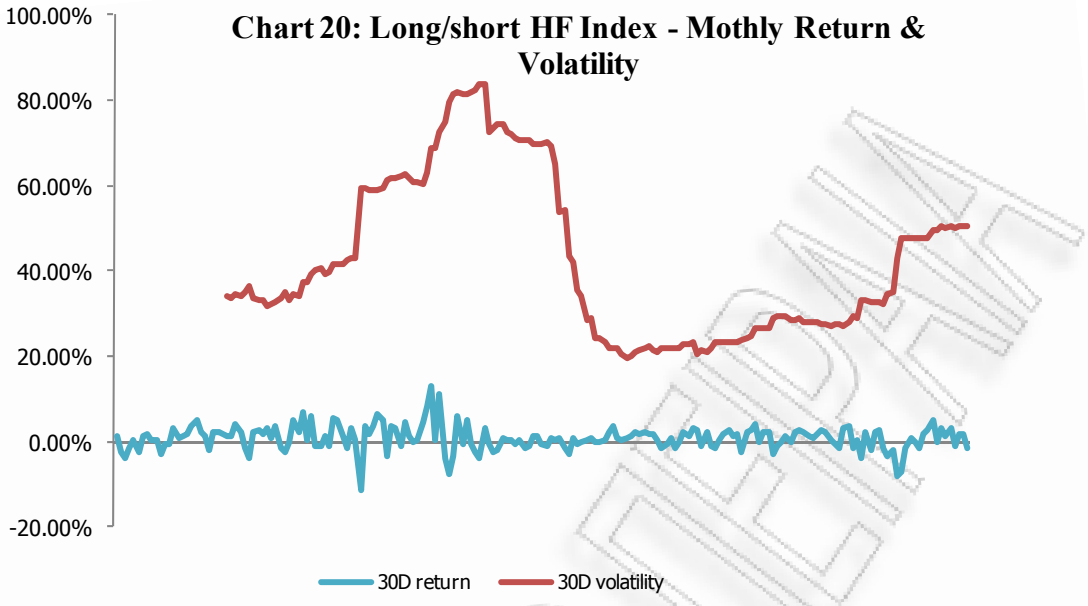
Chart 18 shows a graphic representation of S&P 500 for our data set:



JPM GABI index performed a little worse than the S&P 500 but significantly better on a risk-adjusted basis, as the recent recession did not affect the bond market at the same level as the stock market. Specifically, total return reached 173 percent, while annual return reached 6.74 percent, delivering worse performance by 101bps compared to the S&P 500. Standard deviation, at 7.18 percent, was on average lower than that of the S&P500, highlighting the lower risk compared to the stock market. Chart 19 shows the performance of the bond index we used.



The hedge fund index we used, the Credit Suisse long/short equity hedge fund index, outperformed the other two asset classes for the time period under consideration, delivering cumulative return of 367 percent and annual return of 11.31 percent, significantly higher than the return of both the S&P 500 and the bond index returns. However, it came as no surprise that risk-wise, long/short equity hedge funds have exhibited volatility figures higher than those of the bond index and lower than those of the stock index, with the standard deviation reaching 15.35 percent. This result indicates that the long/short equity hedge fund index can benefit from short-selling as mentioned in the previous section, performing relatively well both in bull and bear markets. It is to be stressed out that although the standard deviation is not an adequate measure of a hedge fund index risk profile, as discussed in Section 1, here it is used to allow for comparisons with the other two asset classes. Results can be seen in Chart 20.



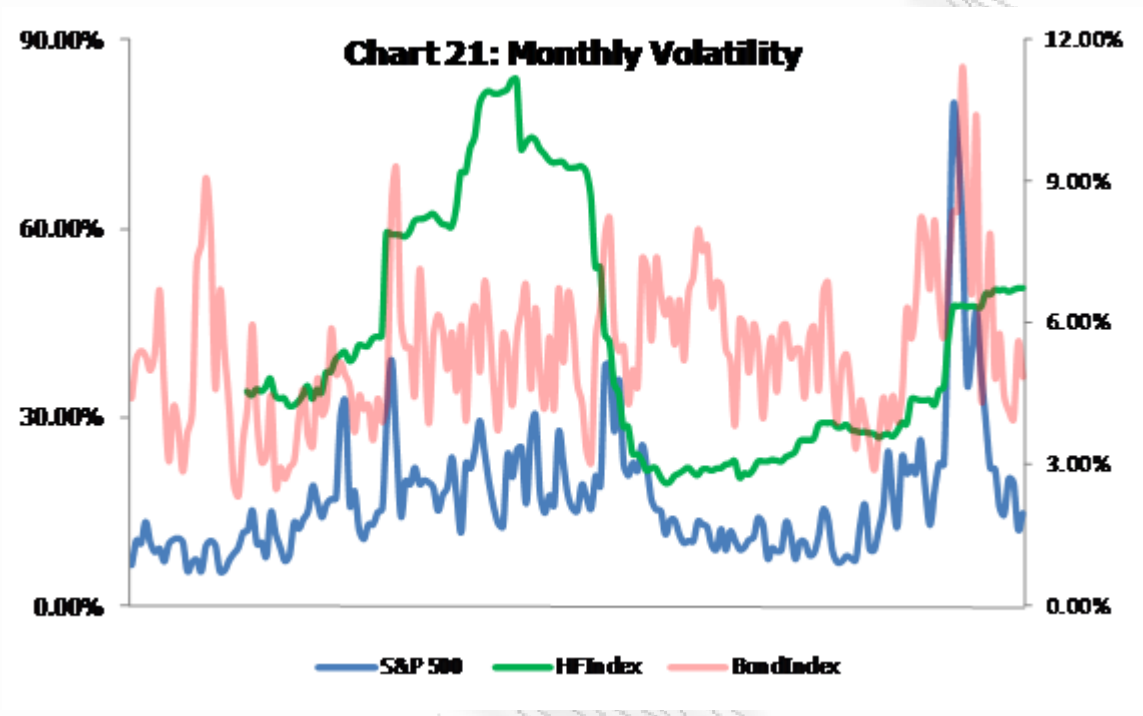
We proceed with the construction the portfolios using the data set and the weights as mentioned above. In order to perform the regression analysis we use the excel program in which we found a very strong correlation between S&P 500 and the hedge fund index of 0.81 percent. Whereas among other asset classes, correlations were significantly lower. All the figures are presented in the following chart:

Table 3: Corellations between the three asset classes

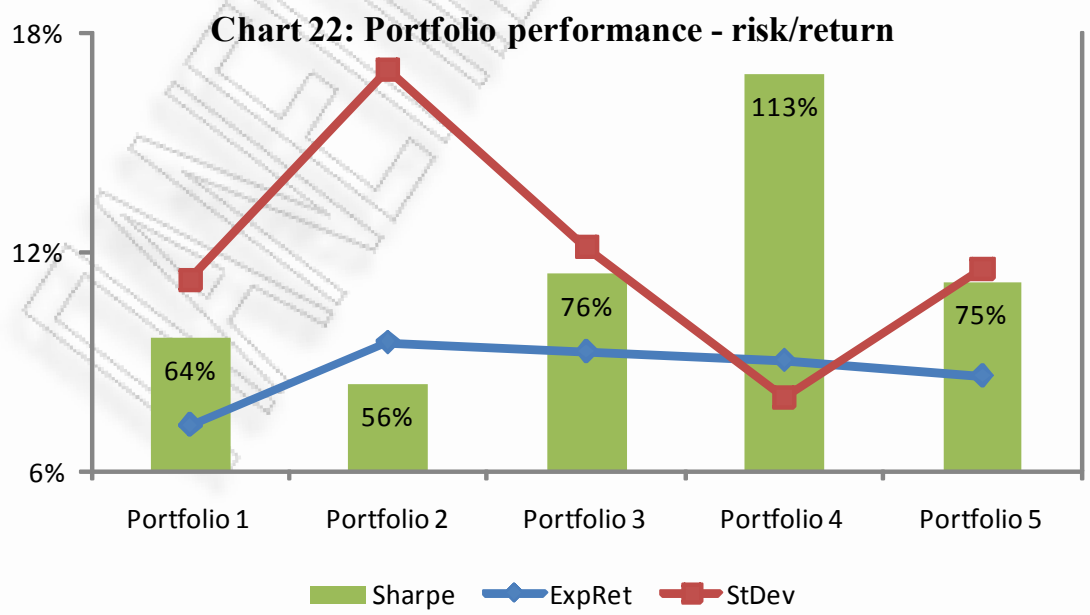
	S&P 500	*BondIndex*	*HFIndex*
S&P 500	1		
BondIndex	0.0709	1	
HFIndex	0.81357	-0.1459137	1

Based on the above calculations, and especially the strong negative correlation between the bond index and the hedge fund index returns, one expects that the introduction of the hedge fund asset class in the portfolios containing the bond index would result in significant diversification benefits. However, as discussed next, this is not absolutely the case: as depicted in the following diagram, where the 30 day volatility of the three indices is charted, there exists a "co-movement" pattern in the three volatility series. Irrespective of the absolute volatility level, there are volatility clusters where the volatility of all three indices spikes at the same time – especially during "crises". Thus, the introduction of hedge funds on a portfolio comprising the other two assets provides

us with some diversification gains only up to a point, due to the offsetting effect of the indices volatility clustering.



Based on the returns, the standard deviations and the correlations mentioned above we have constructed five portfolios. The risk/return characteristics of each portfolio are shown in chart 22:



We witness that the best risk-adjusted performance comes from portfolio 4 (50% JPM GABI + 50% Credit Suisse-Tremont long/short equity hedge fund index), as that generates the highest Sharpe ratio. Portfolio 3 and 5 generate lower Sharpe ratios at 0.76 and 0.75 respectively, mainly due to S&P 500 returns' greater volatility in our sample. The worst result, in terms of Sharpe ratio, comes from Portfolio 2 at 0.56, indicating that the highest expected return implies significant volatility levels resulting in less return per unit of risk. Moreover, we notice that Portfolio 1, the only without hedge funds, delivers the lowest expected return among its peers, thus, we highlight the positive impact of long/short equity hedge funds in a portfolio with different assets. Table 4 shows the results for each portfolio. We summarize the results in the following table:

Table 4: Portfolio Performance

	ExpRet	StDev	Sharpe
Portfolio 1	7%	11%	64%
Portfolio 2	10%	17%	56%
Portfolio 3	9%	12%	76%
Portfolio 4	9%	8%	113%
Portfolio 5	9%	12%	75%

Going forward, we try to monitor the impact of the long/short equity hedge funds in a portfolio by increasing the weight of the hedge fund index by 10 percentage points (starting from zero) under the assumption that the weights of the other two asset classes remain equal at each time. In other words, we examine the marginal change of the portfolio's expected return and standard deviation in order to find the optimal weight for our hedge fund index that is the weight that maximizes the portfolios risk-adjusted return. The results of the test are presented in Table 5.

Table 5: Portfolio asset allocation - HF index weight increase by 10%

S&P 500	BondIndex	HFIndex	ExpRet	StDev	ExpRet / StDev	Marginal return gains	Marginal volatility loss
50%	50%	0%	7.24%	11.24%	0.64		
45%	45%	10%	7.65%	11.19%	0.68	5.62%	-0.41%
40%	40%	20%	8.06%	11.26%	0.72	5.32%	0.65%
35%	35%	30%	8.47%	11.45%	0.74	5.05%	1.68%
30%	30%	40%	8.87%	11.75%	0.76	4.81%	2.62%
25%	25%	50%	9.28%	12.15%	0.76	4.59%	3.43%
20%	20%	60%	9.69%	12.65%	0.77	4.38%	4.08%
15%	15%	70%	10.09%	13.23%	0.76	4.20%	4.57%
10%	10%	80%	10.50%	13.88%	0.76	4.03%	4.91%
5%	5%	90%	10.91%	14.59%	0.75	3.87%	5.13%
0%	0%	100%	11.31%	15.35%	0.74	3.73%	5.25%

A graphical representation of the results is presented below, Charts 22a-c.

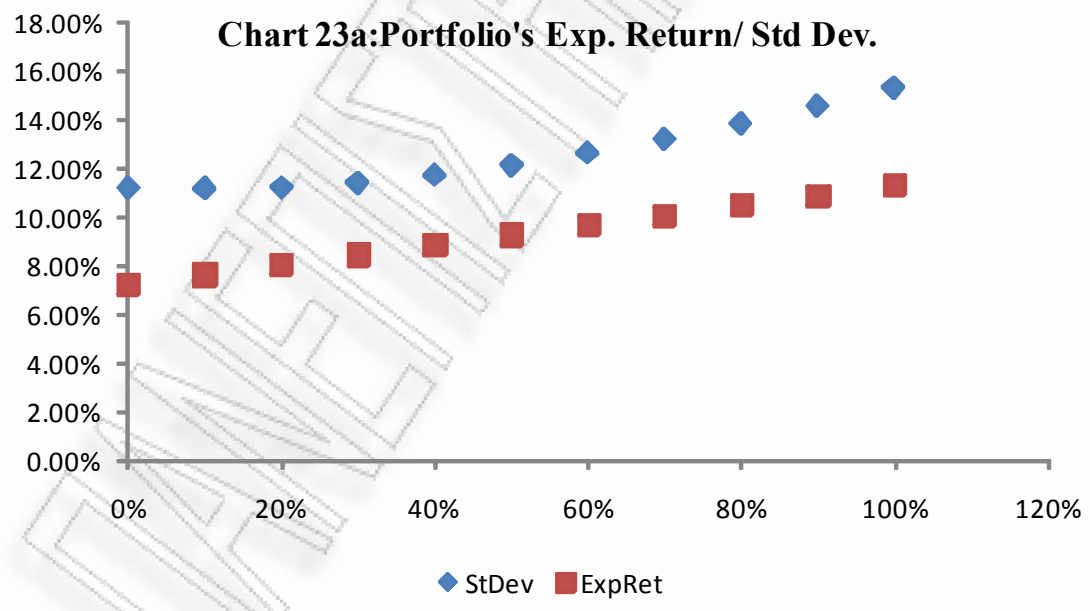


Chart 23b:Portfolio's Exp. Return/ Std Dev.

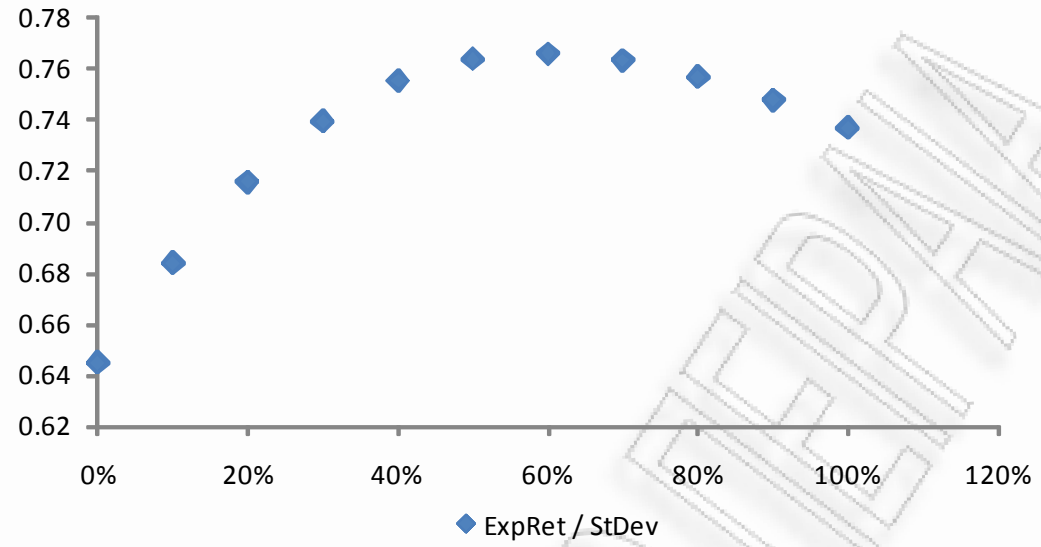
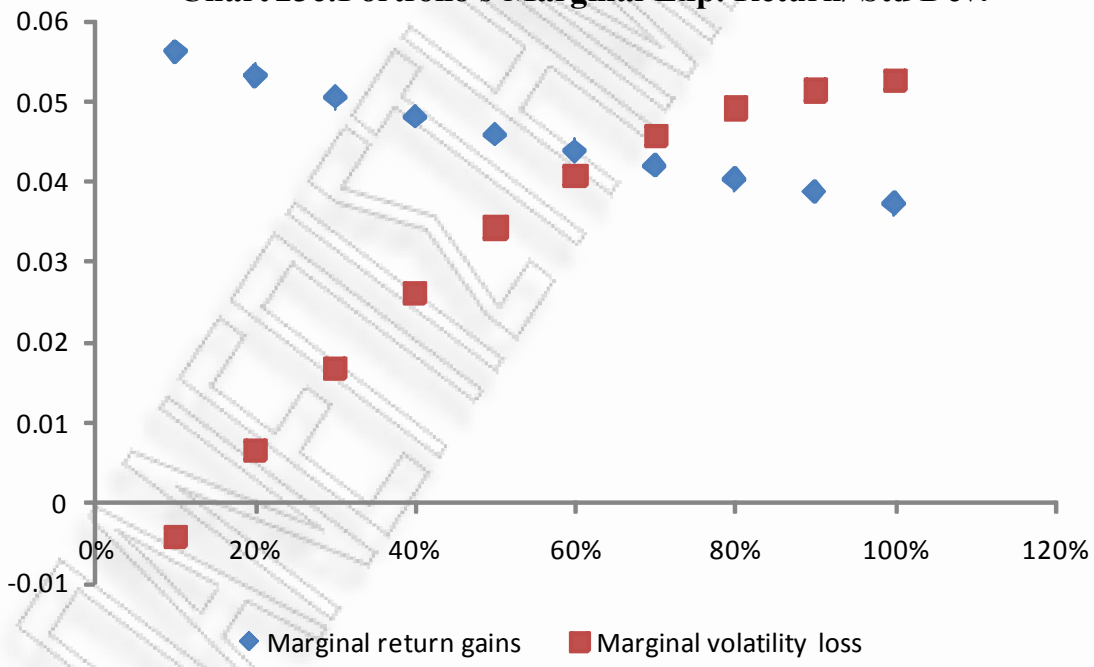


Chart 23c:Portfolio's Marginal Exp. Return/ Std Dev.



From the empirical analysis conducted above, one may conclude that the inclusion of the hedge fund index has a positive impact in our portfolio, but the positive contribution declines as the weight increases. Specifically, we notice that the highest expected return comes when the portfolio includes the hedge fund index with a weight of 60 percent. As

a reminder, we reiterate the constructive assumption we made, that the weights of both S&P 500 and JP Morgan GABI remain equal in performing tests. By increasing the use of the hedge fund index, we notice that the ratio expected return/standard deviation declines.

Section 5: Conclusion

A hedge fund can be defined as a private partnership that invests in heterogeneous types of financial instruments in an attempt to increase expected return while reducing risk. By using an active strategy, the fund manager, tries to obtain the best result from investment opportunities using instruments that are not available to other fund managers. Alternative asset classes such as subordinated debt and derivatives and alternative investment techniques such as are short – selling, leverage and the use of derivates are being used. The high fees paid by investors to the hedge funds, raise the question if actually the hedge funds, literally hedge risk on not.

Although the universe of reported hedge funds is vague, mainly due to the regulatory environment and the biases around the reported figures, the historical evidence we found showed a significant performance of the most widely used strategy, the long/short strategy as compared to other asset classes such as stock and bonds. Using the available data set (1994-2010), we conclude that long/short equity hedge funds reached a greater performance than the other two asset classes, however, evidence show the greater risk that an investor has to beat in order to gain these returns.

In order to examine the impact of long/short equity hedge funds in a portfolio consisting by the asset classes mentioned above, we constructed portfolios with different asset classes. According to the results, we witness that the long/short equity hedge funds do have a positive contribution in our portfolio. Specifically, we performed numerous tests that indicate the induction of a long/short hedge fund index which increases the return while the standard deviation delivers small relative increases compared to the expected return. Moreover, by increasing the contribution of the hedge fund index in our portfolio, using different weights, we notice that the expected return increases at a declining trend. The highest ratio of expected return/standard deviation comes at a weight of 60%, which is considered as the optimal contribution of the long/short hedge fund index in our portfolio.

Using a different time window (2005-2010), due to the lack of available data for the other hedge fund strategies, we reported and compared the main hedge fund strategies,

in terms of risk and return. Although long/short equity hedge funds, seem to perform rather well among its peers, merger arbitrage and event driven hedge funds deliver better results. This fact can be attributed, in our view, to the market trend and the small time window of our data set. The latter hedge funds, according to the theoretical basis of its strategies, are considered as more risky investment vehicles than the long/short equity hedge funds.

Two different methods are described in order to identify the risk factors of the long/short strategy using a linear approach by *Jasmina Hasanhodsic and Andrew W. Law (2007)* and a non-linear approach by *Fung and Hsieh (2005)*. Although the first method does not take into account the use of derivatives and short-selling and uses 6 risk factors - liquid exchange-traded securities – to replicate the long/short equity hedge fund returns, comes into agreement to a certain extent with the non – linear method. The latter, used a four-factor model as described in the previous section and concluded that the risk factor with the main impact is the RMRF (long stocks/short the risk-free asset) and SMB (the spread between small and large cap stocks). The two risk factors together with HML (spread between value and growth stocks) and UMD (momentum) account for 80 percent of the return variation. Managers' alpha account for 20 percent of the return variation. On the other hand, according to the linear approach, manager's alpha accounted for 70.5 percent of the sample, while stocks accounted for 17.8 percent.

In each case we reiterate the view that long/short equity hedge funds do benefit from short-selling but in each case the manager specific alpha, regardless of the actual contribution on the performance, is responsible for the risk implied in the strategy. Expressed differently, L/S equity hedge funds, as the name suggests, derive excess performance from shorting. Besides differences in risk taking behavior, this is a key feature distinguishing L/S funds from other investment vehicles such as mutual funds and other type of hedge funds.

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