Master Thesis

A Study of the Characteristics and Performance of Hedge Funds

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Foreword

This thesis is written in conjunction with our degree in Master of Science in Business Administration at the University of Agder.

The topic chosen for this thesis was hedge funds. The hedge fund industry has grown tremendously the last decades, and the research in this field is still at an early stage. We therefore found this subject interesting. Since our concentration is in finance, it also gave us the opportunity to apply some of what we have learned. Our knowledge of hedge funds was limited, and writing this thesis has therefore been a challenging and educational experience.

We would like to take this opportunity to thank our advisors Valeri Zakamouline and Steen Koekebakker for constructive feedback, and also each other for good cooperation.

Abstract

In this thesis we have examined the characteristics and performance of hedge funds. This is done in light of the expected liberalisation of hedge fund regulations in Norway. Our analysis is mainly of foreign hedge fund indices, but also of a few individual Norwegian hedge funds for a shorter period.

Hedge funds are known for superior mean-variance characteristics. At first glance they do indeed appear attractive. However, when taking into account the often disregarded higher moments of the return distribution, characteristics of negative skewness and positive excess kurtosis are revealed. This should be taken into consideration when evaluating hedge fund performance, since it indicates extreme values of return. It is noteworthy though, that in the shorter period of our analysis, these characteristics have been reduced considerably.

The objective of hedge funds is positive return regardless of market movements, and they could therefore serve well for portfolio diversification purposes. Our studies reveal a low to moderate correlation with traditional assets, and it seems to be lower in bear markets. Our observations also tell us that hedge funds are sensitive to extreme market conditions.

Autocorrelation can cause undervaluation of the volatility of hedge fund returns. The presence of first order autocorrelation among some hedge fund strategies is evident. Consequently, we found overestimation of risk-adjusted performance measures, and it also affected correlation. Among individual Norwegian hedge funds, autocorrelation seems absent.

Literature on hedge funds often focuses on the limitations of traditional performance measures. Using both traditional and innovative performance measures we find that hedge funds, in spite of their characteristics, are ranked higher than traditional asset classes. We also find that the performance ranking of the traditional and innovative measures do not differ considerable from each other.

However, there are several aspects of consideration when analyzing hedge funds. One of the major limitations of the research in this field is caused by the hedge funds' complex nature and lack of transparency. The absence of reliable and accurate data makes it difficult to draw definite conclusions.

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1.0 Introduction

1.1 Problem Definition

Hedge funds' popularity has increased considerably in the recent years. A reason for this is that they are known to provide better mean-variance characteristics as compared to traditional assets.

So far, it has been prohibited by law to establish and advertise hedge funds in Norway. Companies have been forced abroad to set up these types of funds. A new proposal made by the Ministry of Finance suggests a liberalization of the restrictive investment regulations of hedge funds. This will make hedge funds more available to investors in Norway.

In light of this we wish to take a closer look at the characteristics and performance of hedge funds. Are hedge funds' risk-return relationship as attractive as advertised? Do they serve well for diversification? Do hedge funds outperform traditional asset classes? We will try to find answers to these questions by analyzing the Credit Suisse/Tremont Hedge Fund Index and individual Norwegian hedge funds registered at the Nordic Hedge Fund Index. The funds defined as Norwegian are those with Norwegian managers.

The amount and history of Norwegian Hedge funds are limited. Our focus will therefore primarily be on the Credit Suisse/Tremont Hedge Fund Index. We will evaluate a small sample of Norwegian hedge funds against the Credit Suisse/Tremont Hedge Fund Index.

We will start by looking at the statistical properties of the hedge funds' returns. Since hedge funds focus on absolute return, we will measure the hedge funds' correlation with various market indices.

Traditional performance measures are regarded as inadequate for analyzing hedge fund returns. We will therefore apply some innovative measures, which take into account the characteristics of hedge fund returns. The hedge funds will be ranked according to these measures, and Spearman's rank correlation will be used to observe the ranking between the measures. Since autocorrelation of return series may underestimate volatility of hedge funds,

we will adjust the returns for first order autocorrelation to investigate if this affects the observed performance and the correlation with other assets.

1.2. Structure of Thesis

This thesis consists of three main parts:

1. The first part is theoretical and consists of chapter 2 to 7. We start by giving a short presentation of hedge funds. We will then take a closer look at statistical properties of return and modern portfolio theory before we discuss various performance measures. The first part is rounded off with a presentation of hedge funds as well as biases in hedge fund databases.

2. In the second part, consisting of chapter 8 to 11, we start by giving a description of the data used in our analysis. This is followed up by our empirical analysis.

3. The last part starts with chapter 12, where we discuss possible sources of hedge fund performance as well as limitations. The thesis is finalized in chapter 13 with the conclusion of our major findings.

2.0 An Introduction to Hedge Funds

Alfred Winslow Jones is usually acknowledged as the creator of the first hedge fund in 1949. However, Lhabitant (2006) claims that there are earlier evidences of hedge fund writings. The first appears to be the book Scientific Forecasting, which was published in 1931 by Karl Karsten. Here, most of the key principles of managing a hedge fund are summarized. Karsten created a small fund in 1930, but he was primarily interested in testing his theories, not in profits.

2.1 History

Alfred W. Jones created a fund which primarily invested in common stocks. It was based on two assumptions: that he could identify stocks that were overvalued or undervalued, and that market changes could not be foreseen. Anchored in these assumptions, his strategy was to combine long positions in undervalued stocks and short positions in overvalued stocks. The positions were larger than the fund's capital by the use of leverage; Jones financed the purchase of long positions with the income from the short sales. This was the first time short sale and leverage were combined as investment tools. In order to attract investors, Jones charged performance-linked fees of 20 percent of realized profits instead of asset-based management fees. According to Brown and Goetzmann (2003) Carol Loomis was the first person to use the term "hedge fund" in a Fortune magazine article written in 1966. She discussed Jones' fund structure and investment strategy. Until the article was published, Jones had been running his fund in secrecy with hardly any changes in the approach, but then interest in hedge funds and creation of new ones rapidly increased. The number of hedge funds has soared, particularly since the early 1990s. According to Lhabitant (2004), there were only 68 hedge funds in 1984, while estimates suggest that there are now over 6000 hedge funds managing around $600 billion in assets.

2.2 Why Hedge Funds?

McCrary (2005) lists three main reasons for why investors should invest in hedge funds: to increase return, to reduce risk and to increase diversification.

Hedge funds have generally shown a much better risk/return relationship than other assets, at least when only mean and variance is considered. Hedge funds also have a historically low

correlation to the stock and bond markets due to the focus on absolute return. This gives the investors the benefit of diversification.

Other characteristics of hedge funds that attract investors are:

- Hedge fund managers have a low degree of restrictions in their asset management. This improves the possibility of superior returns.
- Managers invest their own money in the funds. This gives confidence, and aligns the interests of investors and managers.
- Because of their favourable fee structure, the hedge fund industry attracts some of the best fund managers.

These features will be described in depth later on.

2.3 The Legal Environment in Norway

So far it has been illegal to establish and advertise hedge funds in Norway. Norway is one of the few countries with such restrictive regulations of these types of securities. Still, some Norwegian fund managers register hedge funds abroad and sell them in Norway. Hedge fund managers are not obliged to report their figures. These issues make it difficult to obtain an overview of the "Norwegian" hedge fund universe. It can be argued that the prohibition of advertisement and establishment of hedge funds are inconsistent with the fact that they can be sold in Norway. However, March 14th 2008 the Ministry of Finance made a proposal for a change in the law concerning securities ("verdipapirfondloven"). Hedge funds are introduced as a subcategory of security funds, and establishment and marketing of hedge funds in Norway will be possible. Hedge funds are given broad access to use various financial vehicles, but the requirements for reporting strategies and risk are sharpened. They will have to send periodical reports to investors as well as the governments. The law also specifies that hedge funds only can be sold to the public after advice from an authorized investment advisor. This is not required for selling to professional investors. The proposal will be voted for in the Parliament, and if accepted implemented at January 1st 2009.

3.0 Statistical Properties of Hedge Fund Returns

In this chapter we will present some statistical properties of hedge fund returns. First we will look at the centralized moments and its properties, as well as the possible disturbance of outliers. Correlation will also be briefly presented, and the presence of autocorrelation in hedge fund returns.

3.1 Return

Early work on return has been on statistical behaviour of net asset value or prices. Recent work in finance concerns time series of return. According to Lhabitant (2004), the reason for this shift is that returns standardize the evolution of a price by considering *price per unit of risk*. The statistical properties of returns are also more appealing than prices.

According to the timeline:

the realized return on a given asset is defined as:

$$r_n = \frac{S_n - S_{n-1}}{S_{n-1}} \tag{3.1}$$

where $n = 1,2,\ldots,N$,

S_n = the given asset's value at time n and

r_n = the realized return on a given asset at time n.

3.2 The Return Distribution and its Centralized Moments

The n[th] central moment around the mean (or expected return) is defined as $\mu_n = E\left[(r - E(r)^n\right]$, where E represents the expectation. Even moments give us the probability of extreme values, while odd moments tell us about the symmetry of the distribution. The mean and variance are called the first and second central moment about the mean. Mean, the expected return, represents the reward. The variance and higher moments represent the uncertainty related to

the reward. Usually, only the two first moments are used. In this thesis we will consider four moments of the central distribution. The two first are the already mentioned mean and variance. The third and fourth is skewness and kurtosis.

3.2.1 The Mean – The First Central Moment

The mean, the first moment of a distribution, is the expected return:

$$\mu = E(r) = \frac{1}{N}\sum_{n=1}^{N} r_n = \bar{r} \tag{3.2}$$

The first central moment about the mean of a distribution is defined as:

$$\mu_1 = E\left[(r - E(r)\right] = \frac{1}{N}\sum_{n=1}^{N} (r_n - \bar{r}) \tag{3.3}$$

The first central moment about the mean is always zero, and consequently usually of no interest.

3.2.1.1 Arithmetic versus Geometric Mean

The first moment, the mean, can be calculated using either the arithmetic or geometric mean. The arithmetic mean, presented in equation 3.2, is often preferred among fund managers. This is partly because it is less complicated to calculate and partly because it yields higher values, making investment appear better. The arithmetic mean is always higher than the geometric. This is because the geometric mean return also accounts for the consequence of compounding. They are only equal if there is no variation in yearly returns. Geometric mean is defined as:

$$\bar{r}_{geometric} = \left[\prod_{n=1}^{N}(1 + r_n)\right]^{1/N} - 1 \tag{3.4}$$

The method to use depends upon the number of periods needed to be measured as well as the desire for accurate calculations. When we want to calculate the mean of many sub-periods, the geometric mean may be preferred since it accounts for compounding. The geometric mean

is also a better measure of past performance, while arithmetic mean is often preferred when predicting future performance.

3.2.2 The Variance – The Second Central Moment

The variance or the standard deviation is the most common measure of risk. The variance is the average squared deviation from the mean return. It is also called the second central moment around the mean, and is given by:

$$Variance = \mu_2 = E\left[(r - E(r)^2\right] = \frac{1}{N}\sum_{n=1}^{N}(r_n - \bar{r})^2 = \overline{\sigma^2} \tag{3.5}$$

Since the units of variance are different from the units of return, it is necessary to transform them into a common unit. This is done by taking the square root of the variance. This measure is called the standard deviation and is often referred to as the volatility:

$$\text{Standard Deviation} = \sqrt{\frac{1}{N}\sum_{n=1}^{N}(r_n - \bar{r})^2} = \overline{\sigma} \tag{3.6}$$

3.2.3 Skewness – The Third Central Moment

The third moment divided by the standard deviation is called skewness. It is the cubed deviation from the mean. Variance only tells us how large the deviation from the expected return is, while skewness is a measure of the symmetry of the distribution. If skewness is positive the distribution has a longer positive tail. This means rather small losses but larger gains. The opposite is true if skewness is negative, and this is a usually undesirable situation with many small gains and larger losses. Skewness is given by:

$$Skewness = \frac{\mu_3}{\sigma^3} = \frac{E\left[(r - E(r)^3\right]}{\sigma^3} = \frac{1}{N}\sum_{n=1}^{N}\frac{(r_n - \bar{r})^3}{\overline{\sigma^3}} = \overline{\mu_3} \tag{3.7}$$

3.2.4 Kurtosis – The Fourth Central Moment

The fourth moment, kurtosis, measures the degree of peakedness and give us the characteristics of the tails of the distribution. In other words, it measures the probability of extreme values. The kurtosis is calculates as follows:

$$Kurtosis = \frac{\mu_4}{\sigma^4} = \frac{E\left[(r - E(r)^4\right]}{\sigma^4} = \frac{1}{N}\sum_{n=1}^{N}\frac{(r_n - \bar{r})^4}{\overline{\sigma^4}} = \overline{\mu_4} \quad (3.8)$$

The excess kurtosis is calculated by subtracting 3:

$$\text{Excess kurtosis} = \overline{\mu}_4 - 3 \quad (3.9)$$

The normal distribution obtains a kurtosis of 3. Excess kurtosis is therefore for simplicity calculated to make this value zero. When the excess kurtosis is positive it is called "leptokurtic". It is then characterized by a distribution with fat tails and peakedness. More of the expected return is located around the mean, but it also has a higher probability of extreme values as compared to a normal distribution. When the excess kurtosis is negative, the shape of the distribution curve is called "platykurtic". The peak is softer and the tails have "shoulders". As opposite to a "leptokurtic", the "platykurtic" distribution has a lower probability of extreme values and fewer values located closer to the mean than a normal distribution.

3.2.5 Hedge Funds and the Normal Distribution

One way of achieving an overall view of the return of an asset is to present it in a relative frequency histogram. This is done by calculating the frequency of different intervals of returns. This enables us to study the shape of the return distribution. Modern Portfolio Theory assumes assets' returns to be normally distributed. The normal distribution (also known as the Gaussian distribution) is a bell-shaped symmetric curve. It is fully described by its mean and standard deviation, and is practical since it is easy to understand and use when analyzing return.

The standard deviation is a powerful and accurate measure of risk, but only if the return distribution is normal. Two investments may have the same mean and standard deviation, but differ significantly in terms of higher moments. Observations made of the financial markets (see for instance Brooks and Kat (2002)) reveal that most return distributions deviate from the normal distribution, and it is known that hedge fund return seldom is normally distributed. This is to due to the use of derivatives and other characteristics of hedge funds, which separate them from other traditional investment funds. According to Schmidhuber and Moix

(2001), hedge funds commonly reveal a hyperbolic return distribution with a negative skewness and a positive excess kurtosis.

The Normal Distribution

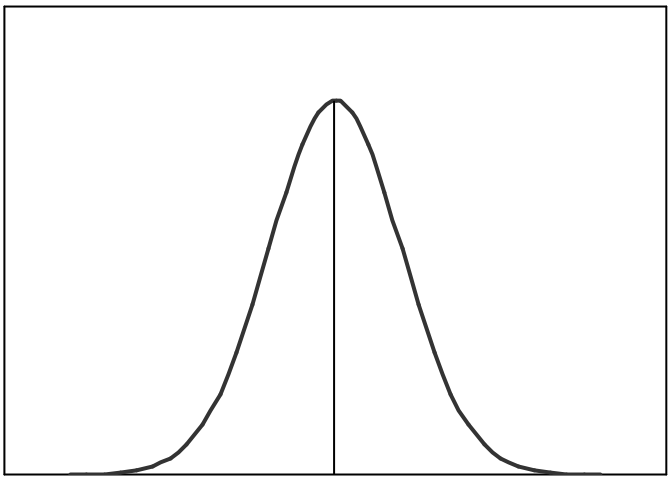

Figure 1: The Normal Distribution

3.2.6 Normality Test of the Return Distribution

There are several ways to test if the return of an asset is normally distributed. A well-known method is the Jarque-Bera test. It tests the null hypothesis that a series of return of an asset is normally distributed, based on the fact that skewness and excess kurtosis in a normal distribution is close to zero. The Jarque-Bera test is given by:

$$Jarque-Bera = \frac{N}{6}\left[Skewness^2 + \frac{Excess\ Kurtosis^2}{4} \right] \tag{3.10}$$

The Jarque-Bera statistic follows a chi-squared distribution with two degrees of freedom. If the value of the test is higher than the critical value, the null hypothesis is rejected. If the data set is rather small, the Jarque-Bera test for normality should be used with caution, since it is asymptotic (Lhabitant 2006).

3.3 Outliers

Returns that are considered to be outliers often occur in finance, and particularly with hedge funds. Lhabitant (2004) describes outliers as returns that depart distinctly from the pattern of

the majority of the returns. No clear boundaries define outliers, but they are generally unusual large or unusual small values compared to the others.

There are two reasons for outliers. They may either be the result of either an error in measurement or of a genuine structural property of the data. If they are due to the first reason, the outliers will distort the interpretation of the data. The outliers can therefore be safely removed from the data set. If they are due to the latter reason, the outliers are important because they indicate extreme behaviour. These outliers should not be removed without further justification.

3.4 Correlation

One of the benefits of hedge funds is that they focus on absolute return. The managers of hedge funds aim at a positive return independently of the market environment. Lhabitant (2004) finds that hedge funds have shown a low to medium correlation with traditional assets like equities and bonds.

There are several methods to measure the correlation between two assets. Two well recognized methods are the Pearson's product-moment correlation and Spearman's rank correlation. The Pearson correlation assumes that the samples are from a population which is normally distributed. This assumption is particularly important in small samples, since outliers can disturb the measurement of the correlation coefficient. Due to this problem, the Pearson's correlation is sometimes replaced by the Spearman's rank correlation, which is less sensitive to outliers. Spearman's rank correlation is a non-parametric measure of correlation. The data is converted to rankings before measuring the correlation coefficient. The correlation coefficient is calculated as follows:

$$Spearman's\ rank\ correlation\ coefficiant = \rho = 1 - 6\sum_{n=1}^{N} \frac{d_{(n)}^2}{N(N^2 - 1)} \qquad (3.11)$$

where N = the number of rankings and

d_n^2 = the nth squared difference of the ranking.

Spearman's rank correlation can obtain a value between -1 and 1, where a positive correlation indicates that the ranks of both variables increase or decrease together. A negative correlation

implies that as the ranks of one variable decrease, the other will increase. If the correlation is close to zero, the rankings of the variables obtain no linear relationship.

3.5 Autocorrelation

Hedge funds often take positions in illiquid securities. This leads to serial correlation in the return series, since market prices may not be available. This makes mark to market difficult, and the last available price or estimates are often used. Brooks and Kat (2002) document highly significant autocorrelation in returns of hedge fund indices. According to Getmansky et al. (2003), reported returns for portfolios of illiquid securities tend to be smoother than true returns. This will understate volatility and overestimate risk-adjusted performance measures. They show that the most likely reason for serial correlation is illiquidity exposure.

The Ljung-Box test is a well-known test for autocorrelation. It is defined as follows:

$$Q = n(n+2)\sum_{k=1}^{m}\frac{\tau_k^{\,2}}{n-k} \tag{3.12}$$

where n = the number of observations,
τ_k= the autocorrelation coefficient at lag k and
m = the number of lags being tested.

The Ljung-Box statistics follows a chi-square distribution with m degrees of freedom under the null hypothesis that the data is random.

3.5.1 Adjusting Returns for Autocorrelation

Geltner (1993) discuss methodologies to unsmooth returns of infrequent valuation of properties in real estate. Following this, Brooks and Kat (2002) derived a method to unsmooth return series with first order autocorrelation. The observed smoothed return of a hedge fund index at time n can be defined as the weighted average of the true return at time n and the observed smoothed return at time n-1:

$$Smoothed\ return = r_n^* = \lambda r_n + (1-\lambda) r_{n-1}^* \tag{3.13}$$

where r_n^* = the observed smoothed return of an index at time n,

λr_n = the true (unobservable) underlying value of an index at time n and

$(1-\lambda) r_{n-1}^*$ = the observed smoothed return of an index at time n-1.

The following equation can then be used to unsmooth the return series:

$$Unsmoothed\ retun = r_n = \frac{r_n^* - \lambda r_{n-1}^*}{1-\lambda} \qquad (3.14)$$

where λ = the first order autocorrelation coefficient of an index,

r_n = the true (unobservable) underlying return of an index at time n,

r_n^* = the observed return of an index at time n and

λr_{n-1}^* = the observed smoothed return of an index at time n-1.

Aside from rounding errors, the new unsmoothed return series will have the same mean as the smoothed. However, the standard deviation will increase if the first order autocorrelation coefficient is positive and decrease if it is negative.

4.0 Modern Portfolio Theory

In this chapter we will present the mean-variance framework as well as the limitations of it when considering hedge funds. In addition, we will briefly present asset pricing models.

4.1 The Mean-Variance Framework

Modern Portfolio Theory was introduced by Harry M. Markowitz in 1952. He won the Nobel Prize for his work on mean-variance selection theory, and in 1959 he published a book about portfolio selection. His research is considered as one of the most important contributions to financial theory through history. The mean-variance framework is widely used in performance evaluation of investments. It has also enthused various extensions and applications.

4.1.1 Markowitz's Efficient Frontier

Prior to Markowitz's portfolio theory, investors' emphasize was on selecting single assets which offered the highest return with the least risk. They constructed a portfolio out of these assets without considering the assets' effect on the portfolio as a whole.

Markowitz's portfolio selection model proposes how rational investors diversify to minimize expected risk and maximize expected return. By diversifying, the overall risk is reduced by spreading the investment among different assets. The less correlated the assets, the less is the risk of the portfolio. In other words, investors should invest in portfolios rather than individual assets.

The model assumes investors to be risk-averse. Mean (or expected return) and standard deviation are proxies for reward and risk. The opportunities available are summarized by the minimum-variance frontier of risky assets. It provides the lowest possible variance achievable for a certain expected return of a portfolio. Rational investors will always choose the portfolio with the lowest risk, given they have the same expected return. If an investor desires higher expected return, he also needs to carry more risk. The trade-off will depend on the individual investor's degree of risk aversion.

The optimal trade-off between risk and expected return is captured by the efficient frontier as shown in figure 2. The efficient frontier is located in the upper region of the minimum-

variance frontier. The assets located below the efficient frontier are considered inefficient since other assets can generate a higher expected return at the same risk. Investors should therefore choose a portfolio located at the efficient frontier.

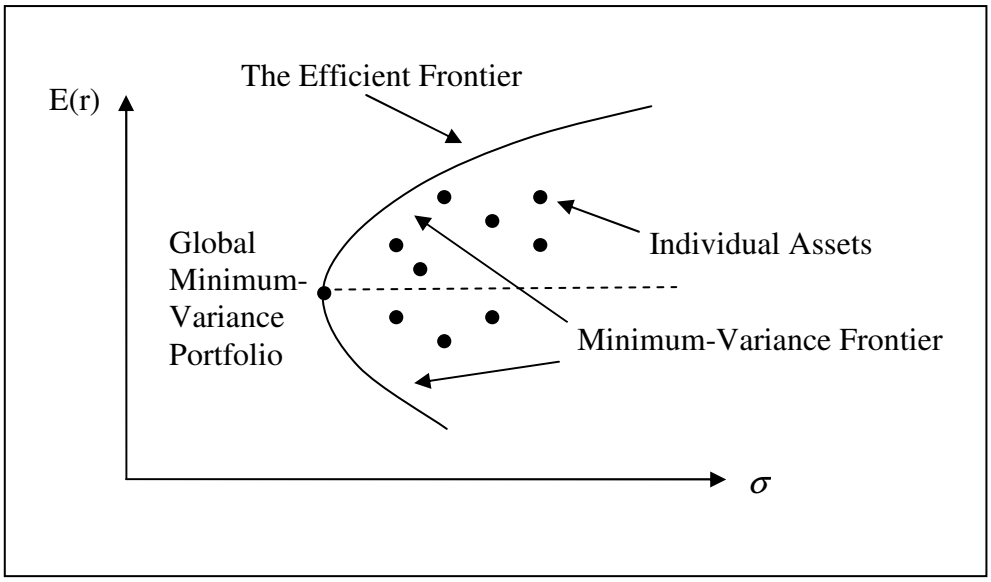

Figure 2: The Efficient Frontier
Source: Bodie et.al. (2005)

4.1.2 The Capital Allocation Line (CAL)

By introducing a risk-free asset into the universe of risky assets, investors are allowed to borrow and loan at a risk-free rate. The risk-free asset is uncorrelated with any other asset. The introduction of a risk-free asset presents risk-return profiles superior to those on the efficient frontier. The capital allocation line shows the portfolio opportunities available to investors when combining a risky with a risk-free asset. The CAL is a straight line and is defined as:

$$E(r_C) = r_f + \sigma_C \frac{E(r) - r_f}{\sigma} \qquad (4.1)$$

where $E(r_C)$ = the expected return of a combination of a given risky portfolio and the risk-free asset,

$E(r) - r_f$ = the expected return of a given risky portfolio above the risk-free rate,

σ = the standard deviation of a given portfolio and

σ_C = the standard deviation of the combination of a given risky portfolio and the risk-free asset.

The slope of the CAL represents the reward-to-variability ratio and is given by:

$$S = \frac{E(r) - r_f}{\sigma} \qquad (4.2)$$

The slope is also known as the Sharpe ratio. The portfolio on the efficient frontier with the highest Sharpe ratio is known as the market portfolio. When the market portfolio is combined with a risk-free asset, it is called the capital market line (CML). It is tangent to the efficient frontier and dominates all other feasible lines, as shown in figure 3.

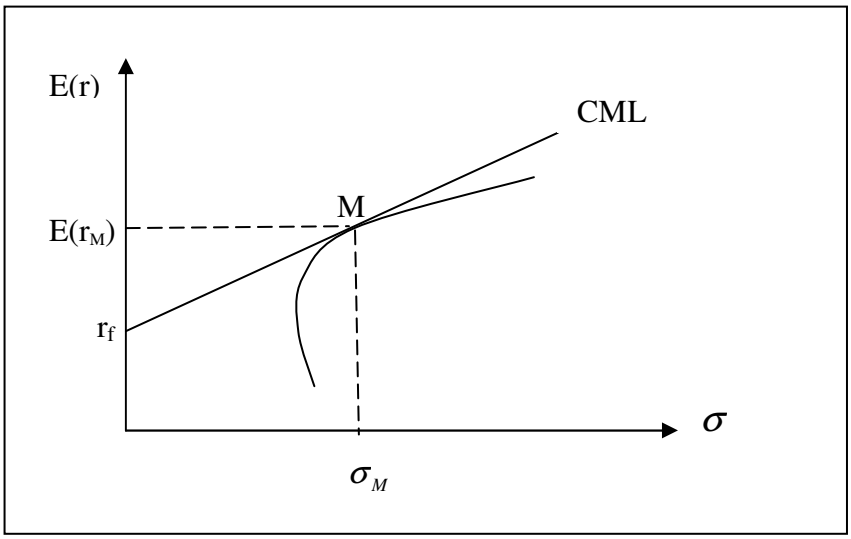

Figure 3: The Capital Market Line
Source: Bodie et.al. (2005)

4.1.3 Criticism of the Mean-Variance Framework

One simplifying assumptions of the mean-variance theory is that risk can be fully described by the variance of return of an asset. This assumption is only valid if returns are normally distributed and/or if investors hold a quadratic utility function.

Quadratic utility functions tell us that investors only care about the two first moments of the distribution to solve the maximization problem, regardless if the returns are normally distributed. This is not coherent with the behaviour of a rational investor.

According to Bodie et al. (2005), the utility that an investor derives from a portfolio, with a given expected return and standard deviation, can be described by the following quadratic utility function:

$$U = E(r) - A\sigma^2 \qquad (4.3)$$

where U = the utility value,

E(r) = the expected return (mean),

$A \geq 0$ = the investor's degree of risk aversion and

σ^2 = the variance.

Thus, the investor only considers mean and variance. The utility function is a curve with a decreasing slope. Since a quadratic utility function only has positive marginal utility under the bounded range, it places unrealistic behaviour on investors. It has a maximum beyond in which the marginal utility of money declines, and according to Wippern (1971) this is an inconsistent and implausible property.

The quadratic utility function also tells us that investors have increasing risk aversion, which implies reduced risk taking as wealth increases. Empirical evidence (see for instance Pratt (1964) and Arrow (1965)) and theoretical considerations, on the other hand, tell us that investors possess a decreasing (absolute) risk-aversion. In the real world, utility functions of investors can be highly complex and of an irregular shape.

If the Markowitz portfolio theory cannot rely on the quadratic utility function of investors, it rests heavily on the assumption that return is normally distributed and fully described by its mean and variance. As stated earlier, hedge fund returns are usually not characterized by a normal distributed return. Investment opportunities characterized by higher moments is therefore eliminated for investors. The mean-variance framework does therefore not fully make sense when analyzing and evaluating hedge funds.

4.2 Asset Pricing Models

Asset pricing models value assets relative to the market or other risk factors. There have been developed a number of asset pricing models. We can separate them into single and multi-factor models. Single-factor models explain the price of an asset by only one factor. Multi-factor models explain the price by several independent factors. In this paper we will present two widely known asset pricing models; the Capital Asset Pricing Model and the arbitrage pricing theory.

4.2.1 The Capital Asset Pricing Model (CAPM)

Markowitz's mean-variance analysis became the foundation of the widely known and applied Capital Asset Pricing Model. The CAPM is a centrepiece of modern financial economics and was developed by William Sharpe (1964), John Lintner (1965) and Jan Mossin (1966). The CAPM describes the relationship between an asset's expected return and risk, and is used in pricing risky assets. It also emphasizes the underlying principle of diversifying.

An important aspect of the CAPM is that volatility can be split into systematic and firm-specific risk. The systematic risk is related to market movements and cannot be diversified away. Firm-specific risk is related to the specific asset and can be eliminated if a portfolio is well diversified. The purpose of diversification is therefore to get rid of unsystematic risk and thus only reward investors for carrying systematic risk.

The main conclusion of the CAPM is that a risky asset's expected return should be given by the risk-free rate of return and its risk-premium:

$$E(r) = r_f + \beta[E(r_M) - r_f] \tag{4.4}$$

where $E(r)$ = the expected return of a given asset,

r_f = the risk-free rate of return,

β = the sensitivity of a given asset's returns to market movements and

$E(r_M) - r_f$ = the market's expected excess return above the risk-free asset.

The CAPM states that fairly priced assets should plot along a straight line called the security market line (SML). By rearranging the equation to excess return we obtain the asset's risk

premium. The slope of the line equals the market's risk premium and its intercepts is at the risk-free rate of return:

$$E(r) - r_f = \beta[E(r_M) - r_f] \quad (4.5)$$

4.2.1.1 The Single Index Model

The CAPM is a theoretical model meant to be interpreted ex-ante. Performance evaluation is often done ex-post, based on historical data. The solution is to transform the CAPM into an ex-post testable relationship. Often this is done by a series regression by taking the excess return of individual assets against the excess return on a market index. This is called the single index model and is defined by:

$$r_n - r_{f,n} = \alpha + \beta[r_{M,n} - r_{f,n}] + \varepsilon(n) \quad (4.6)$$

where $r_n - r_{f,n}$ = the excess return above the risk-free rate of a given asset at time n,

α = the intercept of the regression line,

β = the slope of the regression line for a given asset,

$r_{M,n} - r_{f,n}$ = the market's excess return above the risk-free rate at time n and

$\varepsilon(n)$ = the unexpected firm-specific return for a given asset at time n.

r_n and $r_{M,n}$ are the observed returns of a given asset and the market index proxy at time n, respectively. Given market efficiency and that the CAPM holds, α should not be statistically different from zero, and $\varepsilon(n)$ is expected to have a mean of zero.

Hedge fund managers follow different strategies and styles. It can therefore be argued that single-factor models are not sufficient to explain hedge fund returns. More than one systematic risk factor needs to be explained.

4.2.2 The Arbitrage Pricing Theory (APT)

The arbitrage pricing theory was developed Stephen Ross in 1976. It is less restrictive in its assumption than the CAPM. In the APT, the price of an asset is driven by many factors. It

specifies the returns as linear function of many factors. These are both micro and macro factors. The model can be defined as:

$$E(r) = r_f + \sum_{k=1}^{K} \beta_{i,k} F_k \qquad (4.7)$$

Where K is the number of factors and F is the risk-premium associated with each factor. It is up to each investor to identify the factors affecting an asset, as well as the factors risk premium and the sensitivity of the asset to these factors.

5.0 Risk Adjusted Performance Measures

Investors are considered to be risk averse and need to be compensated for the exposure of risk. Risk adjusted performance measures facilitate the comparison of return related to different levels of risk. A relative performance measure is when an asset is evaluated against a benchmark index. When no benchmark index is used it is called an absolute performance measure. A number of different risk adjusted performance measures has been developed, and it can be a challenge to identify the most appropriate measure.

5.1 Traditional Performance Measures

In the following sections we will present three traditional risk-adjusted performance measures. This is the Sharpe ratio, the Treynor ratio and Jensen's alpha.

5.1.1 The Sharpe Ratio

Nobel price winner William F. Sharpe's (1934 -) work on mutual fund performance is an essential contribution to portfolio performance evaluation. In addition to being one of the originators of the Capital Asset Pricing Model, he developed one of the most commonly used performance measures; the Sharpe ratio, as presented in equation 4.2.

As in mean-variance theory, the Sharpe ratio is based upon the assumptions that returns are normally distributed and/or quadratic utility functions. The Sharpe ratio is an absolute performance measure where no benchmark index is needed. It measures the reward-to-variability; the excess return per unit of risk. The higher Sharpe ratio, the better is the investment.

5.1.2 The Treynor Ratio

The Treynor ratio is a reward-to-risk ratio similar to the Sharpe ratio. The most important difference is that the Treynor ratio focuses only on systematic risk instead of total risk. It is also a relative performance measure, with a proxy of the market as a benchmark. The ratio is named after Jack L. Treynor and is defined as:

$$Treynor\,ratio = \frac{\bar{r} - r_f}{\beta} \tag{5.1}$$

High values of the ratio indicate greater return per unit of market risk and are hence always desirable.

5.1.3 Jensen's Alpha

Jensen's alpha is a relative performance measure named after Harvard professor Michael Jensen. It is based on the CAPM, and is a measure of how much a manager's forecasting ability contributes to the returns of the fund. The alpha is the difference between the realized return and the return predicted by the CAPM. It is defined as:

Jensen's alpha $\alpha = \bar{r} - \left[r_f + \beta(r_M - r_f)\right]$ (5.2)

The CAPM states that only market risk should be rewarded and the alpha should be zero. If this is not the case, the alpha can be interpreted as an indicator of superior performance when it is positive or poor performance when it is negative. If choosing between several funds with identical systematic risk, the fund with the highest alpha should be selected.

5.2 Criticism of Traditional Performance Measures

A shortcoming of the traditional performance measures is that they are based upon the mean-variance theory. Hedge funds typically are not normally distributed, and therefore all aspects of risk are not captured. If the distribution is skewed or have an excess kurtosis which deviates from zero, the traditional performance measures may lead to wrong conclusions. Gregoriou and Gueyie (2003) show that the Sharpe ratio often overestimates the hedge fund performance because of this. Scott and Horvath (1980) also show that under relative weak assumptions investors like positive skewness and dislike positive excess kurtosis. Another drawback with traditional performance measures is that they do not take into account that investors distinguish between upside and downside risk. Investors are often more unpleased with a loss than they are pleased with a gain of equal size. This gives reason for a heavier weighted downside deviation when measuring performance of an asset.

The relative performance measures suffer from further difficulties. One is that beta is used as the only measure of systematic risk. According to Lhabitant (2006) are hedge funds exposed to many factors such as volatility risk, default risk and liquidity risk. The risk factors also vary among the strategies. This complicates the task of finding a suitable benchmark. Relative

performance measures further assume risk factors to be linear. Another faulty is that if the Treynor ratio is used on a beta-neutral hedge fund, it would have a ratio moving towards infinity (Sharma (2004)).

In view of these remarks we therefore choose not to use Jensen's alpha or the Treynor ratio when evaluating hedge fund performance. The only traditional measure we will use is the Sharpe ratio.

5.3 Innovative Performance Measures

Because of the limitations in traditional performance measures, innovative measures have been developed. Several researchers have tried to take into account the fact that standard deviation penalizes upside and downside deviation equally. There have also been developed measures which accounts for higher moments, as well as autocorrelation in return series. We will present some of these pioneering performance measures in this chapter.

5.3.1 Modified Sharpe Ratio

The non-normal returns of hedge funds might cause problems using the traditional Sharpe ratio to evaluate risk-adjusted performance. Gregoriou and Gueyie (2003) therefore developed the modified Sharpe ratio, which is an improvement of the traditional Sharpe ratio. The standard deviation in the traditional Sharpe ratio is replaced with the modified Value-at-Risk (MVaR) developed by Favre and Galeano (2002). In addition to expected return and standard deviation, it takes into consideration skewness and excess kurtosis. Modified Sharpe is defined as:

$$\text{Modified Sharpe ratio} = \frac{\bar{r} - r_f}{MVaR} \tag{5.3}$$

MVaR is based on the Cornish-Fisher expansion (1937) and is defined as:

$$MVaR = E(r) - \left[z_c + \frac{1}{6}\left(z_c^2 - 1\right)S + \frac{1}{24}\left(z_c^3 - 3z_c\right)K - \frac{1}{36}\left(2z_c^3 - 5z_c\right)S^2 \right] \times \sigma \tag{5.4}$$

where E(r) = a given asset's asset expected return, mean.

z_c = critical value for probability (1- α), -1.96 for 95% probability

S = skewness

K = excess kurtosis

σ = a given asset's standard deviation.

Gregoriou and Gueyie (2003) ranked thirty funds of hedge funds according to the Sharpe and modified Sharpe ratio, and the results indicate that the modified Sharpe ratio is lower and more precise when non-normal returns are examined.

5.3.2 Autocorrelation-Adjusted Sharpe Ratio

Lo (2002) documents that positive autocorrelation in hedge fund returns can overstate the Sharpe ratio by as much as 65 percent. When serial correlation is taken into account, the rankings of hedge funds based on the Sharpe ratio can change substantially. He therefore suggests using an autocorrelation-adjusted Sharpe ratio SR(q), which is the defined in the following way:

$$SR(q) = \eta(q)SR \tag{5.5}$$

$$\text{with } \eta(q) = \frac{q}{\sqrt{q + 2\sum_{k=1}^{q-1}(q-k)\,p_k}} \tag{5.6}$$

where SR = the regular monthly Sharpe ratio,

p_k = the k^{th} autocorrelation for hedge fund returns and

$\eta(q)SR$ = the annualized autocorrelation adjusted Sharpe ratio with $q = 12$.

When returns are independently and identically distributed, the annualized Sharpe ratio is calculated by multiplying the monthly Sharpe ratio with the square root of 12 (months). If the return distribution exhibits positive autocorrelation; $\eta(q)$ is less than $\sqrt{q}$. This may overstate the regular Sharpe ratio as compared to the true (autocorrelation-adjusted) Sharpe ratio. In a study of a database provided by Zurich Capital Market, Liang (2003) found that the autocorrelation of hedge the fund returns can have different impacts on the Sharpe ratio.

5.3.3 The Sortino Ratio

The Sortino ratio was developed by Frank Sortino, the director of the pension research institute in San Francisco. The Sortino ratio is a modification of the Sharpe ratio by accounting for asymmetry of the distribution. Instead of focusing on the total risk, it only penalizes for downside risk. It is given by:

$$\text{The Sortino ratio} = \frac{\bar{r} - MAR}{DD} \tag{5.7}$$

The downside deviation equals:

$$DD = \sqrt{\frac{1}{N}\sum_{n=1}^{N}(r_n - MAR)^2} \text{ , with } (r_n - MAR) \text{ if } r_n < MAR \text{, and 0 otherwise.} \tag{5.8}$$

where r_n = the return of a given asset at time n

MAR = the minimum acceptable return (or target rate), and

DD = the downside deviation of a given asset.

MAR is usually set to zero, the risk-free rate or the average return. When the target rate is set to the average historical return, it is called semi-deviation or semi-variance.

5.3.4 Omega

Omega is a performance measurement introduced by Keating and Shadwick (2002). All features of the risk and return of an asset are incorporated into this measure. It partitions return into loss and gain above and below a threshold, and considers the probability weighted ratio above and below the partitioning.

The Omega function is defined in continuous time as:

$$\Omega(L) = \frac{\int_{L}^{b}[1 - F(r)]dr}{\int_{a}^{L}F(r)dr} \tag{5.9}$$

where (a,b) = the interval of returns,

F(r) = the cumulative return distribution and

L = the threshold return.

The threshold depends on individual preferences. The expected gain is the amount by which it exceeds the threshold, and the expected loss is the amount by which it falls below the threshold. The function is decreasing from (a, b) to $(0, \infty)$ and has a mean value of 1. According to Keating and Shadwick (2002) this function can in a mathematical precise sense be viewed as a return distribution itself, since it is not just trying to approximate it as some other performance measurements. No assumptions about risk preferences or utility are needed to use Omega, although one can apply any. Only a simple decision rule that more is preferred than less is needed. Assets are ranked depending on their intervals of return and the Omega accounts for the effect of all moments. The slope of the Omega function tells us about the probability of extreme values; the steeper it is, the less is the probability of extreme values.

De Souza and Gockan (2004) present the Omega formula in a discrete case:

$$\Omega(L) = \frac{\sum_{a}^{b} Max(0, r_n^+)}{\sum_{a}^{b} Max(0, \left| r_n^- \right|)} \qquad (5.10)$$

where r_n^+ (r_n^-) equals the return above (below) the threshold L at time n.

The highest Omega is preferred. The Omega measure tends to supply a different ranking of funds than the traditional performance measures, such as the Sharpe ratio, when there is a significant presence of higher moments. When there is little significance of higher moments, the ranking are to be rather similar.

5.3.5 Kappa

Kaplan and Knowles presented Kappa, a generalized downside risk-adjusted performance measure, in 2004. The term “generalized” means that Kappa can become any risk-adjusted return measure through a single parameter. Kappa is defined as:

$$K_n(\tau) = \frac{\bar{r} - \tau}{\sqrt[n]{LPM_n(\tau)}} \tag{5.11}$$

where $\bar{r}$ = the average periodic return,

τ = the investor's minimum acceptable or threshold return, and

$LPM_n(\tau)$ = the n^{th} lower partial moment with respect to the threshold τ.

The n^{th} lower partial moment can be defined in two ways; using a parameter based calculation or discrete data. A parameter-based calculation involves deriving a continuous return distribution from the values of the first four moments and is defined as:

$$LPM_m(\tau) = \int_{-\infty}^{\tau} (\tau - r)^m \, dF(r) \tag{5.12}$$

A discrete calculation is defined as:

$$LPM_m(\tau) = \frac{1}{N} \sum_{n=1}^{N} \max(\tau - r_n, 0)^m \tag{5.13}$$

where N = the sample size and

r_n = the return observation at time n.

K_n is defined for any value of n exceeding zero. It is obvious that Omega is equal to K_1+1 and the Sortino ratio to K_2.

6.0 Hedge Funds

In this chapter we will present some common characteristics of hedge funds. We will also describe the different hedge fund strategies which will be analyzed in this thesis.

6.1 Hedge Fund Characteristics

There is no precise legal definition of hedge funds. There are several contradictory definitions based on legal structures, superior returns, risk taking or hedging, and more. Nevertheless, hedge funds share some common characteristics that make it possible to distinguish them from traditional investment funds.

- **Absolute Returns**

An often used description of hedge funds is that their managers target absolute returns. According to Hedges (2004), most of the returns of hedge funds are derived from manager skills rather than the returns of an asset class. The managers' objective is to be profitable regardless of the situation in the stock and bond market.

- **Active Management**

The performance of hedge funds normally results from active management decisions together with the skills of the fund's managers. The managers reject traditional theories such as the efficient market hypothesis and modern portfolio theory. They believe that not all assets are priced correctly, and therefore pursue strategies to take advantage of this.

- **Performance Fees**

Hedge funds have more complex fee structures as compared to traditional funds. *Management fees* are basically imposed to meet operating expenses. They are usually a percentage of assets under management, and the size of them range from 1 to 3% per year. *Incentive fees* have the purpose of encouraging managers to achieve the highest returns possible, and usually range from 15 to 25% of the annual realized performance. Many hedge funds include a *hurdle rate* and/or a *high-water mark* clause in order to avoid agency problems and excessive risk taking. The hurdle rate gives a minimum performance the manager must accomplish before he can charge a performance fee. The high-water mark states that previous losses have to be regained by new profits before the incentive fee can be charged.

According to Lhabitant (2006), many hedge funds also include a *proportional adjustment clause.* If some investors withdraw their assets, the manager can reduce proportionally the high-water mark by the percentage of the removed assets. Some funds also have a *clawback clause* and a *loss recovery account.* The clawback clause specifies that a part of the incentive fee will be retained every year, generally until the account reaches a given percentage of the assets. If performance is negative, the clawback account will be debited to the clients' credit at the rate of the incentive fee. The clients can recover a share of their losses with portions of previous paid incentive fees. If the negative performance exceeds the clawback account, future incentive fees will be credited to a loss recovery account. The manager will not earn any incentive fee until it is reduced to zero.

- **Investment Strategies**

Hedge funds have flexible investment policies. This permit the managers to adapt to market conditions and thereby pursue profits or control risk The managers can combine long and short positions, concentrate rather than diversify, borrow and leverage their portfolios, invest in illiquid assets, trade derivatives and hold unlisted securities. If the market is unfavourable, the managers can move into cash, hedge against declines, or attempt to earn profits by short sale. They can also switch strategies or markets if they observe better opportunities.

- **Liquidity**

Traditional funds offer daily subscription and redemption. This is appreciated by investors, but does not come without a cost. The funds have to keep a small pool of cash as a liquidity buffer. This tends to lower the overall performance, since return of cash normally is lower than on other investments. Some investment opportunities are in addition illiquid and hard to sell, and hence not compatible with high liquidity. Most hedge funds therefore limit the subscription and redemption possibilities, and demand a minimum investment period. This is particularly funds investing in illiquid markets and securities. Subscription to close-end funds is only possible during their initial issuing period, while open-end funds offer subscription on a regular basis. The restrictions have a positive impact on a hedge fund's performance, as managers can focus on investing rather than on redeeming assets of investors. They can focus on longer time horizons, hold illiquid positions and reduce cash holdings.

6.2 Hedge Fund Strategies

There are thousand of different hedge funds, and it is difficult to classify them into a limited number of categories. Hedge funds are not a homogeneous group; some funds fit into more than one category, and some funds fit in none. This is partly due to the risk and return characteristics which differ among the hedge funds. There are several different data providers which track thousands of hedge funds. They classify differently regarding number and type of strategies, but they have the most fundamental categories in common. In the following sections we will present the strategies analyzed in this thesis.

6.2.1 Long/Short Equity

This strategy is also called *equity hedge*. The funds combine long positions of equities with short sales with the purpose of reducing market risk. The portfolios can be anywhere between net long and net short depending on market conditions. Normally the managers increase long exposure in bull markets, and decrease it or are net short in bear markets. The short position is used to hedge against a decline in the stock market and to generate an ongoing positive return. The funds earn profits when long positions appreciate and stocks sold short depreciate, and loose otherwise. In bull markets, the source of return is similar to that of traditional stock pickers. The difference is in bear markets, when the funds use short sale and hedging in order to outperform the market.

6.2.2 Dedicated Short Bias

The managers of dedicated short bias funds take more short positions than long positions. The funds earn returns by maintaining net short exposure in long and short equities. Short sale involves searching for overvalued companies, borrow their shares, and sell them short. The managers expect the price to decline so they can buy the shares back at a lower price and return them to the lender. The difference in price is the profit. If the stock price increases, the repurchase price will be higher than the original selling price, and they will make a loss.

An advantage of dedicated short selling is that the opportunities is unexploited, as most traditional asset managers primarily seek long term buy and hold opportunities. However, there are also dangers involved. Stocks tend to appreciate over time and reward investors with a positive risk premium. Short sellers suffer from this natural long-term uptrend. If prices go up, many short sellers have to buy back shares to close their position. The consequence can be

that prices will continue to rise, which leads to more buy-backs and so on. The shorted stock becomes even more overpriced than in the beginning. Dedicated short sale can hence be extremely risky when applied on a stand-alone basis, because the downside potential is theoretically unlimited. As long as the shorted stock price is rising, the short seller is loosing.

6.2.3 Equity Market Neutral

The objective of equity market neutral hedge funds is to construct portfolios without net market exposure. Long and short positions are balanced to remain market neutral at all times. Hence, returns are not affected by market conditions, but only by stock selection. Equity market neutral hedge funds may use a range of strategies. One is arbitrage trading, which can involve trading between futures and common stocks, buying and selling related classes of common stock, or option strategies. According to McCrary (2005), equity market neutral funds are much less linked to financial market uncertainty than funds of common stocks, but despite the name the category is linked to market stock returns.

6.2.4 Event Driven

This strategy is also called *corporate life cycle investing*, and the funds invest in opportunities created by significant transactional events. This is extraordinary corporate transactions such as liquidations, mergers and acquisitions, share buybacks, bankruptcies and reorganisations. The fund managers try to foresee the outcome of a certain transaction and locate the most favourable time to commit capital to this transaction. Some hedge managers use one core strategy while others invest opportunistically across the different types of events. The managers use instruments such as long and short common and preferred stocks, debt securities, warrants, stubs, and options. The performance normally depends on how well the manager forecasts the outcome and times the transactional event.

6.2.5 Distressed Securities

Distressed securities hedge funds focus on investment opportunities in securities of companies in financial distress, default or bankruptcy. The funds are often controversial and viewed as vultures, but they also serve an important role in the restructuring process in distressed firms. Distressed securities trade at large discounts to their intrinsic value, and the fund managers try to profit on the issuer's capability to improve its operation or the success of the bankruptcy process. The strategy is usually long biased, but managers may also take complete long, hedged or complete short positions.

6.2.6 Merger Arbitrage

Merger arbitrage or risk arbitrage normally involves investing in securities of a company which is target of a takeover, merger or other extraordinary corporate transactions after an attempt is announced. The funds purchase stocks of companies being acquired or merged, and sell short stocks of acquiring companies. The typical position includes a long position that can be delivered to close out the short position if the deal is completed, but more complicated positions may also be employed. The profit or loss is the difference between the price of the securities purchased and the realized value when the deal is completed. The success of the strategy normally depends on the proposed merger, tender offer, exchange offer or acquisition being consummated. When a proposal is publicly announced, the value of the securities of the acquiring company is normally greater than of the securities of the target company. Usually the stock of the acquiring company depreciates while the stock of the target company appreciates.

6.2.7 Convertible Arbitrage

Convertible securities such as convertible bonds and convertible preferred stocks or warrants are fixed income instruments that may be converted into equity. Convertible securities are often issued below their fair value, and this creates arbitrage opportunities. In an attempt to benefit from price inefficiencies, convertible arbitrage hedge fund managers buy long positions in convertible securities and hedge a part of the equity risk by selling short the stock. There are several reasons why convertible securities are valued differently from their fair value. According to Lhabitant (2006), pricing of convertible securities is difficult due to the simultaneous presence of interest risk, credit risk, and equity risk, as well as the interaction between these. In addition to this, convertible bonds often have a range of specific features. Issuers of convertible securities are typically young and fast growing with a low debt rating. The market value of the debt is generally closely tied to the market value of the common stock. This is because the company can reliably repay the bonds when it does well.

6.2.8 Emerging Markets

Emerging market hedge funds invest in securities issued by countries or companies of emerging markets. Emerging markets are, according to CS/Tremont, countries which are considered to be in a transitional phase between developing and developed status. This is markets like China, India, Latin America, much of Southeast Asia and parts of Eastern Europe

and Africa. The investments can be in currency, debt, equity or other instruments. The portfolios may be either widely diversified from many countries or focus on a particular country or region. Since there often are no futures or derivatives markets for hedging, the securities are fairly risky. They are usually not hedged, and the funds tend to use little or no leverage. According to McCrary (2005), emerging markets hedge funds have been among the highest-performing, but the funds also have one of the highest volatilities of returns.

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6.2.9 Fixed Income Arbitrage

Fixed income arbitrage hedge funds rely mainly on debt instruments. The funds combine long and short positions with derivative instruments. By doing so they hedge the level of interest rates, credit risks, the rates of one maturity sector versus other maturity sectors, and other factors. The hedges are very effective because interest rates tend to move up and down together. Since they remove much of the day-to-day portfolio risks, arbitrage funds generally have higher leverage than other hedge fund strategies. The funds can take large positions in a foreign currency; thereby hedging away the currency exposure. They can also buy individual issues with considerable interest rate risk and then hedge this away.

6.2.10 Global Macro

Global macro hedge funds have some of the highest return among hedge fund strategies, and have long been the most successful and largest category. The funds can be very different from each other and do not behave in a homogenous way, but according to Lhabitant (2006) most of them have two typical characteristics. The first is the global nature of their strategies. They take leveraged bets across a range of liquid markets in order to profit from anticipated trends, market biases, or expectations about future cyclical or structural changes in specific countries or regions. The second is that their main focus lies on structural macroeconomic imbalances and to discover macroeconomic trends. Most funds only invest once markets have swung furthest away from equilibrium and get out when the imbalance have been corrected.

6.2.11 Managed Futures/Commodity Trading Advisors (CTAs)

According to Lhabitant (2006), “the terms *managed futures, Commodity Trading Advisors* (CTAs) or *trading funds* are now used interchangeably to describe the group of professional money managers that use futures contracts as an investment medium or give advice on trading futures contracts or commodity options”. Managed futures or CTAs primarily invest in listed bond, equity, commodity futures and currency markets. The funds use a significant amount of

leverage as the strategy involves the use of futures contracts. In the 1980s, agricultural and metal futures trading accounted for most of the market activity, and currency and interest rates futures for a small share. Today global markets are dominated by financial futures for currencies, interest rates and stock indices. The term CTA is therefore now a misleading name, as their portfolios have followed the same evolution as the global futures markets and are mainly invested in non-commodity related futures contracts.

6.2.12 Multi-Strategy

Multi-strategy hedge funds allocate capital based on perceived opportunities among a number of hedge fund strategies. Through diversification of capital, the fund managers seek to deliver constantly positive returns in spite of directional movement in equity, interest rate or currency markets. This increased diversification evens the returns and decrease asset-class and single-strategy risks. The strategies used by a multi-strategy hedge fund may be convertible bond arbitrage, equity long/short, statistical arbitrage and merger arbitrage. In addition to achieve improved diversification of the portfolio, managers may use a multi-strategy in order to better use their range of portfolio management skills and philosophies.

6.2.13 Funds of Hedge Funds

Funds of hedge funds invest in other hedge funds. An advantage with this type of fund is that diversification reduces risk. This is particularly an advantage for those who invest limited resources in hedge fund assets. The funds can either invest in funds from a range of strategies, managers, markets and risk factors, or invest in funds following the same strategy. The first method gives the highest risk reduction, as the funds are likely to hold fewer stocks in common. The latter avoids the risk of poor manager performance, while still remaining exposed to an investment style. The major danger with diversification is to overdiversify since each fund already is diversified. Monitoring many funds is also costly and takes time.

Another advantage with funds of funds is the affordability and ease of access. The minimum investment required is often smaller than for regular hedge funds. This makes it possible for smaller investors to afford hedge fund diversification. The conditions for entering and redemption are more flexible than those of the underlying funds. This requires, as explained earlier, a certain level of liquidity, which comes with a cost.

Funds of funds charge several types of fees, with the most common being management fee and performance fees. This extra cost for the investors is the major disadvantage with these funds, because investors have to pay fees in addition to those paid to the funds which are invested in. If the average return of a well and a poorly performing fund is zero, investors still have to pay fee for the well performing fund even though the average return is zero.

7.0 Biases in Hedge Fund Databases

Several factors can affect the quality of the databases. Liang (2003) lists factors that have a positive effect on the quality. The first is that hedge funds which are audited effectively have lower absolute return inconsistency than funds which are not audited. The second factor is that the respect of a transparency principle is a dependable indicator of the quality of the data. Funds of hedge funds seem to report returns more precisely than single hedge funds. Last, there is a significant positive correlation between hedge fund size and auditing; large funds are more often audited than small ones.

Several biases can have important impact on performance measures of hedge fund databases. Lhabitant (2006) claims that there are two main sources of biases in hedge fund databases. The first is how each database is built. Some of these biases are called neutral since they are inbuilt in the data gathering. By using complicated calculations they can be removed, but some will always exist since it is impossible to observe absolutely every hedge fund. The second source is stale hedge fund prices which are being reported directly by the managers. These biases can, in worst case, cause errors that make the data useless. Biases often described in hedge fund literature are survivorship bias, self-selection bias, instant history bias, database/sample selection bias, and infrequent pricing and illiquidity bias.

7.1 Survivorship Bias

Survivorship bias occurs when funds are excluded from databases and performance measures because they no longer exist; when databases only include information from "surviving funds". When a fund is liquidated it is normally due to bad performance or a sequence of large and sudden losses, but there are also other reasons why funds are excluded from databases. The fund can be merged with another fund or stop reporting but remain active. Funds that stop being in a database but still exist are called defunct funds, while funds that exit from a database and stop operating are called dead funds. Well-performing funds that close create a downward bias on measures, while poor-performing funds make an upward bias when excluded from databases. Brooks and Kat (2002) state that around 30 % of newly established hedge funds do not survive the first three years, mainly due to lack of performance. Barry (2002) writes that the occurrence of death among hedge funds is much higher than for traditional mutual funds. Most databases started the data collecting in the middle or end of the 1990s. The hedge funds available today are mainly not the same that

have been available for the last decade and contributed to the successful results. Hence, if disappearance of funds was due to performance reasons and data on those funds were removed from the database, historical returns may be overstated and historical risk understated.

To calculate survivorship bias, we need to calculate the difference between the performance of all funds that existed over a certain period of time and the performance of the funds that are still operating at the end of the period. The difficulty with this method is that the complete sample of hedge funds is not available, so survivorship bias has to be estimated from samples of surviving and dead funds. Most data vendors now include funds that no longer exist in their index calculations and avoid the problem with survivorship bias, but there are some exceptions.

7.2 Self-Selection Bias

Hedge funds are private investment pools and therefore not required to reveal information concerning performance or assets to anyone but their investors. Moreover, it is up to the managers what information is to be provided. As a consequence, the observed hedge funds will not represent a true random sample of the complete population. This creates a bias. since the characteristics and performance of reporting funds may be different from those of the funds which are not reporting.

Funds with good performance which want to attract new investors will have incentives for reporting to databases, while funds with poor performance will not want to report because they will appear bad compared to better performing funds. If reporting funds have better performance than non-reporting funds the databases will have a bias towards the best performing funds. However, there may be other reasons than poor performance to why a fund chooses not to report to a database. Many well-established and well-performing funds do not need or want to report to databases. Reasons for this may be that they have the investors they need, are managing the assets they want, or have reached their target price and thereby see no reason to report. Another reason may be that they are afraid to raise the performance of the database and hence make their individual performance look less differentiated. To summarize, whether the self-reporting bias is positive or negative depends on the circumstances. Since it is difficult to observe the not reporting funds, the impact of the bias cannot be quantified.

7.3 Backfill or Instant History Bias

Géhin (2006) defines instant history bias as "the consequence of adding a hedge fund whose earlier good returns are backfilled between the inception date of the fund and the date on which it enters the database, while bad track records are not backfilled".

Backfill or instant history bias arises when hedge funds are allowed to backfill their historical returns when they join a database. They are entering it with "instant history". The managers are given the opportunity to decide when the fund's track record should be included in the database. According to Barry (2002), the lag that exists in several databases between funds' starting date and the date they enter the database often corresponds to an incubation period of typically 12-18 months which are sponsored by a seed investor. Every manager wants to present best performance possible, and will therefore not report performance information in the incubation period. The manager will request to be included in the database with all of the fund's track record if the performance turns out to be better than for the funds in the database. This will bias the historical performance upwards.

Barry (2002) compared the date each fund was added to the TASS database with the date they started reporting returns. He found that around 80% of all funds backfill at least 6 months of data, around 65% backfill at least 12 months and around half of all funds backfill more than two years. Not all databases allow data to be backfilled, so the exposure of backfill bias varies among data providers. The data will still be distorted since some databases allow it.

7.4 Database/Sample Selection Bias

Database/sample selection bias occurs when a database or sample of funds to analyze is selected. This is because every database is incomplete since most of them only cover funds that meet specific criteria. These are for instance a minimum asset base, an audited track record or some years of existence. These criteria generate a sample selection bias towards particular segments of funds. For instance, some hedge fund strategies like managed futures and funds of hedge funds are excluded from some databases, but not from others.

The criteria of a minimum time of existence creates an upward bias in databases compared to the entire universe of hedge funds since the worst performing funds will never survive long enough to enter the database. These biases are explicit, but there are also implicit selection

biases. One occurs because managers seldom report to all databases, which gives different sample sets and hence different results in the calculations made by the data providers. There are also differences in data selection methods among databases. Some databases let managers input and revise their prices, while others collect data directly from the administrators. The latter method is more reliable, but also more complicated to obtain.

7.5 Infrequent Pricing and Illiquidity Bias

Infrequent pricing and illiquidity bias primarily occurs for hedge funds holding illiquid securities or securities that are complicated to price. These are securities like for instance emerging market bonds, over-the-counter securities and distressed assets. There are small trading volumes and/or unavailability of effectively trading prices daily. The market price is not always available, and determination of fair net asset values becomes subjective and unclear. The last price of the security is often used. This is why this bias also is called stale price bias. In some cases, a price the manager finds reasonable is assigned.

8.0 Data Description

In this chapter we will give a description of the data used in the thesis. We have analyzed hedge fund performance from the databases of CS/Tremont and Hedgenordic. From the CS/Tremont database we analyzed indices, while we analyzed individual Norwegian hedge funds from the Hedgenordic database.

Our empirical part consists of two different time periods. In the first period from January 1998 to February 2008 we only analyze CS/Tremont. The Hedgenordic database has limited information of Norwegian hedge funds previously to 2004. Hence, the second period is from January 2004 to February 2008. For this period we compare individual Norwegian hedge funds with the CS/Tremont indices. We also compare the two periods of CS/Tremont.

As the figures for the funds in the Hedgenordic database were denoted in the local currencies, we have converted the returns into US dollar. This is to make the analysis comparable with the CS/Tremont indices. The various traditional assets are therefore also denoted in US dollars. Hence, our analysis is from a US point of view.

As a proxy for the risk-free rate, we have used the 3-month US Treasury bill. The data is obtained from the US Federal Reserve.

8.1 Credit Suisse/Tremont Hedge Fund Index

The Credit Suisse/Tremont Hedge Fund Index has existed since January 1994 and includes hedge funds from all over the world. The index is constructed using the CS/Tremont database, which tracks more than 4500 funds. The index universe is defined as funds with a minimum of US $50 million asset under management (AUM), a minimum one-year track record, and current audited financial statements. We have downloaded the data from the website of CS/Tremont.

8.1.1 Subcategories

CS/Tremont divides the funds into ten primary subcategories based on their investment style. One of them, event driven, is divided into three subcategories. Funds of hedge funds are not included. The categories are:

- Convertible arbitrage

- Dedicated short bias
- Emerging markets
- Equity market neutral
- Event driven: distressed, multi-strategy and risk arbitrage
- Fixed income arbitrage
- Global macro
- Long/short equity
- Managed futures
- Multi-strategy

8.1.2 Database Construction

According to their web site, the index is the first and largest asset-weighted hedge fund index. As opposed to equal-weighting, this gives a more accurate picture of an investment in the asset class. It is done by analyzing the percentage of assets invested in each subcategory and selecting funds based on those percentages. This matches the shape of the index to the shape of the universe. The index always represents at least 85% of the AUM in each category of the index universe. The current sector weights[1] are presented in figure 4:

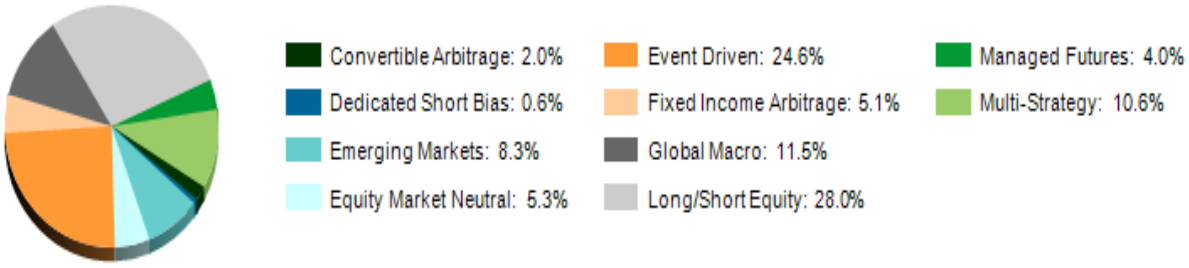

Figure 4: Sector weights of CS/Tremont, April 2008.

The performance data is net of all fees and converted into US dollars. The index is calculated and rebalanced on a monthly basis, while funds are reselected on a quarterly basis.

In order to limit biases in the database, funds that are closed to new investment are included in the index. The historic index data are not adjusted as new funds are added, so new funds will contribute to the index on a going-forward basis only. Corrections to the index will only be made on a going-forward basis. To minimize the effect of survivorship bias, funds in the

[1] April 2008

process of liquidation are not removed. This captures all potential negative performance before a fund stops to operate.

8.2 Nordic Hedge Fund Index

The Nordic Hedge Fund Index is published by Hedgenordic A/S. The index is based on performance reported by hedge fund managers in Sweden, Norway, Finland and Denmark. According to their own assessment, the majority of the Nordic hedge funds are included in the index. It currently consists of 18 Norwegian hedge funds[2] and we have analyzed 9 of them. We have obtained the data by gaining access to the historical data at the website of Hedgenordic.

8.2.1 Subcategories

The individual hedge funds we have analyzed follow four different strategies:

- Long/short equity:
  - ~ Nordic Alpha Plc
  - ~ Sector Maritime Investment
  - ~ Discovery Fund Plc
- Managed futures:
  - ~ Interkraft Energy Fund
- Multi-strategy:
  - ~ WarrenWicklund Diversified Value
  - ~ WarrenWicklund Nordic Hedge I
- Funds of funds:
  - ~ FMG Global Hedge Fund Ltd
  - ~ FMG Bio-Med Hedge Fund Ltd
  - ~ WarrenWicklund Multi-Strategy Fund

In appendix 1 we give a brief description of each fund.

8.2.2 Database Construction

The Nordic Hedge Fund index is asset-weighted. Admission to the index is done continuously. Hedgenordic requires full performance history net of all fees, reported as either

[2] April 2008

monthly return or NAV, in order for funds to be admitted into the index. The fund must also provide the latest annual report and the latest version of the offering Memorandum. New funds will not be included prior to the registration date even if there is a qualified track record.

Hedgenordic declare on their web site that in order to minimize the effect of survivorship bias and more accurately depict the performance of the Nordic hedge fund industry, funds that have been in existence and terminated operations are also entitled for inclusion in the index calculation. Figures for the time period in which a closing fund has been active are also included. Funds that end operations and no longer contribute data to the index will still have their prior performance history maintained.

8.3 Indices for Comparison

We have used different stock, bond and commodity indices for comparison. We will briefly present them in the following sections.

8.3.1 Stock Indices

The stock indices we have used are:

- Morgan Stanley Capital International (MSCI) indices:
  - ~ MSCI World Index. It measures the equity market performance of developed markets. It consists of 23 developed market country indices.
  - ~ MSCI Emerging Markets Index. It measures equity performance of emerging markets. It consists of 25 emerging markets indices.
  - ~ The MSCI Norway Index. We have used this index in the period of January 2004 to February 2008 when we analyzed the Norwegian hedge funds.

  The MSCI indices were gathered at the website of MSCI Barra.
- NASDAQ Composite Index which includes more than 3000 companies. The NASDAQ is an electronic stock exchange. The index measures domestic and international based stocks. The data was obtained from the website of Yahoo! Finance.
- S&P 500 by Standard & Poor's. The index includes the stocks of 500 leading companies in industries of the US economy. The data was acquired from Standard & Poor's' website.

8.3.2 Bond Indices

Bonds are fixed income instruments. Bond indices include government bond, high-yield bonds and corporate bonds among others. For bond indices we chose to use:

- Lehman Global Aggregate Index. It is a measure of the global investment-grade fixed-rate debt markets.
- Lehman US Corporate High-Yield Index. It covers the USD-denominated, non-investment grade, fixed rate, taxable corporate bond market. The index excludes emerging markets debt.

We received the data from the index service of Lehman Brothers.

8.3.3 Commodity Index

For commodities we have used the S&P Goldman Sachs Commodity Index (GSCI). The index is calculated primarily on a world production-weighted basis and contains the main physical commodities in active, liquid futures markets. The data was achieved from the Standard & Poor's index service.

8.4 Description of the Period Analyzed

Three crises have negatively affected the global stock market during the period of January 1998 to February 2008. The first was the Russian crisis in 1998. This crisis was a consequence of the Asian crisis the year before, falling oil prices and the Russian government's covering of budget deficit by short term loans with high interest rate. The second crisis was when the dot com bubble burst in 2000. NASDAQ was highly affected by the rise and fall of the information technology companies, but also the rest of the world's stock markets experienced a decline. The third crisis was the decline because of the September 11th terrorist attack. The stock market has recently been facing a new recession, partly because of the decline in the US economy.

To illustrate how the market has developed, figure 5 shows the growth of $100 for different indices since 1998. Overall, the CS/Tremont is superior to the other indices from the beginning of 2001. This index has also been the most stable, and shows less sensitivity to the crisis than the other indices. NASDAQ deviates from the others, with the peak in March 2000 and the subsequent fall. This is the only index where the $100 is worth less in February 2008. In general, the stock indices reveal high correlation between each other as well as higher variations than the bond indices.

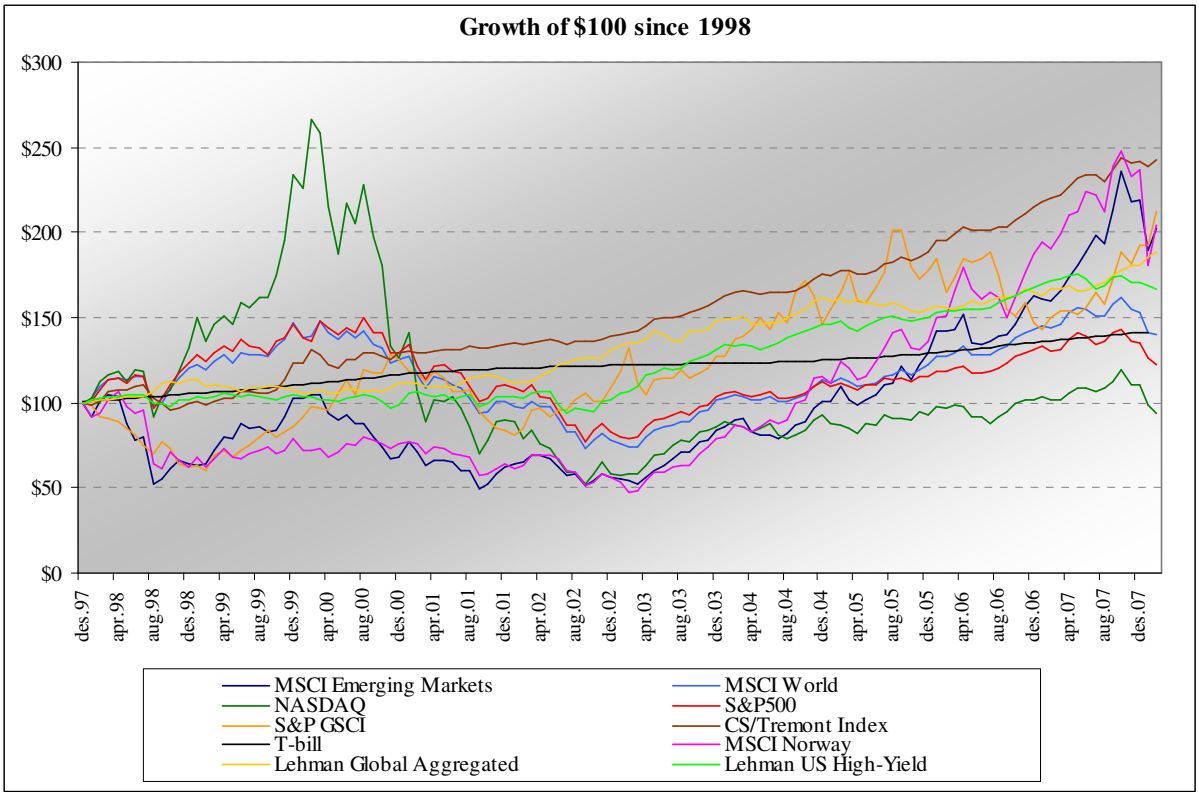

Figure 5: Growth of $100 for the CS/Tremont index, different stock indices and the T-bill. N=122.

9.0 Empirical Results of CS/Tremont (Jan.98- Feb.08)

In this chapter we will start by giving an overview of the development of CS/Tremont Hedge Fund indices during the period from January 1998 to February 2008. We will then present and discuss results from the analysis of CS/Tremont. The findings will be compared with analysis of some general stock, commodity and bond indices.

9.1 An Overview of the Development

Figure 6 shows the development of $100 since January 1998 for the different CS/Tremont strategy indices. Global Macro is the index with the highest return in February 2008, while Dedicated Short Bias has the lowest. The latter is the only index which ends below the starting value. $100 is worth $81 in February 2008, while Global Macro ended on $429. Dedicated Short Bias hedge funds usually perform poorly in long lasting bull periods (Lhabitant (2006)), and we can see from the graph that this index declined in bull periods. The other hedge fund indices show an overall upward trend. However, most of them seem to have been affected by the Russian crisis in 1998. This was at the same time as the successful hedge fund Long Term Capital Management experienced great losses. The fund was bailed out by its major creditors in order to avoid a broader collapse in the financial markets.

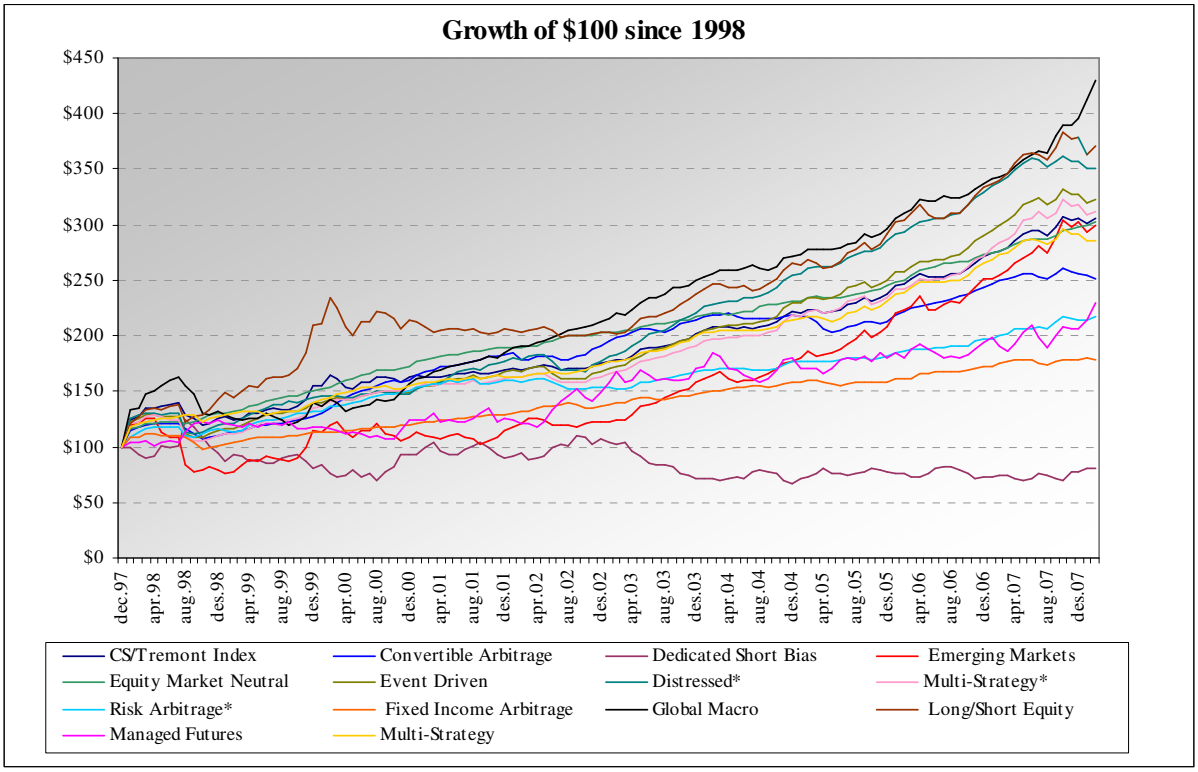

Figure 6: Growth of $100 since 1997 for different CS/Tremont indices. Funds marked with * are subcategories of Event Driven. N=122.

9.2 Summary Statistics

In table 1 we present the summary statistics of CS/Tremont and various stock, commodity and bond indices. We will discuss our major findings in the next sections.

	Summary Statistics Monthly Returns January 1998 – February 2008						
	Mean	**SD**	**Min**	**Max**	**Skewn.**	**Excess Kurt.**	**Jarque-Bera**
Panel A: *CS/Tremont Indices*							
Convertible Arbitrage	0,66	1,41	-4,68	3,57	-1,25	3,03	**78,29***
Dedicated Short Bias	-0,05	5,10	-8,69	22,71	0,97	2,39	**48,06***
Emerging Markets	0,79	4,09	-23,03	15,34	-1,55	9,81	**538,47***
Equity Market Neutral	0,80	0,64	-0,85	2,48	0,32	-0,18	2,26
Event Driven	0,83	1,72	-11,77	3,27	-3,54	23,13	**2974,16***
- Distressed	0,90	1,80	-12,45	3,91	-3,64	24,41	**3299,44***
- Multi-Strategy	0,80	1,89	-11,52	4,66	-2,50	14,7	**1225,99***
- Risk-Arbitrage	0,57	1,29	-6,15	3,81	-1,00	5,68	**184,64***
Fixed Income Arbitrage	0,41	1,11	-6,96	2,05	-3,12	16,77	**1627,57***
Global Macro	0,97	2,44	-11,55	10,16	-0,75	7,43	**291,80***
Long/Short Equity	0,96	3,00	-11,43	13,01	0,21	4,59	**107,83***
Managed Futures	0,72	3,51	-8,62	9,95	0,11	-0,25	0,55
Multi-Strategy	0,73	1,11	-4,76	3,02	-1,17	4,24	**119,16***
CS/Tremont Index	0,75	1,93	-7,55	8,53	-0,03	5,11	**132,94***
Panel B: *Stock Indices*							
MSCI Emerging Markets	1,11	6,94	-29,29	13,55	-0,92	2,06	**39,04***
MSCI World	0,45	4,09	-13,45	8,91	-0,61	0,74	**10,47***
NASDAQ	0,64	8,16	-22,9	21,98	-0,27	0,62	3,47
S&P 500	0,26	4,31	-15,76	9,23	-0,66	1,11	**15,12***
Panel C: *Commodity Index*							
S&P GSCI	1,02	6,39	-14,41	16,89	0,07	-0,37	0,80
Panel D: *Bond Indices*							
Lehman Global	0,53	1,57	-3,66	4,81	0,13	0,17	0,52
Lehman US High-Yield	0,44	2,15	-7,37	7,49	-0,53	2,90	**48,61***

Table 1: Summary statistics of monthly returns in the period from January 1998 to February 2008. Significant numbers are bold at 1%* and 5% level. N=122.

9.2.1 The First Two Moments of the Return Distribution

Hedge funds are known for having mean-variance combination superior to traditional assets. The scatter plot in figure 7 shows the monthly mean-variance characteristics of the various hedge fund indices and traditional assets. The hedge funds do indeed appear attractive since they overall provide a higher return and lower standard deviation. Only MSCI Emerging

Markets and S&P GSCI have a higher mean return, but this is along with a higher standard deviation. Dedicated Short Bias is an exception of the hedge fund indices. It shows a slightly negative return, and the highest monthly standard deviation (5,10%) of the hedge fund indices. As explained earlier, the style of this investment strategy is to identify overvalued companies and sell their shares short. If the strategy fails, it may lead to extreme losses.

When only taking into account mean and volatility, the often advertised mean-variance qualities of hedge funds are supported.

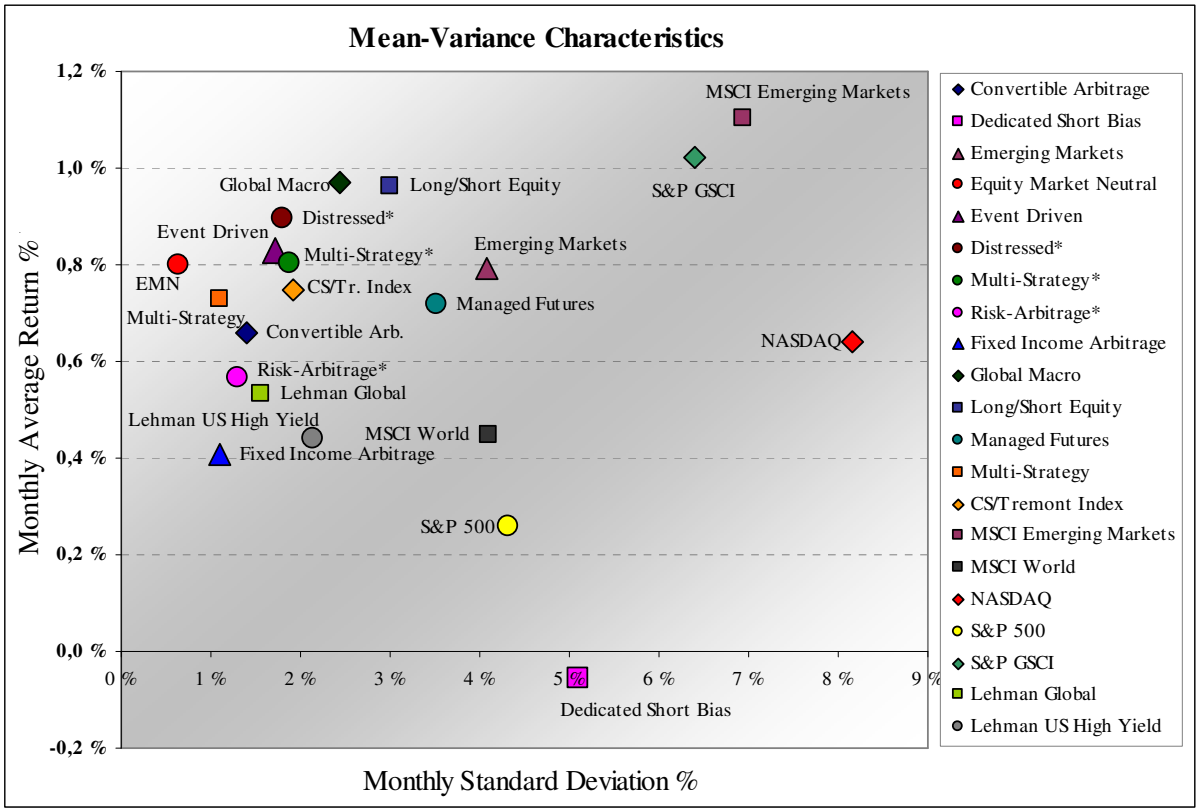

Figure 7: Mean-variance characteristics of the various hedge fund indices. Funds marked with * are subcategories of Event Driven. N=122.

9.2.2 The Third and Fourth Moment of the Return Distribution

Jarque-Bera test is used to see if the returns of the hedge fund strategies are normally distributed. It tests if the distributions have skewness and excess kurtosis close to zero. If the strategies reject the hypothesis of a normal distribution, there should be shown carefulness with rushing conclusions based upon mean-variance characteristics.

All except one of the hedge fund strategies reject the hypothesis of normal distributed returns. The Distressed strategy is the index with the highest value of the Jarque-Bera test. The only strategy which does not reject the test is Managed Futures.

NASDAQ is the only stock index not rejecting the null hypothesis. However, the test values for the stock indices are considerably lower than for the hedge fund indices. The commodity index, GSCI, also shows an approximately normal distribution. Of the bond indices, Lehman US High-Yield is the only one rejecting the hypothesis.

Figure 8 presents the Distressed and Managed Futures' frequency histogram of return. The frequency histogram of Distressed, contrary to Managed Futures, reveals some extreme negative returns as well as more returns centred about the mean. The return distribution of Distressed clearly shows presence of negative skewness and positive excess kurtosis.

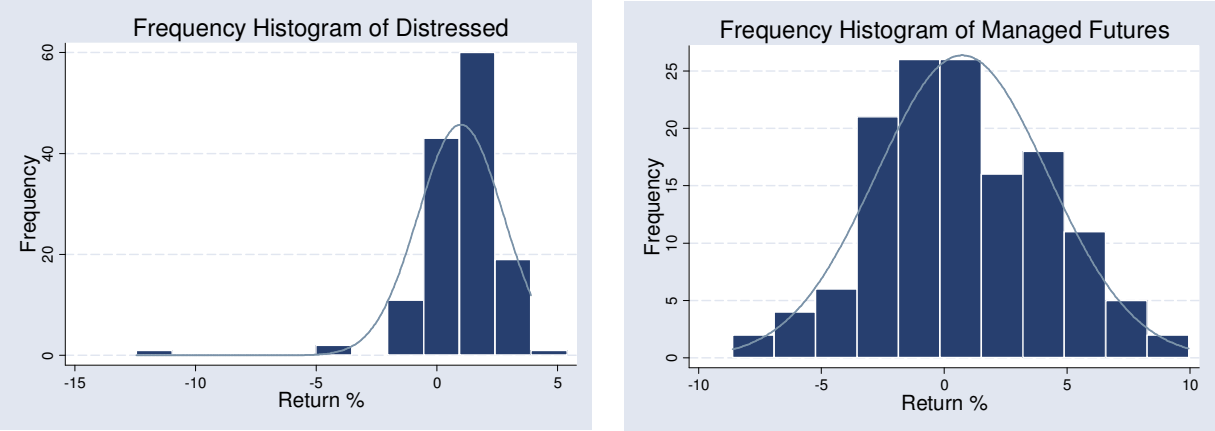

Figure 8: Frequency histograms of returns for Distressed and Managed Futures. N= 122

In figure 9, a scatter plot of skewness and excess kurtosis characteristics is presented. It is noticeable that most of the hedge funds possess a more negative skewness and/or positive excess kurtosis as compared to the equities. This is consistent with earlier research; see for instance Amin and Kat (2003). The Event Driven strategies stand out, in particular the event driven Distressed. It reveals the highest excess kurtosis and most negative skewness of all the indices. Managed Futures and Equity Market Neutral are the only strategies showing a slightly positive skewness and negative excess kurtosis

As mentioned earlier, investors dislike negative skewness and positive excess kurtosis, since it causes a higher probability of extreme losses. It is therefore important not to draw hasty

conclusions only based upon mean and volatility characteristics discussed previously. The image of most of the hedge fund strategies changes when taking into account the often disregarded third and fourth central moments of the return distribution.

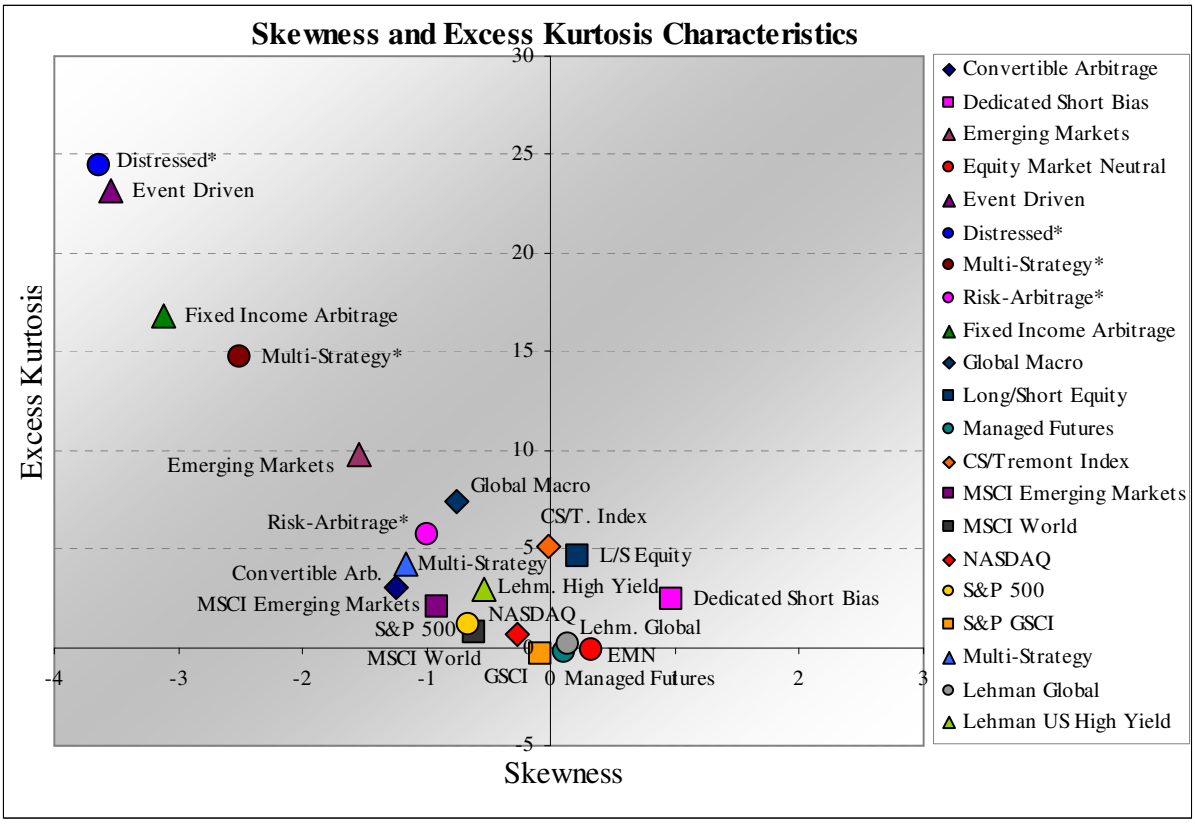

Figure 9: Skewness and excess kurtosis characteristics. Funds marked with * are subcategories of Event Driven. N=122.

9.2.3 Outliers

To see how hedge funds are affected by extreme market conditions, we have compared the returns of the indices with the stock market.

The Russian crisis in 1998 substantially affected the financial market. All of the indices have, with only one exception, their minimum return observation in either August or October 1998. The exception is Managed Futures, which seems unaffected by the Russian crisis. This is most likely due to the different sources of return of Managed Futures as compared to equities. The strategy of Dedicated Short Bias is to profit on market declines, and its maximum observation is in August 1998. Five of the hedge fund indices also have their maximum observations in December 1999, in the period of the dot.com bubble. This is the Credit Suisse

Index, Emerging Markets, the event driven Multi-Strategy, Global Macro and Long/Short Equity.

Observations like those of August and October 1998, as well as December 1999, can be considered outliers since they depart from the pattern of the majority of returns. Outliers highly affect the results of the analysis, but they should not be removed as they represent the behaviour of the hedge fund indices. However, it is interesting to observe how much the results are affected by outliers. When August 1998 is removed from the data sample, excess kurtosis decrease considerably and skewness becomes more positive. Appendix 2 shows the summary statistics of the indices with this month removed. This tells us that hedge funds are affected by macroeconomic events, and it may eliminate some of their diversification benefits.

9.4 Correlation

Hedge funds claim to be independent of general market movements. This may be used by investors for diversification purposes of portfolios. In order to get a better overview of the strength of the relationship between hedge funds and traditional assets, we have calculated the correlation coefficients. They are also calculated within the different hedge fund strategies.

According to Lhabitant (2004), it is important to be careful when using the correlation coefficient as an indicator of the strength of relationship between two variables. One pitfall can be to interpret correlation as a causal relationship. The focus should be on the co-occurrence between the two variables. Correlation also only measures the strength of a linear relationship. Non-linear relationships are not captured. This is important to keep in mind when analyzing indices of hedge funds which have non-linear risk-return payoffs. Another aspect is the presence of outliers, which can bias the results.

The correlation coefficients were calculated using the Spearman's rank correlation. This is because hedge funds usually are not characterized by normal distributions. Spearman's rank correlation is also less sensitive to outliers. Still, Pearson's correlation coefficients were calculated for us to observe the difference (see appendix 3). Overall the Pearson's correlation coefficients showed somewhat higher correlation of hedge funds with equities than when using Spearman.

9.4.1 Correlation of Hedge Fund Indices with Traditional Assets

Several researchers have studied the correlation between hedge funds and other asset classes. Brooks and Kat (2002) find that hedge fund indices' correlation with bonds is low and often negative, with the exception of Macro and Equity Market Neutral. On the contrary, the correlation with stock markets is high, here with the exception of Convertible Arbitrage and Equity Market Neutral.

The correlation between the hedge fund strategies and the traditional assets are shown in table 2, panel A. Overall, we can observe a low to medium correlation between hedge fund indices and equity indices. All hedge fund strategies, except Convertible Arbitrage and Managed Futures, are significantly correlated to MSCI Emerging Market. The Emerging Market index is most positively correlated (0,83). This reflects the nature of this strategy, which is to invest in emerging markets securities like for instance equities. The other strategies show a low to medium correlation with this index.

The Convertible Arbitrage index does not show significant correlation with any of the equity indices. This is probably because this strategy is characterized by less equity market risk. Managed Futures is another strategy which does not show any significant correlation with equities, but as expected a positive correlation with the commodity index S&P GSCI. Along with the Long/Short Equity, it is the only index revealing a significant positive correlation with the commodity index. Several of the strategies are also correlated with NASDAQ, in particular Long/Short Equity (0,70). This point towards investments in stocks of technology companies during this period. Dedicated Short Bias shows a negative correlation with all of the equity indices, making it attractive for investors when the market is declining.

None of the indices reveal correlation with the Lehman Global Aggregated bond index. However, several of the hedge fund indices reveal a low to moderate correlation with the Lehman US High-Yield bond index. Distressed is the index with the highest correlation coefficient (0,56). This possibly reflects some credit exposure. Equity Market Neutral, Global Macro and Managed Futures are the only hedge funds not showing any correlation to this bond index.

	Spearman's Correlation Coefficients January 1998 – February 2008						
	MSCI EM	MSCI World	NASDAQ	S&P 500	S&P GSCI	Leh. Glob Aggr.	Leh. US High-Yield
Panel A: *CS/Tremont Indices*							
Convertible Arbitrage	0,11	0,15	0,14	0,13	0,02	-0,08	**0,33**
Dedicated Short Bias	**-0,65**	**-0,79**	**-0,82**	**-0,79**	-0,05	0,01	**-0,50**
Emerging Markets	**0,83**	**0,66**	**0,54**	**0,56**	0,16	-0,05	**0,41**
Equity Market Neut.	**0,29**	**0,34**	0,16	**0,27**	0,12	0,05	0,07
Event Driven	**0,63**	**0,61**	**0,58**	**0,52**	0,12	-0,05	**0,55**
- Distressed	**0,51**	**0,52**	**0,52**	**0,45**	0,02	-0,09	**0,56**
- Multi-Strategy	**0,64**	**0,60**	**0,54**	**0,52**	0,15	-0,04	**0,49**
- Risk Arbitrage	**0,49**	**0,46**	**0,37**	**0,39**	0,10	0,06	**0,28**
Fixed Income Arb.	**0,19**	0,17	0,13	0,14	0,16	0,13	**0,23**
Global Macro	**0,22**	0,14	0,09	0,08	0,13	0,10	0,11
Long/Short Equity	**0,68**	**0,74**	**0,70**	**0,66**	**0,20**	0,07	**0,42**
Managed Futures	0,09	0,03	-0,04	-0,02	**0,25**	0,30	0,02
Multi-Strategy	**0,42**	**0,50**	**0,37**	**0,39**	0,09	0,11	**0,42**
CS/Tremont Index	**0,64**	**0,64**	**0,57**	**0,54**	0,18	0,05	**0,48**
Panel B: *Traditional Asset Classes*							
MSCI EM.	1						
MSCI World	**0,77**	1					
NASDAQ	**0,66**	**0,83**	1				
S&P 500	**0,69**	**0,95**	**0,86**	1			
S&P GSCI	0,15	0,02	0,02	-0,07	1		
Lehman Global Aggr.	-0,06	-0,01	-0,15	-0,10	0,15	1	
Leh. US High-Yield	**0,41**	**0,43**	**0,42**	**0,43**	-0,02	0,14	1

Table 2: Spearman's correlation coefficients between CS/Tremont hedge fund strategies and traditional assets (panel A) and Spearman's correlation coefficients between traditional assets (panel B). Significance is in bold, and tested with a two-tailed t-test, at a 5% significance level. N=122.

9.4.2 Correlation within Hedge Fund Index Strategies

In table 3, the correlation between the various hedge fund strategy indices is summarized. Managed Futures and Global Macro show little correlation with the other indices. This is noteworthy since these also were of the strategies less correlated with traditional assets. The strategy of Dedicated Short Bias, which was negatively correlated with all equity indices, is also negatively correlated with the other hedge fund strategies.

		Spearman's Correlation Coefficients January 1998 – February 2008													
		a	b	c	d	e	f	G	h	i	j	k	l	M	n
Convertible Arb.	a	1													
Ded. Short Bias	b	**-0,24**	1												
Emerging Markets	c	**0,22**	**-0,57**	1											
Equity Market Neut.	d	**0,34**	**-0,24**	**0,27**	1										
- Event Driven	e	**0,52**	**-0,64**	**0,63**	**0,32**	1									
- Distressed	f	**0,44**	**-0,59**	**0,51**	**0,24**	**0,90**	1								
- Multi-Strategy	g	**0,53**	**-0,59**	**0,66**	**0,33**	**0,93**	**0,71**	1							
Risk Arbitrage	h	**0,41**	**-0,42**	**0,50**	**0,42**	**0,57**	**0,43**	**0,59**	1						
Fixed Income Arb.	I	**0,44**	**-0,20**	**0,28**	**0,29**	**0,46**	**0,41**	**0,45**	**0,29**	1					
Global Macro	j	0,15	-0,14	**0,40**	0,17	**0,28**	0,17	**0,32**	**0,26**	**0,28**	1				
Long/Short Equity	k	**0,24**	**-0,71**	**0,63**	**0,34**	**0,69**	**0,55**	**0,71**	**0,54**	**0,30**	**0,32**	1			
Managed Futures	l	-0,04	-0,09	**0,63**	0,05	0,11	0,11	0,06	0,01	0,09	0,39	0,20	1		
Multi-Strategy	m	**0,56**	**-0,45**	**0,41**	**0,32**	**0,60**	**0,46**	**0,63**	**0,36**	**0,34**	**0,24**	**0,55**	0,15	1	
CS/Tremon Index	n	**0,35**	**-0,60**	**0,71**	**0,29**	**0,77**	**0,62**	**0,80**	**0,54**	**0,42**	**0,59**	**0,88**	**0,27**	**0,62**	1

Table 3: Spearman's correlation coefficients between CS/Tremont hedge fund strategies. Significance of the correlation coefficient is in bold. It is tested with a two-tailed t-test, at a 5% significance level. N=122.

9.4.3 Correlation in Bull and Bear Markets

Caglayan and Edwards (2001) did a research on hedge funds' correlation in bull and bear markets in the period of January 1990 to August 1998. They found a higher positive correlation of hedge funds with stock indices in bear markets. In bull markets the correlation was lower.

We have studied the correlation of hedge fund strategies and traditional assets in bull and bear markets of MSCI World in the period of January 1998 to February 2008. A bull market is defined as when the MSCI World index goes up, and a bear market is defined as when it goes down. Of the period analysed, we have observed 51 bear months and 71 bull months. Figure 10 graphically presents the correlation in bull and bear markets.

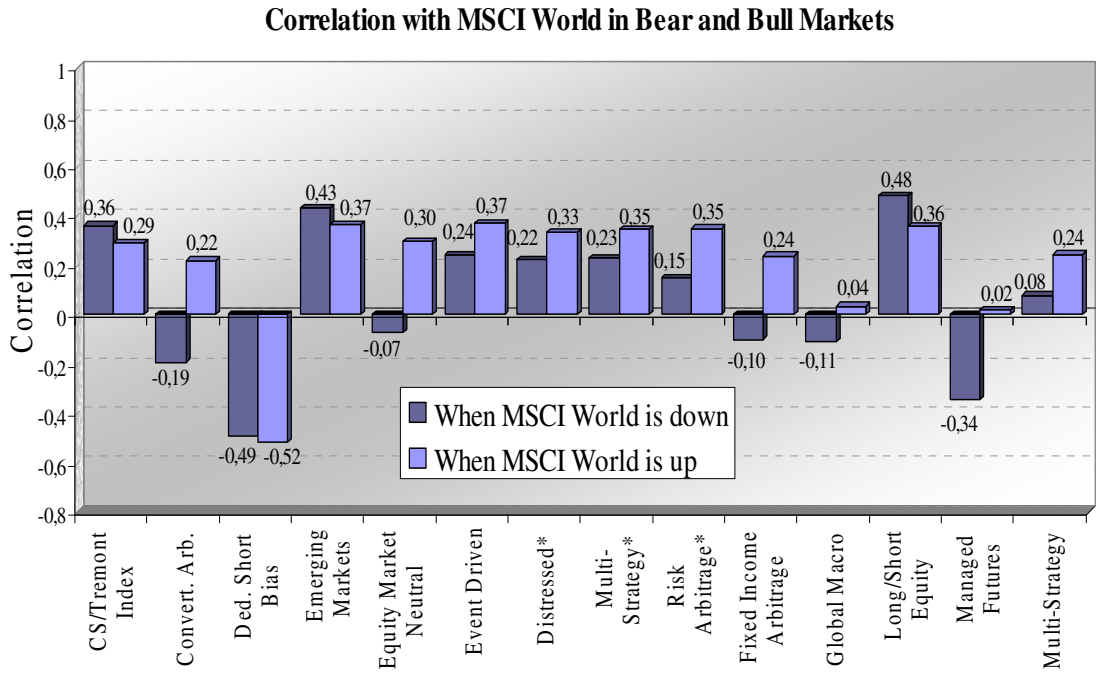

Figure 10: Correlation of CF/Tremont strategy indices with MSCI World in bear and bull markets. Number of bull months is 71, and number of bear months is 51.

By large, the correlation seems to be lower in bear than in bull markets. This is good for investors seeking diversification. The exceptions are Emerging Markets, Long/Short Equity, the CS/Tremont Index and Managed Futures. The latter now reveals a negative correlation in bear markets. Dedicated Short Bias shows an inverse correlation with MSCI World both in bull and bear market. The correlation is somewhat less negative in bear markets.

In appendix 4 a full overview of the correlation between the various indices in bull and bear markets of MSCI World is presented. In bull markets, the strategies in general show significant correlation with MSCI Emerging Markets. In bear markets the amount of hedge funds revealing a significant correlation with equities is more diverse. Managed Futures and Convertible Arbitrage does not show any significant correlation with the traditional indices in bull markets. Managed Futures overall shows a negative correlation with equities in bear markets, and this is also the only time it shows significant correlation with S&P GSCI. In bear markets, nearly all of the hedge fund indices are correlated with Lehman Global US High-Yield. Global Macro is the only index not showing any significant correlation with the indices.

Pearson's correlation in appendix 5 shows, opposite of what found using Spearman, an overall higher correlation with stocks in bear than bull markets. With the other asset classes, the correlation in bull and bear does not differ considerably.

As a comparison, the correlation of traditional indices with MSCI World is shown in figure 11. The correlation with stocks is high as compared to the different hedge fund strategy indices. The correlation coefficients of S&P GSCI and Lehman Global Aggregated, on the other hand, are not significant. Lehman US High-Yield only shows significant correlation in bear markets.

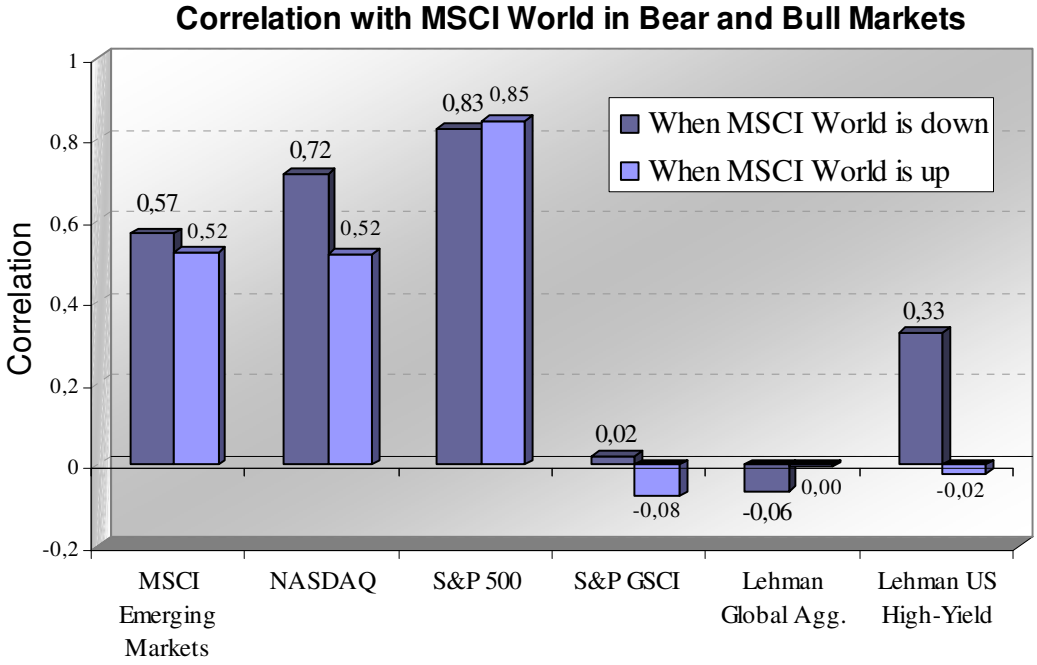

Figure 11: Correlation of traditional assets with MSCI World in bear and bull market. Number of bull months is 71, and number of bear months is 51.

9.4.4 A Summary of Correlation

Hedge funds claim not to be effected by market movements. According to our observations this is not the case for most of the indices. This is consistent with the result of Brooks and Kat (2002). They point out that the situation perhaps would be different if only individual funds were considered. However, investors usually invest in a basket of funds. On the contrary to research done by Caglayan and Edwards (2001), our observations tell us that the correlation with equities is higher in bull and lower in bear markets for most strategies. This diverging

result may be due to the different periods analysed. The methodology used to measure the correlation is another possible cause.

9.5 Performance Measurements

In table 4 we have used the various performance measures presented in chapter 5, in order to rank the hedge fund and traditional indices. It is also done to see if the rankings will differ among the performance measures.

The table shows that the various measures provide different ranking. Still, it is notable that the best and worsted ranked indices are the same, regardless of which performance measure used. Overall, the performance measures rank hedge funds higher than the traditional assets. The exception is Dedicated Short Bias, which has the poorest ranking among both hedge funds and traditional assets. On the contrary, Equity Market Neutral is ranked superior to all of the other indices, regardless of the measure applied.

It is noteworthy that the Lehman Global Aggregated bond index improves its ranking considerably when a threshold of $\tau=0$ is used in the performance measures of Omega, Sortino and $Kappa_3$. It is then ranked better than several of the hedge fund indices. This bond index has relatively few observations below zero, but the amount over the threshold of the risk-free rate is also low. Hence, the frequency of returns over the threshold increases when lowering it to zero. The ranking of these measures can therefore change significantly, depending on the given threshold and the characteristics of the return distribution. The probability of return over the risk free rate of return (T-Bill) is thus higher among hedge funds than the bond-indices. This is also likely due to the higher volatility and extreme values among hedge funds.

	Annualized Performance Measurements January 1998 – February 2008								
	Sharpe Ratio	**Mod. SR**	**AR Adj. SR**	**Omega**		**Sortino**		**Kappa$_3$**	
				τ=0	**τ=rf**	**τ=0**	**τ=rf**	**τ=0**	**τ=rf**
Panel A: *CS/Tremont Indices*									
Convertible Arb.	0,92 *7*	0,31 *6*	0,66 *9*	2,24 *9*	2,04 *7*	1,49 *8*	1,34 *8*	0,94 *4*	0,86 *4*
Ded. Short Bias	-0,23 *21*	-0,15 *21*	-0,21 *21*	0,83 *21*	0,84 *21*	-0,36 *21*	-0,34 *21*	-0,29 *21*	-0,28 *21*
Emerging Markets	0,43 *12*	0,13 *15*	0,36 *15*	1,46 *16*	1,42 *12*	0,60 *16*	0,58 *14*	0,35 *17*	0,34 *15*
Equity Market Neut	2,78 *1*	0,92 *1*	2,21 *1*	24,29 *1*	10,06 *1*	18,00 *1*	10,08 *1*	9,70 *1*	6,06 *1*
Event Driven	1,10 *4*	0,28 *9*	0,88 *4*	2,89 *4*	2,54 *4*	1,53 *7*	1,43 *5*	0,78 *9*	0,75 *8*
- Distressed	1,18 *3*	0,30 *8*	0,95 *3*	3,33 *3*	2,72 *3*	1,72 *4*	1,55 *3*	0,85 *8*	0,80 *7*
- Multi-Strategy	0,93 *6*	0,26 *10*	0,75 *7*	2,54 *5*	2,35 *5*	1,38 *10*	1,35 *7*	0,74 *10*	0,73 *9*
- Risk Arbitrage	0,76 *10*	0,47 *2*	0,62 *10*	2,20 *10*	1,88 *10*	1,31 *11*	1,16 *10*	0,73 *11*	0,68 *10*
Fixed Income Arb	0,39 *16*	0,11 *16*	0,30 *16*	1,53 *13*	1,40 *13*	0,52 *18*	0,47 *16*	0,29 *18*	0,27 *16*
Global Macro	0,97 *5*	0,31 *5*	0,81 *5*	2,49 *6*	2,27 *6*	1,60 *5*	1,48 *4*	0,92 *5*	0,88 *3*
Long/Short Equity	0,79 *9*	0,32 *4*	0,70 *8*	2,09 *11*	1,93 *9*	1,45 *9*	1,34 *9*	0,88 *7*	0,84 *6*
Managed Futures	0,43 *13*	0,20 *12*	0,39 *13*	1,40 *17*	1,36 *15*	0,74 *15*	0,69 *12*	0,55 *14*	0,53 *12*
Multi-Strategy	1,40 *2*	0,43 *3*	1,19 *2*	3,73 *2*	2,91 *2*	2,65 *2*	2,28 *2*	1,49 *3*	1,35 *2*
CS/Tremont Index	0,83 *8*	0,31 *7*	0,76 *6*	2,30 *8*	2,01 *8*	1,53 *6*	1,36 *6*	0,91 *6*	0,84 *5*
Panel B: *Stock Indices*									
MSCI Emerg. Mark	0,41 *14*	0,16 *14*	0,38 *14*	1,51 *14*	1,36 *14*	0,79 *14*	0,57 *15*	0,53 *15*	0,39 *14*
MSCI World	0,14 *19*	0,06 *19*	0,13 *19*	1,32 *18*	1,11 *19*	0,54 *17*	0,19 *19*	0,38 *16*	0,13 *19*
NASDAQ	0,15 *18*	0,07 *18*	0,14 *18*	1,23 *19*	1,12 *18*	0,39 *19*	0,21 *18*	0,28 *19*	0,15 *18*
S&P500	-0,02 *20*	-0,01 *20*	-0,02 *20*	1,17 *20*	0,99 *20*	0,29 *20*	-0,03 *20*	0,20 *20*	-0,02 *20*
Panel C: *Commodity Index*									
S&P GSCI	0,40 *15*	0,19 *13*	0,39 *12*	1,48 *15*	1,33 *16*	0,92 *13*	0,63 *13*	0,70 *13*	0,49 *13*
Panel D: *Bond Indices*									
Lehman Glob. Agg.	0,55 *11*	0,25 *11*	0,49 *11*	2,38 *7*	1,48 *11*	2,30 *3*	0,91 *11*	1,64 *2*	0,68 *11*
Lehman US High-Y	0,25 *17*	0,10 *17*	0,23 *17*	1,74 *12*	1,22 *17*	1,07 *12*	0,35 *17*	0,71 *12*	0,24 *17*

Table 4: Annualized performance measurement for CS/Tremont indices and various indices. Omega, Kappa$_3$ and Sortino is calculated for two different thresholds (τ); zero and risk-free rate of return (T-bill). The ranking of each fund is marked in red. N = 122.

9.5.1 Rank Correlation

Table 5 presents the rank correlation among the performance measures we have used. It tells us that the ranking do not differ considerably. The measure showing a somewhat lower correlation is Kappa$_3$ when the threshold is zero.

		Spearman's Rank correlation January 1998 - February 2008								
		A	b	c	d	e	f	g	h	i
Sharpe Ratio	a	**1**								
Modified Sharpe ratio	b	**0,888**	**1**							
AR-adjusted Sharpe ratio	c	**0,982**	**0,901**	**1**						
Omega t=0	d	**0,939**	**0,817**	**0,938**	**1**					
Omega t=rf	e	**0,990**	**0,868**	**0,966**	**0,953**	**1**				
Sortino t=0	f	**0,900**	**0,844**	**0,918**	**0,938**	**0,879**	**1**			
Sortino t=rf	g	**0,988**	**0,904**	**0,995**	**0,932**	**0,970**	**0,917**	**1**		
$Kappa_3$ t=0	h	**0,847**	**0,855**	**0,861**	**0,875**	**0,823**	**0,970**	**0,866**	**1**	
$Kappa_3$ t=rf	i	**0,944**	**0,945**	**0,953**	**0,871**	**0,922**	**0,903**	**0,962**	**0,909**	**1**

Table 5: Spearman's rank correlation for the various performance measures in the period January 1998 to February 2008. Significance of the correlation coefficient is in bold. It is tested with a two-tailed t-test, at a 5% significance level. N=122.

Several researchers, for instance Brooks and Kat (2002) and Sharma (2004), point out that the Sharpe ratio is not an adequate risk-adjusted performance measure when evaluating hedge fund returns. When ranking the funds, we would therefore expect the Sharpe ratio to be less correlated with ranking of the alternative measures. Eling and Schumacher (2005, 2007) analyzed the correlation between the ranking of individual funds (2007) and of hedge fund indices (2005) using various performance measures. They found a high correlation between the rankings of the performance measures. This is coherent with our observations, and may indicate that the choice of performance measure is less critical than believed by many when ranking hedge funds.

9.6 Autocorrelation

Several researchers like Kat and Lu (2002) and Okunev and White (2003) have revealed significant serial correlations in returns of hedge funds, then mainly first order autocorrelation. We therefore chose to test for first order autocorrelation in the return series. A Ljung-Box test of third order serial correlation was also performed. Table 6 presents the first order autocorrelation coefficients as well as the Ljung-Box Q(3) statistics for the hedge fund indices and the traditional assets.

CS/Tremont Indices	AR(1)	Q(3)
Convertible Arbitrage	**0,51***	**33,29***
Dedicated Short Bias	0,12	2,46
Emerging Markets	**0,23**	**8,42**
Equity Market Neutral	**0,32***	**13,86***
Event Driven	**0,30***	**11,52***
- Distressed	**0,28***	**9,37**
- Multi-Strategy	**0,29***	**10,77**
- Risk-Arbitrage	**0,27***	**13,01***
Fixed Income Arbitrage	**0,36***	**27,97***
Global Macro	**0,24***	7,66
Long/Short Equity	0,13	2,62
Managed Futures	0,12	5,54
Multi-Strategy	**0,21***	6,77
CS/Tremont Index	0,11	2,19

Table 6 a)

Traditional Assets Classes	AR(1)	Q(3)
Panel A: *Stock Indices*		
MSCI Emerging Markets	0,09	1,20
MSCI World	0,10	3,27
NASDAQ	0,05	0,36
S&P 500	0,03	1,69
Panel B*: Commodity Index*		
S&P GSCI	0,03	6,12
Panel C: *Bond Indices*		
Lehman Global Aggreg.	0,14	**8,22**
Lehman US High Yield	0,15	4,95

Table 6 b)

Table 6 a) and 6 b): Test of autocorrelation in the return series of the CS/Tremont indices (6 a)) and the various traditional assets (6 b)); panel A: Stock indices, panel B: Commodity indices and panel C: Bond indices. AR(1) is the first order autocorrelation of returns. Q(3) is the statistics of the Ljung-Box test. Significance are in bold at 1%* and 5% level. N=122.

As table 6 shows, there is evidence of autocorrelation in our findings. Most of the strategies show positive first-order autocorrelation. The Q(3)-statistics for the Ljung-Box test show that several of these indices have to reject the null hypothesis that all of the three first autocorrelation coefficients are jointly zero, but this can be due to the first order autocorrelation. This means that at least one of the coefficients is significantly different from zero. The traditional assets do not show any evidence of significant autocorrelation. This is expected, as they operate in more liquid and efficient markets. The exception is Lehman Global Aggregate, where the null hypothesis of the Ljung-Box test is rejected. This can be due to second or third order autocorrelation.

The consequence of autocorrelation can be undervaluation of volatility and hence overvaluation of risk-adjusted performance measures. As earlier mentioned, a likely reason for the presence of autocorrelation in returns is that funds are operating in illiquid markets. It can create an illiquidity bias, as presented in chapter 7.5. Another reason for autocorrelation, according to Getmansky et al. (2003), may be performance smoothing. This implies reporting only parts of the positive return in order to offset potential future losses. The managers thereby reduce volatility, and improve the results of risk-adjusted performance measures such

as the Sharpe ratio. This is mainly a concern for funds containing illiquid assets, since performance smoothing is difficult for liquid securities which can easily be marked to market.

Convertible Arbitrage is the strategy with the highest first order autocorrelation of returns. The line fit plot in figure 12 makes it easier to see this relationship graphically. Convertible Arbitrage (a) is compared to the stock index S&P500 (b), which has the lowest first order autocorrelation.

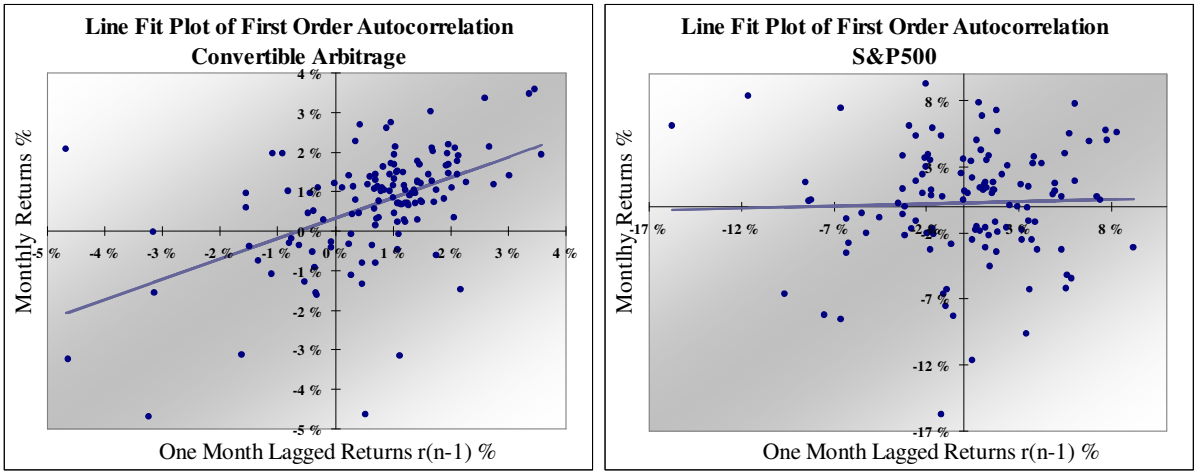

Figure 12 a) and 12 b): First order autocorrelation for Convertible Arbitrage and S&P 500. N=122.

9.6.1 Returns Adjusted for Autocorrelation

Lo (2002) has documented that positive autocorrelation can lead to overestimation of the Sharpe ratio. We examined if the presence of autocorrelation affected our results. Following the method described in equation 3.14, we calculated the unsmoothed return series of the CS/Tremont indices and the various traditional assets.

The summary statistics and performance measures for these unsmoothed returns are shown in appendix 8 and 9. The standard deviation increased for all the indices, consistent with the results of Brooks and Kat (2002). The mean returns are the same, aside from some small rounding errors. This indicates that the autocorrelation leads to underestimation of the volatility. This is shown in figure 13, where we compare the smoothed and unsmoothed return of the hedge fund index which revealed the highest first order autocorrelation; Convertible Arbitrage. The figure clearly depicts the underestimation of volatility.

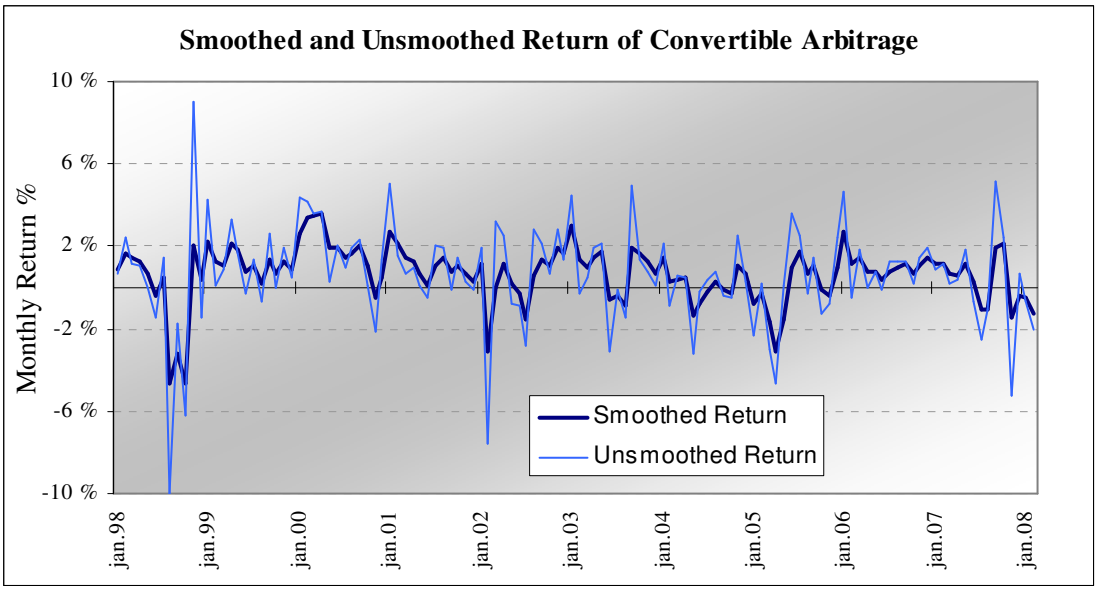

Figure 13: Smoothed and unsmoothed return of Convertible Arbitrage in the period January 1998 to February 2008. N = 122.

If we compare the performance measures before and after calculating unsmoothed returns, we see that the rankings have changed. Some of the indices which had significant autocorrelation, like for instance Convertible Arbitrage, are now ranked lower. However, the differences are not large. The values for the measures have overall decreased, in particular for the Sharpe ratio. The Sharpe ratios of the unsmoothed returns are, as expected, very close to the autocorrelation-adjusted Sharpe ratios of the original returns. As compared to the traditional asset classes, the ranking still favours the smoothed hedge fund indices.

Correlation of the hedge fund indices with other asset classes can also be affected by autocorrelation. In appendix 10 the unsmoothed return's correlation with stock, commodity and bond indices are presented. Convertible Arbitrage was, as mentioned, the strategy showing the highest first order autocorrelation. It now shows significant correlation with several of the stock indices. Its correlation with MSCI Emerging Markets has increased from 0,11 to 0,21. Other hedge fund indices which showed significant first-order autocorrelation, now reveal a somewhat higher correlation with the stock indices.

A benefit of hedge funds is known to be diversification. However, it is important to be aware of the possible presence of autocorrelation. It can disguise significant correlation with other asset classes.

It should be mentioned that we have only removed the first order autocorrelation. According to Okunev and White (2003) this is unsatisfying if the hedge funds reveal significant autocorrelation beyond first order.

10.0 Empirical Results of Norwegian Hedge Funds and CS/Tremont (Jan.04-Feb.08)

In this chapter we will present the empirical findings of the analysis of the period January 2004 to February 2008. For CS/Tremont, we will compare the results with those of the longer period. In addition, we will analyse individual Norwegian hedge funds. This will be related to the analysis of the appropriate strategy indices of CS/Tremont as well as traditional indices. We will start by giving an overview of the development of the shorter period analyzed.

10.1 An Overview of the Development

The shorter period analyzed is mainly characterized by bull markets. No severe crises have affected the stock market. The exception is the recession in the US economy which stroke the world's financial markets at the end of 2007.

10.1.1 CS/Tremont Indices

As we can se from figure 6 in chapter 9.1, the CS/Tremont indices are mainly characterized by an overall upward trend since 2004. The exception is, as before, Dedicated Short Bias.

10.1.2 Individual Norwegian Hedge Funds

Figure 14 shows the development of $100 since January 2004. The Norwegian funds have some of the same pattern as the general stock market, with a decline at the end of 2007. WarrenWicklund Diversified, which follows a multi-strategy, yields the highest return. The fund with the second highest payoff is Sector Maritime Investment, which follows a long/short equity strategy. The two funds of funds FMG Bio-Med and FMG Global have the lowest return. A reason for this may be that as funds of funds they charge extra fees, and these figures are net of all fees.

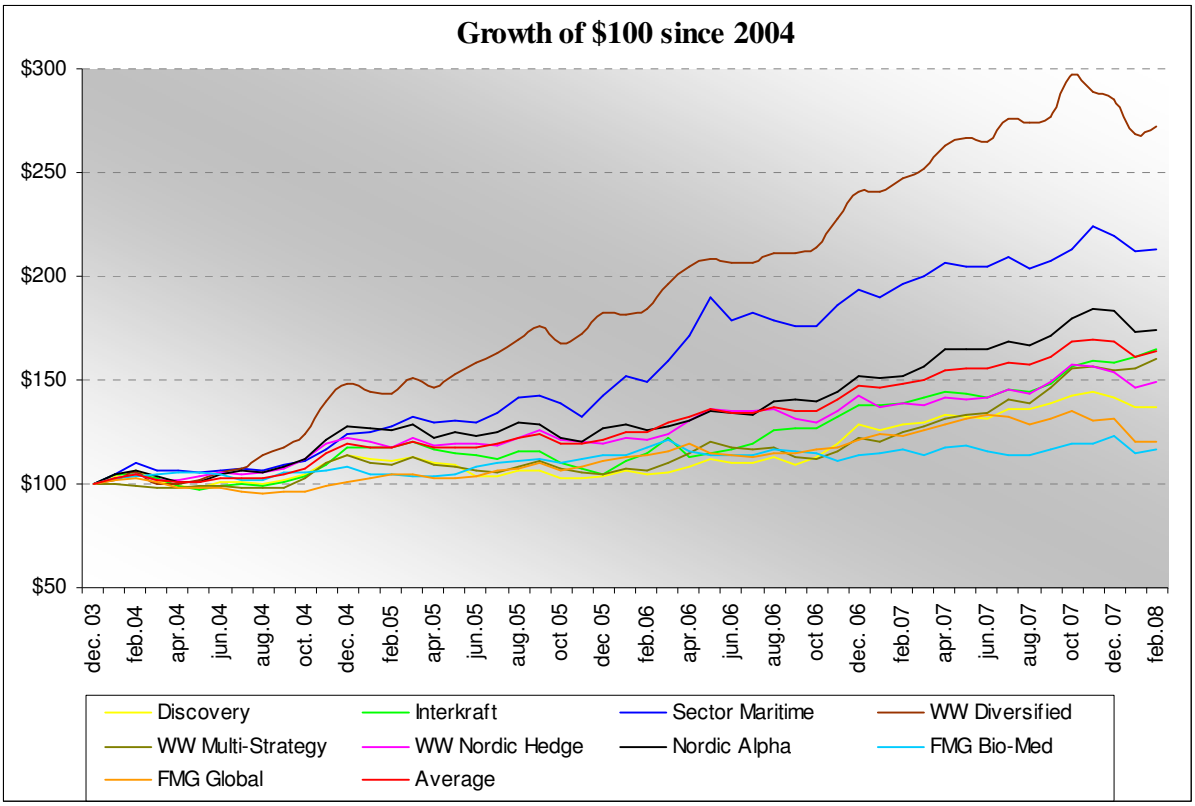

Figure 13: The development of $100 for individual Norwegian hedge funds in the period January 2004 to February 2008. N=50.

10.2 Summary Statistics

Table 7 presents the summary statistics for the CS/Tremont indices and the individual Norwegian hedge funds as compared to the traditional indices for the period January 2004 to February 2008. We will discuss our main findings in the following sections.

10.2.1 The First Two Moments of the Return Distribution

In this first part we will analyze the two first moments of the return distribution, the mean and variance, of the CS/Tremont indices and the individual Norwegian hedge funds.

10.2.1.1 CS/Tremont Indices

All of the CS/Tremont indices show a positive mean return. Most of the strategies have a lower mean and standard deviation than they had in the period of January 1998 to February 2008. However, the difference is relatively small. The standard deviations are lower than for the stock and commodity indices, while there differences in the overall mean return are not large. The exception is the stock indices MSCI Emerging Markets and MSCI Norway. They have a mean superior to those of the CS/Tremont indices, but also higher volatility. The bond

indices show, as expected, overall lower return and standard deviation than the CS/Tremont and traditional indices. This could be due to different market conditions in the periods analyzed.

	Summary Statistics						
	Monthly Return January 2004 – February 2008						
	Mean	SD	Min	Max	Skewn.	Exc. Kurt.	Jarque-Bera
Panel A: *CS/Tremont Index*							
Convertible Arbitrage	0,33	1,14	-3,13	2,75	-0,62	0,60	3,98
Dedicated Short Bias	0,30	3,87	-7,71	10,31	0,46	-0,02	1,73
Emerging Markets	1,31	2,21	-5,02	5,76	-0,72	0,78	5,61
Equity Market Neutral	0,67	0,57	-0,39	2,13	0,43	0,16	1,61
Event Driven	0,96	1,23	-2,44	3,27	-0,68	1,05	**6,15**
- Distressed	0,94	0,98	-1,73	2,67	-0,72	0,92	**6,13**
- Multi-Strategy	1,00	1,52	-3,10	4,31	-0,51	1,23	5,30
- Risk-Arbitrage	0,52	0,92	-1,52	3,22	0,72	1,56	**9,35***
Fixed Income Arbitrage	0,38	0,79	-1,96	2,05	-0,53	0,59	3,04
Global Macro	1,10	1,23	-0,86	4,44	0,85	0,90	**7,66**
Long/Short Equity	0,91	1,83	-4,05	4,18	-0,57	-0,22	2,84
Managed Futures	0,65	3,40	-6,46	6,89	-0,10	-0,92	1,83
Multi-Strategy	0,72	1,12	-1,81	3,02	-0,14	-0,52	0,71
CS/Tremont Index	0,84	1,23	-1,53	3,23	-0,22	-0,58	1,11
Panel B: *Norwegian Hedge Funds*							
Discovery a	0,67	2,65	-4,76	7,62	0,21	-0,15	0,41
FMG Bio-Med d	0,33	2,15	-6,48	4,19	-0,76	0,79	6,17
FMG Global d	0,40	2,16	-8,00	3,05	-1,49	3,33	**41,7***
Interkraft Energy b	1,05	3,01	-7,51	7,90	-0,20	0,45	0,77
Nordic Alpha a	1,16	2,89	-5,86	8,11	-0,20	0,23	0,45
Sector Maritime a	1,58	3,54	-5,84	10,68	0,26	-0,28	0,72
WW Diversified c	2,08	3,48	-5,91	13,07	0,14	1,22	3,28
WW MultiStrategy d	0,98	2,69	-4,33	7,07	0,33	-0,59	1,66
WW Nordic Hedge I c	0,84	2,62	-4,46	6,67	0,14	-0,67	1,10
Average	1,01	2,10	-3,95	6,04	-0,06	0,01	0,03
Panel C: *Stock Indices*							
MSCI Emerging Markets	2,11	5,46	-12,59	11,02	-0,68	0,38	4,13
MSCI World	0,72	2,61	-7,71	5,09	-0,81	0,86	6,95
MSCI Norway	2,41	6,78	-21,07	14,20	-0,64	1,52	8,19
NASDAQ	0,33	4,00	-9,89	7,63	-0,40	-0,31	1,56
S&P 500	0,36	2,42	-6,31	4,24	-0,61	-0,14	3,19
Panel D: Commodity Index							
S&P GSCI	1,43	6,30	-10,71	15,14	-0,20	-0,49	0,83
Panel E: *Bond Indices*							
Lehman Global Aggregate	0,49	1,40	-3,66	2,78	-0,50	-0,06	2,09
Lehman High-Yield	0,48	1,36	-3,54	2,62	-1,08	0,73	**10,88***

Table 7: Summary statistics January 2004 to February 2008. Significance are in bold at 1%* and 5% level. Strategies for Norwegian funds: a = long/short equity, b = managed futures, c = multi-strategy and d = funds of funds. N = 50.

10.2.1.2 Individual Norwegian Hedge Funds

The mean-variance characteristics of the Norwegian funds are presented in figure 14. The characteristics of the associated CS/Tremont indices as well as the indices for stocks, bonds and commodities, are also presented.

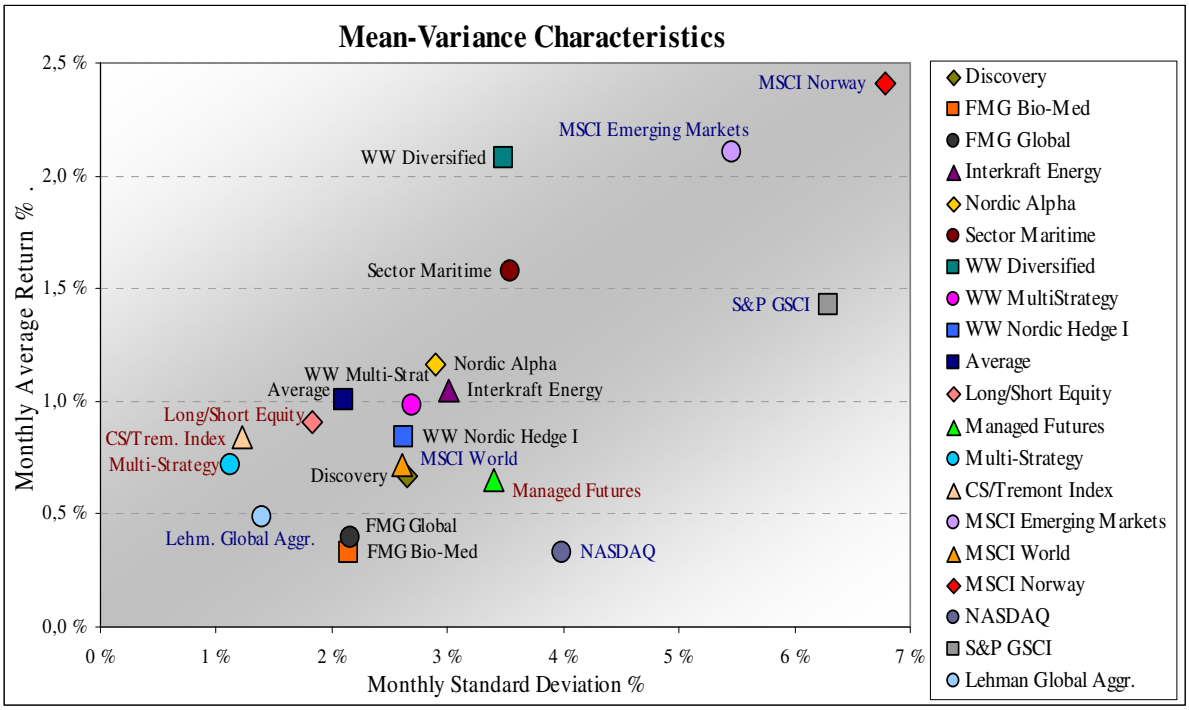

Figure 14: Mean-variance characteristics of Norwegian hedge funds and various indices 2004-2008. N = 50.

As presented in the figure, WarrenWicklund Diversified and Sector Maritime Investment deviate from the other Norwegian funds, with higher monthly mean return and standard deviation. Two of the three Norwegian funds that follow a long/short equity strategy, Nordic Alpha and Sector Maritime, have a higher mean return than the Long/Short Equity index of CS/Tremont. However, as expected do both exhibit a higher standard deviation than the index. Interkraft Energy, the managed futures fund, appears to have superior mean-variance characteristics to the Managed Futures index of CS/Tremont. WarrenWicklund Diversified shows higher mean return than the related CS/Tremont Multi-Strategy index. However, the volatility is also higher. The other multi-strategy fund, WarrenWicklund Nordic, shows a poorer risk-return relationship than the index.

By large, the Norwegian hedge funds have higher mean return than the associated CS/Tremont indices, but they are usually followed by higher volatility. This is expected, since

we are comparing indices with individual funds. High and low mean and standard deviation even each other out for the indices, since they represent a large number of individual funds. Funds of funds are not part of the CS/Tremont database. Hence, the Norwegian funds of funds are not directly comparable with any CS/Tremont index, but the two FMG funds exhibit poor mean-variance characteristics. The Norwegian hedge funds show lower standard deviation than the main share of the stock indices and the commodity index. With the exception of the FMG funds, the Norwegian funds have both higher mean and volatility than the bond indices.

10.2.2 The Third and Fourth Moment of the Return Distribution

The third and fourth moment of the CS/Tremont indices and the Norwegian hedge funds will be discussed in the following sections.

10.2.2.1 CS/Tremont Indices

According to the Jarque-Bera test, a large part of the CS/Tremont hedge fund indices are normally distributed. This was not the case in the extended period. Although, it should be mentioned that our sample data size is rather small and it should therefore not be drawn hasty conclusions. It is difficult to detect non-normality of small sample sizes such as our own, since the Jarque-Bera test is more convenient for larger sample sizes..

The majority of the CS/Tremont indices show a negative skewness. This was also the case in the longer period, but it is less negative for most of the indices. This indicates that the likelihood of small gains and large losses has decreased, but the return distributions still have a somewhat longer negative tail. During the extended period, most of the indices had positive excess kurtosis. In the shorter period, the excess kurtosis has decreased considerably for a large parte of the indices. The values for Distressed have decreased from over 20 to around 1. A likely explanation is the more diverse market conditions of the longer period.

The CS/Tremont indices are not superior to the various traditional indices concerning skewness and excess kurtosis. They all show a slightly negative skewness, and most of them have positive excess kurtosis.

10.2.2.2 Individual Norwegian Hedge Funds

FMG Global is the only Norwegian hedge fund, according to the Jarque-Bera test, which is not normally distributed. This fund has the lowest skewness and highest excess kurtosis of all the funds and indices. However, we should again take into consideration the small data sample.

The skewness and excess kurtosis of the Norwegian funds overall do not differ much from those of either the CS/Tremont indices or the various traditional assets. Discovery, Sector Maritime, WW Multi-Strategy and WW Nordic Hedge show a slightly positive skewness and negative excess kurtosis.

Figure 16 graphically illustrates the skewness and excess kurtosis characteristics for the Norwegian funds, their related CS/Tremont indices as well as the traditional indices. The figure shows that, with a few a few exceptions, they are not centred far from zero.

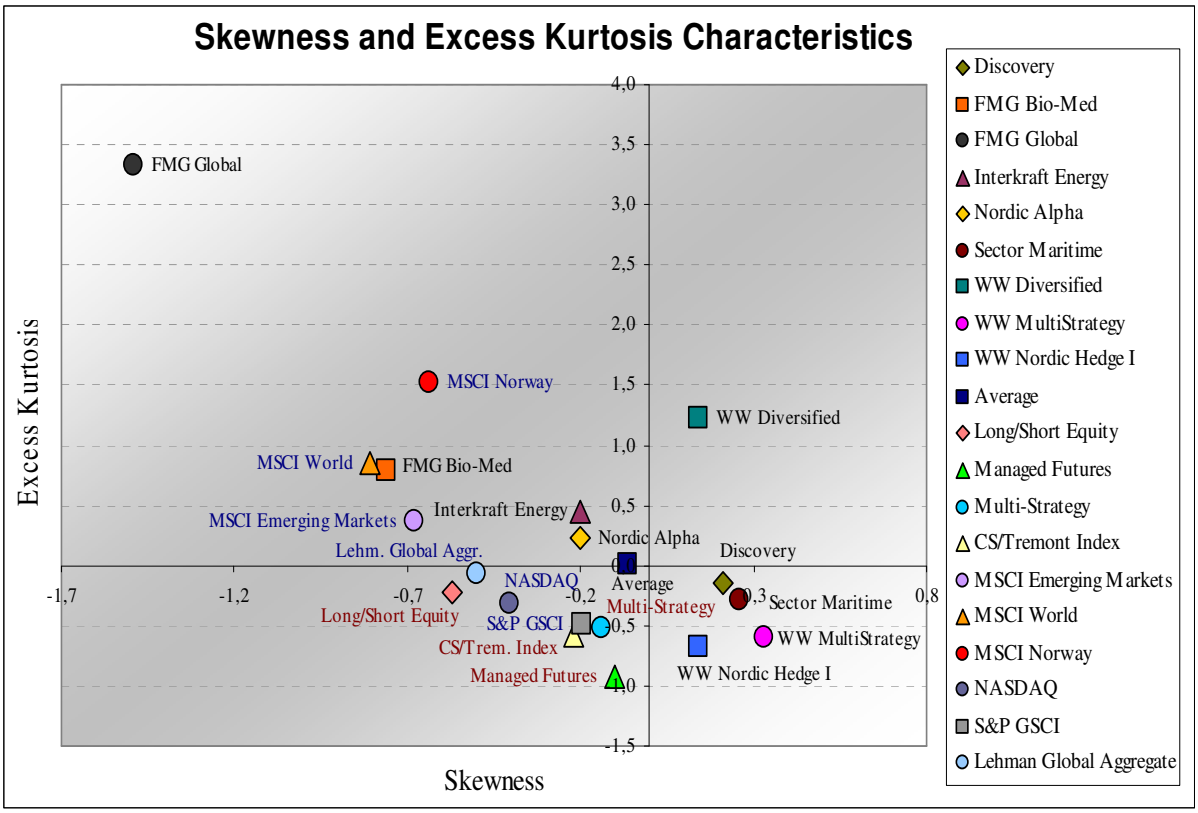

Figure 15: Skewness and excess kurtosis characteristics for Norwegian funds, CS/Tremont indices and various traditional indices. N=50.

10.2.3 Outliers

There are some extreme monthly returns which deviate from the general pattern. These are outliers but, as mentioned earlier in this thesis, they characterize the behaviour of hedge funds. The period has been characterized by bull markets. However, the recession of the US economy may have showed its effect on the world's stock market in January 2008. All of the stock indices have their minimum return in this month. Three of the CS/Tremont indices have its minimum return in January. This is Long/Short Equity, Multi-Strategy and Event Driven (though none of the underlying categories of Event Driven have their minimum return in this month). Several other strategies also show negative return in this month. The exceptions are, as we could assume, Dedicated Short Bias, Equity Market Neutral, Managed Futures, Fixed Income Arbitrage and Global Macro.

A majority of the individual Norwegian hedge funds also have their minimum return in this month. These are WW Diversified, WW Nordic Hedge, Nordic Alpha, FMG Bio-Med and FMG Global. The only funds showing a positive return in January 2008 is Interkraft Energy and WW Multi-Strategy. Interkraft Energy is probably not affected since it trades in the futures market, which shows low correlation with the stock market.

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10.3 Correlation

In this chapter we will present the correlation of the CS/Tremont indices and individual Norwegian hedge funds with the traditional indices. As mentioned before, the shorter period of our analysis is mainly characterized by an upward trend and bull markets. Of the 50 observed months, 32 can be characterized as bull and 18 as bear markets. We have therefore only studied the overall correlation, and not the correlation in bull and bear months.

10.3.1 CS/Tremont Indices

The correlation of CS/Tremont with the traditional stock indices is presented in table 8.
The correlation with MSCI Emerging Markets, MSCI World and S&P 500 is medium to high for a majority of the hedge fund indices. Fixed Income Arbitrage and Equity Market Neutral show a fairly lower correlation with these indices. Dedicated Short Bias shows a medium to high negative correlation. A possible explanation for the higher correlation in the shorter period of our analysis is that the period is mainly characterized by a bull market. As shown in chapter 9, correlation seems to be fairly higher in bull than bear market when using

Spearman's rank correlation. It can be that the longer period provides a better picture of the correlation, since it consists of various conditions of the markets.

	Spearman's Correlation Coefficients January 2004 - February 2008						
	MSCI EM	MSCI World	NASDAQ	S&P 500	S&P GSCI	Leh.Glob Aggr.	Leh.US High-Yield
***Panel A:** CS/Tremont Indices*							
CS/Tremont Index	**0,84**	**0,87**	**0,61**	**0,67**	**0,22**	0,10	**0,41**
Convertible Arbitrage	**0,40**	**0,53**	**0,37**	**0,44**	-0,04	-0,04	**0,43**
Dedicated Short Bias	**-0,57**	**-0,74**	**-0,78**	**-0,75**	0,07	-0,15	**-0,59**
Emerging Markets	**0,89**	**0,72**	**0,44**	**0,46**	**0,30**	**0,25**	**0,37**
Equity Market Neutral	**0,42**	**0,31**	-0,07	0,07	**0,23**	**0,20**	0,04
Event Driven	**0,75**	**0,84**	**0,64**	**0,68**	0,14	0,07	**0,47**
Distressed	**0,60**	**0,81**	**0,60**	**0,65**	0,03	-0,04	**0,46**
Multi-Strategy	**0,75**	**0,78**	**0,60**	**0,64**	0,19	0,10	**0,43**
Risk Arbitrage	**0,65**	**0,64**	**0,47**	**0,46**	**0,26**	**0,35**	**0,39**
Fixed Income Arb.	**0,22**	**0,43**	**0,22**	**0,32**	**0,23**	0,17	**0,23**
Global Macro	**0,59**	**0,45**	0,17	0,24	**0,30**	0,15	0,02
Long/Short Equity	**0,86**	**0,90**	**0,67**	**0,70**	**0,22**	0,13	**0,47**
Managed Futures	**0,54**	**0,53**	**0,45**	**0,44**	0,19	0,10	**0,21**
Multi-Strategy	**0,68**	**0,81**	**0,56**	**0,63**	0,10	0,00	**0,44**
***Panel B:** Traditional Asset Classes*							
MSCI EM	1						
MSCI World	**0,78**	1					
NASDAQ	**0,54**	**0,81**	1				
S&P 500	**0,57**	**0,89**	**0,89**	1			
S&P GSCI	**0,26**	0,00	-0,15	-0,23	1		
Leh. Global Agg	0,18	0,08	-0,06	-0,05	0,12	1	
Leh. US High-Yield	**0,34**	**0,55**	**0,52**	**0,63**	**-0,08**	0,17	1

Table 8: Spearman's correlation coefficients between CS/Tremont hedge fund strategies and traditional assets (Panel A). Spearman's correlation coefficients between traditional assets (Panel B). Significance in bold, tested with a two-tailed t-test, at a 5% significance level. N=50.

10.3.2 Individual Norwegian Hedge Funds

The individual Norwegian hedge fund's correlation with traditional assets is shown in the table in appendix 9. It primarily tells us that the individual hedge funds reveal a low to medium correlation with the traditional assets. As shown in figure 16, the hedge fund showing less correlation with the equities is Interkraft Energy. This is probably due to the fact that this fund trade in the commodity exchange of electrical power at Nord Pool (The Nordic Power Exchange). This market is usually less correlated with the stock market. As compare to the associated hedge fund index of CS/Tremont, Managed Futures and Interkraft shows a lower correlation to the equities.

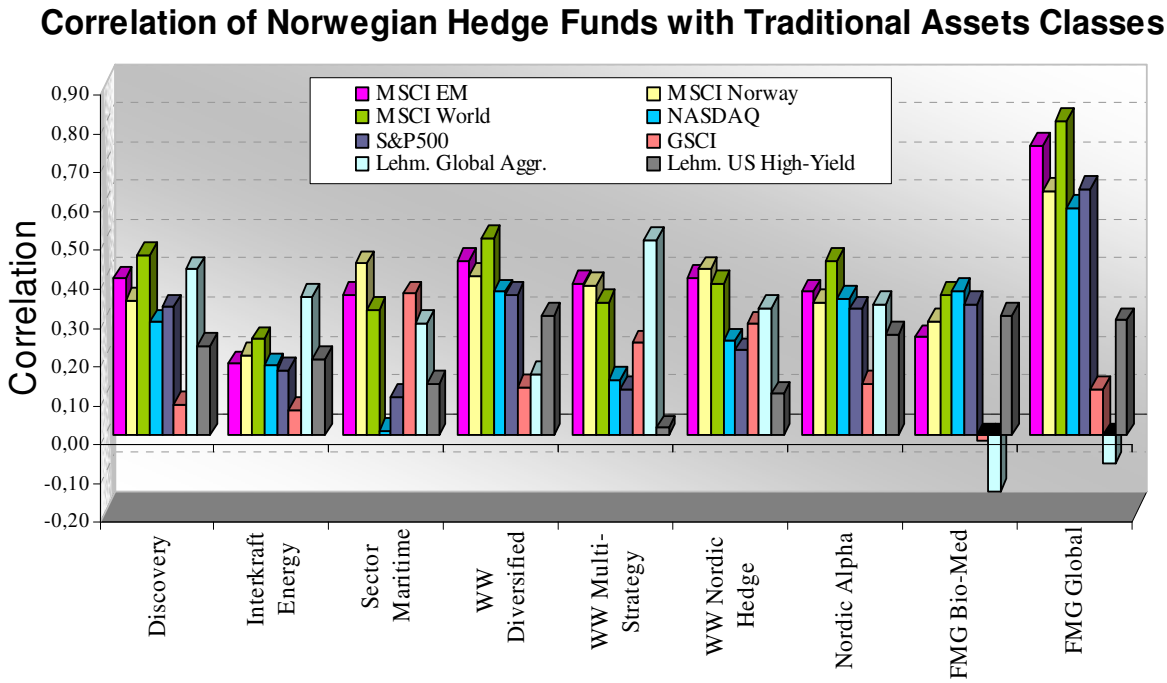

Figure 16: Correlation of Norwegian hedge funds with traditional assets. N=50.

FMG Global is the fund showing the highest correlation with equities. This is a fund of funds, where a large part of the investment is in long/short equity funds in Europe and the US. The rest is invested in global multi-strategy funds. This could make them less protected against market movements as compared to for instance an equity market neutral strategy. Sector Maritime is the fund showing the highest correlation with MSCI Norway (0,44) except from FMG Global. This could be a result of the strategy to invest longs/short in important industries of Norway, such as shipping. This fund also shows the highest correlation with the commodity index S&P GSCI, which could be because the fund trades in commodity markets of for instance oil and gas. The other Norwegian hedge funds show a rather low correlation with the commodity index. Sector Maritime also have lower correlation with the equities than the related Long/Short Equity index of CS/Tremont. Several of the Norwegian hedge funds also reveal significant correlations with NASDAQ. Among the hedge funds showing highest correlation is FMG Bio-Med (0,37). This may reflect the investment strategy which is to invest in funds related to the medical business.

Overall, the individual Norwegian hedge fund is less correlated with traditional assets than the indices of CS/Tremont. For investors, this serves well for diversification. Again it should be mentioned that it would be preferable to analyse the correlation during a period of more diverse market conditions, in order to obtain a more reliable picture.

10.4 Performance Measurement

	Annualized Performance Measurement January 2004 – February 2008								
	Sharpe Ratio	Mod. SR	AR Adj. SR	Omega		Sortino		$Kappa_3$	
				t=0	t=rf	T=0	t=rf	t=0	t=rf
***Panel A:** CS/Tremont Indices*									
Convertible Arb	0,16 *28*	0,06 *28*	0,11 *28*	1,16 *31*	1,12 *29*	0,25 *31*	0,22 *28*	0,18 *31*	0,16 *28*
Ded Short Bias	0,02 *32*	0,01 *32*	0,02 *32*	1,02 *32*	1,02 *32*	0,04 *32*	0,03 *32*	0,03 *32*	0,03 *32*
Emerging Markets	1,62 *7*	0,57 *9*	1,69 *5*	3,31 *10*	3,02 *8*	3,06 *11*	2,81 *8*	2,14 *10*	1,98 *9*
Equity Market N	2,40 *1*	0,82 *2*	2,03 *1*	15,19 *1*	7,48 *1*	14,61 *1*	8,31 *1*	9,55 *1*	5,54 *2*
Event Driven	1,94 *4*	0,63 *5*	1,81 *4*	5,01 *4*	4,18 *4*	4,15 *5*	3,59 *5*	2,72 *5*	2,38 *5*
- Distressed	2,35 *2*	0,72 *3*	1,87 *3*	7,37 *3*	5,25 *3*	5,89 *3*	4,82 *3*	3,68 *3*	3,11 *3*
- Multi-Strat	1,65 *6*	0,57 *7*	1,67 *6*	4,00 *6*	3,49 *6*	3,36 *10*	2,99 *7*	2,21 *9*	2,00 *7*
- Risk-Arb	0,93 *16*	0,42 *16*	0,86 *16*	2,93 *12*	2,14 *15*	2,49 *14*	1,90 *13*	1,68 *13*	1,38 *12*
Fixed Income Arb	0,47 *25*	0,17 *26*	0,39 *25*	1,63 *22*	1,41 *25*	0,89 *24*	0,69 *25*	0,60 *25*	0,49 *25*
Global Macro	2,30 *3*	0,96 *1*	1,94 *2*	10,09 *2*	6,64 *2*	11,65 *2*	7,95 *2*	8,16 *2*	5,69 *1*
Long/Short Equity	1,19 *12*	0,45 *12*	1,08 *13*	2,52 *16*	2,27 *13*	2,32 *15*	2,06 *12*	1,63 *15*	1,48 *11*
Managed Futures	0,38 *26*	0,18 *25*	0,34 *26*	1,33 *29*	1,30 *28*	0,64 *28*	0,60 *26*	0,50 *29*	0,47 *26*
Multi-Strategy	1,37 *9*	0,52 *10*	1,09 *12*	3,54 *8*	2,75 *9*	3,45 *9*	2,76 *9*	2,39 *8*	1,98 *8*
CS/Tremont Index	1,60 *8*	0,59 *6*	1,45 *8*	3,90 *7*	3,10 *7*	4,07 *6*	3,28 *6*	0,84 *21*	0,69 *20*
***Panel B:** Norwegian Hedge Funds*									
Discovery Fund	0,51 *24*	0,24 *21*	0,43 *23*	1,86 *21*	1,44 *24*	1,60 *20*	0,86 *21*	1,22 *19*	0,67 *21*
FMG Bio-Med	0,09 *30*	0,04 *30*	0,10 *30*	1,47 *26*	1,37 *27*	0,54 *29*	0,12 *30*	0,77 *23*	0,09 *30*
FMG Global	0,20 *27*	0,07 *27*	0,18 *27*	1,60 *23*	1,39 *26*	0,88 *25*	0,26 *27*	0,58 *26*	0,18 *27*
Interkraft Energy	0,89 *18*	0,36 *18*	0,77 *18*	2,43 *18*	1,93 *18*	2,19 *18*	1,50 *18*	1,51 *17*	1,05 *17*
Nordic Alpha	1,06 *15*	0,43 *15*	0,93 *15*	2,79 *13*	2,17 *15*	2,65 *13*	1,88 *15*	1,83 *12*	1,32 *15*
Sector Maritime	1,28 *10*	0,57 *8*	1,19 *11*	3,19 *11*	2,58 *10*	3,58 *7*	2,70 *10*	2,61 *6*	2,00 *6*
WW Multi-Strat.	0,91 *17*	0,43 *14*	0,80 *17*	2,57 *15*	1,95 *17*	2,83 *12*	1,80 *17*	2,10 *11*	1,36 *13*
WW Nordic Hedg	0,74 *19*	0,34 *19*	0,67 *19*	2,20 *19*	1,68 *19*	2,19 *17*	1,31 *19*	1,66 *14*	1,01 *18*
WW Diversified	1,80 *5*	0,70 *4*	1,65 *7*	4,63 *5*	3,73 *5*	4,85 *4*	3,95 *4*	3,32 *4*	2,75 *4*
Average	1,21 *11*	0,49 *11*	1,05 *14*	3,42 *9*	2,44 *11*	3,53 *8*	2,30 *11*	2,45 *7*	1,64 *10*
***Panel C:** Stock Indices*									
MSCI Emerg. M	1,16 *13*	0,44 *13*	1,25 *10*	2,63 *14*	2,33 *12*	2,25 *16*	1,90 *14*	1,57 *16*	1,34 *14*
MSCI World	0,58 *21*	0,20 *23*	0,52 *21*	1,94 *20*	1,45 *21*	1,47 *21*	0,74 *23*	1,02 *20*	0,53 *23*
MSCI Norway	1,09 *14*	0,41 *17*	1,25 *9*	2,49 *17*	2,25 *14*	2,14 *19*	1,85 *16*	1,37 *18*	1,20 *16*
NASDAQ	0,05 *31*	0,02 *31*	0,05 *31*	1,22 *30*	1,03 *31*	0,43 *30*	0,07 *31*	0,31 *30*	0,05 *31*
S&P 500	0,12 *29*	0,05 *29*	0,11 *29*	1,43 *28*	1,09 *30*	0,78 *27*	0,17 *29*	0,57 *28*	0,13 *29*
***Panel D:** Commodity Index*									
S&P GSCI	0,63 *20*	0,28 *20*	0,64 *20*	1,59 *24*	1,55 *20*	1,03 *22*	0,99 *20*	0,79 *22*	0,76 *19*
***Panel E:** Bond Indices*									
Lehm. Global Ag	0,54 *22*	0,22 *22*	0,51 *22*	1,57 *25*	1,44 *23*	0,95 *23*	0,81 *22*	0,67 *24*	0,61 *22*
Lehm. US High Y	0,53 *23*	0,19 *24*	0,42 *24*	1,55 *26*	1,45 *22*	0,83 *26*	0,73 *24*	0,57 *27*	0,52 *24*

Table 9: Annualized performance measurement for CS/Tremont Index, Norwegian funds and various indices. Omega, $Kappa_3$ and Sortino is calculated for two different thresholds τ. T-bill is used as rf. The ranking of each fund according to the measures is given after the performance figures. Strategies for Norwegian funds: a = long/short equity, b = managed futures, c = multi-strategy and d = funds of funds. N = 50

Table 9 presents the results of different performance measures for the CS/Tremont index, individual Norwegian hedge funds and various traditional assets.

10.4.1 CS/Tremont Indices

Equity market neutral is the top ranked index also in this period, but not by all the measures. The modified Sharpe ratio and $Kappa_3$ ($\tau = r_f$) rank Global Macro as number one and Equity Market Neutral as number two. All the measures rank Dedicated Short Bias last also in the shorter period. This period has been characterized by bull markets. Since the Dedicated Short Bias strategy is to sell short stocks in overvalued companies, this is a strategy which may perform poorly in bull markets.

10.4.2 Individual Norwegian Hedge Funds

By looking at table 9, it immediately appears as most of the Norwegian funds are ranked lower than the CS/Tremont indices. However, the picture changes when we compare the funds with the related strategy indices.

WarrenWicklund Diversified is the Norwegian fund with the highest ranking. The ranking of this multi-strategy fund vary from 4 to 7. It is ranked higher than the Multi-Strategy index of CS/Tremont by all the measures. The other multi-strategy fund, WarrenWicklund Nordic Hedge, is ranked lower. The Long/Short Equity index of CS/Tremont is ranked in the range of 11 to 15. Sector Maritime has outperformed this index with a ranking of 6 to 11, while Discovery and Nordic Alpha are both ranked lower. All the measures rank Interkraft Energy higher than the Managed Futures index of CS/Tremont. FMG Bio-Med and FMG Global are ranked poorest, also as compared to the traditional assets. The third Fund of Funds, WarrenWicklund Multi-Strategy, is ranked somewhat higher in the range of 12 to 17.

To summarize, around half of the funds have performed better than their associated CS/Tremont indices. The other half have performed worse. The CS/Tremont indices and the Norwegian funds are overall ranked higher than the traditional assets. This indicates that the hedge funds have outperformed the market.

Several factors may have influenced our results, and it is difficult to draw final conclusions. A potential error source is that the number of observations is low. The Norwegian hedge fund industry is young, and there are still relatively few Norwegian hedge funds in existence. In

order to get a sufficient number of funds to analyze, we had to limit the number of years to four. Hence, the individual Norwegian hedge funds studied are far from representative for the entire Norwegian hedge fund industry. A possible consequence of a relatively small data sample is that a few outliers can affect the results substantially. However, the data of the individual Norwegian hedge funds analysis can be more reliable than indices, since the indices are likely to be affected by various biases.

10.4.3 Rank Correlation

Table 10 shows Spearman's rank correlation coefficients for the different performance measures used. As we can see, they are highly correlated. This implies that the deviations between the rankings of the measurements are small and that the funds are ranked rather equal by the various measures. This is also consistent with the correlation of rankings found in chapter 9.

		Spearman's Rank Correlation January 2004 - February 2008								
		a	b	c	d	e	f	g	h	i
Sharpe Ratio	a	**1**								
Modified Sharpe ratio	b	**0,990**	**1**							
AR-adjusted Sharpe ratio	c	**0,988**	**0,973**	**1**						
Omega t=0	d	**0,968**	**0,968**	**0,949**	**1**					
Omega t=rf	e	**0,995**	**0,987**	**0,984**	**0,977**	**1**				
Sortino t=0	f	**0,965**	**0,980**	**0,937**	**0,983**	**0,967**	**1**			
Sortino t=rf	g	**0,993**	**0,995**	**0,977**	**0,975**	**0,991**	**0,976**	**1**		
$Kappa_3$ t=0	h	**0,916**	**0,920**	**0,889**	**0,941**	**0,920**	**0,947**	**0,917**	**1**	
$Kappa_3$ t=rf	i	**0,958**	**0,958**	**0,937**	**0,937**	**0,951**	**0,945**	**0,956**	**0,968**	**1**

Table 10: Spearman's rank correlation for the various performance measures of January 2004 to February 2008. Significance of the correlation coefficient is in bold. It is tested with a two-tailed t-test, at a 5% significance level. N=122.

10.5 Autocorrelation

In table 11 and 12 we present the first order autocorrelation coefficients and the Ljung-Box Q(3) statistics for the CS/Tremont indices, the traditional assets and the Norwegian funds.

10.5.1 CS/Tremont Indices

Three of the CS/Tremont strategies; Convertible Arbitrage, Distressed and Multi-Strategy reveal a significant first order autocorrelation. These were also significant during the longer period, and as mentioned this is probably because they operate in illiquid markets. As for the

Ljung-Box test, four of the strategies reject the null-hypothesis. These are Convertible Arbitrage, Fixed Income Arbitrage, Global Macro and Multi-Strategy. Global Macro is the only index not showing autocorrelation also in the period of January 1998 to February 2007. Overall, there is less evidence of autocorrelation in the CS/Tremont returns in the shorter period as compared to the extended. Since autocorrelation point towards underestimation of volatility, the risk-adjusted performance measures are now more likely to be correct. The results are similar for the stock, commodity and bond indices. Only the bond index Lehman US High-Yield has significant first order autocorrelation.

CS/Tremont Index	**AR(1)**	**Q3**
Convertible Arbitrage	**0,50***	**33,71***
Dedicated Short Bias	0,16	4,04
Emerging Markets	-0,04	0,51
Equity Market Neutral	0,22	5,84
Event Driven	0,08	2,73
- Distressed	**0,32**	5,32
- Multi-Strategy	-0,01	2,88
- Risk-Arbitrage	0,09	3,56
Fixed Income Arbitrage	0,24	**14,96***
Global Macro	0,22	**9,54**
Long/Short Equity	0,12	3,78
Managed Futures	0,16	6,85
Multi-Strategy	**0,32**	**8,3**
CS/Tremont Index	0,11	3,01

Table 11 a)

Traditional Asset Classes	**AR(1)**	**Q3**
Panel A: *Stock Indices*		
MSCI Emerging Markets	-0,07	1,10
MSCI World	0,15	3,74
MSCI Norway	-0,13	2,66
NASDAQ	0,07	4,89
S&P 500	0,16	3,31
Panel B: *Commodity Index*		
S&P GSCI	-0,01	3,20
Panel C: *Bonds Indices*		
Lehman Global Aggregate	0,07	0,8
Lehman High-Yield	**0,32**	**11,01**

Table 11 b)

Table 11: Test of autocorrelation in the return series of the CS/Tremont indices (table 11 a))and of the various traditional assets (table 11 b)); panel A: Stock indices, panel B: Commodity indices and panel C: Bond indices. AR(1) is the first order autocorrelation of returns. Q(3) is the statistics of the Ljung-Box test. Significance are in bold at 1%* and 5% level. N=50.

The shorter period is principally characterized by a bull market. If performance smoothing does exist, it might occur less in bull markets. Another reason could be that there has been a shift in the investment strategy of the hedge funds to more liquid and/or efficient markets. It is difficult to provide an exact reason to why there less autocorrelation in the indices during the shorter period.

10.5.2 Individual Norwegian Hedge Funds

None of the Norwegian hedge funds show a significant first order autocorrelation. Nordic Alpha is the only Norwegian fund which rejects the null hypothesis of the Ljung-Box test. This fund shows significant negative second order autocorrelation. The strategy of Nordic Alpha is long/short equity, and the fund could be operating in inefficient markets.

Norwegian Hedge Funds	AR(1)	Q3
Discovery	0,24	6,22
FMG Bio-Med	-0,05	3,52
FMG Global	0,12	2,04
Interkraft Energy	0,18	3,84
Nordic Alpha	0,17	**11,42***
Sector Maritime	0,09	3,13
WW Diversified	0,10	1,48
WW MultiStrategy	0,15	3,19
WW Nordic Hedge I	0,11	4,65
Average	0,18	5,28

Table 12: Autocorrelation coefficients of individual Norwegian hedge funds. AR(1) is the first order autocorrelation of returns. Q(3) is the statistics of the Ljung-Box test. Significance are in bold at 1%* and 5% level. N=50.

According to Liang (2003), we could expect the autocorrelation to be stronger for individual funds than for style indices. This is because positive and negative autocorrelation may cancel each other out in indices. Our results indicate the opposite: we found more evidence of autocorrelation for the indices. It can be that the Norwegian funds operate in less illiquid markets. For instance, the managed futures fund, Interkraft Energy, invests heavily at Nord Pool. It is considered as a highly liquid market for electricity.

11.0 The Impact of Currency

Since our analysis is from a US point of view, the individual Norwegian hedge funds were converted from Norwegian Kroner and Euro into US dollars. In this chapter we will discuss the main impact this had on our analysis. Appendix 10 and 11 shows the result of the summary statistics and performance measures of the Norwegian funds before we converted the returns. The only hedge funds already denoted in US dollars were FMG Global and FMG Bio-Med.

The converted returns of the hedge funds were somewhat higher. Kroner and Euro have on average been strengthening against US dollars since 1998, hence this was expected. The standard deviation is also fairly higher.

When considering skewness and kurtosis, we can also observe some differences. Skewness is more negative and kurtosis more positive before converting. Consequently, several of the hedge funds reject the Jarque-Bera test of a normal distribution, as compared to the converted.

The tests of first order autocorrelation still remain insignificant for the Norwegian hedge funds before converting. The Ljung-Box Q(3) statistics is rejected for all except one, Discovery. When converted it is rejected for all but Nordic Alpha.

The performance measures overall are somewhat higher for the converted hedge funds. An exception is the Omega measure at a threshold of zero. This is probably due to more returns centred about zero when not converted. However, the converted hedge funds show higher performance among both Sortino and $Kappa_3$ at a threshold of zero.

It can be argued that the higher performance among the hedge funds, when converted, is due to the weak dollar. From a US point of view, the situation would likely change if the US dollar would strengthen against the Norwegian Kroner and Euro.

12.0 Additional Remarks on Hedge Funds

12.1 Potential Sources of Hedge Funds Performance

Several researchers have tried to locate the potential sources of the superior performance of hedge funds as compared to the traditional asset classes. Based on this, we will discuss some aspects that might have affected hedge fund performance.

- Incentive Fees

The incentive fees of hedge funds are meant to encourage managers to increase performance. Ackerman et al. (1999) find that incentive fees explain some of the higher performance when analyzing hedge funds in the period of 1988 to 1995. This is supported by the research of the period 1990 to 1998 performed by Edwards and Caglayan (2001). They find that hedge funds with higher incentive fees have higher excess return than those with a lower incentive fee.

- Manager Skills

Since exploiting mispricing in the market is an important strategy of hedge funds, superior skills among the managers could perhaps be a source of the high performance found in our thesis. Brown et al. (1999) opposes this hypothesis, finding absolutely no evidence of differential skills among offshore hedge fund managers in the period of 1989-1995. On the other hand, Edwards and Caglayan (2001) find some evidence of management skills during the 1990's by analyzing individual hedge funds. However, they do not exclude the possibility that this could be due to accident of history, because of the lack of more diverse markets. It is therefore difficult to draw definite conclusions about manager skills a role in the performance of hedge funds.

- Performance Persistence

Another aspect when we evaluate performance is that superior performance in the past does not necessarily mean superior performance in the future. Brown and Goetzmann (2003) find that persistence of fund returns depends on the particular style of management. Ackerman et al. (1999) found that hedge funds are unable to consistently beat the market.

12.2 Limitations

Some of the positive performance may come from biases due to the difficulty of obtaining complete and correct information of hedge funds. Brown et al. (1999) describe survivorship bias as a result of either self selection or discontinuation. Discontinuation can be due to for instance liquidations, merges or restructures. They estimate it to be about 3 % per year for offshore hedge funds. Liang (2000) finds that survivorship bias exceeds 2 % per year when investigating two major databases, HFR and TASS. He also finds that poor performance is the main reason for funds' disappearance. According to Amin and Kat (2003), survivorship bias creates a downward bias on the standard deviation and kurtosis, as well as an upward bias in skewness. Self-selection bias may also influence our analysis. For instance, there might be an upward bias towards well performing hedge funds in the database due to poor performing funds not reporting. However, this issue is complicated since data is difficult to obtain, and we can only mention the possibility for this bias to exist. The bias might as well be towards well-performing hedge funds not reporting to the database.

In addition to these biases, investors' perception of hedge fund performance varies among indices of the different databases (Brooks and Kat (2002)). Liang (2000) finds relatively few funds in common of various databases. Among the common funds, he finds significant differences in reported returns, net asset value, inception date, fee structures and investment styles. Based upon only one database, it is therefore almost impossible to draw conclusions regarding performance for the entire hedge fund universe.

It is also essential to remember that hedge funds are not available to most people. Hedge funds generally target institutional investors and high net worth individuals, since the minimum investment required is too high for small investors. In addition, many are closed to new investments. The highly regarded manager of the Yale University endowment, David Swensen, has successfully used hedge funds in his investment strategy. His strategy is commonly referred to as the Yale model. Several financial institutions use his success as an argument for investing in hedge funds. However, Swensen does not agree that investing in hedge funds is necessarily the optimal solution for all investors. People in general do not have the capacity to select market-beating managers. Swensen argues that "the only people who should get involved are sophisticated individuals who have significant resources and a highly qualified investment staff" (New York Times (2008)).

13.0 Concluding Remarks

In this thesis we have studied the characteristics and performance of hedge funds. This has been done to see if hedge funds do outperform the market as often believed. We have also studied the correlation of hedge funds with traditional assets, which indicates if diversification benefits do exist. The returns have also been adjusted for autocorrelation in order to see if it would affect our results.

The summary statistics revealed that hedge funds overall have mean-variance characteristics superior to those of the traditional assets. By large, the individual Norwegian hedge funds have both higher mean return and standard deviation than the associated CS/Tremont indices, as expected since we compare indices with individual funds. The higher moments of the return distribution revealed negative skewness and positive excess kurtosis for the hedge funds. Since investors dislike negative skewness and positive excess kurtosis, hedge funds do not appear as attractive as they do at the first glance. These observations changed in the shorter period analysed, where a large part of both the indices and individual Norwegian hedge funds were normally distributed. This diverging result may be due to the different market conditions of the periods analysed.

When analysing correlation, we found a low to medium correlation of hedge fund indices with the stock indices. However, overall the correlation seems to be somewhat lower in bear than bull markets. This could indicate that the benefits of diversification are lower than often claimed. Most of the indices were also correlated to the Lehman US High-Yield index in bear markets, possibly reflecting some credit exposure. The correlation of individual Norwegian hedge funds with traditional assets was overall lower as compared to the associated indices, and they might therefore serve well for portfolio diversification.

By using various performance measures we ranked the indices and Norwegian hedge funds. Spearman's rank correlation indicates a high correlation between the various performance measures. It may be that the choice of performance measure is less critical than often believed. Most of the hedge fund indices are ranked higher than the traditional indices. The results were the same for the shorter period. The measures ranked half of the Norwegian funds superior to the related CS/Tremont index.

There was evidence of autocorrelation in our findings during the extended period of our analysis. We also found presence of autocorrelation in the shorter period, but only for some indices. No first order autocorrelation in the return series was found for the individual Norwegian hedge funds. To see how the autocorrelation affected the hedge fund indices' results in the extended period, we calculated the unsmoothed returns. The volatility increased for those revealing first order autocorrelation, and the values of performance measures decreased. Some of the indices with significant autocorrelation were ranked lower than before, but the ranking still favoured hedge fund indices. When measuring the correlation of hedge funds with traditional asset classes, we could see that the correlation increased for the indices exhibiting highest first order autocorrelation.

We should be careful when interpreting our results. A problem when analyzing hedge funds is the presence of biases in the databases. Some of them are difficult to remove, like for instance the self-selection bias. There also exist evidence that the various databases have relative few hedge funds in common. Due to these biases, the hedge fund databases do not represent a complete random sample of the entire hedge fund universe. This is likely to affect our analysis. Lastly, it should be mentioned that hedge funds are not open to everyone, and the minimum required investment is high.

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WarrenWicklund: http://www.warrenwicklund.no

Yahoo! Finance: http://www.yahoo.com

Appendices

Appendix 1: A Brief Description of the Norwegian Hedge Funds

Discovery Fund Plc.

Strategy: Long/short equity.

Focus on: Equities, interest bearing instruments and cash in the Nordic countries, with the possibility of diversifying in Europe.

Registered in: Ireland

FMG Bio-Med Hedge Fund Ltd

Strategy: Fund of funds

Focus on: Fund managers related to the medical business. The portfolio is diversified between small and medium size managers.

Registered in: Bermuda

FMG Global Hedge Fund Ltd.

Strategy: Fund of funds

Focus on: The fund combines various global hedge strategies. The portfolio is diversified between different managers, with focus on USA, Europe and global multi managers.

Registered in: Bermuda

Interkraft Energy Fund

Strategy: Managed futures

Focus on: It trades in Nord Pool (Nordic power), the European Energy Exchange (German power) and the European Climate Exchange (CO2).

Registered in: The Cayman Islands.

Nordic Alpha Plc

Strategy: Long/short equity.

Focus on: Equity and interest markets in the Nordic countries. The fund focuses on five core sectors in companies in oil and marine, pulp and paper, telecom, banking and consumer products. The investments will primarily be in small and medium capitalised issuers.

Registered in: Ireland

Sector Maritime Investment

Strategy: Long/short equity

Focus: The fund invests in selected shipping industries such as maritime transportation, ship yards, ship suppliers, cruise and ferry, as well as oil and gas services, exploration and production.

Registered in: The Cayman Islands.

WarrenWicklund Diversified Value

Strategy: Multi-strategy

Focus on: Invests in Nordic equities and Norwegian PCPs, a mixture between equity and bonds that are issued by Norwegian savings banks.

Registered in: Norway*

WarrenWicklund Multi-Strategy Fund

Strategy: Fund of funds

Focus on: Hedged equity, high yield and arbitrage styles. A minimum of 40% of the portfolio is managed by external managers, while 40% is invested by the WarrenWicklund Fourth Moment hedge fund in mixed arbitrage strategies.

Registered in: Ireland

WarrenWicklund Nordic Hedge I

Strategy: Multi-strategy

Focus on: Various strategies, but the fund mainly invests in strategies within arbitrage, hedged equity and high yield.

Registered in: Norway*

* As it is a Norwegian registered fund, it is not allowed to utilize leverage or short single stocks. Hedging is therefore done through options on single stocks as well as option and futures on the various Nordic indices.

Appendix 2: Summary Statistics with the month of August 1998 Removed

	Summary Statistics Monthly Returns January 1998 – February 2008						
	Mean	**SD**	**Min**	**Max**	**Skewn.**	**Excess Kurtois**	**Jarque-Bera**
Convertible Arbitrage	0,75	1,28	-4,68	3,57	-1,15	2,97	**79,71**
Dedicated Short Bias	-0,19	4,62	-8,69	13,76	0,38	-0,18	3,43
Emerging Markets	1,12	3,64	-9,78	15,34	-0,05	1,74	**17,15**
Equity Market Neutral	0,86	0,75	-1,15	3,26	0,54	0,89	**11,06**
Event Driven	1,01	1,28	-3,10	3,58	-0,81	1,24	**23,50**
- Distressed	1,09	1,35	-4,27	3,91	-0,76	1,94	**34,43**
- Multi-Strategy	0,98	1,50	-4,74	4,66	-0,52	1,81	**24,72**
- Risk-Arbitrage	0,64	1,13	-2,73	3,81	0,04	0,88	4,45
Fixed Income Arbitrage	0,47	1,07	-6,96	2,05	-3,22	17,83	**2035,80**
Global Macro	1,24	2,71	-11,55	10,16	-0,07	4,99	**141,46**
Long/Short Equity	1,14	2,78	-7,46	13,01	0,84	3,12	**71,36**
Managed Futures	0,66	3,42	-8,62	8,63	-0,04	-0,35	0,73
Multi-Strategy	0,79	1,10	-4,76	3,12	-1,09	4,14	**123,97**
CS/Tremont Index	0,96	1,92	-4,63	8,53	0,74	2,69	**53,42**

Summary statistics of monthly returns for CS/Tremont indices in the period if Jan. 98 to Feb. 08 when August 1998 is removed. Numbers in bold are significant at a 1% level. N=122.

Appendix 3: Pearson's Correlation Coefficients of CS/Tremont with Traditional Assets

	Pearson's Correlation Coefficients January 1998 – February 2008						
	MSCI EM	**MSCI World**	**NASDAQ**	**S&P 500**	**S&P GSCI**	**Lehm. Glob. Aggregated**	**Lehm. US High-Yield**
Panel A: *CS/Tremont*							
Convertible Arbitrage	**0,19**	0,16	0,16	0,16	0,04	-0,12	**0,40**
Dedicated Short Bias	**-0,71**	**-0,79**	**-0,81**	**-0,80**	-0,06	0,03	**-0,53**
Emerging Markets	**0,83**	**0,63**	**0,57**	**0,56**	**0,19**	-0,10	**0,43**
Equity Market Neutral	**0,36**	**0,36**	**0,22**	**0,34**	0,10	0,07	0,15
Event Driven	**0,70**	**0,61**	**0,51**	**0,55**	0,14	-0,14	**0,58**
- Distressed	**0,63**	**0,57**	**0,48**	**0,54**	0,08	-0,14	**0,62**
- Multi-Strategy	**0,69**	**0,58**	**0,49**	**0,51**	0,17	-0,15	**0,50**
- Risk Arbitrage	**0,59**	**0,54**	**0,40**	**0,49**	0,15	0,02	**0,41**
Fixed Income Arbitrage	0,08	0,01	0,01	-0,03	0,11	-0,03	**0,26**
Global Macro	**0,18**	0,09	0,13	0,05	0,11	0,03	0,16
Long/Short Equity	**0,66**	**0,65**	**0,74**	**0,58**	**0,20**	0,04	**0,38**
Managed Futures	-0,06	-0,14	**-0,18**	**-0,20**	**0,25**	**0,36**	-0,16
Multi-Strategy	0,31	**0,32**	**0,31**	**0,24**	0,13	0,08	**0,41**
CS/Tremon Index	**0,59**	**0,53**	**0,59**	**0,45**	**0,21**	-0,01	**0,42**
Panel B: *Traditional Asset Classes*							
MSCI Emerging Markets	1						
MSCI World	**0,79**	1					
NASDAQ	**0,68**	**0,81**	1				
S&P 500	**0,72**	**0,96**	**0,82**	1			
S&P GSCI	**0,20**	0,04	0,06	-0,02	1		
Lehman Global Aggr.	-0,05	-0,02	-0,10	-0,10	0,16	1	
Lehman US High-Yield	**0,53**	**0,52**	**0,49**	**0,51**	-0,02	0,04	1

Pearson's correlation coefficients between CS/Tremont hedge fund strategies and traditional assets (Panel A). Pearson's correlation coefficients between traditional assets (Panel B). Significance is in bold, and tested with a two-tailed t-test, at a 5% significance level. N=122

Appendix 4: Spearman's Correlation Coefficients in Bull and Bear Markets

	Spearman's Correlation Coefficient in Bull Markets January 1998 - February 2008						
	MSCI World	MSCI EM	NASDAQ	S&P 500	S&P GSCI	Leh.Glob Aggr.	Leh.US High-Yield
Panel A: *CS/Tremont Index*							
CS/Tremont Index	**0,29**	**0,27**	0,15	0,09	0,22	0,05	0,02
Convertible Arbitrage	0,22	0,14	0,21	0,15	0,00	0,02	0,20
Dedicated Short Bias	**-0,52**	**-0,27**	**-0,64**	**-0,56**	-0,04	0,02	-0,14
Emerging Markets	**0,37**	**0,63**	0,19	0,15	**0,27**	-0,05	0,16
Equity Market Neutral	**0,30**	**0,26**	-0,01	0,18	0,15	0,21	-0,10
Event Driven	**0,37**	**0,46**	**0,29**	0,20	0,07	-0,07	**0,28**
- Distressed	**0,33**	**0,38**	0,22	0,17	-0,07	-0,05	**0,42**
- Multi-Strategy	**0,35**	**0,41**	**0,26**	0,20	0,13	-0,07	0,17
- Risk Arbitrage	**0,35**	**0,41**	0,21	0,20	0,11	0,15	0,01
Fixed Income Arb.	**0,24**	**0,24**	0,16	0,14	0,19	**0,24**	**0,24**
Global Macro	0,04	0,19	-0,01	-0,09	0,12	0,06	0,00
Long/Short Equity	**0,36**	**0,27**	**0,37**	**0,27**	**0,26**	0,04	-0,09
Managed Futures	0,02	0,20	-0,14	-0,03	0,23	0,22	0,08
Multi-Strategy	**0,24**	0,19	0,06	0,03	0,09	0,17	0,17
Panel B: *Traditional Asset Classes*							
MSCI World	1						
MSCI emerging	**0,52**	1					
NASDAQ	**0,52**	**0,30**	1				
S&P 500	**0,85**	**0,35**	**0,67**	1			
S&P GSCI	-0,08	0,11	-0,04	-0,17	1		
Lehm Global Agg.	0,00	-0,11	-0,21	-0,09	0,12	1	
Lehm US High-Yield	-0,02	0,15	0,03	-0,05	-0,11	0,17	1

Spearman's correlation coefficients between CS/Tremont hedge fund strategies and traditional assets and between traditional assets in bull markets. Significance is in bold, and tested with a two-tailed t-test, at a 5% significance level. N=122.

	Spearman's Correlation Coefficient in Bear Markets January 1998 - February 2008						
	MSCI World	MSCI EM	NASDAQ	S&P 500	S&P GSCI	Leh.Glob Aggr.	Leh. US High-Yield
Panel A: *CS/Tremont Indices*							
CS/Tremont Index	**0,36**	**0,57**	**0,43**	0,24	0,17	0,16	**0,49**
Convertible Arbitrage	-0,19	-0,08	-0,11	-0,08	0,01	-0,20	**0,45**
Dedicated Short Bias	**-0,49**	**-0,51**	**-0,64**	**-0,48**	0,03	0,08	**-0,41**
Emerging Markets	**0,43**	**0,82**	**0,51**	**0,35**	0,09	-0,08	0,26
Equity Market Neut.	-0,07	-0,03	-0,14	-0,10	0,02	-0,13	0,00
Event Driven	0,24	**0,47**	**0,40**	0,17	0,21	-0,06	**0,47**
- Distressed	0,22	**0,39**	**0,42**	**0,20**	0,12	-0,15	**0,49**
- Multi-Strategy	0,23	**0,48**	**0,28**	0,17	**0,28**	-0,05	**0,44**
- Risk Arbitrage	0,15	0,17	0,03	0,12	0,10	-0,03	**0,29**
Fixed Income Arb.	-0,10	0,03	-0,09	-0,05	0,10	-0,01	**0,33**
Global Macro	-0,11	0,05	-0,11	-0,05	0,14	0,16	-0,01
Long/Short Equity	**0,48**	**0,61**	**0,53**	0,26	0,20	0,22	**0,42**
Managed Futures	**-0,34**	-0,26	**-0,29**	**-0,43**	**0,29**	**0,35**	**-0,29**
Multi-Strategy	0,08	0,12	-0,03	-0,06	0,12	0,04	**0,34**
Panel B: *Traditional Asset Classes*							
MSCI World	1						
MSCI emerging	**0,57**	1					
NASDAQ	**0,72**	**0,56**	1				
S&P 500	**0,83**	**0,42**	**0,74**	1			
S&P GSCI	0,02	0,22	-0,01	-0,18	1		
Lehm. Global Agg.	-0,06	-0,09	-0,19	**-0,31**	0,19	1	
Lehm.US High-Yield	**0,33**	**0,29**	**0,32**	**0,39**	0,00	0,07	1

Spearman's correlation coefficients between CS/Tremont hedge fund strategies and traditional assets and between traditional assets in bear markets. Significance is in bold, and tested with a two-tailed t-test, at a 5% significance level. N=122

Appendix 5: Pearson's Correlation Coefficients in Bull and Bear Markets

	Pearson's Correlation Coefficient in Bull Markets January 1998 - February 2008						
	MSCI World	MSCI EM	NASDAQ	S&P 500	S&P GSCI	Leh.Glob Aggr.	Leh. US High-Yield
Panel A: *CS/Tremont*							
CS/Tremont Index	0,07	0,20	**0,34**	-0,11	0,20	-0,11	0,12
Convertible Arbitrage	0,06	0,07	0,13	-0,03	-0,01	-0,03	**0,29**
Dedicated Short Bias	**-0,53**	**-0,24**	**-0,65**	**-0,52**	0,01	-0,03	-0,15
Emerging Markets	**0,30**	**0,66**	0,20	0,04	0,21	-0,16	0,15
Equity Market Neutral	**0,30**	**0,28**	0,01	**0,24**	0,09	0,18	-0,07
Event Driven	**0,28**	**0,43**	0,18	0,02	-0,01	-0,17	**0,33**
- Distressed	**0,24**	**0,30**	0,14	0,04	-0,08	-0,10	**0,51**
- Multi-Strategy	0,23	**0,40**	0,20	-0,01	0,02	-0,22	0,16
- Risk Arbitrage	**0,32**	**0,46**	0,15	0,15	0,10	0,12	0,04
Fixed Income Arb.	-0,10	0,07	0,01	-0,20	0,14	0,01	**0,30**
Global Macro	-0,08	0,08	0,09	-0,19	0,08	-0,09	0,18
Long/Short Equity	0,20	0,21	**0,55**	0,06	0,22	-0,04	-0,05
Managed Futures	-0,09	0,12	**-0,23**	-0,14	0,21	**0,29**	0,02
Multi-Strategy	-0,01	0,07	0,09	-0,12	0,07	0,16	**0,28**
Panel B: *Traditional Asset Classes*							
MSCI World	1						
MSCI emerging	**0,45**	1					
NASDAQ	**0,44**	0,22	1				
S&P 500	**0,87**	**0,29**	**0,50**	1			
S&P GSCI	-0,13	0,12	0,02	-0,18	1		
Lehman Global Agg.	0,02	-0,09	-0,17	-0,04	0,13	1	
Lehman US High-Yield	0,00	0,22	0,14	-0,02	-0,17	0,13	1

Pearson's correlation coefficients between CS/Tremont hedge fund strategies and traditional assets and between traditional assets in bull markets. Significance is in bold, and tested with a two-tailed t-test, at a 5% significance level. N=122.

	Pearson's Correlation Coefficient in Bear Markets January 1998 – February 2008						
	MSCI World	MSCI EM	NASDAQ	S&P 500	S&P GSCI	Leh.Glob Aggr.	Leh.US High-Yield
Panel A: *CS/Tremont*							
CS/Tremont Index	**0,52**	**0,71**	**0,51**	**0,45**	0,20	0,11	**0,44**
Convertible Arb.	0,10	0,17	0,03	0,16	0,07	-0,23	**0,46**
Ded. Short Bias	**-0,61**	**-0,67**	**-0,65**	**-0,64**	-0,03	0,13	**-0,48**
Emerging Markets	**0,57**	**0,86**	**0,52**	**0,55**	0,15	-0,09	**0,36**
Equity Market Neut.	0,10	0,15	-0,01	0,10	0,07	-0,10	0,09
Event Driven	**0,57**	**0,71**	**0,40**	**0,55**	0,23	-0,18	**0,55**
- Distressed	**0,55**	**0,65**	**0,43**	**0,55**	0,13	-0,22	**0,57**
- Multi-Strategy	**0,55**	**0,72**	**0,36**	**0,51**	**0,28**	-0,15	**0,52**
- Risk Arbitrage	**0,47**	**0,50**	0,23	**0,44**	0,17	-0,09	**0,47**
Fixed Income Arb..	0,17	0,15	-0,01	0,17	0,06	-0,14	**0,31**
Global Macro	0,07	0,21	-0,02	0,07	0,15	0,23	0,02
Long/Short Equity	**0,58**	**0,74**	**0,61**	**0,49**	0,17	0,12	**0,40**
Managed Futures	**-0,51**	**-0,37**	**-0,39**	**-0,58**	**0,28**	**0,42**	**-0,41**
Multi-Strategy	0,01	0,08	-0,02	-0,10	0,17	-0,05	**0,31**
Panel B*: Traditional Asset Classes*							
MSCI World	1						
MSCI emerging	**0,71**	1					
NASDAQ	**0,74**	**0,61**	1				
S&P 500	**0,93**	**0,62**	**0,77**	1			
S&P GSCI	0,06	0,26	-0,01	-0,08	1		
Lehm. Global Agg.	-0,15	-0,08	-0,15	**-0,32**	0,20	1	
Lehm.US High-Yield	**0,49**	**0,43**	**0,39**	**0,50**	0,04	-0,05	1

Pearson's correlation coefficients between CS/Tremont hedge fund strategies and traditional assets and between traditional assets in bear markets. Significance is in bold, and tested with a two-tailed t-test, at a 5% significance level. N=122

Appendix 6: Unsmoothed Summary Statistics for CS/Tremont

	Summary Statistics Monthly Returns January 1998 – February 2008								
	Mean	**SD**	**Min**	**Max**	**Skewn.**	**Excess Kurtois**	**Jarque-Bera**	**AR(1)**	**Q3**
Panel A: *CS/Tremont*									
Convertible Arbitrage	0,64	2,47	-10,01	9,07	-0,82	3,99	**94,91***	-0,03	3,17
Dedicated Short Bias	-0,06	5,73	-10,29	25,35	0,96	2,33	**46,19***	0,01	0,52
Emerging Markets	0,79	5,17	-29,95	17,15	-1,80	10,24	**599,24***	0,01	1,10
Equity Market Neutral	0,80	0,90	-1,20	3,19	0,35	-0,37	3,22	0,01	0,61
Event Driven	0,83	2,35	-16,92	4,15	-3,77	25,95	**3710,64***	-0,01	0,34
- Distressed	0,90	2,42	-17,53	5,74	-3,82	27,54	**4152,35***	-0,02	0,43
- Multi-Strategy	0,80	2,54	-16,08	5,89	-2,51	15,37	**1328,94***	-0,02	0,87
- Risk-Arbitrage	0,56	1,71	-8,30	5,42	-0,89	6,11	**205,69***	0,03	2,32
Fixed Income Arbitrage	0,40	1,62	-8,79	6,37	-1,59	9,76	**535,80***	0,07	4,31
Global Macro	0,97	3,12	-13,59	13,32	-0,48	5,70	**169,79***	0,00	0,42
Long/Short Equity	0,96	3,43	-13,30	13,74	0,13	4,07	**84,33***	0,00	0,19
Managed Futures	0,72	3,96	-10,23	11,43	-0,02	-0,17	0,16	0,02	3,68
Multi-Strategy	0,73	1,37	-6,15	3,70	-1,21	4,66	**139,89***	0,01	0,70
CS/Tremont Index	0,75	2,13	-8,60	8,97	-0,07	4,82	**118,19***	0,07	1,48
Panel B: *Stock Indices*									
MSCI Emerging Markets	0,94	7,73	-32,59	14,71	-0,94	1,97	**38,74***	0,00	0,26
MSCI World	0,41	4,51	-14,88	9,69	-0,58	0,69	**9,59***	0,01	1,69
NASDAQ	0,56	8,52	-24,30	22,50	-0,22	0,64	3,17	0,00	0,02
S&P 500	0,27	4,41	-16,21	9,58	-0,65	1,10	**15,07***	0,01	1,48
Panel C: *Commodity Index*									
S&P GSCI	0,89	6,43	-14,41	16,89	0,08	-0,40	0,98	0,03	6,12
Panel D: *Bond Indices*									
Lehman Global	0,53	1,79	-4,43	5,63	0,11	0,22	0,50	0,02	4,66
Lehman US High Yield	0,44	2,47	-8,58	8,47	-0,47	2,94	**49,64***	0,01	1,70

Summary statistics of monthly unsmoothed returns in the period from January 1998 to February 2008. Panel A: CS/Tremont, panel B: Stock indices, panel C: Commodity index and panel D: Bond indices. AR(1) is the first order autocorrelation of returns. Q(3) is the statistics of the Ljung-Box test. Significance are in bold at 1%* N=122.

Appendix 7: Unsmoothed Performance Measures for CS/Tremont

	Unsmoothed Annualized Performance Measurement January 1998 – February 2008								
	Sharpe Ratio	Mod. SR	AR Adj. SR	Omega		Sortino		$Kappa_3$	
				τ=0	τ=rf	τ=0	τ=rf	τ=0	τ=rf
***Panel A**: CS/Tremont*									
Convertible Arb.	0,50 *10*	0,18 *13*	0,51 *10*	2,08 *11*	1,52 *10*	1,36 *11*	0,71 *11*	0,86 *10*	0,46 *12*
Ded. Short Bias	-0,21 *21*	-0,13 *21*	-0,20 *21*	0,97 *21*	0,86 *21*	-0,05 *21*	-0,31 *21*	-0,04 *21*	-0,25 *21*
Emerging Markets	0,34 *15*	0,11 *15*	0,34 *15*	1,54 *15*	1,32 *14*	0,71 *17*	0,45 *15*	0,42 *17*	0,26 *15*
Equity Market Neut.	2,02 *1*	0,76 *1*	1,99 *1*	12,86 *1*	5,00 *1*	13,83 *1*	5,78 *1*	8,86 *1*	3,94 *1*
Event Driven	0,80 *4*	0,21 *8*	0,80 *4*	2,82 *4*	1,99 *4*	1,61 *9*	1,01 *7*	0,82 *12*	0,52 *8*
- Distressed	0,88 *3*	0,23 *6*	0,89 *3*	3,09 *3*	2,20 *3*	1,72 *8*	1,12 *6*	0,86 *9*	0,57 *7*
- Multi-Strat.	0,70 *7*	0,19 *10*	0,71 *6*	2,47 *7*	1,80 *7*	1,54 *10*	0,94 *8*	0,82 *11*	0,51 *9*
- Risk-Arb.	0,57 *9*	0,19 *11*	0,55 *9*	2,43 *8*	1,62 *9*	1,72 *7*	0,85 *9*	1,06 *7*	0,50 *10*
Fixed Income Arb.	0,25 *16*	0,08 *17*	0,24 *16*	2,60 *6*	1,24 *16*	1,87 *5*	0,33 *16*	1,07 *6*	0,20 *17*
Global Macro	0,76 *5*	0,27 *5*	0,76 *5*	2,06 *12*	1,90 *5*	1,22 *12*	1,16 *4*	0,71 *14*	0,71 *5*
Long/Short Equity	0,69 *8*	0,28 *4*	0,69 *8*	2,24 *9*	1,76 *8*	1,74 *6*	1,14 *5*	1,08 *5*	0,72 *4*
Managed Futures	0,38 *13*	0,18 *12*	0,38 *13*	1,57 *14*	1,32 *15*	1,05 *13*	0,60 *13*	0,78 *13*	0,45 *13*
Multi-Strategy	1,13 *2*	0,36 *2*	1,11 *2*	4,09 *2*	2,40 *2*	3,24 *2*	1,74 *2*	1,86 *2*	1,05 *2*
CS/Tremont Index	0,75 *6*	0,28 *3*	0,71 *7*	2,76 *5*	1,86 *6*	2,18 *3*	1,22 *3*	1,30 *4*	0,75 *3*
***Panel B:** Stock Indices*									
MSCI EM	0,38 *14*	0,15 *14*	0,38 *14*	1,46 *17*	1,32 *13*	0,72 *16*	0,52 *14*	0,48 *16*	0,35 *14*
MSCI World	0,12 *19*	0,05 *19*	0,12 *19*	1,29 *18*	1,10 *19*	0,48 *18*	0,17 *19*	0,34 *18*	0,12 *19*
NASDAQ	0,14 *18*	0,07 *18*	0,14 *18*	1,22 *19*	1,12 *18*	0,38 *18*	0,20 *18*	0,27 *19*	0,15 *18*
S&P500	-0,02 *20*	-0,01 *20*	-0,02 *20*	1,16 *20*	0,98 *20*	0,28 *20*	-0,03 *20*	0,19 *20*	-0,02 *20*
***Panel C:** Commodity Index*									
S&P GSCI	0,40 *12*	0,19 *9*	0,39 *12*	1,48 *16*	1,33 *12*	0,92 *14*	0,63 *12*	0,92 *8*	0,49 *11*
***Panel D:** Bond Indices*									
Leh. Global Aggr.	0,48 *11*	0,22 *7*	0,48 *11*	2,13 *10*	1,42 *11*	1,91 *4*	0,78 *10*	1,38 *3*	0,58 *6*
Leh. US High-Yield	0,21 *17*	0,09 *16*	0,21 *17*	1,61 *13*	1,19 *17*	0,91 *15*	0,30 *17*	0,61 *15*	0,20 *16*

Unsmoothed annualized performance measurement for CS/Tremont indices and various indices. Omega, $Kappa_3$ and Sortino is calculated for two different thresholds τ. T-bill is used as rf. The ranking of each fund is marked in red. N = 122.

Appendix 8: Spearman's Correlation Coefficients for Unsmoothed Returns

	Spearman's Correlation Coefficients for Unsmoothed Returns January 1998 – February 2008						
	MSCI EM	MSCI World	NASDAQ	S&P 500	S&P GSCI	Lehm.Glob. Aggr.	Lehm. US High-Yield
Panel A: *CS/Tremont Indices*							
Convertible Arbitrage	**0,21**	**0,21**	**0,19**	0,17	0,04	-0,01	**0,46**
Dedicated Short Bias	**-0,66**	**-0,80**	**-0,83**	**-0,80**	-0,06	0,00	**-0,53**
Emerging Markets	**0,84**	**0,68**	**0,57**	**0,58**	0,17	-0,01	**0,38**
Equity Market Neutral	**0,36**	**0,40**	**0,20**	**0,33**	0,12	0,07	0,11
Event Driven	**0,70**	**0,66**	**0,65**	**0,58**	0,16	0,00	**0,56**
- Distressed	**0,56**	**0,56**	**0,59**	**0,52**	0,09	-0,03	**0,59**
- Multi-Strategy	**0,70**	**0,63**	**0,60**	**0,56**	0,16	-0,03	**0,46**
- Risk Arbitrage	**0,51**	**0,47**	**0,41**	**0,41**	0,13	0,15	**0,31**
Fixed Income Arbitrage	**0,20**	**0,19**	0,18	0,15	0,15	0,13	**0,30**
Global Macro	**0,26**	**0,18**	0,13	0,13	0,13	0,07	0,11
Long/Short Equity	**0,69**	**0,76**	0,71	**0,68**	**0,22**	0,09	**0,43**
Managed Futures	0,11	0,05	-0,03	0,00	**0,26**	**0,27**	0,00
Multi-Strategy	**0,44**	**0,50**	**0,39**	**0,41**	0,10	0,14	**0,43**
CS/Tremon Index	**0,64**	**0,65**	**0,59**	**0,56**	**0,20**	0,06	**0,46**
Panel B: *Traditional Indices*							
MSCI Emerging Markets	1						
MSCI World	**0,78**	1					
NASDAQ	**0,68**	**0,83**	1				
S&P 500	**0,70**	**0,95**	**0,86**	1			
S&P GSCI	0,16	0,03	0,03	-0,07	1		
Lehman Global Aggr.	-0,06	0,01	-0,14	-0,09	**0,19**	1	
Lehman US High-Yield	**0,41**	**0,45**	**0,45**	**0,46**	-0,03	0,11	1

Spearman's correlation coefficients for unsmoothed returns between CS/Tremont hedge fund strategies and traditional assets (Panel A). Spearman's correlation coefficients for unsmoothed returns between traditional assets (Panel B). Significance is in bold, and tested with a two-tailed t-test, at a 5% significance level. N=122

Appendix 9: Correlation of Norwegian Hedge Funds with Traditional Assets

	Correlation of Norwegian Hedge Funds with Traditional Assets January 2004 - February 2008							
	MSCI EM	MSCI Norway	MSCI World	NASDAQ	S&P 500	S&P GSCI	Lehm. Glob Agg	Lehm.US High-Yield
Panel A: *CS/Tremont*								
Discovery	**0,40**	**0,35**	**0,46**	**0,29**	**0,33**	0,08	**0,43**	0,23
Interkraft	0,18	0,21	0,25	0,18	0,17	0,07	**0,36**	0,20
Sector Maritime	**0,36**	**0,44**	**0,32**	0,01	0,10	**0,37**	**0,29**	0,13
WW Diversified	**0,45**	**0,41**	**0,51**	**0,37**	**0,36**	0,12	0,16	**0,31**
WW MultiStrategy	**0,39**	**0,39**	**0,34**	0,14	0,12	0,24	**0,50**	0,02
WW Nordic Hedge	**0,41**	**0,43**	**0,39**	0,24	0,22	**0,29**	**0,33**	0,11
Nordic Alpha	**0,37**	**0,34**	**0,45**	**0,35**	**0,33**	0,14	**0,34**	0,26
FMG Bio-Med	0,25	**0,29**	**0,36**	**0,37**	**0,34**	-0,01	-0,14	**0,31**
FMG Global	**0,75**	**0,63**	**0,81**	**0,59**	**0,64**	0,12	-0,07	**0,30**
Average	**0,50**	**0,49**	**0,55**	**0,35**	**0,36**	0,20	**0,36**	**0,28**
Panel B**:** *Traditional Asset Classes*								
MSCI EM	1							
MSCI Norway	**0,71**	1						
MSCI World	**0,78**	**0,64**	1					
NASDAQ	**0,54**	**0,41**	**0,81**	1				
S&P500	**0,57**	**0,44**	**0,89**	**0,89**	1			
S&P GSCI	0,26	**0,47**	0.00	-0,15	-0,23	1		
Leh.Global Agg.	0,18	0,15	0,08	-0,06	-0,05	0,12	1	
Leh.High-Yield	**0,38**	**0,36**	**0,58**	**0,55**	**0,65**	-0,02	0,22	1

Spearman's rank correlation of individual Norwegian Hedge funds with traditional assets using Spearman's rank correlation. Panel A: CS/Tremont and Panel B: Traditional Asset Classes. Significance is in bold, and tested with a two-tailed t-test, at a 5% significance level. N=50.

Appendix 10: Summary Statistics of Norwegian Funds before Converting

	Summary Statistics Monthly Return January 2004 - February 2008								
	Mean	**SD**	**Min**	**Max**	**Skewn.**	**Excess Kurt.**	**Jarque-Bera**	**AR(1)**	**Q(3)**
Discovery	0,28	1,52	-4,44	4,97	0,32	2,72	**16,25***	0,16	**9,65**
FMG Bio-Med	0,33	2,15	-6,48	4,19	-0,76	0,79	**6,17**	-0,05	3,52
FMG Global	0,40	2,16	-8,00	3,05	-1,49	3,33	**41,70***	0,12	2,04
Interkraft Energy	0,66	2,40	-9,42	5,66	-1,21	5,56	**76,79***	0,10	4,95
Nordic Alpha	0,77	1,95	-6,89	4,44	-1,12	4,22	**47,70***	0,02	2,12
Sector Maritime	1,18	2,61	-4,94	6,93	0,07	0,11	0,07	0,16	2,22
WW Diversified	1,62	2,91	-7,45	7,46	-0,61	0,94	4,95	0,13	0,97
WW MultiStrategy	0,51	0,92	-1,35	2,80	0,01	-0,25	0,14	0,01	2,40
WW Nordic Hedge I	0,37	1,46	-6,03	4,23	-1,34	7,35	**127,59***	0,14	2,60
Average	0,68	1,34	-4,95	2,70	-1,45	4,97	**69,01***	0,14	4,79

Summery statistics of monthly returns in the period from January 2004 to February 2008. Significant number are bold at 1%* and 5% level. AR(1) is the first order autocorrelation of returns. Q(3) is the statistics of the Ljung-Box test. N=50.

Appendix 11: Performance Measurement of Norwegian Funds before Converting

	Annualized Performance Measurement January 2004 – February 2008								
	Sharpe Ratio	**Mod. SR**	**AR Adj. SR**	**Omega**		**Sortino**		**Kappa$_3$**	
				τ=0	τ=rf	τ=0	τ=rf	τ=0	τ=rf
Discovery Fund	0,01	0,00	0,01	1,72	1,40	1,10	0,01	0,73	0,01
FMG Bio-Med	0,09	0,04	0,10	1,47	1,37	0,54	0,12	0,77	0,09
FMG Global	0,20	0,07	0,18	1,60	1,39	0,88	0,26	0,58	0,18
Interkraft Energy	0,56	0,19	0,56	2,24	1,55	1,44	0,79	0,86	0,48
Nordic Alpha	0,88	0,29	0,88	3,09	1,62	2,19	1,33	1,32	0,83
Sector Maritime	1,20	0,51	1,20	3,41	1,62	3,40	2,43	2,30	1,68
WW Multi-Strategy	1,90	0,00	1,90	3,83	1,48	4,45	1,49	3,25	1,14
WW Nordic Hedge	0,23	0,08	0,23	2,12	1,49	1,29	0,32	0,76	0,20
WW Diversified	1,60	0,57	1,60	4,01	1,67	3,77	3,00	2,45	1,98
Average	1,04	0,33	1,04	3,86	1,60	2,95	1,63	1,70	0,98

Annualized performance measurement for CS/Tremont Index, Norwegian funds and various indices before converting returns into dollars. Omega, Kappa$_3$ and Sortino is calculated for two different thresholds τ. T-bill is used as rf. N=50.