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Are Hedge Funds An Attractive Investment Opportunity For A Norwegian Private Investor?

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ABSTRACT

A recent Norwegian legislative proposal, likely to become law in 2014, suggests that hedge funds should be able to approach non-professional, private investors. In light of this, the objective of our thesis is to examine if hedge funds are an attractive investment opportunity for a Norwegian private investor. By defining two sub-questions, we use empirical research and relevant academic literature to study several aspects of hedge funds. Based on the Sharpe ratio and the Modified Sharpe ratio, we find support for hedge funds providing an attractive risk/reward relationship. However, these performance evaluations are insufficient due to the illiquidity of hedge funds, the leverage risks, and the returns biases. As the efficient frontiers of stocks and bonds improve when hedge funds are included, one can argue that hedge funds provide unique returns. However, the non-normality, skewness, and kurtosis may distort the efficient frontiers. In addition, the calculated correlations between hedge funds and traditional assets, as well as the similarities between the payoff structure of hedge funds and short put options, indicate that hedge funds are not providing unique exposure. In total, our recommendation for Norwegian private investors is to be cautious with regards to investing in hedge funds. This is due to the fact that the performance of hedge funds may be distorted, the risk management features may be lower than expected, and hedge funds will likely be an expensive way of obtaining an unattractive payoff structure.

PREFACE

This thesis completes our Double Degree of Master of Science in Financial Economics from the Norwegian School of Economics (NHH) and Master of Science in Management from Louvain School of Management (LSM).

The topic chosen for this thesis was hedge funds. The hedge fund industry has grown tremendously the last decades, and the legal environment in Norway regarding hedge funds is evolving. The common perception of high returns and managers receiving extreme payoffs intrigued us. With an expected liberalisation of hedge fund regulations in Norway, our topic for this thesis is as relevant as ever.

Through our years at NHH and semesters at LSM, we have experienced an increasing interest in finance. A large contributing factor to this has been the excellent finance courses at NHH and LSM. Our knowledge from these courses has been used to answer the research question to the best of our ability.

Writing this thesis has been a challenging and educational experience, where we have achieved a substantial insight into the world of hedge funds. We would like to express our gratefulness for the constructive feedback and the great support we have received from our supervisors, Trond M. Døskeland (NHH) and Philippe Grégoire (LSM).

Date: 21. May 2014, Brussels

Anders Norheim Kvistad

Wilhelm Elias Monclair Thorne

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1.0 INTRODUCTION

This thesis is written in light of the expected liberalisation of hedge fund regulation in Norway, allowing hedge funds to market themselves directly to non-professional investors. We are analysing from a Norwegian private investor's point of view, where the private investor is defined as a risk-averse and non-professional investor. The time period for this analysis is from the beginning of January 2004 to the end of December 2013. Using historical returns as a proxy for expected returns in our research, the findings will give an indication of how hedge funds could perform in the future. The objective of this thesis is to examine the research question:

> *Are hedge funds an attractive investment opportunity for a Norwegian private investor?*

To examine our research question, we have developed two sub-questions. In sub-question I, we look into the following:

> *Do hedge funds provide an attractive risk/reward relationship for a private investor?*

To analyse sub-question I, we explore three aspects regarding the risk/reward relationship of hedge funds. The first aspect is the Sharpe ratio, making it possible to rank standalone investment opportunities. The second aspect is to calculate key statistics, providing insight regarding the normality, skewness, and kurtosis of hedge fund returns. These statistical properties will be used to discuss the relevance of the mean-variance framework. The third and final aspect is to consider the criticism of the mean-variance framework by adjusting the risk measure. To incorporate the adjusted risk measure, we will use the Modified Sharpe ratio instead of the traditional Sharpe ratio to rank the different standalone investments.

In sub-question II, we look into the following:

> *Are hedge funds providing a unique exposure compared to other asset classes for a private investor?*

To analyse sub-question II, we explore three aspects regarding the unique exposure of hedge funds. The first aspect explores if hedge funds provide returns that are uncorrelated from other assets, hence attractive in terms of risk management and justifying the substantial fees demanded by hedge funds managers. The second aspect involves calculating efficient

frontiers for an investment universe consisting of stocks and bonds, both with and without the possibility of investing in hedge funds. The efficient frontiers provide insight regarding the risk management opportunities and justification of hedge funds' use of fees. The third aspect investigates the similarity between the payoff structures of hedge funds and short put options. This will provide us with insight regarding the cost, and the attractiveness of the hedge funds return structure for a private investor.

By elaborating on the two sub-questions, we will be able to analyse if hedge funds are an attractive investment opportunity for a Norwegian private investor. Hedge funds have been analysed in several research papers, and some of the research papers will be presented in this thesis. The mission of our thesis is to add to the research conducted on hedge funds by using Nordic hedge fund data, and by scoping the thesis directly towards a private investor.

1.1 Structure of the thesis

In chapter 2-7, we elaborate on theoretical aspects related to this thesis. Chapter 2 introduces hedge funds. In chapter 3, we look into the statistical properties of hedge fund returns. Chapter 4 explains modern portfolio theory, while chapter 5 elaborates on risk-adjusted performance measures. In chapter 6, we present nine common hedge fund strategies that will be used in the empirical research. The last chapter in the theoretical part of this thesis is chapter 7, presenting the different biases inherent in hedge fund returns data.

In chapter 8, the description of the data that will be used in the empirical research is presented. Chapter 9 consists of the findings and discussion of the findings with regards to sub-question I: The Risk/Reward Relationship of Hedge Funds. Chapter 10 consists of the findings and discussion of the findings with regards to sub-question II: The Uniqueness of Hedge Fund Returns.

Chapter 11 provides limitations and suggestions for further research with regards to the empirical research. In Chapter 12, the final chapter, we present our conclusion. After the conclusion, an appendix is included for more detailed elaborations and illustrations of the findings.

2.0 THE WORLD OF HEDGE FUNDS

This chapter introduces the concept of hedge funds. In the first section, we look into the history of hedge funds. The second section elaborates on the different characteristics of hedge funds, while the third section explains different ways of accessing hedge funds. In the fourth and final section, we elaborate on the Norwegian hedge fund market.

2.1 History

> "Any idiot can make a big return by taking a big risk. You just buy the S&P, you lever up – there's nothing clever about that. What`s clever is to have a return that is risk-adjusted." (Mallaby, 2010)

The beginning of the hedge fund industry is often dated to 1949, widely acknowledged as the year Alfred Winslow Jones set up the first modern hedge fund[1]. However, according to Lhabitant (2006), the first techniques of a modern hedge fund should be credited Karl Karsten. In his work, Karsten presented the "hedge principle": if one expects that some stocks, for example motor stocks, on average will outperform the equity market, then one should buy motor stocks and sell short an equally large amount in dollar value of the market (Lhabitant, 1996). In December 1930, the Karsten Statistical Laboratory started a small fund to test Karsten's research. By June 1931 the fund was up 78%. As Karsten's objective was mainly to justify his theories, and not to earn profits, it still remains a mystery for how long the fund lasted. Opposed to Karsten, Alfred Winslow Jones created a private investment partnership solely to earn money, making him the first hedge fund manager (Lhabitant, 1996).

Similar to Karsten, Jones did not primarily have a financial background as he studied sociology, but he became familiar with finance when he worked for Fortune Magazine during the start of the 1940s. By 1948, Jones had left Fortune and started working on an article as a freelancer, titled "Fashions in Forecasting". The article was about exploring different techniques for market timing, and the research gave Jones the idea to start investing himself (Brown & Christy, 2001). According to Mallaby (2010), Jones' hedge fund followed four main principles. The first principle was the use of a performance fee. Jones kept 20 % of the investment gains from the fund for himself and his team, a measure to sharpen the incentives

[1] The A.W Jones hedge fund is still active today.

of investment managers. Secondly, Jones was eager to avoid regulation, and he deliberately did not advertise the fund to the public in general. This way the fund could invest in any asset class and use any technique that they felt best suited the market situation at any time. The third principle was that Jones balanced his long positions in promising shares, and combined this with short positions in unpromising shares. By doing this correctly, the portfolio would presumably reduce its exposure to general market swings. The final principle was the use of leverage. By reducing the market risk, Jones had the possibility to increase stock specific risk by leveraging his positions.

Throughout the 1960s, hedge funds gained recognition as they delivered huge returns. In 1966, a Fortune Magazine article titled "The Jones nobody keeps up with" highlighted the outstanding record of Jones' hedge fund. Jones had outperformed the best performing mutual fund over the last five years, gaining a return of 670 % over the period compared to the mutual fund's 358% (Fortune Magazine, 1966).

The late 1960s saw the beginning of the hedge funds of Michael Steinhardt, George Soros and several other well-known financial heavyweights. According to Gabelli (2000), there were approximately 200 hedge funds in 1968. Even though Steinhardt and Soros would prove to be quite successful, the hedge fund industry suffered badly during the 1969-70 recession and during the stock market crash of 1973-74 (Ineichen, 2002). When Tremont Partners started researching the hedge fund industry in 1984, they were only able to find 68 funds (Gabelli, 2000).

During the 1980s and 1990s, hedge funds again started to attract much attention from the media and the industry boomed. Tremont Partners estimated that there were approximately 4000 hedge funds in 1999 (Gabelli, 2000). This development continued into the 2000s, and at the end of 2013, hedge funds had approximately 2.600 billion USD in assets under management (BarclayHedge, 2014).

The history of hedge funds has shown that the combination of long/short positions and leverage can be applied to a wide range of financial instruments. Examples of this are how Soros made a fortune trading in currencies ("breaking" the bank of England), how Robertson used derivatives, and how Simons applied advanced mathematics to predict price movements (sparking off the quant movement).

2.2 Characteristics of hedge funds

Hedge funds exhibit a number of different characteristics. There is no single, unitary definition of hedge funds. Ang (2013) states that hedge funds should be defined by what they are not. As most hedge funds are exempt from regulations regarding responsibilities and limitations usually placed on mutual funds, Ang (2013) argues that hedge funds are basically an investment opportunity for rich people. Rich people have the possibility to hire the needed help, and hence they are not in a need of comprehensive investor protection. By stepping out of the regulation scheme to protect investors, hedge funds get a higher degree of flexibility with regards to how they invest, how they disclose information, and how they pay their managers (Ang, 2013).

One of the most apposite definitions of hedge funds, is given by the co-founder of the hedge fund AQR Capital Management, Clifford Asness:

> "Hedge funds are investment pools that are relatively unconstrained in what they do. They are relatively unregulated (for now), charge very high fees, will not necessarily give you your money back when you want it, and will generally not tell you what they do. They are supposed to make money all the time, and when they fail at this, their investors redeem and go to someone else who has recently been making money. Every three or four years they deliver a one-in-a-hundred year flood. They are generally run for rich people in Geneva, Switzerland, by rich people in Greenwich, Connecticut." (Asness, 2004).

As pointed out, there are several common characteristics that separate hedge funds from other investment funds. These characteristics will be elaborated on in the following sub-sections.

2.2.1 Active management

A common characteristic of hedge funds is that they are actively managed. Opposed to passively managed funds, a fundamental assumption of actively managed funds is that the manager has the ability to add value beyond the underlying development of the market (Mallaby, 2010). The implication of this is that the managers reject the efficient market hypothesis, at least in its stronger forms. Ilmanen (2012) states that by investing in hedge funds you bet on the mangers' skill in identifying and exploiting profit opportunities.

2.2.2 Absolute returns

As an actively managed fund, hedge funds have the ability, and perhaps obligation, to separate its performance from the underlying market development. As seen from the original hedge fund of Winslow, a main objective was to hedge away the market risk and aim for absolute returns. Absolute returns deviates from relative returns, as absolute return funds are expected to earn a positive return regardless of any benchmark returns (Stefanini, 2006).

Stulz (2007) refers to the operations of the now famous failure Long-Term Capital Management (LTCM)[2], as an example of a hedging approach supporting absolute returns. LTCM specialised in identifying bonds that were mispriced. The hedge fund sold bonds that were overvalued, while hedging its position against interest rate risk and other relevant risk factors. The idea was that the return of the investment would only depend on the corrections in the mispricing of the bonds, and not on other market factors.

Today, many hedge funds still follow an absolute return approach, though this does not necessarily apply to all hedge funds. As stated by Stulz (2007), not all positions of hedge funds are hedged; hedge funds may not hedge because it is expensive, or as their positions simply cannot be hedged.

2.2.3 Minimums are high

As seen from Asness' definition, hedge funds are investment vehicles for rich people. Hedge funds' exempt from regulation is based on the principle that only "accredited investors"[3], meaning rich people or investment professionals, can invest in the funds (Stulz, 2007). In order to avoid registration under the 1934 Securities Exchange Act in US jurisdiction, hedge funds cannot have more than 499 "qualified purchasers"[4]. The criteria for being a "qualified purchaser" are even stricter than being an "accredited investor". In other words, hedge funds

[2] Long Term Capital Management (LTCM) was a hedge fund utilising absolute-return trading strategies with high financial leverage. LTCM was famous for their Nobel Prize winners, Myron S. Scholes and Robert C. Merton. The failure of LTCM nearly collapsed the global financial system in 1998 (Lowenstein, 2000).
[3] An accredited investor has individual or net worth above $1 million or individual income above $200,000 or joint income of $300,000 in each of the past two years. Institutional investors must have assets exceeding $5 million (Ang, 2013).
[4] Qualified purchasers have at least $5 million in investments. Institutional investors invest at least $100 million or they are pension funds and trusts with at least $25 million in assets (Ang, 2013).

have a limited number of investors and require high minimum investments. However, fund of hedge funds may have lower minimums (Ang, 2013).

2.2.4 Limited access to capital

Most investors in mutual funds have the possibility to get their money back at a daily basis. This is in a sharp contrast to hedge funds where the investors have to accept a longer lock-up period for their investments (Ang, 2013). Most hedge funds allow for withdrawal at a monthly or quarterly basis (Lins, Lemke, Hoenig, & Rube, 2013). Ang (2013) argues that the main reason for the limited access to capital is hedge funds' significant exposure against short positions and other liquidity sensitive positions. Ilmanen (2012) claims that the limited access to capital represent an option-like cost to hedge fund investors, due to the reduced flexibility.

2.2.5 Leverage and Derivatives

An exotic feature of hedge funds is their ability to employ a huge set of different investment strategies**.** Ang (2013) highlights that the use of leverage and derivatives are common investment tools for hedge funds. There is no official reported leverage ratio used by hedge funds due to their limited disclosure. However, an OECD report from 2007 estimated the aggregated hedge fund industry to maintain a leverage ratio above 3:1 (OECD, 2007). Ang et al. (2011) provides similar results, finding gross leverage ratios to be approximately 2:1. Naturally, there is a huge variation in the use of leverage among hedge funds; Long-Term Capital Management had a leverage ratio of 28:1 in 1995 (Schinasi & Todd Smith, 2000). However, the overall perception of hedge funds' use of leverage is probably exaggerated. Compared to investment banks, hedge fund leverage ratios are fairly modest, see figure 1 (Ang, Gorovyy, & van Inwegen, Hedge fund leverage, 2011). One extreme example is Lehman Brothers, which had an accounting leverage ratio of approximately 31:1 in 2007 (Lehman Brothers, 2007). Hedge fund manager Michael Hintze of CQS, stated the following to Financial Times in 2012:

> "Hedge funds are presently leveraged one to three times; if they are mad, five times; if they are insane, 10 times. But 15 or 20 times was normal for banks' trading desks." (Financial Times, 2012)

Hedge funds use leverage when they find it attractive because they have the possibility. Leverage amplifies market risk and is used by hedge funds to generate returns on assets, which on an unlevered basis would not be sufficient to attract funds (Ang, Gorovyy, & van Inwegen, 2011).

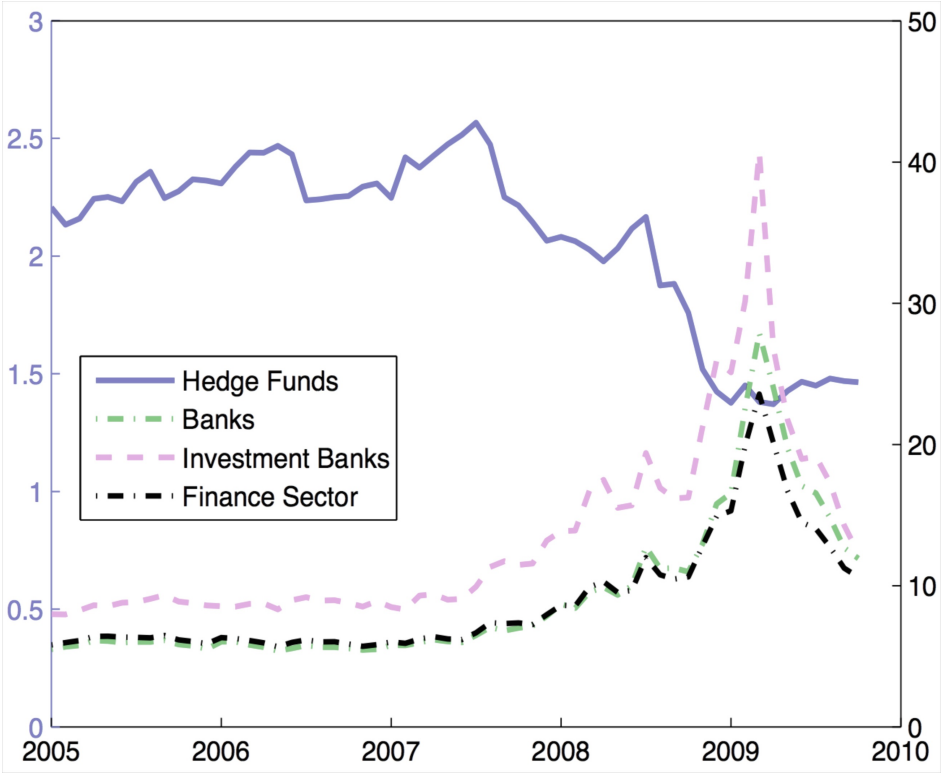


Figure 1: Ang et al. (2011) compared average gross hedge fund leverage with the leverage of banks, investment banks, and the finance sector. The left-hand axis corresponds to average gross hedge fund leverage and the right-hand axis corresponds to the leverage of banks, investment banks, and the finance sector. Source: (Ang, Gorovyy, & van Inwegen, 2011)

Chen (2010) argues that derivatives represent a substantial portion of hedge fund investments. Depending on the purpose, derivatives may both reduce and increase the risk of the investments. The fact that 71 per cent of hedge funds trade derivatives, illustrates the significant use of derivatives by hedge funds (Chen, 2010). In comparison, the findings in Koski & Pontiff (1999) showed that "only" 21 per cent of mutual funs apply derivatives. In contrast to popular perception, hedge funds using derivatives does not necessarily imply higher risk. The after-fee risk-adjusted performance of hedge funds is similar for derivatives users and non-derivative users (Chen, 2010).

2.2.6 Limited disclosure

Hedge funds have looser rules with regards to reporting, compared to other funds. As a consequence, hedge funds limit their disclosure of holdings and investment strategies. In the US, hedge funds with assets above $150 million have to register trades, brokers, leverage, counter-party exposures and techniques for valuing illiquid assets to the Securities and Exchange Commission (SEC). This does not have to be reported directly to the fund investors. However, most funds have some kind of regular reporting to their customers, even though this is usually rather sparse (Ang, 2013).

2.2.7 Manger fees and performance component

> "What is a hedge fund? Anything that charges 2 and 20." (Lhabitant, 2006)

The 2 and 20 refers to the typical fee structure of hedge funds, usually consisting of a management fee and a performance component. The management fee is commonly 2 per cent of the assets under management, and is supposed to cover operating expenses. The performance component is supposed to incentivise the managers to achieve the highest returns possible, and is usually around 20 per cent of annual realised performance. Most hedge funds combine the performance fee with a high-water mark, which is a minimum return that must be achieved before performance fees are eligible. The high-water mark is often combined with a proportional adjustment clause, which gives the fund manager the possibility to reduce the high-water mark by a proportional percentage if investors remove some of their assets (Lhabitant, 1996). In addition to this, many hedge fund managers invest their own money in the fund, increasing the performance incentives (Ilmanen, 2012). The combination of high performance fees and investments in their own funds, have made several of the most successful hedge funds managers billionaires. Table 1 illustrates this, by comparing the top-earning hedge fund mangers against the top-earning CEOs in 2013.

Top-Earning Hedge Fund Managers in 2013				Top-Earning CEOs in 2013			
RANK	NAME	FIRM	EARNINGS, $	RANK	NAME	FIRM	EARNINGS, $
1	David Tepper	Appaloosa Management	2.2 billion	1	Elon Musk	Tesla Motors	78.2 million
2	Raymond Dalio	Bridgewater Associates	1.7 billion	2	Larry Ellison	Oracle	77.0 million
3	Steven Cohen	SAC Capital Advisors	1.4 billion	3	Mario Gabelli	Gamco Investors	69.0 million
4	James Simons	Renaissance Technologies	1.1 billion	4	Robert Kotick	Activision Blizzard	64.9 million
5	Kenneth Griffin	Citadel	900 million	5	Leslie Moonves	CBS	62.2 million
6	Edward Lampert	ESL Investments	750 million	6	John Hammergren	McKesson	51.7 million
7	Stephen Mandel Jr.	Lone Pine Capital	580 million	7	David Zaslav	Discovery Communications Class	49.9 million
8	Leon Cooperman	Omega Advisors	560 million	8	E. Hunter Harrison	Canadian Pacific Railway	49.2 million
9	David Shaw	D. E. Shaw Group	530 million	9	Richard Bracken	HCA Holdings	46.4 million
10	Daniel Loeb	Third Point	380 million	10	Gerald Rubin	Helen of Troy	41.6 million

Table 1: The table illustrates the top-earning hedge fund managers and the top-earning CEOs in 2013. The earning figures are in US Dollars, $. Source: Time Magazine, and Institutional Investors Alpha.

2.3 Different ways of accessing hedge fund returns

The most common way of accessing hedge fund returns is to invest directly in hedge funds. Another possibility is to invest in fund of hedge funds. Funds of hedge funds provide access to hedge funds with a lower minimum capital required, compared to steep minimums required by ordinary hedge funds. Funds of hedge funds provide diversification, oversight (due diligence, fund selection skills etc.), and access to hedge funds that are no longer open for new investors. The downside of investing in funds of hedge funds is the double-layer of fees. According to Ilmanen (2012), funds of hedge funds often use a 1 per cent management fee and a 10 per cent performance fee on top of the 2 and 20 fee-structure of the underlying hedge fund. Hence, funds of hedge funds have lagged the performance of hedge funds due to the double layer of fees (Ilmanen, 2012).

A third and rather new way of accessing hedge funds is to invest in hedge fund indices. Géhin & Vaissié (2004) claims that these products have further increased the liquidity and transparency of hedge fund investing. Investments in hedge fund indices grew rapidly to 10 billion dollars, but are still a small fraction of the total hedge fund industry of approximately 2.600 billion dollars[5] (Géhin & Vaissié, 2004). There are several problems related to investing in hedge fund indices. The presence of different biases in hedge funds indices is substantial. Further, Géhin & Vaissié (2004) argues that most hedge funds indices fail to represent their investment universe, and that many of them turn out to be nothing more than passively managed funds of hedge funds. In addition to this, Ilmanen (2012) suggests that there is low participation from the top hedge funds in these indices, and that investable hedge

[5] BarclayHedge (2014) estimates that the total hedge fund industry consists of approximately 2.200 billion dollars excluding funds of funds, and approximately 2.600 billion dollars in total.

fund indices have consistently underperformed broader hedge fund indices. The number of investable hedge fund indices remains limited today.

2.4 The Norwegian hedge fund market

In this section, we will present the Norwegian hedge fund market. First, we will present the legal environment in Norway. Secondly, we will give a brief explanation of the Norwegian hedge fund market.

2.4.1 The legal environment in Norway

The regulation of hedge funds in Norway is derived from the regulation of alternative investment funds, as there is no specific legal definition of hedge funds. In Norway, alternative investment funds are currently regulated by Verdipapirfondloven (the Norwegian Securities Funds Act). Hedge funds covered by the definition of an alternative investment fund provided by Verdipapirfondloven § 7-2., are supervised by Finanstilsynet (the Financial Supervisory Authority of Norway). There are some fund structures that do not fit the definition of alternative investment funds, but have similar characteristics. These funds may market themselves in Norway by complying with Verdipapirfondloven § 9-4 (The Financial Supervisory Authority of Norway, 2014).

Currently, the legal environment in Norway only allows hedge funds to market themselves and engage with professional customers. Therefore, a Norwegian private investor cannot invest in hedge funds. This is independent of the customer's wishes; a non-professional investor is not allowed to engage privately in hedge funds in Norway (The Financial Supervisory Authority of Norway, 2012).

In order to offer alternative investment funds like hedge funds to professional investors in Norway, the alternative investment fund must have permission from Finanstilsynet. To receive this permission there are two possibilities: either the fund must be Norwegian and established by an asset management company, or registered as a foreign alternative investment fund. In both cases, it has to be clearly stated that the fund is an alternative investment fund through its statutes. Verdipapirfondloven defines several exceptions and special provisions for alternative investment funds. Among these provisions are rules stating that the statutes of the alternative investment fund shall specify the investment universe,

strategy, and risk management mechanisms. With regards to foreign alternative investment funds operating in Norway, a central provision demands that Norwegian investors should be provided the same protection as if they were investing in a Norwegian fund. Verdipapirfondloven further requires a satisfactory cooperation with the financial supervisory authority of the country of origin of the hedge fund. Finanstilsynet currently cooperate on supervisory matters with the US and the EEA countries (The Financial Supervisory Authority of Norway, 2012).

On the 22nd of July 2013, the Alternative Investment Fund Managers Directive (AIFMD) went into force in the EU. The AIFMD is aimed at addressing the perceived lack of coherent regulation of alternative investments funds, including hedge funds (ESMA, 2013). The European Commission stated that the overall ambition of the AIFMD is to:

> "Provide a clear and consistent framework for the regulation and supervision of the AIFMs in the EU, (…) as well as establishing a mechanism for creating a single European market for AIFs" (European Comission, 2011).

The AIFMD regulates alternative investment fund managers operating in the EU, regardless of whether they are based in the EU or elsewhere (Zepeda, 2014). Requirements under the AIFMD exceed the mere registration and disclosure of operating information under the Dodd-Frank Act applicable in the US. The AIFMD addresses obligations relating to the delegation of AIFM functions, obligations with regards to investor protection, conflicts of interest, remuneration policies, and risk management (Zepeda, 2014).

In May 2012, the Financial Supervisory Authority of Norway initiated a process in order to propose the necessary adjustments and changes of the Norwegian regulation to accommodate the adaption of the AIFMD (Schjodt Law Firm, 2013). The deadline for comments expired on the 20th of June 2013, and the legislative proposal (Prop. 77 L 2013-2014) was made public on the 11th of April 2014. At the 13th of May 2014, the Finance Committee of the Norwegian Parliament delivered their recommendation, suggesting that the legislative proposal should be made law (The Norwegian Parliament, 2014). Finanstilsynet expects implementation of the AIFMD to the Norwegian legal system by 2014, provided that the necessary adoption of the new legislation is approved by the Norwegian Parliament (The Financial Supervisory Authority of Norway, 2013). The legislative proposal by the Norwegian Ministry of Finance suggests that the implementation of the AIFMD in Norway

will entail the possibility of marketing and providing hedge funds for all Norwegian investors. This includes both professional and non-professional private investors. In order to ensure appropriate investor protection, the fund managers would face extensive regulation in terms of licensing requirements and organisational requirements. The legislative proposal advises that the Norwegian Ministry of Finance is empowered to determine further requirements through statutory regulation (The Norwegian Ministry of Finance, 2014). These requirements have not yet been drafted.

As of the 21th of May 2014, the legislative proposal has not yet been approved by the Norwegian Parliament. Until the AIFMD has been fully implemented, hedge funds operating in Norway are still subject to the regulations of Verdipapirfondloven elaborated above.

To sum up, hedge funds operating in Norway are currently only allowed to engage with professional customers. However, a recent legislative proposal (Prop. 77 L 2013-2014) will likely be adopted in the first half of 2014, suggesting that hedge funds should be accessible for all Norwegian investors.

2.4.2 Norwegian hedge funds

Alternative investment funds registered in Norway can be found in the license registry of Finanstilsynet. Figure 2 illustrates the recent development of the registered alternative investment funds in Norway. In addition, some foreign-registered funds operate in Norway under the application of the appropriate provisions of Verdipapirloven.

A complete overview of the hedge funds operating in Norway does not exist. Therefore, we have relied on the database of Hedgenordic in order to provide a representation of the Norwegian hedge fund market. Be aware that the dataset of Hedgenordic includes hedge funds that are not to be found in the license registry of Finanstilsynet**.** This may be due to the fact that some of the hedge funds used in our historical dataset are foreign-registered or that they have ceased to exist.

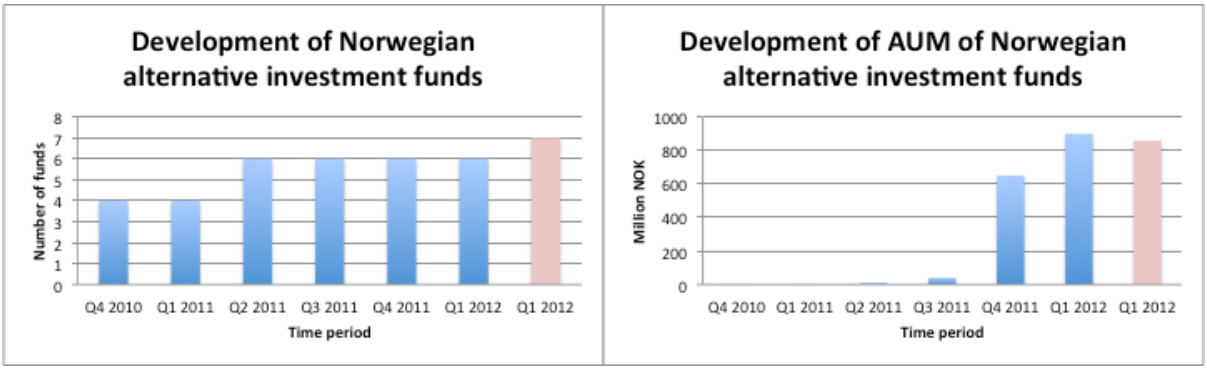


Figure 2: The figure to the left illustrates the recent development of registered alternative investment funds in Norway. The figure to the right illustrates the recent development in assets under management (AUM) of registered Norwegian alternative investment funds. Source: (The Financial Supervisory Authority of Norway, 2012).

3.0 STATISTICAL PROPERTIES OF HEDGE FUND RETURNS

This chapter consists of the theory regarding the statistical properties related to hedge fund index returns. In the first section, we present the definitions of holding period return. In the second section, we introduce the return distribution and the centralised moments. In the third and last section, we present two different correlation coefficients.

3.1 Holding period return

Pinto et al. (2010) defines holding period return as the return earned from investing in an asset over a specified time period. The returns can be separated into investment income (capital gains) and price appreciation components, as shown by the following formula:

$$r = \frac{D_h}{P_0} + \frac{P_h - P_0}{P_0} \tag{3.1}$$

where,

D_h = the dividend paid out at time h,

P_h = the price at time h, and

P_0 = the price at time 0.

If the asset is purchased at t = 0 and sold at t = h, the return consists of received capital gains (D_h) and price increase ($P_h - P_0$) at t = h. Equation 3.1 assumes for simplicity that any capital gains are received at the end of the holding period.

For a holding period in the past, the selling price and the dividend from equitation 3.1 are known. The return is then called realised holding period return, or more simply realised return (Pinto J., Henry, Robinson, & Stowe, 2010). For a future holding period, the returns are random variables where capital gains, buying prices, and selling prices can have a range of different values. Investors can form expectations of what these values will be, known as the expected holding period return or expected return of an asset (Pinto J., Henry, Robinson, & Stowe, 2010).

A common estimate of the expected holding period return is the realised holding period return (Elton, 1999). Elton (1999) highlights that the use of the average realised returns as an indicator for expected returns is based on a belief that information surprises tends to cancel out over a period of study, and therefore provides an unbiased estimate of expected returns.

Following this logic, we use the realised holding period returns as a proxy for the expected holding period returns.

3.2 Return distribution and centralised moments

According to Hens & Bachmann (2008), investments in different assets are usually described by a relative frequency histogram of their returns. This framework enables the possibility of studying the shape of the return distribution and link the return distribution to a specific statistical distribution framework. The most commonly used return distribution framework in finance is tightly linked to modern portfolio theory. In his paper "Portfolio Selection" from 1952, Harry Markowitz suggests that the best method for comparing risky assets is to rate the assets based on their expected return and variance. Based on the ideas of Markowitz (1952), it is convenient to use the statistical distribution that is defined by its expected return and variance – the normal distribution.

3.2.1 Normal distribution

Normal distribution, commonly also referred to as Gaussian distribution, is defined by a bell-shaped curve illustrating the mean (expected return) and the standard deviation of the variables. The normal distribution curve is illustrated in figure 3.

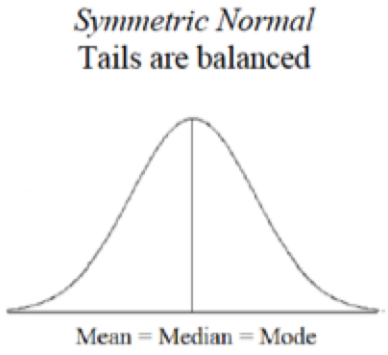


Figure 3: The figure illustrates the normal distribution curve, where Mean = Median = Mode. Source: (Doane & Seward, 2011).

When looking at distributions, moments are defined as numerical characteristics of the probability distribution (Encyclopedia of Mathematics, 2012). We will elaborate on four central moments of the normal distribution.

3.2.2 First central moment – the mean

According to Johnson & Kotz (1970), the first moment of a distribution is the mean, or the expected return of the distribution. This is the value of the variable that is most likely to occur, illustrated by being the highest point of the bell shaped normal distribution curve. The mean is given by:

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

where

E = the expectation operator,

N = the number of observations, and

r_n = the return at time n.

3.2.3 Second central moment – the variance

The second moment of a distribution is the variance (Johnson & Kotz, 1970). Variance is the average squared deviation from the mean. In an investment setting, the variance is the measurement of risk, as specified by Markowitz (1952). Variance is given by:

$$Variance = \sigma^2 = E\left[\left(\bar{r} - E(r)\right)^2\right] = \frac{1}{N}\sum_{n=1}^{N}(r_n - \bar{r})^2 \tag{3.3}$$

where

E = the expectation operator,

N = the number of observations,

r_n = the return at time n, and

$\bar{r}$ = the mean.

As the units of variance differ from the units of return, it is useful to transform the variance into the standard deviation. The standard deviation is equal to the square root of the variance:

$$Standard\ deviation = \sigma = \sqrt{\sigma^2} = \sqrt{\frac{1}{N}\sum_{n=1}^{N}(r_n - \bar{r})^2} \tag{3.4}$$

3.2.4 Third central moment – the skewness

The third normalised moment of the distribution is the skewness. The skewness is the cubed deviation from the mean, measuring the symmetry of the distribution. If the skewness is positive, the distribution will have a longer tail to the right. This implies small losses and larger gains. If the skewness is negative, with a longer tail to the left, the distribution will have larger losses and small gains. A strict normal distribution will have a skewness of zero (Doane & Seward, 2011).

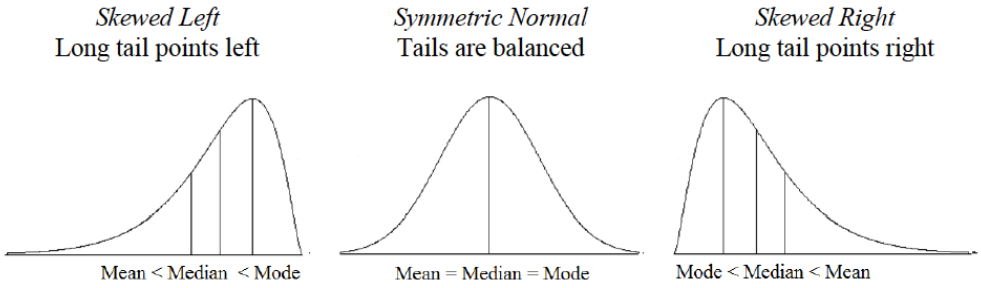


Figure 4: The figure illustrates the effect of skewness on the normal distribution curve. Source: (Doane & Seward, 2011).

The skewness is given by:

$$Skewness(S) = \frac{\mu_3}{\sigma^3} = \frac{E\left[\left(\bar{r} - E(r)\right)^3\right]}{\sigma^3} = \frac{1}{N}\sum_{n=1}^{N}\frac{(r_n - \bar{r})^3}{\bar{\sigma}^3} = \bar{\mu}_3 \qquad (3.5)$$

where

E = the expectation operator,

N = the number of observations,

r_n = the return at time n,

$\bar{r}$ = the mean, and

$\bar{\sigma}^3$ = the standard deviation, with the power of 3.

3.2.5 Fourth central moment – the kurtosis

The fourth moment of the distribution is the kurtosis, which measures the peakedness and tails of the distribution. The kurtosis indicates the probability of extreme values (DeCarlo, 1997).

The kurtosis is given by:

$$Kurtosis = \frac{\mu_4}{\sigma^4} = \frac{E\left[\left(\bar{r} - E(r)\right)^4\right]}{\sigma^4} = \frac{1}{N}\sum_{n=1}^{N}\frac{(r_n - \bar{r})^4}{\bar{\sigma}^4} = \bar{\mu}_4 \qquad (3.6)$$

where

E = the expectation operator,

N = the number of observations,

r_n = the return at time n,

$\bar{r}$ = the mean, and

$\bar{\sigma}^4$ = the standard deviation, with the power of 4.

A normal distribution obtains a kurtosis of 3. The excess kurtosis is therefore calculated to make this value zero, and given by:

$$Excess\ kurtosis\ (K) = \bar{\mu}_4 - 3$$

For a normal distribution with excess kurtosis of zero, the curve will have a bell shape, known as Mesokurtic distribution. Positive excess kurtosis, Leptokurtic distribution, will have more values close to the mean, as well as higher probability of extreme values compared to a normal distribution. The curve will then have higher peakedness and fat tails. Negative excess kurtosis, Platykurtic distribution, will have a lower possibility of extreme values and fewer values located close to the mean. The curve will have a softer peak and smaller "shoulders" on the edge, in other words light tails and flatness (DeCarlo, 1997). The effect of excess kurtosis can be seen in figure 5.

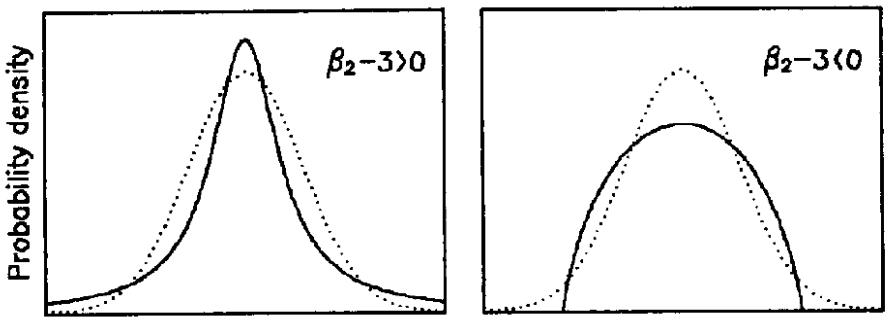


Figure 5: The dotted lines indicate the normal distribution, while the solid lines indicate the distributions with positive excess kurtosis (left panel) and negative excess kurtosis (right panel). $\beta_2 - 3$ = excess kurtosis, where $\beta_2 = \bar{\mu}_4$. Source: (DeCarlo, 1997).

3.2.6 Normality tests

According to Rachev et al. (2010), there are several ways of testing whether a given data set is normally distributed. A normality test that takes into consideration the higher moments of skewness and kurtosis is the Jarque-Bera test (Rachev, Hoechstoetter, Focardi, & Fabozzi, 2010). The Jarque-Bera test, defines a null hypothesis stating that the data is normally distributed, and an alternative hypothesis stating that the distribution is arbitrary. To test the null hypothesis, the Jarque-Bera evaluates whether the data have skewness and kurtosis matching a normal distribution. Kat & Brooks (2001), among others, use this test for testing the normality of hedge fund returns.

The Jarque-Bera, *JB*, test statistic is given by:

$$JB = \frac{N}{6}\left(S^2 + \frac{K^2}{4}\right) \tag{3.7}$$

where

N = the number of observations or degrees of freedom in general,

S = the sample skewness, $\bar{\mu}_3$, and

K = the sample excess kurtosis, $\bar{\mu}_4 - 3$.

The Jarque-Bera test statistic is based on a chi-squared distribution with two degrees of freedom. From this chi-squared distribution, a critical value is defined. The null hypothesis is rejected if the value of the test statistics exceeds the critical value (Jarque & Bera, 1980).

3.3 Correlation

In statistics, correlation refers to relationships involving dependence. Dependence is a statistical relationship between two random variables or sets of data. The correlation will tell you the degree to which the variables tend to move together. The correlation will only infer on co-movement and is not related to causality (Ji, 2006). The reason for investors' interest in correlation can be found in the modern portfolio theory of Markowitz (1952). Markowitz stated that diversification could be reached from any combination of assets that is not perfectly positively correlated. There are several different methods for estimating the correlation between data series. Two of the most commonly used are Pearson's product-

moment correlation coefficient and Spearman's rank correlation (Lomax & Hahs-Vaughn, 2012).

3.3.1 Pearson's product-moment correlation coefficient

Pearson's product-moment correlation coefficient assumes that the data samples are from a normally distributed population. Pearson's correlation measures the linear correlation between two variables, and estimates a value of the correlation ranging from -1 to +1. There is no correlation if the value is zero, there is perfect negative correlation if the value is -1, and there is perfect positive correlation if the value is +1 (Lomax & Hahs-Vaughn, 2012).

Pearson's correlation coefficient for a population, $\rho_{x,y}$, is given by:

$$\rho_{x,y} = \frac{cov(r_x, r_y)}{\sigma_x \sigma_y} = \frac{E\left[(r_x - \mu_x)(r_y - \mu_y)\right]}{\sigma_x \sigma_y} \tag{3.8}$$

where

cov = the covariance,

σ_i = the standard deviation of i,

E = the expectation operator,

μ_i = the mean of i, and

r_i = the sample data (e.g. return) of i.

Pearson's correlation coefficient could also be applied to a sample of the population, where the formula is given by:

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2} \cdot \sqrt{\sum_{i=1}^{n}(Y_i - \bar{Y})^2}} \tag{3.9}$$

where

X_i, Y_i = a sample pair of data,

$\bar{X}$ = the mean of the sample scores of X, and

$\bar{Y}$ = the mean of the sample scores of Y.

3.3.2 Spearman's rank correlation coefficient

Spearman's rank correlation coefficient is suitable for data series that are not normally distributed, or if there are huge outliers in the dataset. Spearman's correlation is a non-parametric measure of correlation. This implies that it can be used when the variables are not related by a linear function, and without knowing the joint probability distribution of the variables. The method of Spearman converts the data to rankings before the correlation is calculated, using the Pearson method on the rankings. The interpretation of Spearman's correlation is similar to Pearson's correlation: a positive correlation coefficient indicates co-movement between variables, a negative correlation coefficient indicates that one variable decreases as the other increases, and a zero correlation coefficient indicates no tendency (Lomax & Hahs-Vaughn, 2012).

The Spearman's rank correlation coefficient, ρ, is given by the formula:

$$\rho = 1 - 6 \sum_{n=1}^{N} \frac{d_{(n)}^2}{N(N^2 - 1)} \tag{3.10}$$

where

N = the number of rankings, and

$d_{(n)}^2$ = the nth square difference of the ranking.

3.3.3 Statistical significance of correlation coefficient: two-sided t-test

According to Furr (2005), the statistical significance of correlation coefficients can be calculated in order to state, with a given amount of certainty, whether there is correlation present. The statistical significance of correlation coefficients can be tested using a two-sided t-test, given the following assumptions (Snedecor & Cochran, 1989):

1. The samples are drawn from populations that follow a bivariate normal distribution.
2. The samples are random samples from the population.
3. The population correlation coefficient is zero.

The test statistic, *T*, is given by:

$$T = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}} \tag{3.11}$$

where

N = sample size, and

r = sample correlation.

The test statistic follows a t-distribution with N-2 degrees of freedom, and is compared to a critical value derived from the chosen confidence interval (Furr, 2005). We have chosen a 5% confidence level for our calculations, implying that there is a less than 5% chance of an incorrect rejection of the null hypothesis (Furr, 2005). The most common significance test of a correlation defines a null hypothesis stating that the population correlation is zero ($H_0: \rho = 0$) (Furr, 2005). If the calculated test statistic is above the critical value, the null hypothesis is rejected. In our empirical research, we will use the following hypothesis:

$H_0: \rho = 0$

$H_A: \rho \neq 0$

4.0 MODERN PORTFOLIO THEORY

The first section of this chapter presents the mean-variance framework. The second and last section of this chapter, gives a brief description of asset pricing models.

4.1 The Mean-Variance framework

Modern portfolio theory was introduced in Markowitz (1952), building on mean-variance selection theory. Markowitz' research is considered among the most important contributions to financial theory, and he was awarded the Nobel Memorial Prize in Economic Science in 1990. Though it has inspired and led to various extensions and applications, the mean-variance framework is still widely used in performance evaluation of investments (Frängsmyr, 1991). In the following sub-sections, we elaborate on the Markowitz efficient frontier, the capital allocation line, and criticism of the mean-variance framework.

4.1.1 Markowitz Efficient Frontier

The introduction of Markowitz' modern portfolio theory was revolutionary in the world of finance. At the time, investors were emphasising the selection of single assets with the highest returns and lowest risk (Galloppo, 2010). Investors would compose a portfolio without considering the assets' effect on the total portfolio. Markowitz proposed a new way of creating a portfolio, by suggesting that investors should diversify their investments to minimise expected risk and maximise expected returns. According to Markowitz (1952), the overall portfolio risk can be reduced if the investor diversifies the portfolio by investing in different assets.

Markowitz' modern portfolio theory assumes investors to be risk-averse. When faced with two investments with similar expected return, but with different risks, a risk-averse investor will prefer the one with the lower risk (Danthine & Donaldson, 2005).

Expected return and standard deviation are used as proxies for reward and risk, and the available investment opportunities will constitute the minimum-variance frontier of risky assets. The minimum-variance frontier provides the highest possible return for a given risk, and vice-versa the lowest possible risk for a given return. The trade-off between risk and return will depend on the investor's degree of risk aversion. The optimal trade-off between risk and expected return is captured by the efficient frontier, shown in figure 6. The efficient

frontier is located above and to the right of the global minimum variance portfolio, on the minimum-variance frontier. Assets located below the efficient frontier are considered inefficient, as other assets can generate higher expected return at the same risk (Bodie, Kane, & Marcus, 2005).

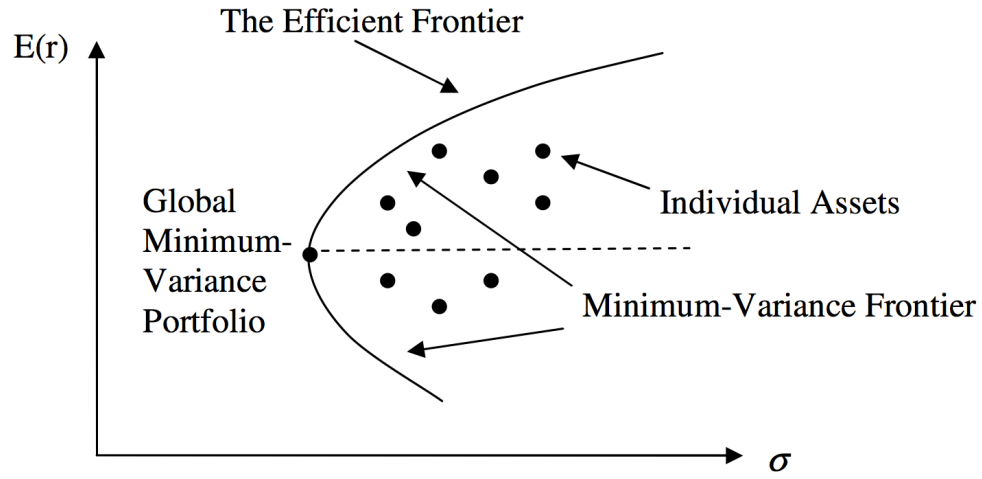


Figure 6: The figure illustrates the minimum-variance frontier, the global minimum variance portfolio, and the efficient frontier. The X-axis indicates the standard deviation (σ), while the Y-axis indicates the expected return (E(r)). Source: (Bodie, Kane, & Marcus, 2005).

4.1.2 The Capital Allocation Line

By introducing a risk-free asset, it is possible to create a risk-return profile that is superior to those on the efficient frontier. The risk-free asset is uncorrelated with the other asset classes, and allows the investors to borrow and loan at a risk-free rate. Combining the risk-free asset with a given combination of risky assets, located on the efficient frontier, will create the capital allocation line (CAL). The CAL shows the investor's available portfolio opportunities from the combination of the risky portfolio and the risk-free asset. The CAL is a straight line and is defined as:

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

where

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

$E(r)$ = the expected return of a given risky portfolio,

r_f = the risk-free rate,

σ = the standard deviation of a given portfolio, and

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

The slope of the CAL represents the risk/reward ratio, also known as the Sharpe ratio (Sharpe, 1964):

$$Slope = \frac{E(r) - r_f}{\sigma} \tag{4.2}$$

The portfolio on the efficient frontier with the highest risk/reward ratio is known as the market portfolio (indicated with an M in figure 7). By combining the market portfolio with a risk-free asset, the capital market line (CML) is created. The CML is a tangent to the efficient frontier, and would be the optimal choice for every investor. Each investor can move up or down, depending on how much risk they want, by either investing a part of the portfolio in the risk-free asset (decreasing the total risk) or by gearing[6] the portfolio (increasing the total risk) (Bodie, Kane, & Marcus, 2005).

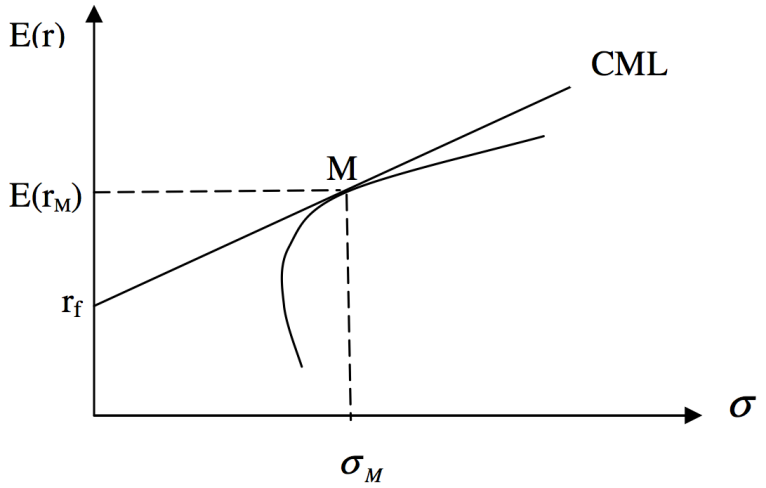


Figure 7: The figure illustrates the capital market line (CML), and the market portfolio (M). The X-axis indicates the standard deviation (σ), while the Y-axis indicates the expected return (E(r)). Source: (Bodie, Kane, & Marcus, 2005).

[6] Gearing indicates that the investor is borrowing money at risk-free rate to invest in risky investment, like the market portfolio.

4.1.3 Criticism of the Mean-Variance framework

One simplifying assumption of the mean-variance framework is that risk can be fully described by the variance. To be valid, portfolio theory based on the mean-variance framework has to satisfy one of the following assumptions (Tobin, 1958):

1. Distribution of asset returns belongs to the two-parameter family[7], e.g. normally distributed returns.
2. The investor holds a quadratic utility function, i.e. the investor's goal is to maximise return and minimise variance of the return distribution.

In order to solve the maximisation problem, a quadratic utility function implies that the investor only cares about the first two moments of the distribution: the mean and the variance. Bodie et al. (2005) describes the utility that an investor derives from a portfolio with an expected return and standard deviation as the following quadratic utility function:

$$U = E(r) - A\sigma^2 \tag{4.3}$$

where

U = the investors utility,
$E(r)$ = the expected return (mean),
A = the investor's degree of risk aversion (where $A \geq 0$), and
σ^2 = the variance.

Indicated by this quadratic utility function, the utility function is a curve with a decreasing slope, where the investor only considers the expected return (mean) and variance. A quadratic utility function, like the one described above, will only have a positive marginal utility under the bounded range. According to Wippern (1971), this places an unrealistic behaviour on the investors.

From the utility function in equation 4.3, one can derive that the investors have an increasing risk aversion. An increasing risk-aversion implies reduced risk taking as wealth increases. Empirical evidence and theoretical consideration would indicate differently. Pratt (1964) and

[7] Distributions belonging to the two-parameter family can be described by two parameters. An example is the normal distribution that can be described by its mean and standard deviation.

Arrow (1965) indicate that investors have a decreasing absolute risk-aversion[8]. In the real world, the utility functions will not be as simple as described above, as the utility functions can be highly complex and have an irregular shape (Hens & Bachmann, 2008). As the second assumption of Tobin (1958) is not satisfied, one has to assume that the returns are normally distributed, fully described by its mean and variance, for the Markowitz portfolio theory to be valid.

4.2 Asset Pricing Models

Asset pricing models value assets relative to the market or other sources of risk, also known as "factors". One usually separates between single and multifactor models. The most recognised single-factor model is the Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965), and Mossin (1966). The CAPM explains the price of an asset by one single factor, the sensitivity of a given asset's returns to market movements (known as the market beta). A multifactor model, like the Arbitrage Pricing Theory of Ross (1976), uses several factors in the calculation of the expected return. The sensitivity to changes in each factor is represented by a factor-specific beta coefficient. Each investor needs to identify the factors that are affecting an asset, as well as the factors' risk premium and the sensitivity of these factors. Later extensions have been made to adopt the factor-specific beta coefficients outside the equity universe. In this context, the term alternative betas is used to describe the factor-specific beta coefficients that measures the sensitivity of an asset to the different risk premiums that are available in the global financial markets (Jaeger, 2008).

[8] Absolute risk-aversion is independent of the wealth of the investor, i.e. the investor will not change his risk preferences when his wealth changes (Hens & Bachmann, 2008).

5.0 RISK-ADJUSTED PERFORMANCE MEASURES

For a risk-averse investor, the level of returns must be compared to the risk undertaken, and the investor needs to be compensated for the risk exposure. The risk-adjusted performance measures can be divided into relative- and absolute performance measures. Relative performance measures evaluate an asset's risk-adjusted returns in reference to a benchmark (Le Sourd, 2007). As many of the hedge fund strategies are very different, one could argue that each strategy would need its own benchmark. Ilmanen (2012) argues that for hedge funds, as "absolute return funds", the appropriate benchmark would be cash, while others would argue for a benchmark consisting of both stocks and bonds. Due to the difficulties of finding an appropriate benchmark for hedge funds, we have scoped this assignment to look at performance measures that do not use a benchmark, the absolute performance measures (Le Sourd, 2007).

In this chapter, we present two different performance measures. In the first section, we introduce the traditional Sharpe ratio, while the second and last section elaborates on the Modified Sharpe ratio.

5.1 The Sharpe ratio

In addition to being one of the originators of the CAPM, William F. Sharpe developed one of the most commonly used performance measures, the Sharpe ratio. The Sharpe ratio is based upon the assumptions of mean-variance theory, assuming that returns are normally distributed and/or that the investor has a quadratic utility function (Sharpe, 1966).

The Sharpe ratio measures the risk premium compared to the total risk of the portfolio. The ratio describes how much excess return you are receiving for the extra volatility that you endure for holding a risker asset. The Sharpe ratio for investment i, SR_i, is defined as (Sharpe, 1966):

$$SR_i = \frac{E(r_i) - r_f}{\sigma_i} \tag{5.1}$$

where

$E(r_i)$ = the expected return of the investment,

r_f = the return on the risk-free asset, and

σ_i = the standard deviation of the investment returns.

As the Sharpe ratio is based on the total risk of the investment, which is made up by the systematic and unsystematic risk[9], the Sharpe ratio is most appropriate for evaluating relatively diversified portfolios. Assuming the investment to be standalone, it will penalise non-diversified portfolios by taking into account the unsystematic risk. A standalone investment is defined as a single investment, not taking into account how the investment would affect the investor's portfolio. The higher Sharpe ratio, the better is the investment (Christy & Clendenin, 1978).

5.1.1 Criticism of the Sharpe ratio

The Sharpe ratio is based on mean-variance theory, assuming that all asset returns are normally distributed and/or that investors have mean-variance preferences, ignoring skewness and excess kurtosis. When using traditional performance measures on distributions that are skewed or have excess kurtosis, the inherent risk is not fully captured. As a consequence, this may lead to wrong conclusions on the risk-adjusted performance. Under relative weak assumptions, Scott & Horvath (1980) shows that investors like positive skewness and dislike positive excess kurtosis. A further drawback is the fact that traditional performance measures do not distinguish between upside and downside risk, as investors are often more unpleased with a loss than they are pleased with a gain of equal size. As a consequence, one can argue that the downside deviation should be heavier weighted when measuring the performance of an asset (Hens & Bachmann, 2008).

5.2 The Modified Sharpe ratio

Several innovative performance measures have been developed as a consequence of the limitations of the traditional performance measures. In this section, we look further into the Modified Sharpe ratio, presented in Gregoriou & Gueyie (2003).

In 2002, Favre & Galeano introduced the Modified Value-at-Risk (MVaR). The MVaR is defined as:

$$MVaR = E(r_i) - \left[z_c + \frac{1}{6}(z_c^2 - 1)S + \frac{1}{24}(z_c^3 - 3z_c)K - \frac{1}{36}(2z_c^3 - 5z_c)S^2\right] \cdot \sigma_i \quad (5.2)$$

[9] Systematic risk is the variance due to the common market factor (known as the market beta in the CAPM framework), while the unsystematic risk is the variance due to firm specific unanticipated events.

where

$E(r_i)$ = a given investment/asset/portfolio's expected return, the mean,

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

S = the sample skewness,

K = the sample excess kurtosis, and

σ_i = a given investment/asset/portfolio's standard deviation.

Relying on the work of Favre & Galeano (2002), Gregoriou & Gueyie (2003) introduced an extension of the traditional Sharpe ratio, the Modified Sharpe ratio. The authors proposed to use MVaR instead of the standard deviation as the risk measure. The replacement of the standard deviation is justified by the fact that the MVaR takes skewness and kurtosis into account, in addition to mean and standard deviation. Gregoriou & Gueyie (2003) found that the traditional Sharpe ratio overestimates the performance in comparison to the Modified Sharpe ratio for non-normal results. The exception is when the normal Sharpe ratio is negative.

The Modified Sharpe ratio for investment i, $SR_i^{Modified}$, is defined as (Gregoriou & Gueyie, 2003):

$$SR_i^{Modified} = \frac{E(r_i) - r_f}{MVaR_i} \tag{5.3}$$

where

$E(r_i)$ = a given investment/asset/portfolio's expected return, the mean,

r_f = the risk free return, and

$MVaR_i$ = the Modified Value-at-Risk.

5.2.1 Criticism of the Modified Sharpe ratio

The Modified Sharpe ratio provides a useful extension to the Sharpe ratio, as it takes into consideration the higher moments of the return distribution. However, the use of the Modified Sharpe ratio as a performance measure has some flaws. The critique of the traditional Sharpe ratio with regards to differentiating between downside and upside risk is not fully corrected under the Modified Sharpe ratio. Research by Lo (2002), suggests that

autocorrelation[10] in hedge fund returns data can overstate the Sharpe ratio by 65 per cent. Similar to the Sharpe ratio, the Modified Sharpe ratio does not adjust for autocorrelation, and thus may overstate fund performance. With regards to the biases inherent in returns data (see chapter 7.0), the Modified Sharpe ratio is not able to correct for these biases, and the return performance may therefore be inflated (Ilmanen, 2012).

[10] For theory on autocorrelation, see appendix H.

6.0 HEDGE FUND STRATEGIES

Over the years, hedge funds have been known to use a variety of different strategies. On the most basic level, hedge funds can be classified into two different categories: directional and non-directional. The non-directional hedge funds are considered to be "market neutral", i.e. not depending on the direction of the market. Directional hedge funds, also known as "market timing funds", use strategies based on the anticipation of future market movements. Directional strategies are generally designed to exploit short-term market inefficiencies (Fung & Hsieh, 1999).

The wide variety of strategies that persist among different hedge funds, provide very different risk and return profiles. Hedge fund strategies are not homogenous; each fund manager argues that their strategy is unique, making it difficult to describe them. However, it is possible to group the strategies into certain fundamental categories. This makes it possible to evaluate how a particular strategy might perform under certain macroeconomic conditions.

In this chapter, we will present some of the most common hedge funds strategies. Credit Suisse, Hedgenordic and several other data providers assign hedge funds to these different strategies. In the following sections, we will elaborate on nine hedge fund strategies: Long/Short Equity, Dedicated Short Bias, Merger Arbitrage, Fixed-Income Arbitrage, Convertible Arbitrage, Global Macro, Managed Futures & Commodity Trading Advisors, Multi-Strategy, and Fund of Hedge Funds.

6.1 Long/Short Equity

Long/Short equity, also called equity hedge, are strategies where hedge fund managers purchase stocks they believe to be undervalued, and/or sell short stock they deem to be overvalued. A short position is when a manger borrows shares to sell to a third part. The hedge funds will profit when the long positions appreciate and if the short positions depreciate. By combining long and short position of equities, the managers try to reduce the market risk. In most cases, hedge funds with a long/short equity strategy will have a positive exposure to the equity markets. For example, having 70% of the funds invested long in stocks and 30% invested in the shorting of stocks, indicating no use of leverage. In the given example, the net exposure to the equity markets is 40%. However, if the manager increases the long position in the fund to 80%, while still maintaining a 30% short position, the fund

would have a gross exposure of 110%, indicating a leverage of 10%. It is normal that managers increase their long exposure in bull markets, and decrease it or go net short in bear markets[11] (Ang, 2013).

6.2 Dedicated Short Bias

Dedicated short bias strategies involve holding a net short exposure to the market. Dedicated short bias strategies earn profits when the market declines, holding investments that are overall biased to the short side. As the manager expects the stock price to decline, he or she will buy the shares back at a lower price and return them to the lender with a profit. However, if the price increases, the original selling price will be lower than the repurchase price, and the manger will suffer a loss. Dedicated short bias strategies can be extremely risky when applied on a stand-alone basis, as the theoretical downside potential is unlimited (Stefanini, 2006).

As most traditional managers have a primary focus on long term buy and hold opportunities, a dedicated short selling strategy will be unexploited. An unexploited strategy indicates an advantage for the mangers, but also a high degree of uncertainty and additional risks involved. Short sellers will suffer from natural long-term bull markets, as stocks tend to appreciate over time (Stefanini, 2006).

6.3 Merger Arbitrage

Merger arbitrage strategies derive its returns from takeover activity. The strategies involve investing in securities of a company that is targeted for a takeover or merger, after the transaction is announced. When a takeover is publicly announced, the value of the acquiring company's shares is potentially overvalued. As the deal is subjected to certain conditions, like regulatory approval and a favourable vote by target company shareholders, the target company shares trade for less than the merger consider the per-share value to be. The hedge fund may purchase shares in the targeted company, and sell short the acquiring company's shares. A typical position involves holding a long position that can close out the short position if the deal is completed. The potential profit or loss depends on the difference

[11] A "bull" market is charactherised by optimism, where market securities are expected to rise. A "bear" market is charactherised by pessimism, where market securities are expected to fall (Stefanini, 2006).

between the price spread of the shares purchased and the realised value when the deal is completed (Ang, 2013).

6.4 Fixed-Income Arbitrage

With fixed-income arbitrage strategies, hedge funds seek out returns from risk-free government bonds, eliminating credit risk. The funds combine long and short positions with derivative instruments, making leveraged bets on whether the shape of the yield curve will change over a time period. These kinds of bets can be very effective as interest rates tend to move up and down together. As the strategies remove much of the day-to-day portfolio risks, fixed-income arbitrage funds usually use high leverage to boost what would otherwise be fairly modest returns (Stefanini, 2006).

6.5 Convertible Arbitrage

A convertible security is a type of financial instrument that can be converted into another type of financial instrument. The most common convertible securities are convertible bonds and convertible preferred stock, which can be changed into equity or common stock.

Convertible arbitrage is a type of long/short equity strategy. However, instead of purchasing and shorting stocks, a convertible arbitrage strategy involves taking a long position in convertible securities and a short position of the same company's common stock. The idea behind the convertible arbitrage strategies are that a company's convertible bonds might be priced inefficiently relative to the company's stock, as pricing a convertible security often is very difficult. According to Lhabitant (2006), correctly pricing convertible securities are difficult as there are simultaneous presences of interest risk, credit risk, and equity risk, as well as the interaction between these. As convertible securities often are valued differently than their fair value, hedge funds will attempt to profit from the arbitrage opportunity that occurs. Issuers of convertible securities are typically young and fast growing companies, with a low debt rating (Stefanini, 2006).

6.6 Global Macro

Generally, global macro strategies are known to create some of the highest hedge fund returns, but the strategies also involve taking a high degree of risk (Mallaby, 2010). Many of

the most profiled hedge funds, such as the Quantum Fund of George Soros and the Long Term Capital Management fund, pursued a global macro strategy.

Global macro funds tend to be very different from each other and they invest in all the core asset classes (stocks, bonds, and cash), as well as currencies, commodities, and other forms of derivatives. According to Lhabitant (2006), most global macro funds have two typical characteristics: a global perspective and a main focus on the macroeconomic environment. With a global perspective, they can easier diversify their investments and increase the size of the markets they invest in. As a consequence, they can be larger than most other hedge funds before capacity issues challenge them. Focusing on the macroeconomic environment, they will analyse and exploit structural macroeconomic imbalances and try to discover macroeconomic trends (Stefanini, 2006).

6.7 Managed Futures & Commodity Trading Advisors

Lhabitant (2006) states that:

> ”Managed futures, Commodity Trading Advisors (CTAs) and 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 follow a set of investment strategies, utilising futures contracts and options on a wide variety of goods. They may invest in physical goods like agricultural products, forest products, metals and energy, as well as non-commodity related futures like financial instruments such as indices, bonds, and currencies (Gregoriou, 2008). With an investment strategy involving investments in futures, the hedge funds use leverage to increase their amount invested. A CTA is often compensated through management fees and profit incentive fees. The management fees are calculated as a percentage of the equity in the fund, while the incentive fees are calculated as a percentage of new trading profits. As non-commodity related futures like currencies, interest rates, and stock indices dominate the global markets today, the term CTA might be misleading for new investors (Stefanini, 2006).

6.8 Multi-Strategy

By definition, multi-strategy hedge funds will engage in various investment strategies, assumed to increase the diversification. The investment objective of multi-strategy funds is to deliver constantly positive returns, regardless of the movement of the equity, the interest rate and the currency markets. There are no limitations of which strategies a multi-strategy fund can use. Strategies that are normally included are long/short equity and merger arbitrage (Stefanini, 2006).

Multi-strategy funds will rarely be the best performing category of hedge funds, over a short-term time horizon. However, they can offer investors access to a variety of strategies and thereby improve the risk-adjusted returns of concentrated investment portfolios (Stefanini, 2006).

6.9 Fund of Hedge Funds

Fund of hedge funds strategies, also known as fund of funds, involve creating a portfolio consisting of shares in a number of different hedge funds. The underlying hedge funds that are chosen vary from fund to fund. Fund of funds may invest in hedge funds using a particular management strategy, or invest in hedge funds with a range of strategies. By investing in fund of funds, one can increase the diversification and thereby reduce the risk. However, as each fund is already diversified, there is a risk that the investor will end up back at the market portfolio at substantial cost (Cochrane, 2014).

Investing in fund of hedge funds will gain the investor the access to experienced management. Both the portfolio mangers of the fund of funds, using their skills to select superior underlying funds, and the different hedge fund managers, will do their best to produce alpha. Monitoring several funds is costly and takes time. Fund of hedge funds have requirements regarding entering and withdrawing from the fund, but compared to a normal hedge fund, their conditions are usually much more flexible than the underlying fund. Fund of hedge funds usually contains a double-layer of fees. The 2 and 20 must be paid to the hedge funds invested in, in addition to a common 1 and 10 per cent management and performance fee to the managers of the fund of hedge funds (Ilmanen, 2012).

7.0 Biases in Hedge Fund Databases

This chapter elaborates on the biases present in hedge fund databases. Several factors influence the quality of historical return data from hedge funds. According to Fung & Hsieh (2001), three factors cause the biases' presence in hedge fund return-data. The first factor is that hedge funds are organised as private investment vehicles. For this reason, participation in hedge fund databases is voluntary. Secondly, the databases have different criteria for including hedge funds, implying that the selection of database will have huge impact on the perceived return of hedge funds. The third aspect is that most commercial hedge fund databases were established as late as in the 1990s.

The following sections will introduce the most common biases present in hedge fund databases: Survivorship bias, Backfill bias, Self-selection bias, Infrequent pricing & Illiquidity bias, Difficulty of obtaining hedge fund returns, and Database/Sample selection bias.

7.1 Survivorship bias

Survivorship bias appears when funds stop reporting, either when they are under distress or have ceased to exist. As a consequence, the database will only contain the funds that are operating at the end of the sampling period, the survivors. Usually, funds cease to exist because of poor performance. Therefore, the database will show historical returns that are biased upwards, and historical risk that is biased downwards (Fung & Hsieh, 2001). Survivorship bias can also be a factor for mutual funds in general. Malkiel (1995) finds that survivorship bias for mutual funds can be calculated by finding the population of all mutual funds that operated during a certain period. Then the average return of all these funds is compared to the return of the surviving funds at the end of the period, where the difference equals the survivorship bias. Fung & Hsieh (2001) points out that the method of Malkiel (1995) is difficult for predicting the survivorship bias, as most hedge fund databases started operating in the 1990s. Therefore, funds that ceased to exist pre 1990s are not part of the dataset. The difference between funds that simply exited the database (defunct funds) and funds that ceased to exist (dead funds) further complicates the estimation of the survivorship bias (Fung & Hsieh, 2001). Ang (2013) argues that hedge funds mainly report to databases in order to advertise themselves. Funds that produce extraordinary good returns will generally not be in need of capital, their returns market themselves, and will not necessarily report

return data. Anecdotal evidence on this is provided by Fung & Hsieh (1997) who claims that Soros' Quantum Fund rejected new inflows in the period after 1992. According to Ang (2013), hedge fund databases therefore miss both the extreme left- and right-hand tails. In general, the returns reported are too good (Ang, 2013). The result of Aiken et al. (2013) shows that the difference in risk-adjusted returns between reporting hedge funds and non-reporting hedge funds is 5.3% in favour of the reporting hedge funds. Malkiel and Saha (2005) supports this as they find the difference in returns of reporting hedge funds and hedge funds that stop reporting to be 4.4%.

It reasonable to assume that the survivorship bias provides a perception of hedge fund returns that is artificially too good.

7.2 Backfill bias

Backfill bias occurs when hedge funds are provided the option to "backfill" their historical returns at the time they enter a database. Lhabitant (1996) argues that this gives the possibility for funds to decide when to be included in the database. Given this possibility, funds with superior histories are more likely to report them and the aggregated returns will look better (Ilmanen, 2012). Several studies have tried to measure the backfill bias. Fung & Hsieh (2000) compares an investment in a portfolio of hedge funds starting from the inception of each fund to an investment in a portfolio of the same funds, starting from the day they entered the TASS database[12]. The average difference between the two portfolios is considered the backfill bias. On average, Fung & Hsieh (2000) suggests that this difference is 1.4 percentage points a year. Ilmanen (2012) supports Fung & Hsieh (2000), suggesting a difference of about 2% – 4% reduction in average hedge fund returns when adjusting for the backfill bias. The bias is assumed to be smaller for value-weighted averages as the backfilling is more common among small, younger funds.

7.3 Self-selection bias

The self-selection bias relates to the voluntary reporting of returns to a database. Hedge funds are private investment vehicles and they only have to report return data to their investors. Different funds will have different incentives to report or not report to database providers.

[12] The Lipper Trading Advisor Selection System (TASS) database is a hedge fund database containing over 7000 actively reporting hedge funds.

The returns data in a database will not represent a true random sample of the population of hedge funds. Fung & Hsieh (2001) argues that the self-selection bias appears in two different forms. First, the funds with good return data and looking for new investors, are more likely to report to a database. This effect will skew the database to show better performance. Secondly, many hedge funds chose not to participate in a database because they are sufficiently well known, or are not looking for more investors. Many of the funds that do not report to the databases are among the most successful, skewing the database to show weaker performance. Therefore, Ilmanen (2012) argues that the effect of the self-selection bias is ambiguous.

7.4 Mark-to-Market Problems: Infrequent pricing and Illiquidity bias

Asness et al. (2001) emphasises that hedge fund returns are subject to stale or managed prices, lowering estimates of correlation to traditional indices. Hedge funds hold a wide range of illiquid and difficult-to-price securities. The inaccessibility of prices for these securities provides hedge funds with different possibilities for how they mark their holdings for month-end reporting. As an example, hedge funds may use either the last available trade, or even guesstimates to mark month-end holdings. Asness et al. (2001) further suggests that the widespread practice of calculating performance and statistical measures on a monthly basis, may provide hedge fund managers with a strong incentive to show monthly returns that are uncorrelated with other assets. Asness, the co-founder of AQR Capital, suggests that the best way to deal with the mark-to-market problem for hedge fund returns is to use longer time horizons. The mark-to-market problem then will be a smaller component of these returns (Asness, Krail, & Liew, 2001).

7.5 Difficulty of obtaining hedge fund index returns

Ang (2013) raises an important warning regarding the challenge of replicating hedge fund index returns. There are no cheap and investable index funds that can replicate hedge fund returns in a similar way as the equity index funds replicate equity returns. In addition, it will not be feasible for an investor to invest in all of the hedge funds included in an index. This is due to the fact that hedge funds may be closed for additional investors, the minimum investments are high, and even if the hedge fund leaves the index your investment will still be locked-up in the fund (Ang, 2013).

7.6 Database/Sample Selection bias

The database selection bias occurs as there are differences between the databases gathering hedge fund returns, and as every database is incomplete. The databases have different inclusion criteria; some databases may demand a minimum asset base, a certain years of existence, or other characteristics. These selection criteria generate a sample selection bias towards certain types of hedge funds, e.g. hedge funds with a certain size. It is important to be aware of this when using hedge fund return databases, as illustrated by the difference in hedge funds returns in figure 8 (Ilmanen, 2012).

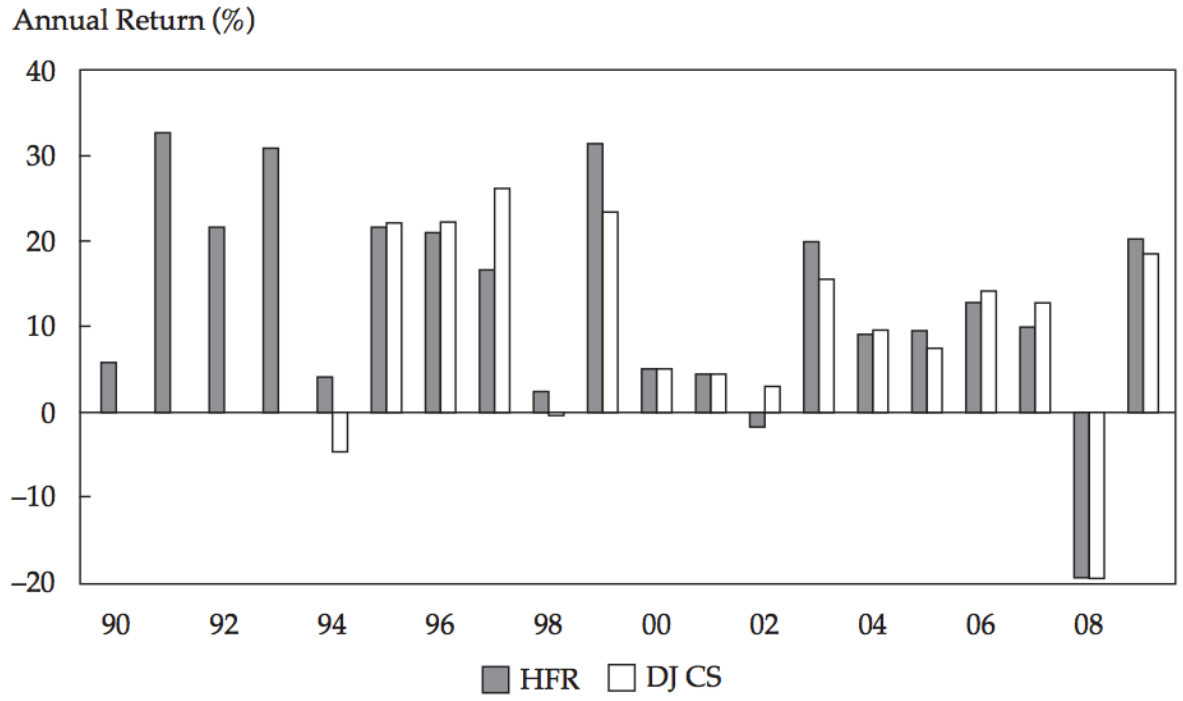


Figure 8: The figure illustrates the Database/Sample selection bias, showing the contrast of the annual returns of two hedge fund indices: the HFR Hedge Fund Index and the Credit Suisse Hedge Fund Index. Source: Ilmanen (2012).

8.0 DATA DESCRIPTION

In this chapter, we provide a description and justification of the data used in the empirical research. As a proxy for the risk-free rate, we have used monthly returns data of 3-month US Treasury bills. The risk-free rate was obtained from the US Federal Reserve, and we have used an arithmetic average of the monthly risk-free rate in our calculations. The hedge fund return data is obtained from Credit Suisse and Hedgenordic. We use indices from MSCI, Standard & Poor's, and the Oslo Stock Exchange as a proxy for equity returns. In order to estimate bond returns, we use indices from JPMorgan and Bank of America Merrill Lynch. Note that we only use return indices for our calculations, and that the indices are net of all fees. Table 2 illustrates monthly descriptive statistics of the indices used in the empirical research.

Indicies:	Mean	Min.	Max.	Std. Dev.
CS HF Index	0.50%	-6.78%	3.98%	1.71%
CS Long/Short Equity HFX	0.55%	-8.14%	5.10%	2.33%
CS Fixed Income Arbitrage HFX	0.33%	-15.12%	4.24%	2.02%
CS Global Macro HFX	0.66%	-6.86%	4.35%	1.54%
CS Dedicated Short Bias HFX	-0.67%	-11.97%	9.81%	4.35%
CS Managed Futures HFX	0.25%	-6.67%	6.66%	3.17%
CS Multi-Strategy HFX	0.53%	-7.63%	4.19%	1.69%
CS Convertible Arbitrage HFX	0.35%	-13.46%	5.65%	2.40%
NHX Nordic Index	0.36%	-4.57%	3.11%	1.17%
NHX Norway	0.46%	-4.88%	3.96%	1.70%
NHX Equities	0.42%	-5.41%	4.65%	1.49%
NHX Fixed Income	0.50%	-9.60%	4.10%	1.87%
NHX Funds of Funds	0.21%	-3.68%	2.27%	1.00%
NHX Managed Futures & CTA	0.29%	-4.81%	7.93%	2.39%
NHX Multi Strategy	0.43%	-2.87%	3.18%	0.97%
MSCI World	0.38%	-21.13%	10.35%	4.71%
MSCI AC Asia	0.35%	-20.73%	11.88%	5.10%
MSCI AC Europe	0.33%	-24.82%	12.69%	5.97%
MSCI EM	0.66%	-32.16%	15.41%	7.04%
SP500	0.37%	-18.56%	10.23%	4.31%
OSEBX	0.92%	-29.06%	14.69%	6.70%
BofA Global Broad	0.37%	-3.81%	5.78%	1.63%
JPM EMBI Global Composite	0.67%	-16.12%	7.48%	2.65%
BofA Global High Yield	0.68%	-17.79%	10.85%	3.04%

Table 2: This table illustrates monthly descriptive statistics of the indices used in the empirical research. The time period analysed is Jan 04 – Dec 13. Our calculations are based on data collected from: Credit Suisse, Hedgenordic, MSCI, YahooFinance, Euroinvestor, BofA, and JPMorgan.

In the first section of this chapter, we present a description of the period analysed. The second and final section provides a justification of the indices used in our empirical research. For a full description of the hedge fund indices, and the stock and bond indices used for comparison, see appendix A – C.

8.1 Description of the period analysed

In our empirical research, we analyse the period from the beginning of January 2004 to the end of December 2013. Figure 9 illustrates how the market has developed, and shows the nominal growth of $100 invested in 2004 for some of the indices used in the empirical research.

Figure 9: The figure illustrates the nominal growth of $100 for the primary indices used in the empirical research for the whole time period (January 2004 – December 2013). Our calculations are based on data collected from: Credit Suisse, Hedgenordic, MSCI, YahooFinance, Euroinvestor, BofA and JPMorgan.

During the time period analysed, the global stock market was affected by the worst financial crisis since the Great Depression of the 1930s. Caprio et al. (2010) have labelled the time period between the summer of 2007 and the late spring of 2009 as the "Great Financial Crisis", characterised by unsettled and dysfunctional markets. The "Great Financial Crisis" resulted in a total collapse of several large financial institutions, the bailout of banks by national governments, and a period of downturns in the stock markets around the world. The crisis played a significant role in the failure of key businesses and a decline in consumer wealth. As a consequence of the downturn in the economic activity, the crisis lead to a global recession and a European sovereign-debt crisis, which started in 2008 and are still affecting the European markets (Caprio, D'Apice, Ferri, & Puopolo, 2010).

8.2 Justification of the data

In order to analyse if hedge funds are an attractive investment opportunity for a Norwegian private investor, we use a set of comparable risky assets. In addition to hedge funds, we chose to focus the analysis on the core risky assets, which are defined as stocks and bonds (Dispas & Govaerts, 2013). We use indices as a proxy for asset class performance; the method used by, among others, Sharpe (1992). We chose to work with indices mainly for two reasons: First, indices are broad and easy to handle. Secondly, returns data from specific hedge funds are not easily accessible. Therefore, as highlighted by Kat & Brooks (2001), a common approach is to use hedge fund return indices gathered from renowned hedge fund database providers.

The indices chosen are frequently used benchmark indices for the different asset classes. In addition to the broad indices covering global investment opportunities, Norwegian indices are included for stocks and hedge funds. This is to incorporate the effects of an assumed home bias[13]. For bonds and hedge funds, note that the indices we have used are not investable, a private investor can therefore not easily replicate these positions.

8.2.1 Stocks

The stock indices used in our empirical research is selected to cover the parts of the worldwide stock market that would be plausible for a Norwegian private investor to invest in. Due to an assumed home bias, the OSEBX is included. The OSEBX is an investable index, which comprises the most traded shares, listed on the Norwegian stock market. Further on, we use the investable S&P 500 index to provide a representative sample of the 500 leading companies within the US economy (SEC, 2014). We included the MSCI World Index as it covers the global stock market, and is commonly used as a benchmark for the overall stock market performance (Chakrabarti, Huang, Lee, & Jayaraman, 2002). In addition to this, the MSCI Emerging Markets, MSCI AC Asia, and MSCI AC Europe are added to the investment universe of our private investor in order to broaden the dataset.

[13] Home bias is the investors' tendency to invest a large amount in domestic equities, despite the alleged benefits of diversifying into foreign equities. The bias is believed to be a result of the extra difficulties associated with investing in foreign equities (Hens & Bachmann, 2008).

8.2.2 Bonds

The bond indices are chosen based on the principle of covering the parts of the worldwide bond market that could be plausible investments for a Norwegian private investor. The indices used cover both the government bond market, and the corporate bond market. The BofA Merrill Lynch Global Broad Market Bond Index covers investment grade bonds, both government and corporate, issued in developed markets. The JPM Global EMBI Composite covers government bonds issued in emerging markets, while the BofA US High Yield Master II covers the US denominated high yield market. The BofA US High Yield Master II is considered an appropriate benchmark for high yield bonds, as the US market is the largest high yield bond market in the world (The Economist, 2013).

With regards to the Norwegian bond market, Nordea have recently developed a Norwegian bond index, the Nordea Norwegian Bond Index. As this index was developed in 2013, the dataset is not sufficient for use in this empirical research (Nordea Markets, 2013).

8.2.3 Hedge Funds

The hedge fund indices have been chosen with regards to covering most of the hedge fund market. The Credit Suisse is considered as a broad global market index for hedge funds (Darbyshire & Hampton, 2012). In addition to this, several hedge fund indices from Hedgenordic have been included to cover the Nordic hedge fund market. Indices covering the different hedge fund strategies have been included, to highlight the performance among the hedge funds strategies.

With regards to the upcoming legislation on hedge funds in Norway, one can argue that higher regulatory requirements would limit the possible hedge funds available to Norwegian private investors, hence weakening the representativeness of the hedge funds indices used in our calculations. However, as one aim of the AIFMD is to provide a consistent framework for the regulation of hedge funds, we find it reasonable that most of the hedge funds in the indices will adapt this regulation. By following the regulations, the hedge funds will be a possible investment opportunity for a Norwegian private investor.

9.0 SUB-QUESTION I: THE RISK/REWARD RELATIONSHIP OF HEDGE FUNDS

In this chapter, we will explore sub-question I: *Do hedge funds provide an attractive risk/reward relationship for a private investor?*

To elaborate on sub-question I, we will look into three aspects regarding the risk/reward relationship of hedge funds: the Sharpe ratio, Key statistics, and the Modified Sharpe ratio.

First, we explore the traditional performance measure of Sharpe (1966), in order to compare the risk/reward relationship of standalone investments in hedge funds, bonds, and stocks. Secondly, we present some key statistics of hedge fund returns. The calculations of key statistics will provide us insights regarding the normality of hedge fund returns in order to determine if the assumptions of Tobin (1958) are fulfilled, which could justify the use of the mean-variance framework. Further on, the key statistics will provide us with insight regarding the skewness and kurtosis of hedge fund returns. The third and final aspect is a discussion of the critique regarding the mean-variance framework, and explores how the use of a Modified Sharpe ratio will affect the risk-reward characteristics of hedge funds. The Modified Sharpe ratio will take into consideration our findings from key statistics regarding skewness and kurtosis.

In the first section, 9.1 Findings, we will present the findings regarding the four aspects of risk/reward characteristics. In the second and last section, 9.2 Discussion of the findings, we will present a discussion of our findings with regards to the attractiveness of the risk/reward relationship of hedge funds for a private investor.

9.1 Findings

In this section, we present the findings from the empirical research with regards to sub-question I. The first sub-section illustrates the calculated Sharpe ratios, the second sub-section presents the key statistics, while the third sub-section illustrates the calculated Modified Sharpe ratios.

9.1.1 Sharpe ratios

An overview of the Sharpe ratios of the different stocks -, bonds - and hedge funds indices is presented in table 3. Table 3 also provides a ranking of the Sharpe ratios calculated for the different indices, with the highest Sharpe ratio ranked as 1. In general, hedge funds have the highest Sharpe ratios, with the Credit Suisse Global Macro HFX ranked as number 1. Note that both the NHX Multi Strategy and the Credit Suisse Multi Strategy hedge funds are top 3. The highest ranked bond index, JPM EMBI Global Composite, is ranked as number 5, while the highest ranked stock index, OSEBX, is ranked as number 13 with a Sharpe ratio of 0.1182. The Norwegian hedge fund index, NHX Norway, is ranked as number 8 with a Sharpe ratio of 0.1946.

From table 3, it is evident that several of the hedge fund and bond indices provide high Sharpe ratios relative to the dataset. In general, the hedge fund and bond indices provide higher risk-adjusted returns compared to the stock indices, with some exceptions.

Index	Sharpe Ratio	Rank
Credit Suisse Global Macro HFX	0.3423	1
NHX Multi Strategy	0.3132	2
Credit Suisse Multi-Strategy HFX	0.2387	3
Credit Suisse HF Index	0.2212	4
JPM EMBI Global Composite	0.2031	5
NHX Fixed Income	0.2006	6
NHX Nordic Index	0.1961	7
NHX Norway	0.1946	8
NHX Equities	0.1931	9
Credit Suisse Long/Short Equity HFX	0.1822	10
BofA Global High Yield	0.1804	11
BofA Global Broad	0.1474	12
OSEBX	0.1182	13
Credit Suisse Fixed Income Arbitrage HFX	0.0987	14
Credit Suisse Convertible Arbitrage HFX	0.0941	15
NHX Funds of Funds	0.0838	16
MSCI EM	0.0757	17
NHX Managed Futures & CTA	0.0676	18
SP500	0.0568	19
MSCI World	0.0544	20
MSCI AC Asia	0.0442	21
Credit Suisse Managed Futures HFX	0.0391	22
MSCI AC Europe	0.0340	23
Credit Suisse Dedicated Short Bias HFX	-0.1834	24

Table 3: The table illustrates the Sharpe ratios of the different indices in a ranked order. The time period analysed is Jan 04 – Dec 13. Our calculations are based on data collected from: Credit Suisse, Hedgenordic, MSCI, YahooFinance, Euroinvestor, BofA, and JPMorgan.

Figure 10 graphs and groups the different hedge funds, stocks, and bonds with regards to their Sharpe ratios. From the figure, it is evident that stocks in general have the lowest Sharpe ratios, while hedge funds have high differences depending on the strategies.

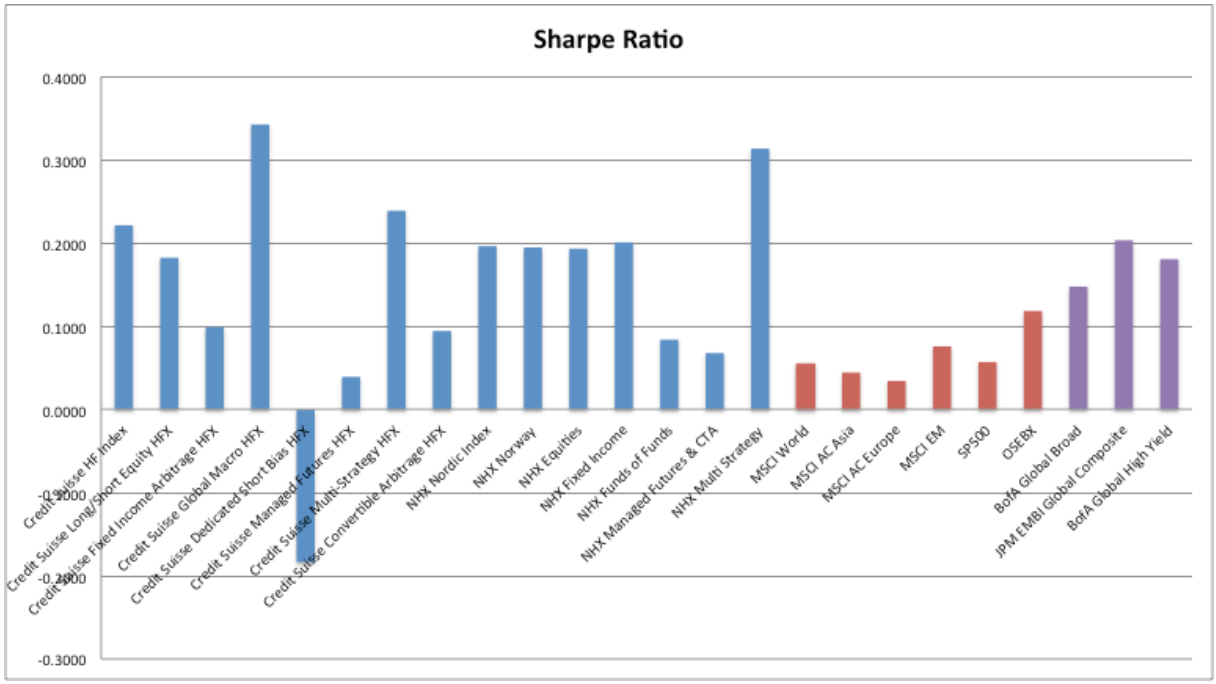


Figure 10: Sharpe ratios of the different indices. Blue colour indicates hedge fund indices, red indicates stock indices, and purple indicates bond indices. The time period analysed is Jan 04 – Dec 13. Our calculations are based on data collected from: Credit Suisse, Hedgenordic, MSCI, YahooFinance, Euroinvestor, BofA, and JPMorgan.

9.1.2 Key Statistics (Skewness & Kurtosis)

Table 4, illustrates our calculations of the key statistics for the Credit Suisse and Hedgenordic indices. The hedge fund indices exhibit significant negative skewness, including both the broad Credit Suisse HF Index and NHX Norway. Our findings exhibit significant positive excess kurtosis for the hedge fund indices. The exceptions are Credit Suisse Dedicated Short Bias HFX and Credit Suisse Managed Futures HFX, as they do not have positive excess kurtosis.

The normality of the returns data is tested using a Jarque-Bera normality test. The Jarque-Bera test defines a null hypothesis stating that the data is normally distributed, and an alternative hypothesis stating that the data is arbitrarily distributed. From a chi-squared distribution, the Jarque-Bera test defines a critical value of 5.99 based on a 5% significance

level with 2 degrees of freedom**.** The critical value is exceeded for most of the hedge funds indices, indicating that the hedge fund indices are not normally distributed. The exceptions are Credit Suisse Dedicated Short Bias HFX, Credit Suisse Managed Futures HFX and NHX Multi Strategy where we accept the null hypothesis.

Indicies:	Mean	Min.	Max.	Std. Dev.	Skewness	Excess Kurtosis	Jarque-Bera
CS HF Index	0.50%	-6.78%	3.98%	1.71%	-1.46	4.12	126.26
CS Long/Short Equity HFX	0.55%	-8.14%	5.10%	2.33%	-1.02	1.74	35.58
CS Fixed Income Arbitrage HFX	0.33%	-15.12%	4.24%	2.02%	-4.64	30.57	5059.40
CS Global Macro HFX	0.66%	-6.86%	4.35%	1.54%	-1.24	5.46	178.58
CS Dedicated Short Bias HFX	-0.67%	-11.97%	9.81%	4.35%	0.21	-0.07	0.91*
CS Managed Futures HFX	0.25%	-6.67%	6.66%	3.17%	-0.06	-0.93	4.36*
CS Multi-Strategy HFX	0.53%	-7.63%	4.19%	1.69%	-1.96	7.30	340.65
CS Convertible Arbitrage HFX	0.35%	-13.46%	5.65%	2.40%	-2.93	16.36	1497.59
NHX Nordic Index	0.36%	-4.57%	3.11%	1.17%	-0.95	2.55	50.15
NHX Norway	0.46%	-4.88%	3.96%	1.70%	-0.77	0.71	14.13
NHX Equities	0.42%	-5.41%	4.65%	1.49%	-0.91	2.43	45.75
NHX Fixed Income	0.50%	-9.60%	4.10%	1.87%	-3.13	14.04	1171.63
NHX Funds of Funds	0.21%	-3.68%	2.27%	1.00%	-1.03	2.45	51.11
NHX Managed Futures & CTA	0.29%	-4.81%	7.93%	2.39%	0.54	0.70	8.26
NHX Multi Strategy	0.43%	-2.87%	3.18%	0.97%	-0.30	0.81	5.02*

Table 4: The table illustrates the summary statistics of monthly returns in the period analysed. Minimum (Min.) and maximum (Max.) are based on respectively the lowest and highest monthly returns that occurred during the time period. The Jarque-Bera normality test follows the chi-distribution, χ^2, with 2 degrees of freedom under the null hypothesis, and with 5% significance level and a critical value of 5.99. Accepted null hypothesises are marked with a * (Kat & Brooks, 2001).

9.1.3 Modified Sharpe ratios

The effects of implementing the Modified Sharpe ratio adopted from Gregoriou & Gueyie (2003) are illustrated in table 5.

Index	Modified Sharpe	Rank	(SR Rank)
NHX Multi Strategy	0.1210	1	(2)
Credit Suisse Global Macro HFX	0.1096	2	(1)
NHX Norway	0.0762	3	(8)
Credit Suisse Multi-Strategy HFX	0.0760	4	(3)
Credit Suisse HF Index	0.0758	5	(4)
NHX Equities	0.0711	6	(9)
NHX Nordic Index	0.0711	7	(7)
Credit Suisse Long/Short Equity HFX	0.0688	8	(10)
BofA Global Broad	0.0630	9	(12)
NHX Fixed Income	0.0618	10	(6)
JPM EMBI Global Composite	0.0596	11	(5)
BofA Global High Yield	0.0529	12	(11)
OSEBX	0.0418	13	(13)
NHX Managed Futures & CTA	0.0369	14	(18)
NHX Funds of Funds	0.0314	15	(16)
Credit Suisse Fixed Income Arbitrage HFX	0.0301	16	(14)
MSCI EM	0.0288	17	(17)
Credit Suisse Convertible Arbitrage HFX	0.0280	18	(15)
SP500	0.0220	19	(19)
MSCI World	0.0206	20	(20)
Credit Suisse Managed Futures HFX	0.0195	21	(22)
MSCI AC Asia	0.0177	22	(21)
MSCI AC Europe	0.0135	23	(23)
Credit Suisse Dedicated Short Bias HFX	-0.1082	24	(24)

Table 5: The table illustrates the Modified Sharpe ratios of the different indices, in a ranked order. The far right column illustrates rankings based on the Sharpe ratio (SR). The time period analysed is Jan 04 – Dec 13. Our calculations are based on data collected from: Credit Suisse, Hedgenordic, MSCI, YahooFinance, Euroinvestor, BofA, and JPMorgan.

From table 5, it its evident that the rankings based on the Modified Sharpe ratios are rather similar to the rankings based on the Sharpe ratios. In general, hedge funds perform better than stocks and bonds if the Modified Sharpe ratio is used as the performance measure. The most significant differences are the improved performance of NHX Norway and the weakened performance of JPM EMBI Global Composite. The NHX Norway climbed five places, while the JPM EMBI Global Composite dropped six places.

Figure 11 graphs and groups the different hedge funds, stocks, and bonds with regards to their Modified Sharpe ratios.

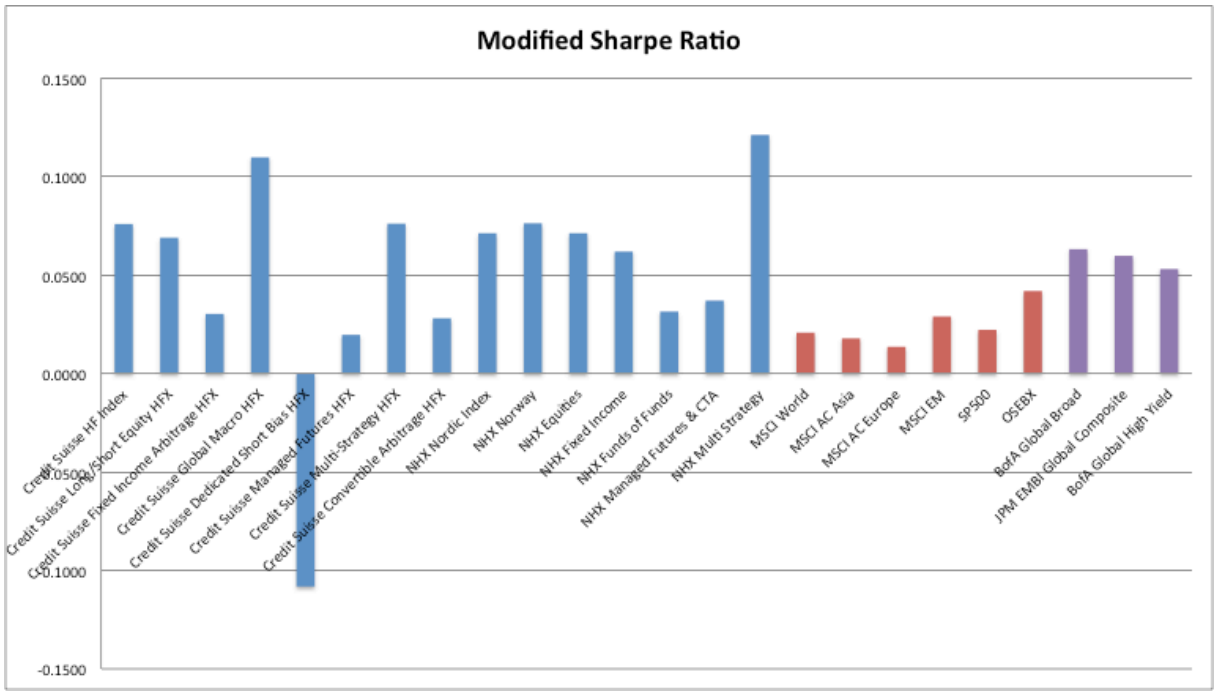


Figure 11: Modified Sharpe ratios of the different indices. Blue colour indicates hedge fund indices, red indicates stock indices, and purple indicates bond indices. The time period analysed is Jan 04 – Dec 13. Our calculations are based on data collected from: Credit Suisse, Hedgenordic, MSCI, YahooFinance, Euroinvestor, BofA, and JPMorgan.

9.2 Discussion of the findings

In this section, we will discuss the findings regarding sub-question I of the research question. We have divided the findings into three sub-sections: Sharpe ratios, Key statistics, and Modified Sharpe ratios.

9.2.1 Sharpe ratios

The reasoning behind risk-adjusting the returns is to associate a level of risk to the returns generated. The Sharpe ratio provides a possibility to rank and evaluate the performance of standalone investments. A standalone investment is defined as a single investment, not taking into account how the investment would affect the investor's portfolio.

In general, we observed that hedge funds had higher Sharpe ratios compared to stocks. The Hedgenordic indices had five out of seven indices ranked top 9. With regards to a possible home bias, it is natural to assume that a Norwegian private investor would invest in Nordic hedge funds, supporting that hedge funds could provide an attractive risk/reward relationship.

Another observation is that the NHX Managed Futures & CTA and the NHX Funds of Funds indices are lower ranked. Ilmanen (2012) argues that funds of funds indices could produce more realistic Sharpe ratios, as several of the reporting biases would be reduced. This could explain why the observed Sharpe ratio of the NHX Funds of Funds is lower compared to the other Hedgenordic indices. Another explanation could be the fact that funds of funds contain double layers of fees. As we use net returns data, this would affect the returns and thereby the Sharpe ratio of funds of funds.

Liang (1999) and Schneeweis & Martin (2000) support our findings of higher Sharpe ratios for hedge funds compared to stocks. Based on his findings, Liang (1999) suggests that hedge funds dominate mutual funds, and provide investors with improved risk-adjusted returns. An interesting observation is the negative Sharpe ratio of the Credit Suisse Dedicated Short Bias HFX, suggesting that the hedge fund index returns are significantly lower than the risk free return. Our findings also indicate that during the time-period we investigated, bonds produced relatively good Sharpe ratios. This could be due to the recent period of stellar price increase in worldwide bond markets. Bill Gross[14] argues that we have seen a "three decade bull run in bonds" (Wall Street Journal, 2013).

Based solely on the framework of Sharpe (1966), hedge funds would provide a superior risk/reward relationship compared to stocks and bonds. With regards to a private investor comparing standalone investment opportunities, our findings clearly indicate that hedge funds do indeed seem to be an attractive investment opportunity.

9.2.2 Key Statistics

From the Jarque-Bera test, we found that the hedge fund returns of the Credit Suisse and Hedgenordic indices are not normally distributed. As a consequence, none of the assumptions of Tobin (1958) for validating the mean-variance framework is satisfied: the returns are not normally distributed, and according to Hens & Bachmann (2008) the investor does not hold a quadratic utility function. This dismisses the use of a mean-variance framework for evaluating hedge funds.

[14] Bill Gross is the co-founder and chief investment officer of PIMCO. PIMCO is among the largest bond investors in the world. By 31st of December 2013, they held over $1.9 trillion in assets under management.

Favre & Signer (2002) criticises the inability to take into account the negative skewness and high kurtosis that is present for hedge fund returns data. According to Ilmanen (2012), hedge funds returns show significant negative skewness and fat tails. Similarly, our findings suggest that there is substantial negative skewness and high kurtosis present with regards to hedge fund returns in the period analysed.

According to Harvey & Siddique (2000) and Guidolin & Nicodano (2013), the average investor dislikes negative skewness and high kurtosis. As investors care about more than just expected returns and variance, one can argue that the Sharpe ratio has clear deficiencies. Kat & Brooks (2001) states that the Sharpe ratio is insufficient as performance measure, and that the attractive Sharpe ratios of hedge funds could be compared to the fact that there are "no free lunches" in finance; investors will pay for the attractive Sharpe ratio with a negative skewness and higher kurtosis in the return distribution. In addition to this, Ilmanen (2012) argues that many hedge funds load up on various other risk factors that are not well measured through the Sharpe ratio. Ilmanen (2012) suggests that alternative betas, illiquidity, lack of transparency, and leverage risks are risks that are understated by the evaluation of hedge funds based on the Sharpe ratio.

Relying on the logic of Kat & Brooks (2001) and Ilmanen (2012), a private investor will not adequately assess the effect on the risk/reward characteristics of hedge funds by using the Sharpe ratio: the investor needs to take several other factors, such as the skewness and kurtosis, into consideration.

9.2.3 Modified Sharpe ratios

One performance measure that takes more than just the risk premium and standard deviation into consideration is the Modified Sharpe ratio. The Modified Sharpe ratio is based on the Modified Value-at-Risk (MVaR), which is used as the denominator instead of the standard deviation. According to Gregoriou & Gueyie (2003), the justification for replacing the standard deviation by MVaR is that the latter adjusts for skewness and kurtosis. By implementing MVaR, the critique from Harvey & Siddique (2000), Kat & Brooks (2001), Ilmanen (2012), and Guidolin & Nicodano (2013) is brought to attention.

As the Modified Sharpe ratio implements the effect of skewness and kurtosis, we expected a substantial change in the rankings of hedge funds when the performance measure was changed. However, the findings illustrated differently. From the findings, it is evident that the Modified Sharpe ratios do not significantly alter the rankings of the assets. Evaluated by the Modified Sharpe ratio, hedge funds remain an attractive standalone investment opportunity for private investors.

Even though the Modified Sharpe ratio adjusts for skewness and kurtosis, it may not be sufficient to provide an absolute conclusion. Ilmanen (2012) reports on a number of other factors distorting the Sharpe ratio as a performance measurement; the illiquidity of hedge funds, the leverage risks, and the returns biases. A study done by Ibbotson, Chen, & Zhu (2011) found that adjusting for survivorship and backfill bias had an combined impact of 7.2 percentage points reduction on the annual return of an equally weighted hedge fund portfolio. In addition, Kat & Brooks (2001) observed significant autocorrelation[15] in their studies of hedge fund returns. The observed autocorrelation would systematically lead estimates of the standard deviation to be biased downwards, which could explain why we find higher Sharpe and Modified Sharpe ratios for the hedge fund indices. As the biases, autocorrelation, and other factors are not adjusted for in the Modified Sharpe performance measure, one can argue that the adjustments made by going from Sharpe to Modified Sharpe may not be sufficient to correctly estimate the risks of investing in hedge funds.

Based solely on the framework of Gregoriou & Gueyie (2003), our findings indicate that hedge funds do indeed seem to be an attractive standalone investment opportunity for private investors. The change of performance measure from the Sharpe ratio to the Modified Sharpe ratio had a lower impact than expected. However, as documented by Ilmanen (2012), several other factors that are not adjusted for under the Modified Sharpe ratio may distort the evaluation of hedge fund performance.

[15] For theory regarding autocorrelation, see appendix H.

SUMMARISING SUB-QUESTION I: *Do hedge funds provide an attractive risk reward/relationship for a private investor?*	
	Findings:
Sharpe ratios:	The Sharpe ratios indicate an attractive risk/reward relationship.
Modified Sharpe ratios:	The Modified Sharpe ratios indicate an attractive risk/reward relationship.
Limitations:	Ilmanen (2012) reports on a number of factors distorting the Sharpe and the Modified Sharpe ratio, such as the illiquidity of hedge funds, the leverage risk, and the returns biases.

Table 6: The table summarises sub-question I: Do hedge funds provide an attractive risk/reward relationship for a private investor?

10.0 SUB-QUESTION II: THE UNIQUENESS OF HEDGE FUND RETURNS

From sub-question I of the analysis, we discovered that hedge funds seem attractive, but that the performance may be distorted due to biased returns data and insufficient risk measures. This chapter directs the attention towards the second sub-question of our research question: *Are hedge funds providing a unique exposure compared to other asset classes for a private investor?*

In order to answer sub-question II, we look at three aspects of hedge funds. The first aspect is the correlation of hedge funds and traditional assets. The second aspect is an analysis of how an efficient frontier consisting of stocks and bonds is affected by including hedge funds to the investment universe. The third and final aspect elaborates on the resemblance between hedge funds and a short put option.

To analyse the first aspect, the correlation between hedge funds and traditional assets is calculated with regards to the whole time period from the beginning of January 2004 to the end of December 2013. In addition, we analyse the change in correlations during the "Great Financial Crisis". The analysis of the correlations provides us with important insights regarding whether a private investor can obtain similar returns at a lower cost, and whether a private investor can improve the risk management opportunities by investing in hedge funds.

The second aspect is an analysis of efficient frontiers based on the framework of Markowitz (1952). The findings will provide us with insight regarding how a well-diversified portfolio is affected by including hedge funds. If hedge funds improve the efficient frontier, they provide a better optimal portfolio for a private investor than what could be obtained from investing solely in stocks and bonds, implying unique returns.

Based on our findings regarding the skewness and kurtosis of hedge fund returns, we discuss the final aspect by looking into the resemblance between hedge funds and a short put option. This will provide us with important insights regarding whether hedge funds provide a cost-effective way of obtaining returns for a private investor, and whether the hedge fund payoff structure is attractive for private investors.

We will begin this chapter by presenting relevant literature on the uniqueness of hedge fund returns in the first section, 10.1 Relevant academic literature on the uniqueness of hedge fund returns. In the second section, 10.2 Findings, we present the findings from our empirical research. In the last section, 10.3 Discussion of the findings, we will discuss our findings with regards to the uniqueness of hedge fund returns, by elaborating on the correlations, the efficient frontiers, and the short put resemblance of hedge funds.

10.1 Relevant academic literature on the uniqueness of hedge fund returns

There are arguments suggesting hedge funds have the possibility to generate unique returns that would be difficult, some would even say impossible, to obtain for other types of funds. The way hedge funds trade, dynamically churning securities, employing leverage, and using derivatives, provides hedge funds the possibility to emphasise risk factors that are less significant in long-only, passive asset allocations (Ang, 2013). Ilmanen (2012) states that the restrictions of investor redemptions provide hedge fund managers the ability to extract liquidity premiums from the markets. Another argument suggests that the significant performance fees and the common structure of hedge fund managers investing in their own funds, provides an appropriate alignment of incentives. Ilmanen (2012) found that hedge funds where the managers had a significant exposure of their own money lost less than traditional money managers during 2007-2008. In addition to the incentive schemes, Jame (2013) advocates that hedge funds have the ability to attract the most talented investment managers. Other arguments are hedge funds' ability to enter a variety of different asset classes, and the broad and different economic functions they are able to offer. Ilmanen (2012) argues that fair rewards could be expected from the economic functions conducted by hedge funds, such as capital provision, risk sharing, and market completion.

If hedge funds are able to gain an edge from their flexible structures compared to traditional funds, and could be labelled as absolute return funds, it is reasonable to assume that they will have low correlation with traditional assets**.** Fung & Hsieh (1997) are early proponents of the low correlations between hedge funds and core asset classes. Liang (1998) supports this view, and further attributes the low correlation to the flexible investment strategies of hedge funds and the non-traditional asset classes they invest in, such as derivatives. According to Liang (1998), hedge funds provide investors with unique returns, stating "the empirical evidence

[on hedge fund returns] indicates that hedge funds differ substantially from traditional investment vehicles such as mutual funds".

Ang (2013) contradicts the supposedly low correlations between hedge funds and traditional assets. Looking at monthly returns data from January 2000 to September 2012, Ang finds a very high correlation between hedge funds and stocks. The findings of Ang (2013) suggest high hedge fund returns in the early 2000s, a huge decrease in 2008, and a steady recovery after 2009, which is similar to the performance of the equity market. Ang (2013) is supported by, among others, Kat & Brooks (2001), as their research indicate a high positive correlation between hedge funds and stocks. Kat & Brooks (2001) further documents that different hedge fund strategies are highly correlated, even for the strategies that initially seem to have little in common, e.g. long/short equity and emerging markets. Their findings imply several common systematic risk factors that hedge funds share with stocks. Cochrane (2014) embraces this view, stating that hedge funds trade in the exactly same securities as traditional funds, and thereby could not be considered a new asset class. Cochrane further points out that in addition to trading in common securities, hedge funds on aggregate resembles a common security; an option (Cochrane, 2014). This is illustrated in figure 12.

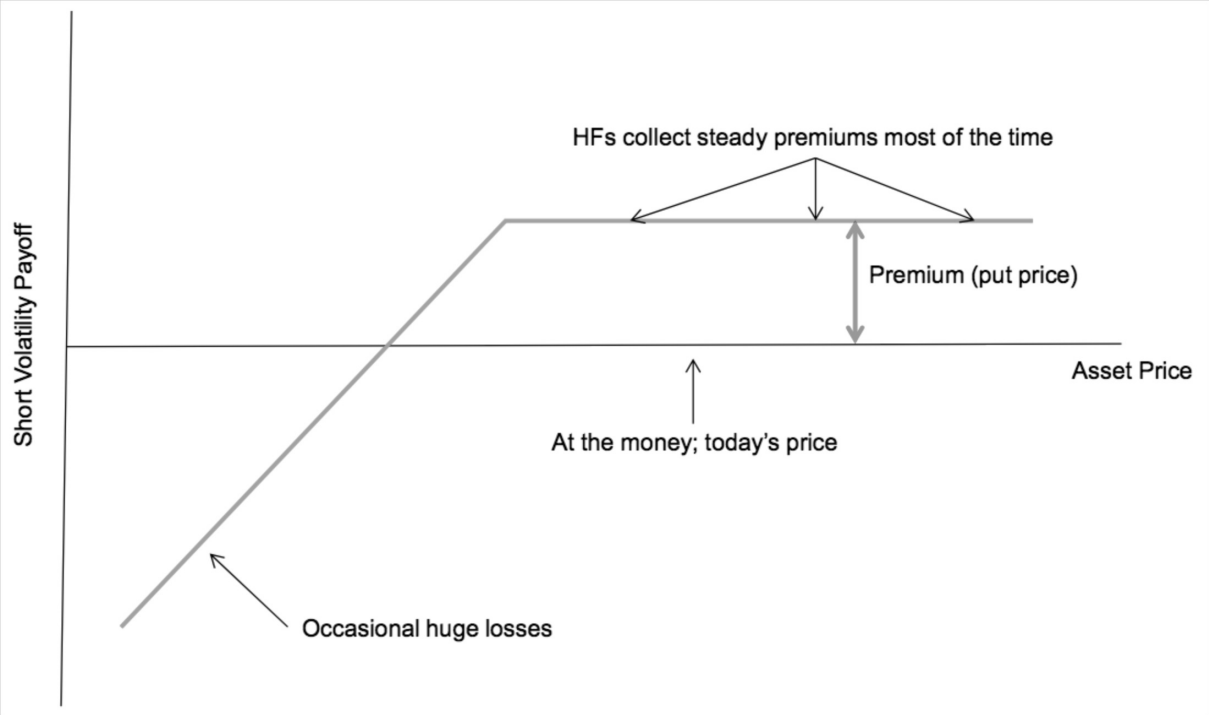


Figure 12: The figure illustrates the similarity of the payoff structure of hedge funds and short put options. The x-axis shows the asset price, while the y-axis shows the payoff of the hedge fund. Hedge funds collect steady premiums most of the time, but occasionally huge losses occur. Source: (Ang, 2013)

Academic literature on hedge funds provides arguments for unique hedge fund returns, uncorrelated from other assets, as suggested by Liang (1998). On the other hand, academic literature, such as Ang (2013), argue that hedge funds are highly correlated with traditional assets, and that the hedge fund returns are nothing but a short put option. This could imply that hedge funds do not provide unique returns. The next sections describe our findings with regards to the correlation of hedge funds to traditional assets, the effect of hedge funds on an efficient frontier consisting of stocks and bonds, and a discussion regarding the resemblance between hedge fund returns and a short put option.

10.2 Findings

In this section, we present the calculated correlations and the efficient frontiers. In the first sub-section, we present our findings of the correlations between hedge funds and core assets. This sub-section further includes the calculated correlations from the "Great Financial Crisis". As the key statistics indicated non-normality of the data used, the correlations were calculated using Spearman's rank correlation. In the second sub-section, we present our calculated efficient frontiers.

10.2.1 Spearman's rank correlation

Table 7 illustrates the Spearman's rank correlations. The findings indicate that stocks are highly positively correlated with both the Credit Suisse and Hedgenordic hedge fund indices. With regards to the S&P 500, only two out of fifteen observations are significantly different from 0. The significant results indicate a lower correlation between S&P 500 and the hedge fund indices, compared to the other stock indices. The Credit Suisse Dedicated Short Bias HFX has negative correlations with the stock indices.

Credit Suisse indices and traditional assets:	MSCI World	MSCI AC Asia	MSCI AC Europe	MSCI EM	SP500	OSEBX
Credit Suisse HF Index	0.8204	0.7642	0.7952	0.8038	-0.0098*	0.7717
Credit Suisse Long/Short Equity HFX	0.8949	0.8153	0.8683	0.8635	0.0221*	0.8287
Credit Suisse Fixed Income Arbitrage HFX	0.4988	0.3961	0.4987	0.3960	0.1839	0.3991
Credit Suisse Global Macro HFX	0.3325	0.4047	0.3349	0.4376	-0.1470*	0.3491
Credit Suisse Dedicated Short Bias HFX	-0.7658	-0.6335	-0.6685	-0.6126	-0.0662*	-0.5764
Credit Suisse Managed Futures HFX	0.2972	0.2620	0.2644	0.2962	-0.0866*	0.2899
Credit Suisse Multi-Strategy HFX	0.7585	0.6845	0.7284	0.6836	0.0468*	0.6836
Credit Suisse Convertible Arbitrage HFX	0.5648	0.4998	0.5332	0.4963	0.1398*	0.5348

Hedgenordic indices and traditional assets:	MSCI World	MSCI AC Asia	MSCI AC Europe	MSCI EM	SP500	OSEBX
NHX Nordic Index	0.7250	0.6936	0.7084	0.7545	0.0883*	0.7888
NHX Norway	0.6470	0.5873	0.6319	0.6314	0.0502*	0.7474
NHX Equities	0.6875	0.6485	0.6827	0.7027	0.1142*	0.7624
NHX Fixed Income	0.3200	0.2760	0.2903	0.2583	0.1913	0.2741
NHX Funds of Funds	0.6373	0.6021	0.6304	0.6594	-0.0020*	0.7246
NHX Managed Futures & CTA	0.2878	0.2683	0.2578	0.3245	-0.0746*	0.3086
NHX Multi Strategy	0.6616	0.6644	0.6867	0.7655	0.0538*	0.7387

Table 7: The table illustrates the Spearman's correlation between the hedge fund indices and stock indices. Note that * marks insignificant results, tested with a two-tailed t-test, at a 5% significance level. The t-test documents whether there is correlation significantly different from 0: H_0: $\rho = 0$, H_A: $\rho \neq 0$. N=119. The time period analysed is Jan 04 – Dec 13. Our calculations are based on data collected from: Credit Suisse, Hedgenordic, MSCI, YahooFinance, and Euroinvestor.

From table 8, we see that the correlations between bonds and hedge funds are mainly positive, but compared to the correlations between stocks and hedge funds they are lower. Interestingly, the Credit Suisse Global Macro HFX has higher correlation with bonds than the Credit Suisse Fixed Income Arbitrage HFX. Bank of America Global High Yield Bond index is showing generally insignificant observations with regards to our null hypothesis, and will not be further elaborated on.

Credit Suisse indices and traditional assets:	BofA Global Broad	JPM EMBI Global	BofA Global HY
Credit Suisse HF Index	0.2802	0.3375	-0.0369*
Credit Suisse Long/Short Equity HFX	0.2551	0.3762	0.0422*
Credit Suisse Fixed Income Arbitrage HFX	0.2438	0.2110	0.0932*
Credit Suisse Global Macro HFX	0.3860	0.2245	-0.1488*
Credit Suisse Dedicated Short Bias HFX	-0.1704*	-0.3509	-0.0999*
Credit Suisse Managed Futures HFX	0.2384	0.0957*	-0.0529*
Credit Suisse Multi-Strategy HFX	0.1796*	0.3269	-0.0361*
Credit Suisse Convertible Arbitrage HFX	0.0786*	0.2689	0.0454*

Hedgenordic indices and traditional assets:	BofA Global Broad	JPM EMBI Global	BofA Global HY
NHX Nordic Index	0.1440*	0.3431	0.0746*
NHX Norway	0.0282*	0.2393	-0.0104*
NHX Equities	0.0512*	0.2410	0.0884*
NHX Fixed Income	0.1241*	0.3929	0.3029
NHX Funds of Funds	0.1076*	0.2452	-0.0320*
NHX Managed Futures & CTA	0.2424	0.1350*	-0.1194*
NHX Multi Strategy	0.1727*	0.4116	0.1305*

Table 8: The table illustrates the Spearman's correlation between the hedge fund indices and bond indices. Note that * marks insignificant results, tested with a two-tailed t-test, at a 5% significance level. The t-test documents whether there is correlation significantly different from 0: H_0: $\rho = 0$, H_A: $\rho \neq 0$. N=119. The time period analysed is Jan 04 – Dec 13. Our calculations are based on data collected from: Credit Suisse, Hedgenordic, BofA, and JPMorgan.

Table 9 illustrates the effect the "Great Financial Crisis" had on the correlations between hedge funds, stocks and bonds. The first period analysed is from the beginning of January 2004 to the end of December 2013, excluding the "Great Financial Crisis" (illustrated as "Excluding the crisis" in table 9). The second period analysed is the "Great Financial Crisis", from the end of June 2007 to the end of June 2009 (illustrated as "2007-2009" in table 9). The Credit Suisse hedge fund indices show ambiguous, but slightly lower correlations with the MSCI World during the financial crisis. The correlations with OSEBX, on the other hand, have increased. The Hedgenordic indices show a significant increase of correlation with the MSCI World and the OSEBX during the financial crisis.

As the hedge fund indices' correlations with BofA Global Broad index are insignificant with regards to the null hypothesis, we will not elaborate on these correlations further.

Credit Suisse indices and traditional assets:	**MSCI World**		**OSEBX**		**BofA Global Broad**	
Time:	Excluding the crisis	"2007-2009"	Excluding the crisis	"2007-2009"	Excluding the crisis	"2007-2009"
Credit Suisse HF Index	*0.8542*	0.6774	*0.7327*	0.8600	*0.3428*	0.1800*
Credit Suisse Long/Short Equity HFX	*0.9049*	0.7965	*0.7796*	0.8817	*0.2760*	0.2870*
Credit Suisse Fixed Income Arbitrage HFX	*0.3917*	0.6270	*0.2504*	0.6800	*0.3843*	0.0870*
Credit Suisse Global Macro HFX	*0.4436*	0.1270*	*0.3786*	0.2878*	*0.3905*	0.3896*
Credit Suisse Dedicated Short Bias HFX	*-0.7860*	-0.6530	*-0.5603*	-0.5374	*-0.2763*	0.0017*
Credit Suisse Managed Futures HFX	*0.4536*	-0.1461*	*0.3909*	-0.0243*	*0.2633*	0.1565*
Credit Suisse Multi-Strategy HFX	*0.8079*	0.5591	*0.6796*	0.7417	*0.2815*	0.043*
Credit Suisse Convertible Arbitrage HFX	*0.5049*	0.5496	*0.4645*	0.6591	*0.1560**	0.0617*

Credit Suisse indices and traditional assets:	**MSCI World**		**OSEBX**		**BofA Global Broad**	
Time:	Excluding the crisis	"2007-2009"	Excluding the crisis	"2007-2009"	Excluding the crisis	"2007-2009"
NHX Nordic Index	*0.7008*	0.7035	*0.7534*	0.8557	*0.1491**	0.2026*
NHX Norway	*0.5925*	0.6591	*0.7092*	0.8452	*0.0656**	0.0078*
NHX Equities	*0.6746*	0.6843	*0.7306*	0.8461	*0.0380**	0.1635*
NHX Fixed Income	*0.1867*	0.5643	*0.1597**	0.5800	*0.2201*	0.1513*
NHX Funds of Funds	*0.6342*	0.5452	*0.6751*	0.8017	*0.1482**	0.0774*
NHX Managed Futures & CTA	*0.3596*	0.0617*	*0.3449*	0.1643*	*0.2402*	0.2539*
NHX Multi Strategy	*0.6128*	0.6757	*0.7099*	0.7948	*0.1179**	0.3052*

Table 9: The table illustrates a comparison of the Spearman's correlation between hedge fund indices and MSCI World, OSEBX, and BofA Global Broad. Two time periods are analysed. The first period is from the beginning of January 04 to the end of December 13, excluding the "Great Financial Crisis" ("Excluding the crisis"). The second period is the "Great Financial Crisis", from the end of June 07 to the end of June 09 ("2007-2009"). Note that * marks insignificant results, tested with a two-tailed t-test, at a 5% significance level. The t-test documents whether there is correlation significantly different from 0: H_0: $\rho = 0$, H_A: $\rho \neq 0$. N_1=94 and N_2=24 for respectively "Excluding the crisis" and "2007-2009". Our calculations are based on data collected from: Credit Suisse, Hedgenordic, MSCI, Euroinvestor, and BofA.

10.2.2 Efficient Frontiers for different asset classes

A comparison of the efficient frontiers of the stocks-, bonds-, and hedge funds indices can be seen in figure 13. For a monthly return of 1%, the standard deviation of stocks is above 4%**,** bonds' standard deviation is approximately 4%, while hedge funds' is approximately 1%. The efficient frontier of hedge funds lies above and to the left of the other efficient frontiers, implying superiority of hedge funds.

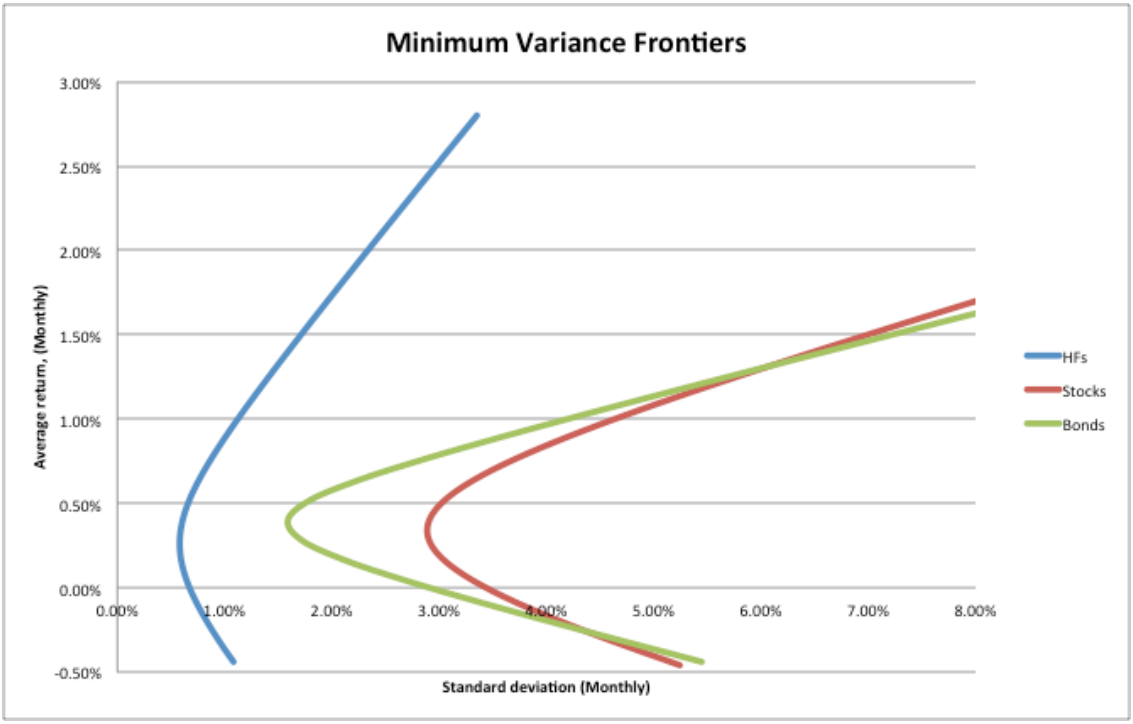


Figure 13: Minimum variance frontiers for three portfolios consisting of i) hedge fund indices (blue line), ii) stock indices (red line), and iii) bond indices (green line). Note that the hedge fund indices are not investable, and the hedge fund efficient frontier cannot be obtained for a private investor. The time period analysed is Jan 04 – Dec 13. Our calculations are based on data collected from: Credit Suisse, Hedgenordic, MSCI, YahooFinance, Euroinvestor, BofA, and JPMorgan.

By creating efficient frontiers, with and without the possibility to invest in hedge funds, we get an indication of whether hedge funds provide unique returns. Figure 14 illustrates the efficient frontiers created, where we have included two hedge funds, the NHX Norway and the Credit Suisse HFX, to a portfolio consisting of stocks and bonds (see appendix G for an efficient frontier where all the hedge fund indices are included). The blue line illustrates the efficient frontier without hedge funds, while the red line illustrates the efficient frontier with hedge funds. The efficient frontier with hedge funds lies above and to the left of the original efficient frontier, implying a lower global minimum variance point, and an improved optimal portfolio.

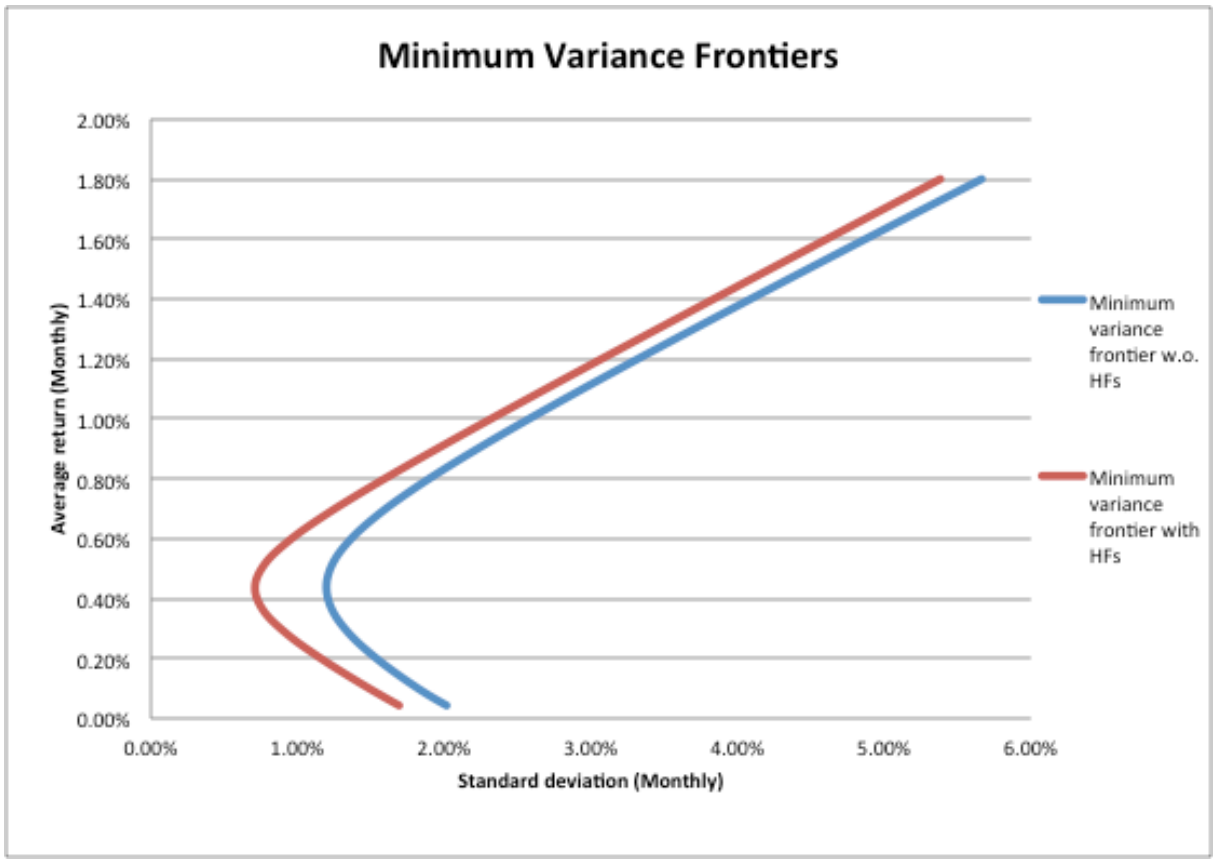


Figure 14: Minimum variance frontiers of portfolios with (red line) and without (blue line) the possibility to invest in hedge funds. In the portfolio with the possibility to invest in hedge funds, we have included two hedge fund indices in the calculations: the NHX Norway and the Credit Suisse HFX. The time period analysed is Jan 04 – Dec 13. Our calculations are based on data collected from: Credit Suisse, Hedgenordic, MSCI, YahooFinance, Euroinvestor, BofA, and JPMorgan.

10.3 Discussion of the findings

In this section we will discuss the findings regarding sub-question II. The discussion is divided into three sub-sections. First, there is discussion with regards to correlations. Then, there is a discussion on efficient frontiers, while the last sub-section elaborates on hedge funds' resemblance with a short put option strategy.

10.3.1 Correlations

The key statistics calculated in sub-question I of the analysis indicated that hedge fund returns exhibit non-normality. Therefore, the correlations elaborated in this section are based on Spearman's rank correlation.

Tables 7 and 8 illustrate our calculated correlations between hedge funds and stocks, and hedge funds and bonds. With a correlation below 1, indicating that there is not a perfect positive correlation[16], there will be diversification benefits from including hedge funds to a portfolio of stocks and bonds. Unlike traditional fund managers, hedge fund managers can combine long and short positions, and thereby isolate the manager's security selection and/or timing skill from the performance of the underlying asset (Asness, Krail, & Liew, 2001). This feature of hedge funds is attractive, as it seemingly could be possible to offer investments with high returns, uncorrelated to traditional assets.

Fung & Hsieh (1997), Liang (1998), Agarwal & Naik (1999) and Peskin et al. (2000) all find moderate to low correlations between hedge funds and traditional assets. Agarwal & Naik (1999) states that the low correlation of hedge funds with traditional assets provide excellent diversification opportunities. Based on their findings of the diversification abilities of hedge funds, Agarwal & Naik (1999) recommends investors to allocate a significant part of their portfolio to hedge funds.

Our findings, however, are more in line with Kat & Brooks (2001), Ilmanen (2012), and Ang (2013). They find correlations between hedge funds and stocks to be below 1, but rather high. These high correlations suggest that even though there is possible to obtain some diversification benefits, the diversification possibilities seem to be substantially lower than what is communicated under the slogan of absolute return funds. Interestingly, regardless of all the different strategies deployed by hedge fund managers, the aggregate performance of hedge funds is tightly related to the traditional stock market. An example supporting this argument is the Barron's top 100 hedge fund awards, documenting the 100 best performing hedge funds. According to this year's list, many of the best performing hedge funds in 2013 were equity specialists. Indeed, the best performing Glenview Offshore Opportunity Fund had two-thirds of its portfolio in 20 long equity positions (Barron's, 2014). With regards to bonds, our findings are coherent with Kat & Brooks (2001), as they find bonds to have positive, but lower correlation with hedge funds compared to the correlation between stocks and hedge funds. Therefore, a portfolio of hedge funds and bonds would provide better diversification possibilities compared to a portfolio of hedge funds and stocks.

[16] We have not statistically tested if the correlations are significantly different from one. However, we have tested for statistical significance of the presence of correlation, and calculated estimates of the correlations. The statement is based on our calculated estimates.

Fung & Hsieh (1997) advocates that different hedge fund strategies may have converging exposure, referring to this as "diversification implosion". Fung & Hsieh (1997) looks at the steady positive trend that was developing in the US bonds market in 1993. During this period, Global Macro hedge funds positioned themselves long and leveraged in US bonds. Coincidently, Trend Following hedge funds using technical analysis on market prices, invested in the same manner. When the bond market declined sharply in 1994, the portfolios lost value and moved both Global Macro and Trend Following hedge funds down together. This example indicates that diversification possibilities between different hedge fund strategies are lower than presumed. Appendix F illustrates our findings of the correlations between the different hedge fund indices, which are in accordance with the findings of Fung & Hsieh (1997).

The correlations during a period of equity market turmoil are of interest. This is a period, when one should expect the uniqueness of hedge funds to justify its fees, by providing low correlations and absolute return characteristics**.** Ang (2013) uses the financial crisis of 2007-2009 to argue that hedge funds are not absolute return funds. According to Ang (2013), on aggregate, hedge funds posted large losses during the financial crisis, and this applied to both market timers and non-directional hedge funds. These findings are in line with Ilmanen (2012), as he found that for the 12 worst months for equities in the period from 1990 to 2009, hedge fund were down in all of them, and vice versa. Our data indicates that both the Credit Suisse HFX and NHX Norway posted losses during the financial crisis. Studies suggest that not only do hedge funds loose money during poor equity market conditions; hedge funds increase their correlation with stocks. Caglayan & Edwards (2001) measured the correlations between hedge funds and stocks in the time period from January 1990 to August 1998. Their results suggest that during poor equity markets, the correlation between hedge funds and stocks increases. Supporting Caglayan & Edwards (2001), Guesmi et al. (2014) finds particularly high correlations between hedge funds and equities during recessions. With regards to the term "absolute return funds", the investor wants a steady return and a low correlation between stocks and hedge funds during poor equity markets, providing diversification to the portfolio. Increasing positive correlation, when the opposite is preferred, is not an attractive feature and not strengthening the argument for providing absolute returns. Our findings with regards to the correlation between stocks and hedge funds during the financial crisis are more ambiguous. The correlations suggest that both the Credit Suisse hedge fund indices and the Hedgenordic indices increased their correlation with OSEBX

during the "Great Financial Crisis". In addition, the correlations between the Hedgenordic indices and the MSCI World index increased in this time period. However, our results were equivocal with regards to the correlation between the Credit Suisse hedge fund indices and the MSCI World index. Therefore, our findings are not sufficiently distinct to agree with Caglayan & Edwards (2001) and Guesmi et al. (2014) that the correlations between stocks and hedge funds increased during the poor equity markets.

According to Asness et al. (2001), the correlation of hedge funds and stocks may even be higher than it initially appears to be due to the illiquidity bias. The illiquidity bias illustrates how hedge funds intentionally or unintentionally price their securities with a lag. As hedge fund managers have a high degree of freedom regarding reporting, the presence of lagged prices due to either illiquidity or managed prices can lead to artificially lower estimates of volatility and correlation to traditional indices. Asness et al. (2001) finds that the monthly correlation estimates greatly understate hedge fund equity market exposure. They document that by changing from monthly to quarterly returns data, the correlations will increase.

Due to the high correlation between hedge funds and stocks, hedge funds seem to include a significant equity market component. This has two important implications for a private investor. First**,** there are multiple and cheaper ways of obtaining equity market returns. In active fund management, a common perception is that true alpha (if it even exists) is the active management component that deserves the highest fees, while the rest is paid for by the beta (Asness, 2004). Alpha is generally considered as the return from skilful active management. Ilmanen (2012) argues that a better definition of alpha is the part of the return that cannot be explained by common risk factors. According to Ilmanen (2012), this definition illustrates that alpha is defined with respect to a particular asset-pricing model. The model decides which factors drive expected returns, and alpha is the intercept or the average unexplained component. Ilmanen (2012) further suggests that the latter definition of alpha better highlights the process of alphas becoming betas over time. Ilmanen (2012) argues that at each step when the alphas become betas, the return factors are incorporated and put pressure on the management fees. Well-known systematic factors do not justify high performance fees, in contradiction to pure alphas. With lower fees, the investor's net returns will improve as investment costs decrease (Ilmanen, 2012). Given that hedge funds provide returns that are seemingly linked to the equity market returns, there are indications of hedge funds providing returns that are not entirely unique. If this is the case, the hedge fund

managers will have a harder time justifying their fees: the private investor should not pay "alpha-fees" for returns generated from systematic factors. By lowering the investment costs, private investors would increase their net returns. Relying on this logic, hedge funds seems to be an expensive way for the investor to obtain returns generated from systematic risk factors. In other words, as the returns from hedge funds are not unique, other investment vehicles could be cheaper and better suited for the private investor.

Secondly, the high correlations with stocks indicate that hedge funds may provide less attractive risk management opportunities than the name suggests. As both Ilmanen (2012) and Ang (2013) demonstrate, hedge funds loose when everything else loose. In other words, adding hedge funds to your portfolio of stocks may not drastically reduce your risk. Kat & Brooks (2001) further suggests that different hedge fund strategies are highly correlated, implying that not only do hedge funds move down with stocks, they also move down together. In other words, holding different hedge fund strategies is not an effective way of diversifying. This is supported by Cochrane (2014) stating that investors are likely to hold several funds to diversify across fund managers with the result of getting back to the market portfolio. If you chose this diversifying strategy across hedge funds, you will indeed end up with an expensive way of obtaining the market portfolio. In total, adding hedge funds to your investment portfolio will likely provide lower risk management opportunities than expected.

Some cautionary notes are worthwhile at this point. We find high correlations between hedge funds and stocks, which is coherent with Kat & Brooks (2001), Ilmanen (2012), and Ang (2013). But these findings contradict the findings of Fung & Hsieh (1997), Liang (1998), Agarwal & Naik (1999) and Peskin et al. (2000). The diverging results can be due to different time periods investigated. Correlations change over time, but as Ang (2013) illustrates, hedge funds have likely become more correlated with traditional assets over the recent years. A further caution is related to the fact that we look at aggregated hedge fund performance. We find that the Dedicated Short Bias hedge fund strategy provides low correlations with traditional assets, and indeed single funds may provide stellar performance and low correlations. However, as our findings illustrates that this is not a common feature of all hedge funds, the investor needs to be careful when assessing hedge funds.

The high correlations between hedge funds and traditional assets imply that the diversification benefits of hedge funds are lower than expected. In addition, the similarity to

equity market returns indicates that hedge fund returns could be obtained more cost-effective. Based on our findings of high estimated correlations between hedge funds and stocks, supporting the findings of with Kat & Brooks (2001), Ilmanen (2012), and Ang (2013), there are indications that hedge funds are not providing unique exposure compared to other assets.

Even though the high correlations between hedge funds and traditional assets may indicate lower diversification benefits than expected, the high correlations do not eliminate the possibility of some diversification benefits from hedge funds. To further investigate whether hedge funds provide unique returns, the next sub-section analysis how the correlations of hedge funds affect a well-diversified portfolio by elaborating on the efficient frontiers with and without the possibility to invest in hedge funds.

10.3.2 Efficient Frontiers

From sub-question I, the Sharpe ratios indicated that hedge funds as a standalone investment provided attractive risk/reward characteristics for a private investor. By creating efficient frontiers with the possibility to invest in hedge funds, one can see if hedge funds provide a unique exposure when included in a well-diversified portfolio of stocks and bonds.

In our comparison of the efficient frontiers for the different assets, the efficient frontier of hedge funds lies above and to the left of the efficient frontiers of both stocks and bonds. Relying on the mean-variance framework of Markowitz (1952), the hedge fund efficient frontier offers a higher return for a given level of risk. Our findings are coherent with the research of Jaeger (2001), where Jaeger argues that hedge funds have risk/reward characteristics superior to traditional asset classes. A similar result becomes evident if we look at a portfolio originally consisting of stocks and bonds, and then add two hedge fund indices. Figure 14 illustrates the improvement of the new efficient frontier, which provides the investors with investment opportunities at a higher return for a given level of risk.

Several studies support the superior risk/reward characteristics of including hedge funds in a portfolio, when using the traditional Markowitz framework. Liang (1999), investigating the time period from January 1994 to December 1996, found that hedge funds have an efficient frontier above mutual funds. As hedge funds dominated the mutual funds in the research, Liang (1999) advocates that hedge funds provide a more efficient investment opportunity for

investors. Schneeweis & Martin (2000) looks at the time period from January 1990 to December 1998, and supports Liang's findings. Schneeweis & Martin (2000) used Markowitz risk/reward optimisation on a portfolio consisting of 50/50 in stocks and bonds[17], and studied the effect of adding hedge funds to this portfolio. They found that adding hedge funds improved the efficient frontier[18] (Schneeweis & Martin, 2000).

Based on our findings, supported by Liang (1999) and Schneeweis & Martin (2000), the efficient frontier is improved when hedge funds are included to the investment universe. As the efficient frontier is improved, there are two implications for a private investor regarding fees and risk management. With calculations based on net returns, the improved efficient frontiers imply that a private investor will receive a more efficient investment opportunity set, and that hedge funds can justify their high fees. This contradicts our arguments regarding the correlations, as we indicated that there were cheaper ways of obtaining the same returns. With regards to the second implication, the efficient frontiers suggest improved risk management opportunities for a portfolio when including the possibility of investing in hedge funds, as the standard deviation decreases for a given level of return. Relying on our assertions above, one can argue that hedge funds provide unique exposure compared to stocks and bonds as the risk/reward relationship improves.

Even though hedge funds seem to provide unique exposure, the efficient frontiers must be considered in light of our findings of the key statistics. The Jarque-Bera test indicated non-normality of hedge fund returns data, dismissing the assumptions of Tobin (1958). In addition, we found that hedge fund returns exhibit negative skewness and positive excess kurtosis. With these characteristics, the use of standard deviation as a risk measure is not adequate. By implementing MVaR as the risk measurement, Favre & Signer (2002) argues that the efficient frontier will move "downwards", as MVaR adjusts for skewness and kurtosis (see figure 15). This implies that our findings of unique returns based on efficient frontiers adopted from Markowitz (1952) may be distorted.

[17] 50% was invested in S&P 500, and the other 50% was invested in the Lehman Brothers Government/Corporate Bond Index.
[18] In their research paper, Schneeweis & Martin (2000) refer to efficient frontier as the efficiency line.

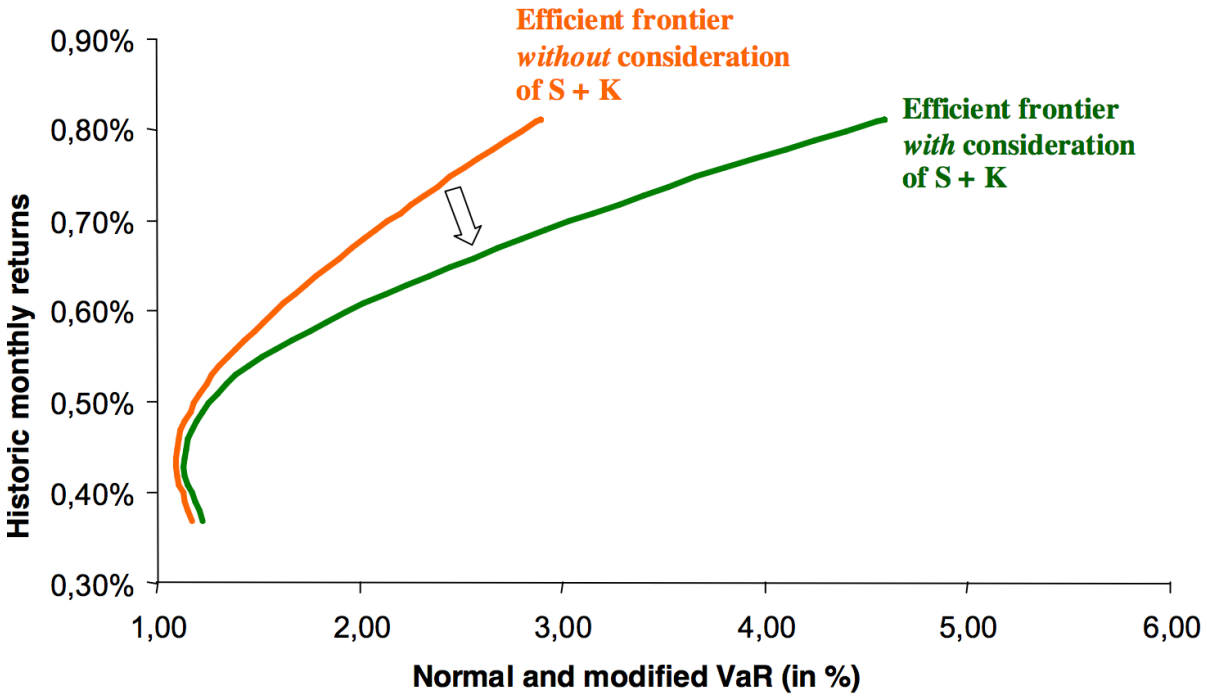


Figure 15: The figure illustrates the efficient frontiers with and without the consideration of skewness (S) and kurtosis (K). As illustrated the efficient frontier moves down and to the right when skewness and kurtosis is adjusted for. The efficient frontiers are created from a sample portfolio of stocks and bonds with a maximum of 10% invested in hedge funds. The x-axis indicates the normal and modified VaR in %, while the y-axis indicates the historic monthly returns. Source: (Favre & Signer, 2002).

Based on our calculations of efficient frontiers relying on the framework of Markowitz (1952), there is support of hedge funds providing a unique exposure. However, as our results are not adjusted for non-normality, skewness, and kurtosis, our findings may be distorted.

10.3.3 A Short Put?

The argumentation of Cochrane (2014) regarding the resemblance of hedge funds and short put options is proved through the work of Mitchell & Pulvino (2000). Mitchell & Pulvino (2000) analyses the risk/reward profile for a sample of risk-arbitrage hedge funds during the period 1990 to 1998. They find that the risk-arbitrage returns are positively correlated with stocks in downward markets, but uncorrelated with stocks in flat and appreciating markets. They further suggest that returns are usually small and steady, but occasional huge losses occur. In other words, their findings suggest that returns from risk-arbitrage hedge funds are similar to those obtained from selling uncovered index put options (Mitchell & Pulvino, 2000). The findings of Mitchell & Pulvino (2000) are illustrated in figure 16.

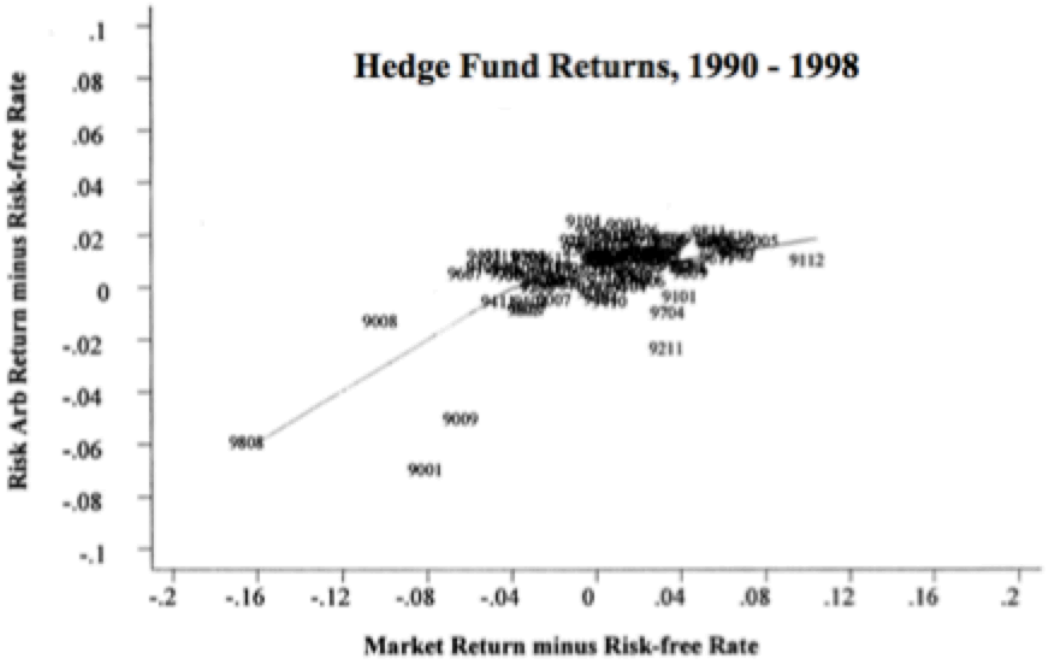


Figure 16: The figure illustrates Mitchell & Pulvino's findings regarding hedge fund returns, resembling short put. The x-axis indicates market premiums, and the y-axis indicates the risk-arbitrage strategy premiums. Source: (Mitchell & Pulvino, 2000).

The findings of Mitchell & Pulvino (2000) become intuitive by looking at the typical price movements during the risk-arbitrage sub-strategy: merger arbitrage. Figure 17 illustrates the typical stock price movements of an acquired firm from the merger is announced to the merger is completed or fails.

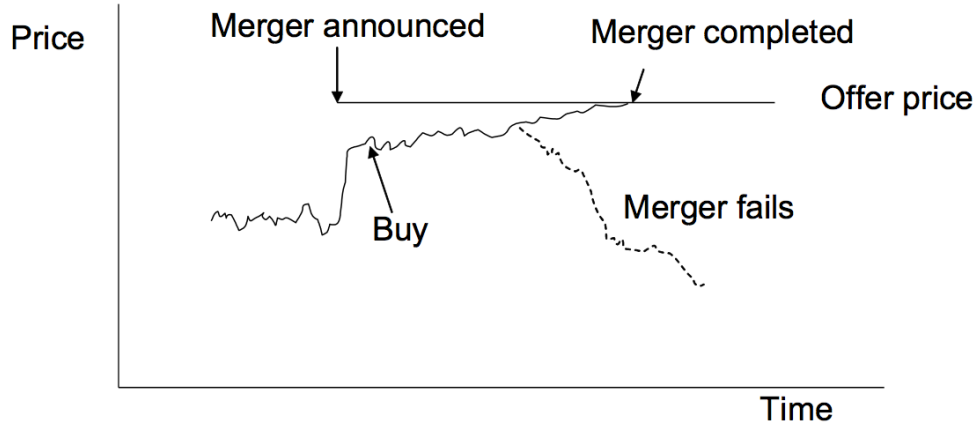


Figure 17: The figure illustrates how the price of a stock of the acquired firm usually moves during speculations of a merger. If the merger is completed, the investor in the acquired company will earn a small profit. If the merger fails, the investor can loose substantially. The x-axis indicates the stock price of the acquired firm, while y-axis indicates the evolution of time. Source: (Cochrane, 2014)

These findings are coherent with Agarwal & Naik (2000). Although hedge funds can deploy all sorts of dynamic trading strategies, a few simple option writing/buying strategies are able to explain a significant proportion of the variation in hedge fund returns over time (Agarwal & Naik, 2000). Jurek & Stafford (2012) goes further as they show that a simple strategy of selling out-of-the money puts accurately matches the risk profile of the hedge fund index and actually does it better.

Ilmanen (2012) states that the negative skewness and excess kurtosis of hedge funds indicate that they provide misleadingly long periods of solid profits at the expense of some rare disastrous losses. The extension of this assertion is that hedge funds have a payoff structure similar to a short put option. Our findings from the key statistics in sub-question I of the analysis suggest negative skewness and high kurtosis for hedge funds. Therefore, we can support the assertion that hedge fund returns on aggregate have characteristics that resembles the payoff of a short put option.

There are two important implications of hedge funds equalling short put options. The first implication regards the risk attributes of a short put option. Fenghua et al. (2014) states that standard financial theory in general assumes some degree of inherent risk aversion, even though risk preferences differ among investors and over time. Favre & Signer (2002) points out that for a risk-averse investor the high negative skewness is an unattractive feature, as there is a higher probability for lower returns. This is supported by Scott & Horvath (1980), as they showed that investors would prefer high first and third moments (mean and skewness), while they prefer low second and fourth moments (variance and kurtosis). In other words, the short put payoff structure may be in contradiction to the most common risk preferences of private investors. Note also that losses may be larger for hedge funds than a common short put strategy, as hedge funds deploy leverage. Elaborating on the different risk preferences of an investor and its implications is beyond the scope of this thesis. However, we would like to highlight that a private investor should consider if a short put payoff structure is desirable, before investing in hedge funds.

The second implication is related to the costs. The knowledge of the high correlation with the equity market and the continuous disclosure of hedge fund return factors may put pressure on the costs related to investing in hedge funds. With several similarities between hedge funds and a short put option, one can further question the high performance fees. Cochrane (2014)

argues that hedge funds are not a new asset class; "they only trade in the stuff you already own". Based on this insight, the idea must be to find the fund manager with superior trading skills. The lack of persistence among top hedge fund managers, proved by Malkiel & Saha (2005), is a discouraging sign. As Ang (2013) points out, the knowledge of hedge funds' return characteristics shines an ironic light on pension funds that buys volatility protection, while they hold hedge funds that provide the exact opposite exposure. If investors are looking for a short put payoff structure, Jurek & Stafford (2012) shows that over the period 2006 to 2012, a short put investment would have returned 10.2% in excess of T-bills, compared to 6.3% for hedge funds. In other words, hedge funds may be an expensive way of obtaining short put returns.

Even though the high correlations to traditional assets, and the high resemblance between the payoff structure of hedge funds and short-put options can be problematic, there are definitely some attractive attributes of hedge funds present. Ilmanen (2012), Ang (2013), and Cochrane (2014) all agree that hedge funds may be earning fair rewards for the various economic functions they provide. Ilmanen (2012) highlights these functions to be capital provision, risk sharing, liquidity provision, and market completion. Some of the functions and risk premiums collected by hedge funds may not be otherwise available for investors. Indeed, Cochrane (2014) argues that there are rewards to be made from new "style" risks, and hedge funds may provide an organisational form that can be a useful way to access these investments. Ang (2013) suggests that the barriers to entry are low for some of the factor strategies employed by hedge funds, and that there is room for innovation with regards to how these factor premiums are achieved. Ang (2013) states that there are some mutual funds that have strategies similar to hedge funds, but with more investor protection, and that some exchange-traded funds are specialising in factor premiums chased by hedge funds. Ilmanen (2012) notes that hedge fund beta investing can be reasonable as it focuses on capturing only the alternative betas[19], but argues that capturing the betas requires skill in defining them and implementing them. By definition, the pure alpha will not be possible to obtain.

Ang (2013) points out that by 2013, there are no large-scale factor portfolios for volatility, liquidity or momentum factors that are diversified across asset-classes and sufficiently cheap.

[19] Ilmanen (2012) refers to alternative beta in this context as risk premia, which are available in the financial markets beyond the most traditional risk factors stated in, for example, CAPM and the Fama-French three-factor model. Ilmanen (2012) refers to value, carry, volatility and mechanical investment rules with regards to merger arbitrage and convertible arbitrage as examples of alternative (or hedge fund) betas.

Some very large investors have created their own factor portfolios, but this is not possible for private investors. Pointed out by Ang (2013), there is a need for a new generation of index-style factor funds that provide low-cost exposure to the risk factors inherent in hedge funds. The best hedge funds will then probably still exist if they can deliver more than the factor returns, but the standards for hedge funds performance will be raised. Private investors will then be better off if they can access new factor premiums more cheaply.

Based on our findings of significant negative skewness and positive excess kurtosis, there is evidence of hedge funds having a payoff structure similar to the payoff structure of a short put. Our findings are in accordance with Ilmanen (2012), Ang (2013), and Cochrane (2014), and suggest that the returns generated from hedge funds are not unique, but could be obtained with lower fees through a short put option strategy. In addition, the payoff structure of hedge funds, with steady returns and occasional losses, do not match the preferred payoff structure of the common private investor.

SUMMARISING SUB-QUESTION II: *Are hedge funds providing a unique exposure compared to other asset classes for a private investor?*	
	Findings:
Correlations:	Correlations indicate that hedge funds do *not* provide a unique exposure.
The Efficient Frontiers:	The efficient frontiers indicate that hedge funds do provide a unique exposure.
A Short Put?	With a payoff structure similar to a short put, one could argue that hedge funds do *not* provide a unique exposure.
Limitations:	The findings of non-normality, skewness, and kurtosis may distort our findings regarding the calculated efficient frontiers.

Table 10: The table summarises sub-question II: Are hedge funds providing a unique exposure compared to other asset classes for a private investor?

11.0 LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

In this chapter, we will comment on the limitations of our thesis. These limitations will be the basis for our proposed further research.

An important underlying assumption in our thesis is the use of historical returns as a proxy for expected returns. Elton (1999) points out that this assumption relies on a belief that information surprises tend to cancel out during the period of study. However, Elton (1999) argues that this belief is misplaced. He documents that even the weak condition that realised returns should exceed the risk free rate, in order for realised returns to be a proxy for expected returns, can be discarded for long time periods. Other and more precise proxies for expected returns could have provided us with more accurate return estimates, e.g. the use of asset pricing models.

Note that we have analysed hedge funds on aggregate and that single hedge funds may provide other investment characteristics. Every hedge fund is different; an example of this is the performance of John Paulson's hedge fund, Paulson & Co. The fund successfully predicted the sub-prime crisis in 2007 and made a fortune from it, which is in stark contrast to the overall weak performance of hedge funds during the "Great Financial Crisis" (Zuckerman, 2009). Ironically, Paulson & Co lost 50% of its investment capital in a bad gamble in 2011 (The Norwegain Financial Daily, 2013). In our analysis, we have only looked at the broad picture, not considered the fact that some hedge funds may deliver outstandingly good or bad results. However, the aggregated picture with regards to hedge fund performance remains a useful reality check for a private investor exploring the possibility of investing in hedge funds.

There are several important biases of hedge fund returns that we have not corrected for, which may affect our findings. Brown et al (1999) argues that the survivorship bias overstates hedge fund returns by 3 % annually, indicating that the performance measures we have used exaggerates the risk/reward evaluation of hedge funds. In addition to this, Amin & Kat (2003) argues that the survivorship bias creates a downward bias on the standard deviation and kurtosis, as well as an upward bias in skewness. Therefore, the fact that we have not adjusted for survivorship biases may explain the similarity in the calculated Sharpe and Modified Sharpe ratios. The self-selection bias could also affect our results. The best funds

may not have any incentives for reporting results, as they are not looking for more investors. On the other hand, the worst performing funds do not report results to avoid bad publicity (Ilmanen, 2012). The effect of the self-selection bias on our findings is therefore ambiguous.

Our thesis is affected by the difficulty of obtaining hedge fund index returns, see section 7.5. There are no cheap and investable index funds that replicate hedge fund returns in a similar way as the equity index funds replicate equity returns. As a consequence, a private investor would not be able to hold positions in hedge funds similar to the hedge fund indices we have used. In relation to this, note that the superiority of hedge funds shown in figure 13 (illustrating the minimum variance frontiers of hedge funds, stocks, and bonds) may be overstated, as the private investor cannot invest in the hedge fund indices.

A further effect that may bias our dataset is the presence of autocorrelation. Autocorrelation is present when there is a mathematical similarity between a given time series, and a lagged version of the same time series over successive time intervals. According to Kat & Brooks (2001), autocorrelation in hedge fund returns may systematically lead the estimated standard deviations to be biased downwards. This implies that by not adjusting for autocorrelation, our performance measures and efficient frontiers calculated for the hedge fund indices may be overstated.

The different indices trying to document the performance of the hedge fund market vary substantially among the different database providers. Liang (2000) finds relatively few funds in common for the various databases, indicating the presence of a database bias. Among the common funds, Liang finds significant differences in reported returns, net asset value, fee structures and investment styles (Liang, 2000). Relying on the insights of Liang (2000), it is problematic to draw conclusions regarding the whole hedge fund universe based only on two hedge fund databases. Increasing the number of hedge fund return databases could have provided a more comprehensive analysis of hedge fund returns.

As we saw from the calculated correlations, several results are insignificant with regards to our null hypothesis stating that there is no correlation present. With insignificant results, we cannot conclude with certainty and this makes the analysis insufficient. Especially the analysis of correlations during the “Great Financial Crisis” presented challenges due to insignificant results. We could not say anything with regards to the correlations between

hedge funds and bonds, and the correlation between the hedge funds and stocks where ambiguous. As this is an interesting aspect regarding hedge funds' claim of being absolute return funds, it is a limitation of our thesis and an interesting subject for further research. Ideas for further research could be to calculate rolling correlations, use longer time periods (quarterly instead of monthly results) or go deeper into the returns of hedge funds during the "Great Financial Crisis".

Another limitation with regards to our calculated correlations is related to the test of the statistical significance. Kubinger et al. (2007) argues that confirming the correlation coefficient merely to be unequal to zero does not entail much gain of information, unless the correlation coefficient is sufficiently large, and this in turn explains a relevant amount of variance. Kubinger et al. (2007) suggests that a more practical approach should be taken when defining the null hypothesis. Our approach has not been directly in accordance with the suggestions from Kubinger et al. (2007), as we have not included a significance test with a null hypothesis stating that the correlation coefficient is equal to 1. Such a test would have provided us with the possibility to see if the calculated correlations are statistically different from 1. By altering the null hypothesis, we could have obtained further insight with regards to whether hedge funds are statistically different from stocks and bonds. This could be interesting with regards to further research on whether hedge funds are a separate asset class.

Further on, the fact that we only used the Sharpe ratio and the Modified Sharpe ratio as performance measures is a limitation. We have not included the Autocorrelation-adjusted Sharpe ratio, the Sortino ratio, Omega, or Kappa, which are all interesting performance measures for this assignment. Together with the fact that we have scoped the assignment to not look into relative performance measures, there are plenty of interesting subjects for further research. Examples could be to identify appropriate benchmarks for evaluating hedge funds, investigate the ability of hedge funds to generate alphas, or evaluate hedge funds based on some of the performance measures mentioned above.

Ang (2013) have discussed how index factor funds will be the future for the world of hedge funds. It took 40 years from the academic beginning of cheap equity index funds before it was mainstream, but it will not necessarily take the same amount of time for factor hedge funds. Further research regarding factor premiums, looking into the possibility of such index factor funds could be both innovative and interesting.

12.0 CONCLUSION

A recent Norwegian legislative proposal, likely to become law in 2014, suggests that hedge funds should be able to approach non-professional, private investors. In light of this, the objective of our thesis is to examine if hedge funds are an attractive investment opportunity for a Norwegian private investor. To answer this research question, we defined two sub-questions regarding the attractiveness of the risk/reward characteristics and the uniqueness of the returns of hedge funds.

To answer the first sub-question, the analysis examined three aspects regarding the risk/reward relationship of hedge funds: the Sharpe ratio, key statistics and the Modified Sharpe ratio. From the Sharpe ratio rankings, we found that hedge funds provide superior risk/reward characteristics compared to stocks and bonds. However, the key statistics dismissed Tobin's (1958) assumptions regarding normality of the returns data, indicating that a mean-variance framework is not suitable for hedge funds. In addition, the key statistics documented significant negative skewness and positive excess kurtosis in hedge fund returns data, further diminishing the credibility of the traditional Sharpe ratio as a performance measure for hedge funds. To accommodate the shortcomings of the Sharpe ratio, the Modified Sharpe ratio was introduced. The performance of hedge funds remained superior to traditional assets. However, Ilmanen (2012) points out several effects that may distort the performance measuring of hedge funds rather than just the skewness and kurtosis. Therefore, the Modified Sharpe ratio may overstate the risk-adjusted performance of hedge funds.

To answer the second sub-question, the analysis examined three aspects regarding the unique exposure of hedge funds compared to other assets: the correlation between hedge funds and traditional asset classes, the efficient frontiers, and the resemblance between the payoff structure of a hedge fund and a short put option. With improved efficient frontiers when hedge funds are included to the investment universe, hedge funds provide private investors a unique exposure. However, these findings may be distorted due to not considering non-normality, skewness, and kurtosis. The calculated correlations were moderate to high between hedge funds and traditional asset classes, which could indicate that hedge funds loose when traditional assets loose. Therefore, private investors' possibility to improve their risk management by investing in hedge funds is more limited than originally expected from funds labelled as "absolute return funds". A further insight, with regards to the moderate to

high correlation, is the indication of a significant equity component in hedge fund returns (Ang, 2013). Relying on the argumentation of Ilmanen (2012), that every time a risk factor becomes systematic it puts pressure on the management fees, one can argue that hedge funds is an expensive way of obtaining returns that resembles traditional asset returns. This is further supported by our findings of high similarity between the payoff structure of hedge funds and a short put option. Jurek & Stafford (2012) finds that a strategy of selling put options accurately matches the risk profile of hedge funds and provides higher net returns. This implies that the payoff structure of hedge funds can be obtained at a lower cost. A second implication of the similarities between hedge funds and short put options relies on the insights of Favre & Signer (2002); arguing that investors find a payoff structure of small gains and occasional huge losses unattractive. This suggests that hedge funds provide an unattractive payoff structure for the common private investor.

To conclude on our research question, the analysis regarding the risk/reward relationship of hedge funds indicates that hedge funds are an attractive investment opportunity for a Norwegian private investor. However, these performance evaluations are inadequate. In addition, our analysis indicates that hedge funds do not provide unique exposure compared to other assets; hedge funds provide similar returns as traditional assets at higher costs, they provide lower risk management exposure than expected, and an unattractive payoff structure for a Norwegian private investor. Therefore, hedge funds seem to be an ineffective and unattractive investment opportunity for a Norwegian private investor. However, our results provide no justification for categorically rejecting investing in hedge funds.

Based on our analysis, our advice for a Norwegian private investor considering hedge funds as an investment opportunity is the following:

- Look beyond traditional performance measures.
- Do the returns justify the high fees? Your returns should not be possible to obtain at a lower cost.
- Hedge funds are likely to move in accordance with your holdings in stocks and bonds, hence not providing absolute returns.
- Beware that hedge funds provide a reasonable possibility of huge occasional losses.

Bibliography

Agarwal, V., & Naik, N. (1999). *On Taking the 'Alternative' Route: Risks, Rewards, Style and Performance Persistence of Hedge Funds* . London Business School. London Business School.

Agarwal, V., & Naik, N. (2000). *Performance Evaluation of Hedge Funds with Option-based and Buy-and-Hold Strategies.* London Business School, FA Working Paper. London Business School.

Agarwal, V., Daniel, N., & Naik, N. (2009, Septembre 15). *Rice university webapge.* Retrieved February 17, 2014 from Rice university webpage: http://finance.rice.edu/seminar/Abstracts/pdf09_10/Naik.pdf

Aiken, A. L., Clifford, C. P., & Ellis, J. A. (2013). Out of the dark: Hedge fund reporting biases and commercial databases. *Review of Financial Studies* (26).

Amin, G., & Kat, H. (2003). Hedge Fund Performance 1990-2000. Do the Money Machines' Really Add Value? . *Journal of Financial and Quantitative Analysis , 38*, 251-274.

Ang, A. (2013, October 2). *Andrew Ang webpage*. Retrieved February 12, 2014 from Columbia Business School: http://www.columbia.edu/~aa610/

Ang, A., Gorovyy, S., & van Inwegen, G. (2011). *Hedge fund leverage.* National Bureau of Economic Research. National Bureau of Economic Research.

Arrow, K. (1965). *Aspects of the theory of risk bearing.* Helsinki: Yrjo Jahnssonin Saatio.

Asness, C. (2004). An Alternative Future: An Exploration of the Role of Hedge Funds . *Journal of Portfolio Management , 30* (5 (30th Anniversary Issue)), 94-103.

Asness, C. (2004, Fall). An Alternative Future: Part II - An exploration of the role of hedge funds. *The Journal of Portfolio Management* , 8-23.

Asness, C., Krail, R., & Liew, J. (2001, January 10). *Do Hedge Funds Hedge.* Retrieved February 10, 2014 from Social Science Research Network: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=252810

BarclayHedge. (2014). *barclayhedge.com*. Retrieved May 13, 2014 from http://www.barclayhedge.com/research/indices/ghs/mum/HF_Money_Under_Management.html

Barclays. (2014, March 07). *Barclays Bond Indices.* Retrieved March 09, 2014 from Barclays Bond Indices: https://index.barcap.com/show?url=Benchmark_Indices/Aggregate/Bond_Indices

Barron's. (2014, May 17). *Barron's*. Retrieved May 20, 2014, from Barron's Top 100 Hedge Funds: http://online.barrons.com/news/articles/SB50001424053111903843804579532040267881368

Berger, A., Kabiller, D., & Crowell, B. (2010). Is Alpha Just Beta Waiting to Be Discovered? What the Rise of Hedge Fund Beta Means for Investors. *Journal of Investment Strategy , 5* (1), 21-29.

Bernardo, A., & Ledoit, O. (2000). Gain, Loss and Asset Pricing. *Journal of Political Economy , 108* (1), 144-172.

Bloomberg Businessweek. (2013, July). Hedge Funds are for suckers. 8-10.

Blundell-Wignall, A. (2007). *An overview of hedge funds and structured products: Issues in leverage and risk.* OECD, Directorate for Financial and Enterprise Affairs.

Bodie, Z., Kane, A., & Marcus, A. (2002). *Investments* (5th Edition ed.). Irwin/McGraw-Hill.

Bodie, Z., Kane, A., & Marcus, A. (2005). *Investments* (6th ed.). New York: McGraw-Hill.

Bollen, P., & Pool, V. (2009). Do Hedge Fund Managers Misreport Returns? Evidence from the pooled distribution. (64), 5.

Brooks, C., & Kat, H. (2001). *The Statistical Properties of Hedge Fund Index Returns and Their Implications for Investors* . Cass Business School, Alternative Investments Research Centre. Cass Business School.

Brown, H., & Christy, J. (2001, November 6). Growing Pains. *Forbes Magazine* .

Brown, S., Goetzmann, W., & Ibbotson, R. (1999). Offshore hedge Funds: Survival & Performance 1989-1995 . *Journal of Business , 72* (1), 91-118.

Caglayan, M., & Edwards, F. (2001). Hedge fund and commodity fund investment styles in bull and bear markets. *The Journal of Portfolio Management* , pp. 97-108.

Caprio, G., D'Apice, V., Ferri, G., & Puopolo, G. (2010). *Macro Financial Determinants of the Great Financial Crisis: Implications for Financial Regulation.* SSRN Working Paper No. 1788063.

Chakrabarti, R., Huang, W., Lee, J., & Jayaraman, N. (2002, April). The "Index Effect" on stock prices and trading volumes: International Evidence. *Working paper* .

Chen, Y. (2010, Januray 31). Derivatives use and risk taking: Evidence from the hedge fund industry. *Journal of Financial and Quantitative Analysis* .

Christy, G., & Clendenin, J. (1978). *Introduction to Investments.* New York: The McGraw-Hill Companies.

Cochrane, J. (2014). *Faculty of Chicago Booth*. Retrieved April 09, 2014 from faculty.chicagobooth.edu/john.cochrane/research/ppts/hedge_talk.ppt

Cornish, E., & Fisher, R. (1937). Moments and Cumulants in the Specification of Distributions. *Revue de l'Institut International de Statistiques , 5*, 307-320.

Credit Suisse. (2014). *Overview: Credit Suisse Hedge Fund Indexes*. Retrieved March 06, 2014 from Hedgeindex.com: http://www.hedgeindex.com/hedgeindex/secure/en/indexperformance.aspx?cy=USD&indexname=HEDG

Danthine, J.-P., & Donaldson, J. (2005). *Intermediate Financial Theory* (Vol. 2nd). Elsevier Academic Press.

Darbyshire, P., & Hampton, D. (2012). *Hedge Fund Modeling and Analysis Using Excel and VBA*. New York: John Wiley & Sons.

DeCarlo, L. (1997, February). *On the Meaning and Use of Kurtosis.* Retrieved February 25, 2014 from Columbia University: http://www.columbia.edu/~ld208/psymeth97.pdf
Directive 2011/61 on Alternative Investment Fund Managers (European Comission 2011).

Dispas, C. (Performer). (2013). *Alternative Investments for Portfolio Management - Class 3 & 4.* Louvain School of Management, Louvain-la-Neuve.

Dispas, C., & Govaerts, D. (2013, November). *Alternative Investments for Portfolio Management - Class 12.* (C. Dispas, Performer)

Doane, D., & Seward, L. (2011, February). *American Statistical Association.* Retrieved February 25, 2014 from amstat.org: http://www.amstat.org/publications/jse/v19n2/doane.pdf

Elton, E. (1999, August). Expected return, realized return & asset pricing tests. *The Journal of Finance* , pp. 1199-1220.

Encyclopedia of Mathematics. (2012, May 4). *Encyclopedia of Mathematics*. Retrieved February 20, 2014 from Encyclopedia of Mathematics: http://www.encyclopediaofmath.org/index.php?title=Moment&oldid=25957

ESMA. (2013, August 13). Guidelines on the key concepts of the AIFMD. European Securities and Markets Authority (ESMA).

Fabozzi, F., & Pilarinu, E. (2002). *Investing in emerging fixed income markets.* New York, New York: John Wiley & Sons.

Favre, L., & Galeano, J. (2002). Mean-Modified Value-at-Risk Optimization with Hedge Funds. *The Journal of Alternative Investment , 5* (2), 21-25.

Favre, L., & Signer, A. (2002, June). The difficulties of measuring the benefits of hedge funds. *Journal of Alternative Investment* .

Federal Research Bank of St.Louis. (2009). *Federal Research Bank of St.Louis*. Retrieved March 14, 2014 from FRED: http://research.stlouisfed.org/fred2/series/BAMLH0A0HYM2

Financial Times. (2010). *Financial Times*. Retrieved March 14, 2014 from ft.com: http://lexicon.ft.com/Term?term=EMBI

Financial Times. (2012, April 9). Hedge funds keep a lid on leverage. *Financial Times* .

Finans Norge. (2013, June 27). *Finans Norge*. Retrieved March 6, 2014 from Finans Norge: http://www.fno.no/Nyheter/2013/06/hedgefond-til-ikke-profesjonelle/

Fortune Magazine. (1966, April). The Jones Nobody Keeps Up With. *Fortune Magazine - The Jones Nobody Keeps Up With* .

Frängsmyr, T. (1991). *The Nobel Prizes 1990.* Stockholm: Nobel Foundation.

Fung, W., & Hsieh, D. (1997, Summer). Empirical Characteristics of Dynamic Trading Strategies: The Case of Hedge Funds . *The Review of Financial Studies* , pp. 275-302.

Fung, W., & Hsieh, D. (1999). A Primer on Hedge Funds . *Journal of Empirical Finance* , 309-331.

Fung. W., & Hsieh, D. (2000). Performance Characteristics of Hedge Funds and Comodity Fund: Natural vs Spurious Biases.

Fung, W., & Hsieh, D. (2001, August 20). Hedge-Fund Benchmarks: Information Content and Biases. *Social Science Research Network* , p. 24.

Furr, R. (2005). *Wake Forest University.* Retrieved May 17, 2014 from psych.wfu.edu/furr/311/SigCorr.pdf

Gabelli, M. (2000, October 25). *Gabelli Funds.* Retrieved March 4, 2014 from gabelli.com: http://www.gabelli.com/news/mario-hedge_102500.html

Galloppo, G. (2010). A Comparison of Pre and Post Modern Portfolio Theory Using Resampling. *Global Journal of Business Research* (4), 1-16.

Géhin, W., & Vaissié, M. (2004). *Hedge fund indices: investable, non-investable and strategy benchmarks.* EDHEC risk and asset management research centra.

Gregoriou, G. (2008). *Encyclopedia of Alternative Investments.* Boca Raton: Chapman & Hall / CRC.

Gregoriou, G., & Gueyie, J.-P. (2003). Risk-Adjusted Performance of Funds of Hedge Funds Using a Modified Sharpe Ratio. *The Journal of Wealth Management , 6* (3), 77-83.

Guesmi, e. a. (2014). *Are hedge funds uncorrelated with financial markets? An empirical assessment.* Ipag Business School. Paris, France: Ipag Business School.

Guidolin, M., & Nicodano, G. (2013, January 22). *University of Wienna.* Retrieved April 5, 2014 from http://www.wu.ac.at/gc/whatwedo/bridging/lectures/2013/nicodano_presenting_slides2013.pdf

Harding, D. (2002). *A Critique of the Sharpe Ratio.* London: Winton Capital Management.

Harvey, C., & Siddique, A. (2000, June). Conditional Skewness in Asset Pricing Tests. *The Journal of FInance* (3).

Hedgenordic. (n.d.). *HEDGENORDIC.COM*. Retrieved March 04, 2014 from HedgeNordic: NHX: http://nhx.hedgenordic.com/?pageid=61

Hedgenordic. (2011, July). *HEDGENORDIC.COM*. Retrieved March 04, 2014 from HedgeNordic Web site: http://nhx.hedgenordic.com/?pageid=20

Hedgenordic. (2011, July). *HEDGENORDIC.COM*. Retrieved March 06, 2014 from Index Construction Rules: http://nhx.hedgenordic.com/?pageid=20

Hens, T., & Bachmann, K. (2008). *Behavioural finance for private banking.* Chichester, West Sussex: John Wiley & Sons Ltd.

Hodges, S. (1998). *A Generalization of the Sharpe Ratio and its Applications to Valuation Bounds and Risk Measures.* University of Warwick, Financial Options Research Centre. Working Paper.

Ibbotson, R., Chen, P., & Zhu, K. (2011). The ABCs of Hedge Funds: Alphas, Betas, and Costs. . *Financial Analysts Journal , 67* (1), 15-25.

Ilmanen, A. (2012). *Expected Returns On Major Asset Classes.* John Wiley & Sons, Inc.

Ineichen, A. (2002). *Absolute Returns: The Risk and Opportunities of Hedge Fund Investing.* Hoboken: John Wiley & Sons .

Jaeger, L. (2001). *The Benefits of Alternative Investment Strategies in the Institutional Portfolio.* Working paper, Swiss Alternative Investments Group.

Jaeger, L. (2008). *Alternative Beta Strategies and Hedge Fund Replication.* New York: John Wiley & Sons.

Jame, R. (2013). *How do Hedge Fund "Stars" Create Value? Evidence from Their Daily Trades Russell Jame** . University of Kentucky. University of Kentucky.

Jarque, C., & Bera, A. (1980). Efficient tests for normality, homoscedasticity and serial independence of regression residuals. *Economics Letters* (Volume 6).

Ji, C. (2006, 9 26). *University of North Carolina.* Retrieved February 25, 2014 from Webpage of the University of North Carolina:
http://www.stat.unc.edu/faculty/cji/155/Lec07.pdf

Johnson, N., & Kotz, S. (1970). *Distributions in statistics - Continous Univariate Distributions, Vol. 1.* New York: John Wiley & Sons.

Kat, H., & Brooks, C. (2001). *The Statistical Properties of Hedge Fund Index Returns and Their Implications for Investors.* Cass Business School, Alternative Investment Centre. London: Cass Business School.

Koski, J., & Pontiff, J. (1999). How are derivatives used? Evidence from the mutual fund industry. *Journal of Finance* (54).

Kubinger, K., Rasch, D., & Simeckova, M. (2007). Testing a correlation coefficient's significance. *Psychology Science* (Volume 49), 74-87.

Le Sourd, V. (2007). *Performance Measurment for Traditional Investment.* EDHEC, Risk and Asset Management Research Centre. Nice: EDHEC Business School.

Lehman Brothers. (2007). *Annual Report 2007.* Lehman Brothers.

Leland, H. (1999). Beyond Mean-Variance Performance Measurement in a Nonsymmetrical World. *Financial Analysts Journal , 54*, 27-36.

Lhabitant, F.-S. (1996). *Handbook of Hedge Funds.* West Sussex, England: John Wiley & Sons Ltd.

Lhabitant, F.-S. (2006). *Handbook of Hedge Funds.* West Sussex, England: John Wiley & Sons Ltd.

Liang, B. (1999, July/August). On the Performance of Hedge Funds. *Financial Analysts Journal , 55* (4), pp. 72-85.

Liang, B. (2000). Hedge Funds: The Living and the Dead. *Journal of Financial and Quantitative Analysis , 35* (3), 309-326.

Lins, G., Lemke, T., Hoenig, K., & Rube, P. (2013). *Hedge Funds and Other Private Funds: Regulation and Compliance.*

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics , 47* (1), 13-37.

Ljung, G., & Box, E. (1978, January). On a Measure of a Lack of Fit in Time Series Models. *Biometrika* .

Lo, A. (2002). The Statistics of the Sharpe Ratio. *Financial Analyst Journal* , pp. 36-52.

Lomax, R., & Hahs-Vaughn, D. (2012). *Statistical Concepts* (Vol. 3rd). New York: Routledge.

Lowenstein, R. (2000). *When Genius Failed.* New York: Random House.

Malkiel, B. (1995, June 20). Returns from investing in Equity Mutual Funds 1971-1991. *Journal of Finance* .

Malkiel, B., & Saha, A. (2005, December 30). Hedge Funds: Risk and Return. *Fiancial Analysts Journal* .

Mallaby, S. (2010). *More Money Than God.* New York: Penguin Group.

Markowitz, H. (1952). Portfolio Selection. *The Journl of Finance , 7* (1), 77-91.

Merrill Lynch. (2001, March). *Merrill Lynch Wealth Management.* Retrieved March 14, 2014 from wealthmanagement.ml.com: http://wealthmanagement.ml.com/publish/mkt/pdfs/marketindexdescriptions_01212011.pdf

Mitchell, M., & Pulvino, T. (2000, October). Characteristics of Risk and Return in Risk Arbitrage . *Journal of Finance*.

Morningstar. (2014, January 16). *Morningstar*. Retrieved March 9, 2014 from http://www.morningstar.com/cover/videocenter.aspx?id=631185

Mossin, J. (1966). Equilibrium in a Capital Asset Market. *Econometrica , 34* (4), 768-783.

MSCI, I. (2013, November 27). *Index Definitions - Tools and Data - MSCI*. Retrieved March 06, 2014 from MSCI Web site: http://www.msci.com/products/indices/tools/index.html#AC

MSCI, I. (2014). *MSCI World Index.* Retrieved March 06, 2014 from MSCI Inc: http://www.msci.com/resources/factsheets/index_fact_sheet/msci-world-index.pdf

Nordea Markets. (2013, January 29). *Nordea.no*. Retrieved April 7, 2014 from Nordea.no: http://newsroom.nordea.com/no/2013/01/29/nordea-markets-med-nyvinning/

OECD. (2007). *An Overview of Hedge Funds and Structured Products: Issues in Leverage and Risk.* OECD, Financial Market Trends.

oslobors.no. (2014, April 24). *oslobors.no*. Retrieved April 24, 2014 from http://www.oslobors.no/markedsaktivitet/stockIndexOverview?newt__ticker=OSEBX

Pinto, J., Henry, E., Robinson, T., & Stowe, J. (2010). *Equity asset valuation* (2nd Edition ed.). Hoboken, New Jersey: John Wiley & Sons, Inc.

Pratt, J. (1964). Risk Aversion in the Small and in the Large. *Econometrica , 32* (1/2), 122-136.

Rachev, S., Hoechstoetter, M., Focardi, S., & Fabozzi, F. (2010). *Probability and Statistics for Finance.* Hoboken, New Jersey: John Wiley & Sons.

Ross, S. (1976). The arbitrage theory of capital asset pricing. *Journal of Economic Theory , 13* (3), 341-360.

Ruane, K., & Seitzinger, M. (2010). *Hedge Funds: Legal History and the Dodd-Frank Act.* Congressional Research Service.

S&P Dow Jones Indices. (2014, March 31). *S&P 500.* Retrieved April 24, 2014 from http://www.spindices.com/idsenhancedfactsheet/file.pdf?calcFrequency=M&force_download=true&hostIdentifier=48190c8c-42c4-46af-8d1a-0cd5db894797&indexId=340

Schinasi, G., & Todd Smith, R. (2000). *Portfolio diversification, leverage and financial contagion.* IMF.

Schjodt Law Firm. (2013, March 11). AIFM-Loven.

Schneeweis, T., & Martin, G. (2000). *The Benefits of Hedge Funds: Asset Allocation for the Institutional Investor.* Center for International Securities and Derivatives Markets. University of Massachusetts, Amherst,.

Scott, R., & Horvath, P. (1980). On the Direction of Preference for Moments of Higher Order than the Variance . *The Journal of Finance , 45* (4), 915-919.

SEC. (2014). *sec.gov*. Retrieved May 14, 2014 from sec.gov: http://www.sec.gov/answers/indices.htm

Shapiro, A. (Performer). (2003, Oct 10). *Foundations of Finance: Index Models (Lecture 8).* NYU, Stern, New York, NY.

Sharma, N. (2004). A.I.R.A.P. – Alternative RAPMs for Alternative Investments . *Journal of Investment Management , 3* (4).

Sharpe, W. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *Journal of Finance , 19* (2), 425-442.

Sharpe, W. (1966). Mutual Fund Performance. *Journal of Business , 39* (1), 119-138.

Snedecor, G., & Cochran, W. (1989). *Statistical methods.* Iowa, Ames, Iowa: Iowa State University Press.

Sharpe, W. (1992, Winter). Asset Allocation: Management Style and Performance Measurement. *Journal of Portfolio Management* , pp. 7-19.

Statman, M. (1987). How Many Stocks Make a Diversified Portfolio? *Journal of Financial and Quantitative Analysis , 22* (3), 353-363.

Stefanini, F. (2006). *Investment strategies of hedge funds.* West Sussex: Wiley Finance.

Stulz, R. (2007). *Hedge Funds: Past, Present and Future.* Fisher College of Business - Ohio State University. National Bureau of Economics.

The Economist. (2013, October 19). An appetite for junk.

The Financial Supervisory Authority of Norway. (2014, March 9). (A. N. Kvistad, Interviewer)

The Financial Supervisory Authority of Norway. (2012). *Finansielle utviklingstrekk.* Oslo: The Financial Supervisory Authority of Norway.

The Financial Supervisory Authority of Norway. (2013, September 16). Gjennomføring av AIFM-direktivet i Norge (EN: Implementation of the AIFMD in Norway).

The Financial Supervisory Authority of Norway. (2012, Januray 5). *The Financial Supervisory Authority of Norway*. Retrieved March 4, 2014 from The Financial Supervisory Authority of Norway: http://www.finanstilsynet.no/no/Verdipapiromradet/Forvaltningsselskaper/Tema/Spesialfond/

The Norwegain Financial Daily. (2013, April 13). Hedge von Helvete.

The Norwegian Ministry of Finance. (2014, April 11). *regjeringen.no*. Retrieved April 22, 2014 from regjeringen.no: http://www.regjeringen.no/nb/dep/fin/pressesenter/pressemeldinger/2014/Forslag-til-ny-lov-om-forvaltning-av-alternative-investeringsfond.html?id=757286

The Norwegian Parliament. (2014, May 13). *stortinget.no*. Retrieved May 14, 2014 from stortinget.no: https://www.stortinget.no/no/Saker-og-publikasjoner/Publikasjoner/Innstillinger/Stortinget/2013-2014/Inns-201314-194/

Tobin, J. (1958). Liquidity preference as behavior towards risk. *The Review of Economic Studies , 25*, 65-86.

UBS. (2013, June). *UBS Index Overview*. Retrieved March 9, 2014 from UBS Index Definitions: www.ubs.com/2/e/us.../index_definitions.pdf

Wall Street Journal. (2013, May 10). *Wall Street Journal*. Retrieved May 6, 2014 from Wsj.com: http://blogs.wsj.com/moneybeat/2013/05/10/bill-gross-bull-market-in-bonds-is-over/

Wang, P. (2009, Sept 10). *5 Lessons from the Crash*. Retrieved April 10, 2014 from CNN Money: http://www.money.cnn.com/2009/09/09/news/economy/financial_crisis.moneymag/index.htm

Wippern, R. (1971). Utility Implications of Portfolio Selection and Performance Appraisal Models. *The Journal of Financial and Quantitative Analysis , 6* (3), 913-924.

Zepeda, R. (2014, January 7). To EU, or not to EU: that is the AIFMD question. *Journal of International Banking Law and Regulation* .

Zuckerman, G. (2009). *The Greatest Trade Ever*. New York: Crown Publishing Group.

APPENDIX

Appendix A: Hedgenordic – The Nordic Hedge Fund Index

Hedgenordic is a provider of different Nordic hedge fund indices, and is the only online service provider of its kind to feature a combination of Nordic index data and database information. According to their own assessment, the majority of the Nordic hedge funds are included in the indices. We have downloaded the data directly for the website of Hedgenordic (Hedgenordic).

The Nordic Hedge Fund Index (NHX) is an equally weighted hedge fund index. The index is based on data reported directly to Hedgenordic by the hedge fund managers. An overview of the funds included in the NHX is shown in following figure:

The Nordic Hedge Fund Index (NHX)

Country	*Number of funds*	*Strategy*	*Number of funds*
Norway	33	Equities	60
Sweden	99	Fixed Income	16
Denmark	18	Fund of Funds	32
Finland	11	Managed Futures & CTA	21
Iceland	1	Multi Startegy	33
Total funds included	162	Total funds included	162

Figure A.1: The figure illustrates an overview of the different funds included in the Nordic Hedge Fund Index (NHX). Source: (Hedgenordic)

The NHX Index can be divided into several sub-categories, based on strategy or the origin of the hedge fund. Together with the NHX Index, we have used the following six sub-indices in our empirical research (Hedgenordic): The NHX Norway, the NHX Equities, the NHX Fixed Income, the NHX Fund of Funds, the NHX Managed Futures & CTA, and the NHX Multi Strategy. An overview of the six sub-indices can be seen in appendix A.1.

Appendix A.1: Database Construction

The Hedgenordic indices are asset-weighted, and admission to the indices is done continuously. In order for funds to be admitted, Hedgenordic requires that full performance history net of all fees, reported as either monthly return or net asset value (NAV), are

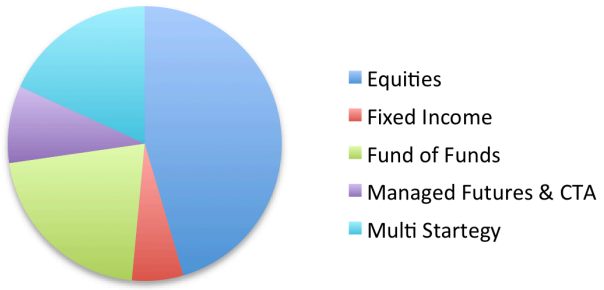
available to the Hedgenordic database. Before a fund can be admitted to the index, the fund must supply the latest annual report and the latest version of the offering memorandum, the private placement memorandum, or the prospectus to the Hedgenordic staff. New funds will not be included prior to the registration, even if there is a qualified track record (Hedgenordic, 2011).

Hedgenordic declares that in order to minimise the effect of the survivorship bias and more accurately represent the performance of the Nordic hedge fund industry, funds that have been in existence and terminated operations prior to the 1st of June 2005, are eligible for inclusion in the index calculations. Funds that end their operations and no longer contribute to the indices will have their prior performance history maintained (Hedgenordic, 2011).

The NHX Norway is an index consisting of the 33 Norwegian hedge funds that report to Hedgenordic:

NHX Norway

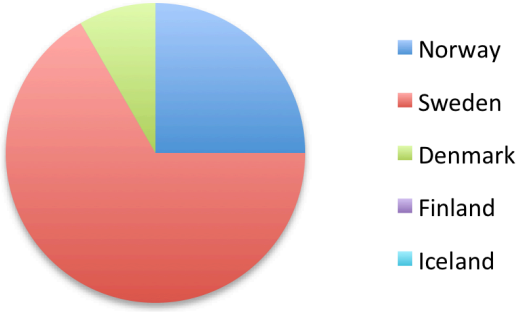
Strategy	*Number of funds*
Equities	15
Fixed Income	2
Fund of Funds	7
Managed Futures & CTA	3
Multi Startegy	6
Total funds included	33



The NHX Equities Index consists of Nordic hedge funds with equity strategies:

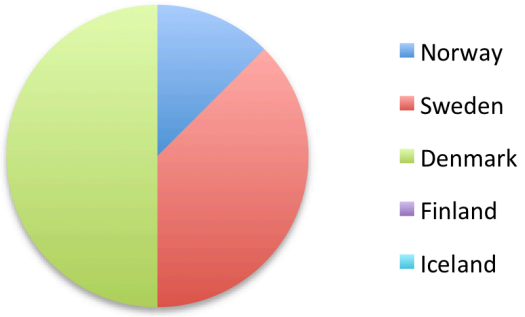
NHX Equities

Norway	15
Sweden	40
Denmark	5
Finland	0
Iceland	0
Total funds included	60



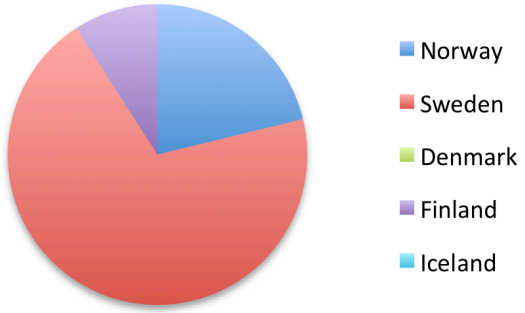
The NHX Fixed Income Index consists of Nordic hedge funds with fixed income strategies:

NHX Fixed Income	
Norway	2
Sweden	6
Denmark	8
Finland	0
Iceland	0
Total funds included	16



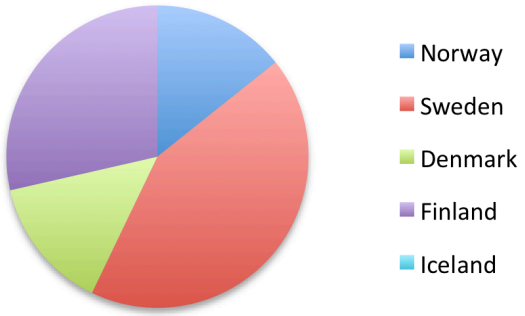
The NHX Fund of Funds Index consists of Nordic hedge funds with fund of funds strategies:

NHX Fund of Funds	
Norway	7
Sweden	23
Denmark	0
Finland	3
Iceland	0
Total funds included	33



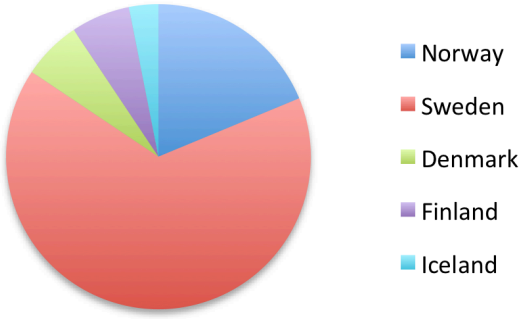
The NHX Managed Futures & CTA Index consists of Nordic hedge funds with managed futures and/or CTA strategies:

NHX Managed Futures & CTA	
Norway	3
Sweden	9
Denmark	3
Finland	6
Iceland	0
Total funds included	21



The NHX Multi Strategy Index consists of Nordic hedge funds with multi strategies:

NHX Multi Strategy	
Norway	6
Sweden	21
Denmark	2
Finland	2
Iceland	1
Total funds included	32



Appendix B: Credit Suisse Hedge Fund Index

The Credit Suisse Hedge Fund Index has existed since January 1994. The Index is created by using data from the Credit Suisse Hedge Fund Database, tracking approximately 9,000 funds. The index is calculated and rebalanced on a monthly basis, and reflects performance net of all performance fees and expenses (Credit Suisse, 2014). Since 2000, the Credit Suisse indices has been run on a real time basis, so there should be little survivorship or backfill bias after that point (Ilmanen, 2012). We have obtained the historical data directly from Credit Suisse's web site.

The main index, the Credit Suisse Hedge Fund Index, is an asset-weighted fund index which only includes funds. Other sub-indices used in our empirical research are: the Credit Suisse Long/Short Equity HF Index, the Credit Suisse Fixed Income Arbitrage HF Index, the Credit Suisse Global Macro HF Index, the Credit Suisse Dedicated Short Bias HF Index, the Credit Suisse Managed Futures HF Index, the Credit Suisse Multi-Strategy HF Index, and the Credit Suisse Convertible Arbitrage HF Index.

Appendix B.1: Database Construction

The Credit Suisse Hedge Fund indices' defined universe is funds with a minimum of US$ 50 million assets under management (AUM), a minimum one-year track record, and current audited statements. The index will in all cases represent at least 85% of the AUM in each respective category of the index universe. The index is an asset-weighted index, where the funds within the index are separated into ten primary subcategories based on their investment strategy. The methodology analyses the percentage of assets invested in each subcategory and selects funds for the index based on those percentages, matching the shape of the index to the shape of the universe. Funds are reselected on a quarterly basis. To minimise the survivorship bias, funds are not removed from the index until they are fully liquidated or fail to meet the financial reporting requirements (Credit Suisse, 2014).

Appendix C: Indices for Comparison

We have used different stock and bond indices in our empirical research. In this section, we will briefly present them.

C.1 Stock Indices

We have used the following stock indices in our empirical research:

C.1.1 The Morgan Stanley Capital Indices

The Morgan Stanley Capital Indices (MSCI) is a US-based provider of several equity and fixed income indices. We have downloaded data and used the following four indices from the MSCI website:

i) The MSCI World Index

The MSCI World Index captures large and mid cap equities across 23 developed markets. With 1,609 constituents, the index covers approximately 85% of the free float-adjusted market capitalisation in each country (MSCI, 2014).

ii) The MSCI AC Asia Index

The MSCI AC (All Country) Asia Index is a free float-adjusted market capitalisation weighted index that is designed to measure the equity market performance in Asia. The MSCI AC Asia Index consists of the following 11 developed and emerging market country indices: China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand (MSCI, 2013).

iii) The MSCI AC Europe Index

The MSCI AC Europe Index is a free float-adjusted market capitalisation weighted index that is designed to measure the equity performance of the developed markets in Europe. The MSCI AC Europe Index consist of the following 15 developed market indices: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom (MSCI, 2013).

iv) The MSCI Emerging Markets Index

The MSCI Emerging Markets (EM) Index is a free float-adjusted market capitalisation index that is designed to measure equity market performance of emerging markets. The EM Index consists of the following 21 emerging market country indices: Brazil, Chile, China, Colombia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Peru, Philippines, Poland, Russia, South Africa, Taiwan, Thailand, and Turkey (MSCI, 2013).

C.1.2 Standard & Poor's 500

The Standard & Poor's 500, known as the S&P 500, is a stock market index based on the market capitalisation of the 500 leading companies, capturing approximately 80% of available market capitalisation in the US. The S&P 500 components and their weightings are determined by S&P Dow Jones Indices. It is one of the most commonly followed equity indices, and is by many considered to be the best representation of the US stock market (S&P Dow Jones Indices, 2014). The data of S&P 500 was acquired from Yahoo Finance.

C.1.3 The Oslo Stock Exchange Benchmark Index

The Oslo Stock Exchange Benchmark Index (OSEBX) is a total return index that functions as an indicator of the overall performance of the Oslo Stock Exchange. The OSEBX is based on a representative sample of all listed shares on the Oslo Stock Exchange (oslobors.no, 2014). We downloaded the data of OSEBX online from Euroinvestor's web site.

C.2 Bond Indices

The bond indices we have used include corporate bonds and government bonds at investment grade level, as well as high yield bonds. We have focused on the following bond indices:

C.2.1 BofA Merrill Lynch Global Broad Market Bond Index

The BofA Merrill Lynch Global Broad Market Bond Index is considered a broad index covering the investment grade[20] bond market of the developed economies. The index tracks the performance of investment grade debt publicly issued in the major US and Eurobond

[20] Investment grade bonds are bonds rated BBB- or higher by Standard & Poor's or Baa3 or higher by Moody's. Investment grade bonds are assumingly safer than lower rated bonds, but provide lower yields. Debt rated below investment grade is called high yield or junk debt. This debt is riskier, but provide higher yields.

markets. The index includes sovereign, quasi-government, corporate, securitised, and collateralised fixed income securities (Merrill Lynch, 2001).

C.2.2 JPM Global EMBI Composite

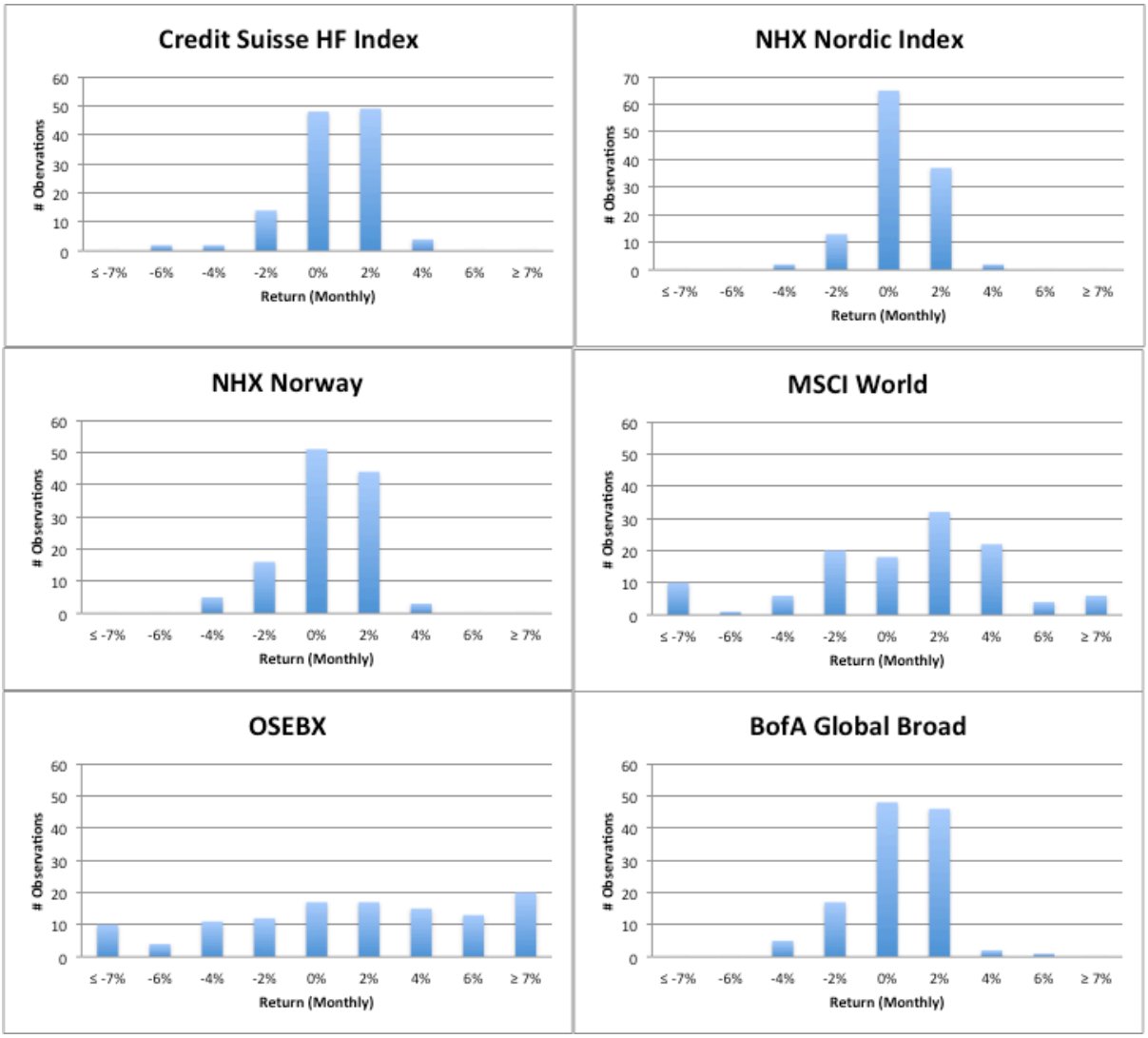
The JPM Global EMBI Composite is a bond index maintained by JPMorgan, covering the total return performance of government bonds issued by selected emerging market economies. The index includes sovereign bonds denominated in US dollars, and is weighted in accordance with market capitalisation. The largest weights have historically been attributed to debt issued by Mexico, Russia and Brazil (Financial Times, 2010). Fabozzi & Pilarinu (2002) states that the JPM EMBI Global is the appropriate benchmark for an emerging market bond portfolio.

C.2.3 BofA US High Yield Master II

The BofA US High Yield Master II tracks the performance of US dollar denominated corporate debt publicly issued in the US domestic market. The debt included is rated below investment grade, based on an average rating from Moody's, S&P and Fitch. Index constituents are capitalisation-weighted based on their amount outstanding. As the US dollar denominated corporate debt market is the largest in the world, the BofA US High Yield Master II is considered a good benchmark for the high yield bond market (Federal Research Bank of St.Louis, 2009).

Appendix D: Statistical properties of selected indices

In the following graphs, we have plotted some key indices to illustrate their distributions. "# Observations" indicate the number of observations observed, while "Return (Monthly)" is categories indicating the monthly return observed.



Appendix E: Findings: The Pearson's Correlation

Appendix E consist of the Pearson's correlation calculations:

Credit Suisse indices and traditional assets:	MSCI World	MSCI AC Asia	MSCI AC Europe	MSCI EM	SP500	OSEBX
Credit Suisse HF Index	*0.8188*	*0.7911*	*0.8086*	*0.8402*	*0.1819*	*0.8385*
Credit Suisse Long/Short Equity HFX	*0.8858*	*0.8509*	*0.8757*	*0.8857*	*0.1808*	*0.8632*
Credit Suisse Fixed Income Arbitrage HFX	*0.6063*	*0.5631*	*0.5780*	*0.5983*	*0.2904*	*0.6076*
Credit Suisse Global Macro HFX	*0.3932*	*0.4504*	*0.4015*	*0.5039*	*0.0966**	*0.4505*
Credit Suisse Dedicated Short Bias HFX	*-0.7356*	*-0.6377*	*-0.6621*	*-0.6278*	*-0.0199**	*-0.5308*
Credit Suisse Managed Futures HFX	*0.1215**	*0.1331**	*0.1294**	*0.1666**	*-0.0789**	*0.1546**
Credit Suisse Multi-Strategy HFX	*0.7552*	*0.7259*	*0.7434*	*0.7597*	*0.2420*	*0.8001*
Credit Suisse Convertible Arbitrage HFX	*0.6299*	*0.6288*	*0.6078*	*0.6404*	*0.3100*	*0.6831*

Hedgenordic indices and traditional assets:	MSCI World	MSCI AC Asia	MSCI AC Europe	MSCI EM	SP500	OSEBX
NHX Nordic Index	*0.7466*	*0.7528*	*0.7323*	*0.7873*	*0.2571*	*0.8300*
NHX Norway	*0.7012*	*0.6706*	*0.6908*	*0.6978*	*0.1721**	*0.8108*
NHX Equities	*0.7615*	*0.7484*	*0.7495*	*0.7745*	*0.2845*	*0.8253*
NHX Fixed Income	*0.5414*	*0.5465*	*0.4926*	*0.5478*	*0.3341*	*0.5414*
NHX Funds of Funds	*0.6328*	*0.6525*	*0.6352*	*0.7034*	*0.1637**	*0.7746*
NHX Managed Futures & CTA	*0.1281**	*0.1438**	*0.1316**	*0.1920*	*-0.0315**	*0.1754**
NHX Multi Strategy	*0.6355*	*0.6640*	*0.6463*	*0.7156*	*0.1453**	*0.6987*

Table E-1: The table illustrates the Pearson's correlation between the hedge fund indices and stock indices. Note that * marks insignificant results, tested with a two-tailed t-test, at a 5% significance level. The t-test documents whether there is correlation significantly different from 0: H_0: $\rho = 0$, H_A: $\rho \neq 0$. N=119. Source: Credit Suisse, Hedgenordic, MSCI, YahooFinance, and Euroinvestor.

Credit Suisse indices and traditional assets:	BofA Global Broad	JPM EMBI Global	BofA Global HY
Credit Suisse HF Index	*0.3174*	*0.5406*	*0.2741*
Credit Suisse Long/Short Equity HFX	*0.3143*	*0.5403*	*0.3077*
Credit Suisse Fixed Income Arbitrage HFX	*0.2346*	*0.5733*	*0.3750*
Credit Suisse Global Macro HFX	*0.4333*	*0.4613*	*0.2567*
Credit Suisse Dedicated Short Bias HFX	*-0.1741**	*-0.3742*	*-0.0614**
Credit Suisse Managed Futures HFX	*0.2678*	*0.0562**	*-0.0511**
Credit Suisse Multi-Strategy HFX	*0.2085*	*0.5171*	*0.3022*
Credit Suisse Convertible Arbitrage HFX	*0.2044*	*0.5836*	*0.4598*

Hedgenordic indices and traditional assets:	BofA Global Broad	JPM EMBI Global	BofA Global HY
NHX Nordic Index	*0.2032*	*0.5006*	*0.3734*
NHX Norway	*0.0713**	*0.3686*	*0.2312*
NHX Equities	*0.1240**	*0.4522*	*0.3747*
NHX Fixed Income	*0.2365*	*0.6291*	*0.5404*
NHX Funds of Funds	*0.1924*	*0.4462*	*0.2542*
NHX Managed Futures & CTA	*0.2108*	*0.0129**	*-0.0533**
NHX Multi Strategy	*0.1783**	*0.3800*	*0.2600*

Table E-2: The table illustrates the Pearson's correlation between the hedge fund indices and bond indices. Note that * marks insignificant results, tested with a two-tailed t-test, at a 5% significance level. The t-test documents whether there is correlation significantly different from 0: H_0: $\rho = 0$, H_A: $\rho \neq 0$. N=119. Source: Credit Suisse, Hedgenordic, BofA and JPMorgan

Credit Suisse indices and traditional assets:	**MSCI World**		**OSEBX**		**BofA Global Broad**	
Time:	Excluding the crisis	"2007-2009"	Excluding the crisis	"2007-2009"	Excluding the crisis	"2007-2009"
Credit Suisse HF Index	*0.8592*	0.7531	*0.7739*	0.8722	*0.3661*	0.3462*
Credit Suisse Long/Short Equity HFX	*0.9263*	0.8344	*0.8066*	0.9391	*0.2867*	0.4200
Credit Suisse Fixed Income Arbitrage HFX	*0.3763*	0.7203	*0.2553*	0.7281	*0.3373*	0.3053*
Credit Suisse Global Macro HFX	*0.3846*	0.3787*	*0.3591*	0.4926	*0.4289*	0.4903
Credit Suisse Dedicated Short Bias HFX	*-0.8230*	-0.6341	*-0.6105*	-0.4500	*-0.2654*	-0.0328*
Credit Suisse Managed Futures HFX	*0.3496*	-0.2616*	*0.3657*	-0.1361*	*0.3362*	0.1343*
Credit Suisse Multi-Strategy HFX	*0.8234*	0.6797	*0.7225*	0.8284	*0.3020*	0.2110*
Credit Suisse Convertible Arbitrage HFX	*0.5839*	0.6618	*0.4858*	0.7713	*0.1921**	0.2831*

Credit Suisse indices and traditional assets:	**MSCI World**		**OSEBX**		**BofA Global Broad**	
Time:	Excluding the crisis	"2007-2009"	Excluding the crisis	"2007-2009"	Excluding the crisis	"2007-2009"
NHX Nordic Index	*0.6887*	0.7746	*0.7706*	0.8771	*0.1730**	0.3058*
NHX Norway	*0.6640*	0.7273	*0.7496*	0.9008	*0.0941**	0.0787*
NHX Equities	*0.7175*	0.7783	*0.7706*	0.8726	*0.0577**	0.2731*
NHX Fixed Income	*0.1920**	0.7057	*0.1571**	0.6855	*0.2428*	0.3213*
NHX Funds of Funds	*0.5874*	0.6288	*0.7029*	0.8266	*0.1949**	0.2548*
NHX Managed Futures & CTA	*0.2525*	-0.0690*	*0.2968*	0.0381*	*0.2509*	0.1323*
NHX Multi Strategy	*0.6624*	0.5893	*0.7418*	0.6733	*0.1450**	0.2657*

Table E-3: The table illustrates a comparison of the Pearson's correlation between hedge fund indices and MSCI World, OSEBX, and BofA Global Broad. Two time periods are analysed. The first period is from the beginning of January 04 to the end of December 13, excluding the "Great Financial Crisis" ("Excluding the crisis"). The second period is the "Great Financial Crisis", from the end of June 07 to the end of June 09 ("2007-2009"). Note that * marks insignificant results, tested with a two-tailed t-test, at a 5% significance level. The t-test documents whether there is correlation significantly different from 0: H_0: $\rho = 0$, H_A: $\rho \neq 0$. N_1=94 and N_2=24 for respectively "Excluding the crisis" and "2007-2009". Our calculations are based on data collected from: Credit Suisse, Hedgenordic, MSCI, Euroinvestor, and BofA.

Traditional asset classes:	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
MSCI World (i)	1.0								
MSCI AC Asia (ii)	*0.8874*	1.0							
MSCI AC Europe (iii)	*0.9709*	*0.8627*	1.0						
MSCI EM (iv)	*0.8843*	*0.9182*	*0.8855*	1.0					
SP500 (v)	*0.2325*	*0.2199*	*0.2456*	*0.2131*	1.0				
OSEBX (vi)	*0.8289*	*0.7794*	*0.8286*	*0.8368*	*0.2108*	1.0			
BofA Global Broad (vii)	*0.4104*	*0.4353*	*0.4685*	*0.4408*	*0.1077**	*0.1930*	1.0		
JPM EMBI Global Composite (viii)	*0.6407*	*0.6746*	*0.6370*	*0.7103*	*0.1402**	*0.5515*	*0.6314*	1.0	
BofA Global High Yield (ix)	*0.3645*	*0.3820*	*0.3691*	*0.3791*	*0.7419*	*0.3498*	*0.3362*	*0.4501*	1.0

Pearson's of different HF strategies:	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
Credit Suisse HF Index (a)	1.0														
Credit Suisse Long/Short Equity HFX (b)	*0.9322*	1.0													
Credit Suisse Fixed Income Arbitrage HFX (c)	*0.7142*	*0.5629*	1.0												
Credit Suisse Global Macro HFX (d)	*0.7009*	*0.5562*	*0.5376*	1.0											
Credit Suisse Dedicated Short Bias HFX (e)	*-0.5482*	*-0.6787*	*-0.3179*	*-0.1166**	1.0										
Credit Suisse Managed Futures HFX (f)	*0.3577*	*0.2897*	*-0.0368**	*0.5153*	*-0.1482**	1.0									
Credit Suisse Multi-Strategy HFX (g)	*0.9410*	*0.8542*	*0.7761*	*0.5983*	*-0.4737*	*0.1519**	1.0								
Credit Suisse Convertible Arbitrage HFX (h)	*0.7801*	*0.6833*	*0.8567*	*0.5777*	*-0.3455*	*0.0205**	*0.8743*	1.0							
NHX Nordic Index (i)	*0.8760*	*0.8577*	*0.5699*	*0.6083*	*-0.5382*	*0.3430*	*0.8109*	*0.6942*	1.0						
NHX Norway (j)	*0.8000*	*0.8260*	*0.4645*	*0.3739*	*-0.5545*	*0.1786**	*0.7792*	*0.6061*	*0.8491*	1.0					
NHX Equities (k)	*0.8366*	*0.8524*	*0.5430*	*0.4903*	*-0.5649*	*0.1679**	*0.8095*	*0.6772*	*0.9481*	*0.8684*	1.0				
NHX Fixed Income (l)	*0.5223*	*0.4835*	*0.7060*	*0.3701*	*-0.3386*	*-0.1146**	*0.5817*	*0.7199*	*0.5898*	*0.4278*	*0.5305*	1.0			
NHX Funds of Funds (m)	*0.8611*	*0.8075*	*0.5539*	*0.6738*	*-0.4096*	*0.4789*	*0.7792*	*0.6448*	*0.9083*	*0.7669*	*0.8114*	*0.4797*	1.0		
NHX Managed Futures & CTA (n)	*0.3239*	*0.2698*	*-0.0334**	*0.4385*	*-0.1423**	*0.7869*	*0.1389**	*0.0354**	*0.4035*	*0.2319*	*0.1817*	*-0.0536**	*0.4677*	1.0	
NHX Multi Strategy (o)	*0.6633*	*0.7167*	*0.2852*	*0.3550*	*-0.5163*	*0.2260*	*0.5794*	*0.4206*	*0.7684*	*0.7124*	*0.7269*	*0.3574*	*0.6421*	*0.2912*	1.0

Correlation matrix with the whole time period analysed, excluding the "Great Financial Crisis":

Traditional asset classes:	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
MSCI World (i)	1.0								
MSCI AC Asia (ii)	*0.8184*	1.0							
MSCI AC Europe (iii)	*0.9582*	*0.7713*	1.0						
MSCI EM (iv)	*0.8408*	*0.8652*	*0.8299*	1.0					
SP500 (v)	*-0.0491**	*-0.0236**	*-0.016**	*-0.0687**	1.0				
OSEBX (vi)	*0.7839*	*0.6598*	*0.7791*	*0.7727*	*-0.0714**	1.0			
BofA Global Broad (vii)	*0.3736*	*0.3597*	*0.4376*	*0.4054*	*-0.0307**	*0.1537**	1.0		
JPM EMBI Global Composite (viii)	*0.4734*	*0.5391*	*0.4938*	*0.6219*	*-0.1310**	*0.3841*	*0.6383*	1.0	
BofA Global High Yield (ix)	*-0.0086**	*-0.0391**	*0.0102**	*-0.0262**	*0.6757*	*-0.0222**	*0.0354**	*0.0334**	1.0

Pearson's of different HF strategies:	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
Credit Suisse HF Index (a)	1.0														
Credit Suisse Long/Short Equity HFX (b)	*0.9372*	1.0													
Credit Suisse Fixed Income Arbitrage HFX (c)	*0.4945*	*0.3216*	1.0												
Credit Suisse Global Macro HFX (d)	*0.6711*	*0.4626*	*0.4426*	1.0											
Credit Suisse Dedicated Short Bias HFX (e)	*-0.7244*	*-0.8176*	*-0.2878*	*-0.2529*	1.0										
Credit Suisse Managed Futures HFX (f)	*0.5796*	*0.4107*	*0.1828**	*0.6555*	*-0.2916*	1.0									
Credit Suisse Multi-Strategy HFX (g)	*0.9250*	*0.8870*	*0.5416*	*0.5155*	*-0.6963*	*0.3765*	1.0								
Credit Suisse Convertible Arbitrage HFX (h)	*0.6582*	*0.5819*	*0.6798*	*0.3197*	*-0.4946*	*0.2021**	*0.7636*	1.0							
NHX Nordic Index (i)	*0.8690*	*0.8156*	*0.2901*	*0.5876*	*-0.5867*	*0.5647*	*0.7653*	*0.4968*	1.0						
NHX Norway (j)	*0.7511*	*0.7855*	*0.1556**	*0.3165*	*-0.6180*	*0.3429*	*0.7165*	*0.4458*	*0.8330*	1.0					
NHX Equities (k)	*0.8339*	*0.8387*	*0.2973*	*0.4286*	*-0.6346*	*0.3318*	*0.7987*	*0.5249*	*0.9192*	*0.8590*	1.0				
NHX Fixed Income (l)	*0.1894**	*0.1721**	*0.1925**	*0.0774**	*-0.2499*	*0.0737**	*0.1387**	*0.2122*	*0.2346*	*0.1586**	*0.1448**	1.0			
NHX Funds of Funds (m)	*0.8015*	*0.7342*	*0.2169*	*0.6162*	*-0.4738*	*0.6585*	*0.6768*	*0.4187*	*0.9015*	*0.7400*	*0.7600*	*0.2056*	1.0		
NHX Managed Futures & CTA (n)	*0.4371*	*0.3137*	*0.0808**	*0.5316*	*-0.2079*	*0.7786*	*0.2398*	*0.1210**	*0.5612*	*0.3223*	*0.2716*	*0.0585**	*0.5917*	1.0	
NHX Multi Strategy (o)	*0.7053*	*0.7195*	*0.1867**	*0.3235*	*-0.5407*	*0.3016*	*0.6732*	*0.4152*	*0.7880*	*0.7103*	*0.7469*	*0.2506*	*0.6634*	*0.2869*	1.0

Credit Suisse indices and traditional assets:	MSCI World	MSCI AC Asia	MSCI AC Europe	MSCI EM	SP500	OSEBX	BofA Global Broad	JPM EMBI Global	BofA Global HY
Credit Suisse HF Index	*0.8592*	*0.7933*	*0.8207*	*0.8411*	*-0.0564**	*0.7739*	*0.3661*	*0.4134*	*-0.0559**
Credit Suisse Long/Short Equity HFX	*0.9263*	*0.8348*	*0.8777*	*0.8771*	*-0.0410**	*0.8066*	*0.2867*	*0.3981*	*-0.0353**
Credit Suisse Fixed Income Arbitrage HFX	*0.3763*	*0.2818*	*0.4134*	*0.2935*	*0.0454**	*0.2553*	*0.3373*	*0.1767**	*0.0629**
Credit Suisse Global Macro HFX	*0.3846*	*0.4289*	*0.3655*	*0.4722*	*-0.0975**	*0.3591*	*0.4289*	*0.3073*	*-0.1242**
Credit Suisse Dedicated Short Bias HFX	*-0.8230*	*-0.6981*	*-0.7219*	*-0.6926*	*0.0475**	*-0.6105*	*-0.2654*	*-0.3373*	*-0.0160**
Credit Suisse Managed Futures HFX	*0.3496*	*0.3228*	*0.3018*	*0.3649*	*0.0262**	*0.3657*	*0.3362*	*0.2312*	*0.0703**
Credit Suisse Multi-Strategy HFX	*0.8234*	*0.7660*	*0.8018*	*0.7788*	*-0.0433**	*0.7225*	*0.3020*	*0.3596*	*-0.1012**
Credit Suisse Convertible Arbitrage HFX	*0.5839*	*0.5206*	*0.5777*	*0.5062*	*0.0771**	*0.4858*	*0.1921**	*0.2619*	*0.0460**

Hedgenordic indices and traditional assets:	MSCI World	MSCI AC Asia	MSCI AC Europe	MSCI EM	SP500	OSEBX	BofA Global Broad	JPM EMBI Global	BofA Global HY
NHX Nordic Index	*0.6887*	*0.6858*	*0.6550*	*0.7269*	*0.0370**	*0.7706*	*0.1730**	*0.2994*	*0.0426**
NHX Norway	*0.6640*	*0.6105*	*0.6372*	*0.6293*	*-0.0033**	*0.7496*	*0.0941**	*0.2296*	*-0.0337**
NHX Equities	*0.7175*	*0.7034*	*0.6835*	*0.7274*	*0.0547**	*0.7706*	*0.0577**	*0.2209*	*0.0310**
NHX Fixed Income	*0.1920**	*0.2185*	*0.1794**	*0.2163*	*0.0571**	*0.1571**	*0.2428*	*0.3446*	*0.1965**
NHX Funds of Funds	*0.5874*	*0.5959*	*0.5684*	*0.6449*	*-0.0023**	*0.7029*	*0.1949**	*0.2862*	*0.0238**
NHX Managed Futures & CTA	*0.2525*	*0.2194*	*0.2188*	*0.2811*	*0.0320**	*0.2968*	*0.2509*	*0.1294**	*0.0020**
NHX Multi Strategy	*0.6624*	*0.6604*	*0.6619*	*0.7474*	*0.0266**	*0.7418*	*0.1450**	*0.3908*	*0.0591**

Traditional asset classes:	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
MSCI World (i)	1.0								
MSCI AC Asia (ii)	0.9501	1.0							
MSCI AC Europe (iii)	0.9856	0.9570	1.0						
MSCI EM (iv)	0.9370	0.9637	0.9559	1.0					
SP500 (v)	0.4010*	0.3787*	0.4371	0.4293	1.0				
OSEBX (vi)	0.8512	0.8613	0.8701	0.8896	0.3586*	1.0			
BofA Global Broad (vii)	0.5461	0.5908	0.5981	0.5364	0.3194*	0.3006*	1.0		
JPM EMBI Global Composite (viii)	0.8071	0.8018	0.8027	0.7997	0.3431*	0.6923	0.6587	1.0	
BofA Global High Yield (ix)	0.5767	0.6161	0.6151	0.6120	0.8185	0.5281	0.6066	0.6655	1.0

Credit Suisse indices and traditional assets:	MSCI World	MSCI AC Asia	MSCI AC Europe	MSCI EM	SP500	OSEBX	BofA Global Broad	JPM EMBI Global	BofA Global HY
Credit Suisse HF Index	0.7531	0.7736	0.7732	0.8438	0.2950*	0.8722	0.3462*	0.6641	0.4464
Credit Suisse Long/Short Equity HFX	0.8344	0.8740	0.8597	0.9132	0.3530*	0.9391	0.4200	0.7142	0.5650
Credit Suisse Fixed Income Arbitrage HFX	0.7203	0.6953	0.6992	0.7639	0.3325*	0.7281	0.3053*	0.7852	0.4373
Credit Suisse Global Macro HFX	0.3787*	0.4484	0.4176	0.5148	0.2099*	0.4926	0.4903	0.5786	0.4307
Credit Suisse Dedicated Short Bias HFX	-0.6341	-0.5751	-0.5610	-0.5647	-0.0327*	-0.4500	-0.0328*	-0.4326	-0.0802*
Credit Suisse Managed Futures HFX	-0.2616*	-0.1758*	-0.1999*	-0.1618*	-0.2619*	-0.1361*	0.1343*	-0.2124*	-0.1744*
Credit Suisse Multi-Strategy HFX	0.6797	0.6895	0.6874	0.7623	0.3418*	0.8284	0.2110*	0.6414	0.4544
Credit Suisse Convertible Arbitrage HFX	0.6618	0.6938	0.6515	0.7297	0.3921*	0.7713	0.2831*	0.7723	0.5778

Hedgenordic indices and traditional assets:	MSCI World	MSCI AC Asia	MSCI AC Europe	MSCI EM	SP500	OSEBX	BofA Global Broad	JPM EMBI Global	BofA Global HY
NHX Nordic Index	0.7746	0.8057	0.7898	0.8508	0.3962*	0.8771	0.3058*	0.7048	0.5911
NHX Norway	0.7273	0.7372	0.7356	0.7910	0.3012*	0.9008	0.0787*	0.5376	0.4376
NHX Equities	0.7783	0.7817	0.7971	0.8280	0.4431	0.8726	0.2731*	0.6908	0.6102
NHX Fixed Income	0.7057	0.7075	0.6719	0.7262	0.4203	0.6855	0.3213*	0.8000	0.6292
NHX Funds of Funds	0.6288	0.6844	0.6645	0.7588	0.2333*	0.8266	0.2548*	0.6135	0.3997*
NHX Managed Futures & CTA	-0.0690*	0.0450*	-0.0205*	0.0648*	-0.1366*	0.0381*	0.1323*	-0.1964*	-0.1235*
NHX Multi Strategy	0.5893	0.6744	0.6042	0.6943	0.2234*	0.6733	0.2657*	0.3628*	0.4252

Pearson's of different HF strategies:	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
Credit Suisse HF Index (a)	1.0														
Credit Suisse Long/Short Equity HFX (b)	0.9388	1.0													
Credit Suisse Fixed Income Arbitrage HFX (c)	0.8373	0.7577	1.0												
Credit Suisse Global Macro HFX (d)	0.7280	0.6584	0.5956	1.0											
Credit Suisse Dedicated Short Bias HFX (e)	-0.3043*	-0.4117	-0.4001*	0.0650*	1.0										
Credit Suisse Managed Futures HFX (f)	0.0656*	0.0639*	-0.2115*	0.4263	0.2271*	1.0									
Credit Suisse Multi-Strategy HFX (g)	0.9575	0.8682	0.8466	0.6480	-0.2572*	-0.0841*	1.0								
Credit Suisse Convertible Arbitrage HFX (h)	0.8677	0.8185	0.8952	0.6949	-0.2697*	-0.1478*	0.9268	1.0							
NHX Nordic Index (i)	0.8705	0.9011	0.7281	0.6290	-0.4443	-0.0282*	0.8506	0.8475	1.0						
NHX Norway (j)	0.8625	0.8720	0.6839	0.4296	-0.4001*	-0.1949*	0.8849	0.7884	0.8627	1.0					
NHX Equities (k)	0.8222	0.8552	0.6885	0.5408	-0.4319	-0.1317*	0.8254	0.8105	0.9769	0.8726	1.0				
NHX Fixed Income (l)	0.6628	0.7011	0.7796	0.4820	-0.4501	-0.3361*	0.7072	0.8383	0.8032	0.6286	0.7589	1.0			
NHX Funds of Funds (m)	0.9089	0.8869	0.7367	0.7377	-0.2679*	0.2131*	0.8610	0.8128	0.9033	0.7824	0.8480	0.6296	1.0		
NHX Managed Futures & CTA (n)	0.2405*	0.2422*	-0.1363*	0.4417	0.0310*	0.8273	0.0878*	-0.0255*	0.1744*	0.0412*	0.0428*	-0.1878*	0.3341*	1.0	
NHX Multi Strategy (o)	0.6139	0.6945	0.3572*	0.3927*	-0.4386	0.0802*	0.5124	0.4632	0.7372	0.6955	0.6857	0.4520	0.5924	0.3913*	1.0

Appendix F: Findings: The Spearman's Correlation

Correlation matrix from the whole time period analysed:

Traditional asset classes:	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
MSCI World (i)	1.0								
MSCI AC Asia (ii)	0.8276	1.0							
MSCI AC Europe (iii)	0.9528	0.7872	1.0						
MSCI EM (iv)	0.8272	0.8877	0.8390	1.0					
SP500 (v)	0.0778*	0.0412*	0.0995*	0.0446*	1.0				
OSEBX (vi)	0.7804	0.6989	0.7843	0.7942	-0.0485*	1.0			
BofA Global Broad (vii)	0.3442	0.3727	0.4103	0.3806	0.0926*	0.1208*	1.0		
JPM EMBI Global Composite (viii)	0.4787	0.5473	0.4839	0.5509	0.0707*	0.3664	0.5725	1.0	
BofA Global High Yield (ix)	0.1481*	0.0999*	0.1557*	0.1253*	0.6713	0.0298*	0.1928	0.2535	1.0

Spearman's of different HF strategies:	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
Credit Suisse HF Index (a)	1.0														
Credit Suisse Long/Short Equity HFX (b)	0.9384	1.0													
Credit Suisse Fixed Income Arbitrage HFX (c)	0.5587	0.4703	1.0												
Credit Suisse Global Macro HFX (d)	0.6574	0.4967	0.3139	1.0											
Credit Suisse Dedicated Short Bias HFX (e)	-0.6101	-0.7023	-0.3720	-0.1284*	1.0										
Credit Suisse Managed Futures HFX (f)	0.5240	0.3990	0.1320*	0.6558	-0.1856	1.0									
Credit Suisse Multi-Strategy HFX (g)	0.9015	0.8479	0.6015	0.4855	-0.5794	0.3112	1.0								
Credit Suisse Convertible Arbitrage HFX (h)	0.6997	0.6239	0.6877	0.3257	-0.4560	0.1444*	0.8123	1.0							
NHX Nordic Index (i)	0.8816	0.8584	0.4390	0.5286	-0.5541	0.4395	0.7943	0.6110	1.0						
NHX Norway (j)	0.7469	0.7712	0.3615	0.3274	-0.5269	0.2458	0.7493	0.6115	0.8365	1.0					
NHX Equities (k)	0.8116	0.8260	0.4058	0.3875	-0.5487	0.2433	0.7804	0.6032	0.9241	0.8331	1.0				
NHX Fixed Income (l)	0.2705	0.2717	0.3910	0.0719*	-0.3549	-0.0170*	0.3295	0.3970	0.3703	0.3306	0.2851	1.0			
NHX Funds of Funds (m)	0.8676	0.8127	0.3741	0.6138	-0.4323	0.5742	0.7503	0.5507	0.8998	0.7703	0.7761	0.2972	1.0		
NHX Managed Futures & CTA (n)	0.4817	0.3890	0.1035*	0.5872	-0.1563*	0.8215	0.2785	0.1718*	0.4752	0.2800	0.2388	-0.0269*	0.5638	1.0	
NHX Multi Strategy (o)	0.7003	0.7317	0.2639	0.3666	-0.4753	0.2704	0.6225	0.4577	0.8023	0.6888	0.7328	0.2899	0.6774	0.3294	1.0

Correlation matrix for the whole time period analysed, excluding the "Great Financial Crisis":

Traditional asset classes:	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
MSCI World (i)	1.0								
MSCI AC Asia (ii)	*0.7841*	1.0							
MSCI AC Europe (iii)	*0.9448*	*0.7183*	1.0						
MSCI EM (iv)	*0.7978*	*0.8366*	*0.7984*	1.0					
SP500 (v)	*-0.0569**	*-0.0811**	*-0.0135**	*-0.0414**	1.0				
OSEBX (vi)	*0.7236*	*0.6142*	*0.7338*	*0.7484*	*-0.1405**	1.0			
BofA Global Broad (vii)	*0.3687*	*0.3560*	*0.4225*	*0.3783*	*0.0331**	*0.1256**	1.0		
JPM EMBI Global Composite (viii)	*0.3649*	*0.4861*	*0.3952*	*0.5179*	*-0.01778**	*0.3074*	*0.5842*	1.0	
BofA Global High Yield (ix)	*0.0051**	*-0.0600**	*0.0172**	*0.0356**	*0.6032*	*-0.0320**	*0.0405**	*0.1142**	1.0

Spearman's of different HF strategies:	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
Credit Suisse HF Index (a)	1.0														
Credit Suisse Long/Short Equity HFX (b)	*0.9328*	1.0													
Credit Suisse Fixed Income Arbitrage HFX (c)	*0.4695*	*0.3306*	1.0												
Credit Suisse Global Macro HFX (d)	*0.7156*	*0.5232*	*0.3911*	1.0											
Credit Suisse Dedicated Short Bias HFX (e)	*-0.6847*	*-0.7615*	*-0.3184*	*-0.2692*	1.0										
Credit Suisse Managed Futures HFX (f)	*0.6414*	*0.4899*	*0.2269*	*0.6660*	*-0.3312*	1.0									
Credit Suisse Multi-Strategy HFX (g)	*0.9098*	*0.8771*	*0.4702*	*0.5651*	*-0.6579*	*0.4501*	1.0								
Credit Suisse Convertible Arbitrage HFX (h)	*0.6446*	*0.5498*	*0.5388*	*0.3618*	*-0.4562*	*0.2392*	*0.7282*	1.0							
NHX Nordic Index (i)	*0.8696*	*0.8451*	*0.2767*	*0.5952*	*-0.5671*	*0.5867*	*0.7767*	*0.5110*	1.0						
NHX Norway (j)	*0.6921*	*0.7356*	*0.1579**	*0.3589*	*-0.5554*	*0.3889*	*0.6835*	*0.4926*	*0.8183*	1.0					
NHX Equities (k)	*0.7923*	*0.8325*	*0.2548*	*0.4270*	*-0.5925*	*0.3445*	*0.7732*	*0.5257*	*0.9027*	*0.8119*	1.0				
NHX Fixed Income (l)	*0.1632**	*0.1508**	*0.1726**	*0.0976**	*-0.2836*	*0.0957**	*0.1329**	*0.1781**	*0.2266*	*0.1616**	*0.1389**	1.0			
NHX Funds of Funds (m)	*0.8288*	*0.7792*	*0.2242*	*0.6351*	*-0.4518*	*0.6923*	*0.7134*	*0.4460*	*0.8989*	*0.7491*	*0.7377*	*0.1955**	1.0		
NHX Managed Futures & CTA (n)	*0.5247*	*0.4127*	*0.1230**	*0.5645*	*-0.2430*	*0.8165*	*0.3396*	*0.2098*	*0.5665*	*0.3701*	*0.2911*	*0.0069**	*0.6285*	1.0	
NHX Multi Strategy (o)	*0.6675*	*0.7020*	*0.1427**	*0.3607*	*-0.4878*	*0.3475*	*0.6299*	*0.4174*	*0.7810*	*0.6870*	*0.6995*	*0.2278*	*0.6601*	*0.3388*	1.0

Credit Suisse indices and traditional assets:	MSCI World	MSCI AC Asia	MSCI AC Europe	MSCI EM	SP500	OSEBX	BofA Global Broad	JPM EMBI Global	BofA Global HY
Credit Suisse HF Index	*0.8542*	*0.7794*	*0.8069*	*0.8139*	*-0.0588**	*0.7327*	*0.3428*	*0.2862*	*-0.0737**
Credit Suisse Long/Short Equity HFX	*0.9049*	*0.7955*	*0.8650*	*0.8515*	*-0.0420**	*0.7796*	*0.2760*	*0.2921*	*-0.0239**
Credit Suisse Fixed Income Arbitrage HFX	*0.3917*	*0.2758*	*0.4336*	*0.2801*	*0.0681**	*0.2504*	*0.3843*	*0.0831**	*-0.0165**
Credit Suisse Global Macro HFX	*0.4436*	*0.5004*	*0.4059*	*0.5039*	*-0.0521**	*0.3786*	*0.3905*	*0.2326*	*-0.1115**
Credit Suisse Dedicated Short Bias HFX	*-0.7860*	*-0.6479*	*-0.6898*	*-0.6408*	*0.0063**	*-0.5603*	*-0.2763*	*-0.2900*	*-0.0696**
Credit Suisse Managed Futures HFX	*0.4536*	*0.3839*	*0.3719*	*0.4146*	*0.0485**	*0.3909*	*0.2633*	*0.1545**	*0.0707**
Credit Suisse Multi-Strategy HFX	*0.8079*	*0.7330*	*0.7838*	*0.7366*	*-0.0417**	*0.6796*	*0.2815*	*0.2589*	*-0.1292**
Credit Suisse Convertible Arbitrage HFX	*0.5049*	*0.4498*	*0.4974*	*0.4454*	*0.0666**	*0.4645*	*0.1560**	*0.1684**	*-0.0478**

Hedgenordic indices and traditional assets:	MSCI World	MSCI AC Asia	MSCI AC Europe	MSCI EM	SP500	OSEBX	BofA Global Broad	JPM EMBI Global	BofA Global HY
NHX Nordic Index	*0.7008*	*0.6770*	*0.6755*	*0.7494*	*0.0038**	*0.7534*	*0.1491**	*0.2532*	*-0.0128**
NHX Norway	*0.5925*	*0.5492*	*0.5971*	*0.6017*	*-0.0186**	*0.7092*	*0.0656**	*0.1604**	*-0.0874**
NHX Equities	*0.6746*	*0.6565*	*0.6621*	*0.7213*	*0.0236**	*0.7306*	*0.0380**	*0.1440**	*-0.0086**
NHX Fixed Income	*0.1867*	*0.1665**	*0.2073*	*0.1497**	*0.1266**	*0.1597**	*0.2201*	*0.2951*	*0.2830*
NHX Funds of Funds	*0.6342*	*0.5907*	*0.6152*	*0.6448*	*-0.0290**	*0.6751*	*0.1482**	*0.1968**	*-0.0524**
NHX Managed Futures & CTA	*0.3596*	*0.2833*	*0.2942*	*0.3429*	*0.0224**	*0.3449*	*0.2402*	*0.1596**	*-0.0741**
NHX Multi Strategy	*0.6128*	*0.5921*	*0.6376*	*0.7349*	*-0.0084**	*0.7099*	*0.1179**	*0.3550*	*0.0534**

Traditional asset classes:	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
MSCI World (i)	1.0								
MSCI AC Asia (ii)	*0.9339*	1.0							
MSCI AC Europe (iii)	*0.9687*	*0.9322*	1.0						
MSCI EM (iv)	*0.9122*	*0.9470*	*0.9461*	1.0					
SP500 (v)	*0.3748**	*0.3217**	*0.3983**	*0.4122*	1.0				
OSEBX (vi)	*0.8461*	*0.8417*	*0.8383*	*0.8617*	*0.1348**	1.0			
BofA Global Broad (vii)	*0.4652*	*0.5191*	*0.5235*	*0.4235*	*0.3174**	*0.2104**	1.0		
JPM EMBI Global Composite (viii)	*0.7478*	*0.7513*	*0.6852*	*0.6635*	*0.2887**	*0.5035*	*0.5861*	1.0	
BofA Global High Yield (ix)	*0.5043*	*0.5174*	*0.5226*	*0.4974*	*0.8096*	*0.2313**	*0.6165*	*0.6070*	1.0

Credit Suisse indices and traditional assets:	MSCI World	MSCI AC Asia	MSCI AC Europe	MSCI EM	SP500	OSEBX	BofA Global Broad	JPM EMBI Global	BofA Global HY
Credit Suisse HF Index	0.6774	0.7000	0.6904	0.7870	0.0948*	0.8600	0.1800*	0.4122	0.0965*
Credit Suisse Long/Short Equity HFX	0.7965	0.8296	0.8157	0.8887	0.1887*	0.8817	0.2870*	0.5409	0.2791*
Credit Suisse Fixed Income Arbitrage HFX	0.6270	0.5974	0.5574	0.6583	0.3165*	0.6800	0.0870*	0.5043	0.2548*
Credit Suisse Global Macro HFX	0.1270*	0.2157*	0.1861*	0.2426*	-0.1478*	0.2878*	0.3896*	0.2061*	-0.0400*
Credit Suisse Dedicated Short Bias HFX	-0.6530	-0.5843	-0.5713	-0.5583	-0.1391*	-0.5374	0.0017*	-0.5496	-0.2009*
Credit Suisse Managed Futures HFX	-0.1461*	-0.1252*	-0.0626*	-0.1087*	-0.3374*	-0.0243*	0.1565*	-0.1183*	-0.2635*
Credit Suisse Multi-Strategy HFX	0.5591	0.5643	0.5296	0.6696	0.1957*	0.7417	0.043*	0.3748*	0.1339*
Credit Suisse Convertible Arbitrage HFX	0.5496	0.5226	0.4722	0.5974	0.1565*	0.6591	0.0617*	0.5122	0.1774*

Hedgenordic indices and traditional assets:	MSCI World	MSCI AC Asia	MSCI AC Europe	MSCI EM	SP500	OSEBX	BofA Global Broad	JPM EMBI Global	BofA Global HY
NHX Nordic Index	0.7035	0.7226	0.7130	0.8113	0.2504*	0.8557	0.2026*	0.5530	0.3191*
NHX Norway	0.6591	0.6687	0.6391	0.7539	0.1661*	0.8452	0.0078*	0.3696*	0.1452*
NHX Equities	0.6843	0.6678	0.7061	0.7835	0.2870*	0.8461	0.1635*	0.4783	0.3287*
NHX Fixed Income	0.5643	0.5591	0.4704	0.5930	0.2983*	0.5800	0.1513*	0.7052	0.4009*
NHX Funds of Funds	0.5452	0.5774	0.5730	0.6835	0.0496*	0.8017	0.0774*	0.3539*	0.0565*
NHX Managed Futures & CTA	0.0617*	0.1304*	0.1217*	0.1313*	-0.1948*	0.1643*	0.2539*	0.0304*	-0.1617*
NHX Multi Strategy	0.6757	0.7557	0.7078	0.7765	0.1443*	0.7948	0.3052*	0.4896	0.2939*

Spearman's of different HF strategies:	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)
Credit Suisse HF Index (a)	1.0														
Credit Suisse Long/Short Equity HFX (b)	0.9443	1.0													
Credit Suisse Fixed Income Arbitrage HFX (c)	0.7930	0.7383	1.0												
Credit Suisse Global Macro HFX (d)	0.5826	0.5000	0.3104*	1.0											
Credit Suisse Dedicated Short Bias HFX (e)	-0.3600*	-0.4565	-0.4287	0.1322*	1.0										
Credit Suisse Managed Futures HFX (f)	0.1904*	0.1756*	-0.0374*	0.6000	0.2278*	1.0									
Credit Suisse Multi-Strategy HFX (g)	0.9235	0.8383	0.8383	0.4496	-0.3009*	-0.0026*	1.0								
Credit Suisse Convertible Arbitrage HFX (h)	0.8443	0.7661	0.8791	0.4548	-0.3809*	-0.0061*	0.9374	1.0							
NHX Nordic Index (i)	0.8696	0.8496	0.7409	0.4261	-0.4913	0.0452*	0.7887	0.7635	1.0						
NHX Norway (j)	0.9078	0.8670	0.7443	0.3504*	-0.3496*	-0.1096*	0.9104	0.8130	0.8278	1.0					
NHX Equities (k)	0.8409	0.8139	0.6817	0.3513*	-0.4200	-0.0043*	0.7783	0.7191	0.9713	0.8452	1.0				
NHX Fixed Income (l)	0.5965	0.5722	0.8035	0.1887*	-0.5122	-0.2357*	0.6922	0.8209	0.7470	0.6078	0.6722	1.0			
NHX Funds of Funds (m)	0.9261	0.8757	0.7339	0.6174	-0.3452*	0.2939*	0.8426	0.7904	0.8835	0.8139	0.8374	0.5957	1.0		
NHX Managed Futures & CTA (n)	0.3722*	0.3609*	0.0930*	0.6261	0.0609*	0.7835	0.2113*	0.1930*	0.2513*	0.0930*	0.1365*	-0.0339*	0.4617	1.0	
NHX Multi Strategy (o)	0.7670	0.7965	0.4574	0.3965*	-0.3965*	0.1148*	0.6304	0.5643	0.8217	0.7191	0.7817	0.4878	0.6904	0.4113	1.0

Appendix G: Efficient frontiers with and without HFs – including all HFs

By creating efficient frontiers, with and without the possibility to invest in hedge funds, we get an indication of whether or not the hedge funds will have a positive effect on the risk/reward relationship of a private investor's portfolio. Figure G-1 illustrates the efficient frontiers created, where we have included all the hedge funds indices to a portfolio consisting of stocks and bonds. The blue line illustrates the efficient frontier without hedge funds, while the red line illustrates the efficient frontier with hedge funds.

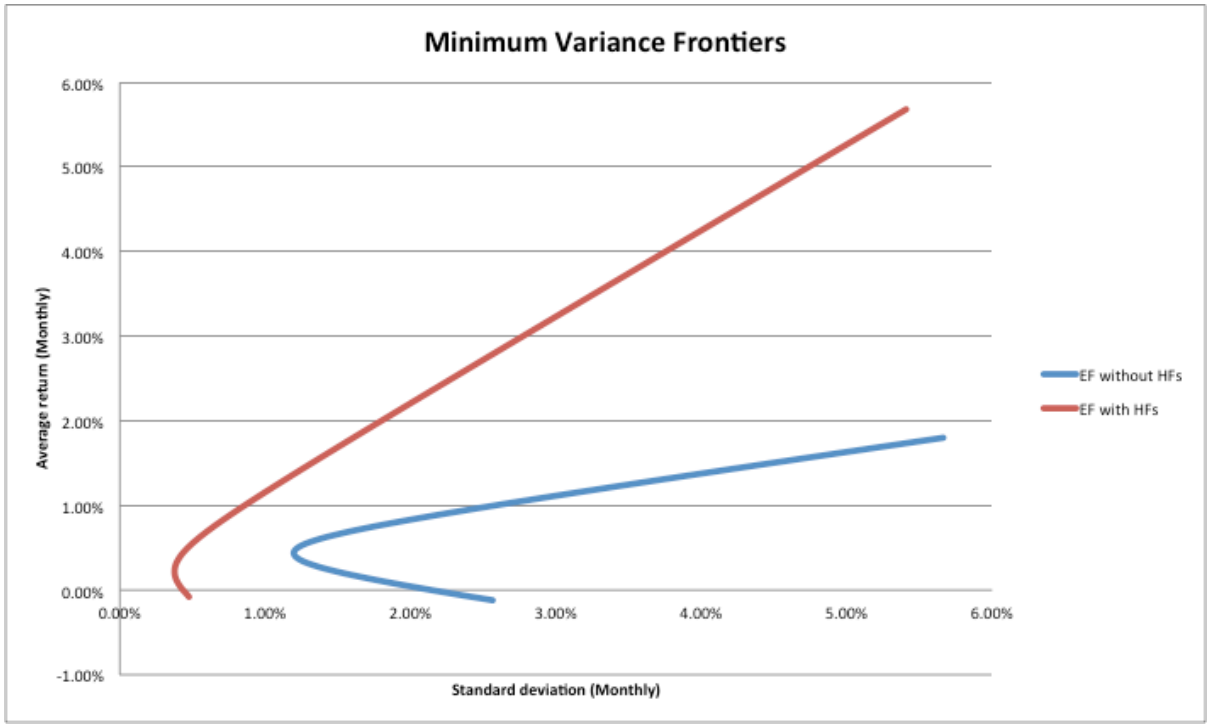


Figure G-1: Minimum variance frontiers of portfolios with (red line) and without (blue line) the possibility to invest in hedge funds. In the portfolio with the possibility to invest in hedge funds, we have included all the hedge fund indices in the calculations. The time period analysed is Jan 04 – Dec 13. Our calculations are based on data collected from: Credit Suisse, Hedgenordic, MSCI, YahooFinance, Euroinvestor, BofA, and JPMorgan.

Figure G-2 illustrates efficient frontiers created solely from the different hedge fund strategy indices from Credit Suisse and Hedgenordic (NHX). The NHX efficient frontier has a lower global minimum variance point, whereas the Credit Suisse efficient frontier is steeper. This indicates that one could be able to achieve a higher Sharpe ratio investing in a portfolio consisting of Credit Suisse hedge funds indices. However, if the investor's main objective is to minimise risk (standard deviation), the NHX hedge fund indices is preferred.

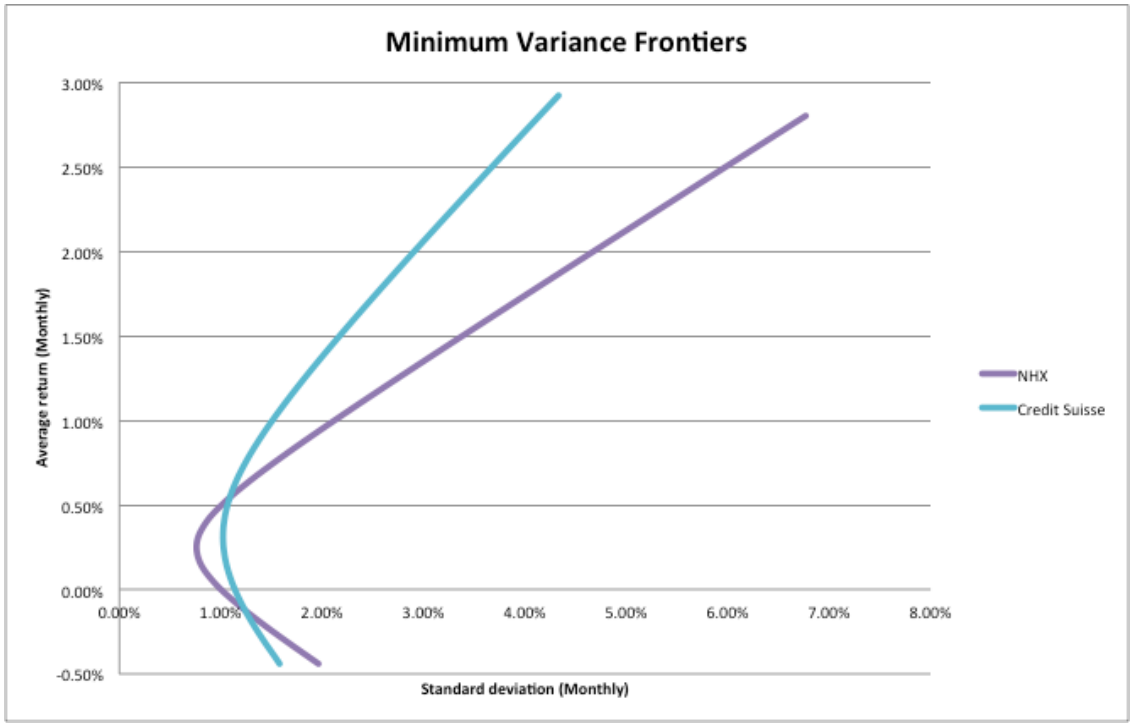


Figure G-2: Minimum variance frontiers for the hedge fund indices of NHX (purple line) and Credit Suisse (turquoise line). The time period analysed is Jan 04 – Dec 13. Our calculations are based on data collected from: Credit Suisse and Hedgenordic.

Appendix H: Theory: Autocorrelation

Autocorrelation is present when there is a mathematical similarity between a given time series and a lagged version of the same time series over successive time intervals. As autocorrelation compares the correlation of variables with itself over time, autocorrelation is also usually referred to as serial correlation or lagged correlation. As for other correlation coefficients, the autocorrelation coefficient can range from perfect negative correlation (-1) to perfect positive correlation (+1). If the autocorrelation is perfectly positive, an increase in one time series will lead to a similar increase in the other time series. If the autocorrelation is perfectly negative, an increase in one time series will lead to a proportionate decrease in the other time series. The presence of significant autocorrelation in a time series implies predictability of future values, as they will be correlated (Rachev, Hoechstoetter, Focardi, & Fabozzi, 2010).