SCHOOL OF BUSINESS ECONOMICS AND LAW
GÖTEBORG UNIVERSITY

IS HISTORICAL DATA A GOOD ESTIMATE OF THE FUTURE RISK OF FUNDS?

-A study on the Swedish Hedge Fund market

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Autors:
Martin Irding
Joacim Lydén

Tutor:
Magnus Willesson

Abstract

Predicting the future is something that every person trading with financial instruments or commodities, which have prices that depend on a future demand, tries to do. The objective of this thesis has been to examine whether or not historical returns are a good way to measure a funds future risk. To do this a new model for fund evaluation has been developed called the outside value method. The outside value method uses linear regression to build a predicted future average return based on the historical performance, and the historical standard deviation to build a prediction interval of 95% surrounding the average line. The model is built up using historical data up until one year before the last observed value. The prediction is then compared with the actual performance of this last observed year. Given the statistical prediction, 95% of the observation should lie within the interval which in this study would mean that approximately 10 out of the 204 observations.

To limit the scope of the thesis one particular category of funds has been selected, hedge funds. Hedge funds is a collective name for a lot of different funds that uses different kinds of special trading strategies, such as short selling and leveraging by taking on debt. There is no clear definition on what a hedge fund is; however, most hedge funds are surrounded by some sort of secrecy regarding their trading strategy, something that strongly reduces the amount of information visible to the investor. Hedge funds claim to be a more stable investment since they aim to produce an absolute return no matter in which direction the market is going. The claim of stability together with the lack of information makes hedge funds a particularly interesting category for conducting a risk study.

Of the 204 observations 8 ended up outside the interval which is close enough to the ten expected for the conclusion to be drawn that the hypothesis is true. Even though the average leads to this general conclusion there are still single outside values in the model that occurs with probability as low as 3,34499*10^-5, which may lead to questioning of the overall results. The key question, to whether or not the outside-value method is a useful tool for predicting the future risk of funds, is if the interval is narrow enough for a prediction to be of any value. This is something that is left for discussion and most probably something that is connected to personal preferences.

Key Words: **Hedge funds, Risk, Regression, Prediction interval.**

Content

1 Preface

This Thesis has been written at the institution for Industrial and Financial Economy in collaboration with the hedge fund manager Superfund AG. The collaboration with Superfund AG is based on our interest in the financial markets and alternative ways of investing and the increased general interest for hedge funds. Superfund expressed interest in supporting a bachelor's thesis through a university contact. For the initial meeting they had prepared a list of topics that would be interesting for them. After discussing the suggestions with our tutor Magnus Willeson one of the ideas was selected in a somewhat altered form. Superfund has been extremely helpful and generous offering both time and material. We have during the course of the thesis performed a number of smaller interviews and had a full afternoon of presentation and discussions in their office in Stockholm. The results that we are presenting are totally based on scientific analysis of objective data and we are not in any way controlled or affected by any influence from Superfund. The results will be presented in form of a formal presentation to Superfund together with the final report.

The objective of the report has been to create an evaluation model that can be used on any kind of financial instrument and then apply that on a specific category, in this case, hedge funds. Through this approach a general evaluation of an entire fund category is obtained together with a comparative analysis within the category.

The first part describes why we have selected hedge funds and also describes in brief the strategy of the funds that we have selected and the specifics for the hedge fund industry. The second part describes the method that we have developed for general evaluation of funds and the statistical theory that is the basis for this. The last part analyses the results achieved using the model and compares the outcome of this model with the generally used performance[1] measures in the hedge fund industry.

2 Background

An investor's different investment alternatives can be evaluated in a countless number of different ways and each investor has got his or her own strategy of investing. For an investor seeking higher returns than risk-free investments offer, the stock markets has been the most popular investment alternative for over 100 years, This has to a large extent been possible through formalisation and standardisation of transaction routines which have enabled complex transfers of ownership to be made on a blink of an eye. This development of the stock market has produced numerous amounts of derivatives and the supply of financial products is growing every day. As structured products and different kinds of funds become more synthetic, the true

[1] The term performance is used to describe the increase in value of the fund from one period to the next, since the model constructed in this thesis is based on monthly returns of the fund the word performance should henceforth be read as monthly increase in value of the fund.

underlying values becomes harder for the investor to assess and the gap between the investor and the assets becomes wider. In this process the financial institutes and fund managers influence grows and the investor is forced to trust the information that they wish to make public, this phenomenon is known as "black-box" trading, meaning that input and output to the black box is the only thing visible (Covel, 2006). The traditional fundamentalist that searches for long term trends in society and want to make own analysis of the investment has got a harder time doing so if he or she wants to take part in the more synthetically instruments offered.

According to Johan Eriksson and Roni Bicér the fund manager's primary marketing information is the historical returns of their funds, this information is the only thing that they know for sure and it is also a factor that is highly valued by the investors. The potential problem that the investors face is that the institutions managing the funds usually have dozens of different fund alternatives and new funds are started continuously as old ones is taken away. The different funds strategies will of course have different performance over time, depending partially on the level of risk involved in a certain fund etc. but also on pure coincidences in the economy. Since the institutions have a lot of funds with different performance there will always be a few funds that perform extraordinary, and these funds will of course get a more prominent place in the marketing.[2]

From this statement arises the question that this thesis work aim to answer: Is looking at the historical risk of a fund a good way to determine the future risk of a fund i.e. is the level of risk constant in a particular fund or is it something that changes over time?

This question is to be answered by developing a general method for fund evaluation using statistical theory, and then apply that method on the particular category of funds that is of interest. The theoretical future performance based on historical data, will be calculated with linear regression and then compared with the true performance to assess how much the true performance deviates from what could have been expected. This analysis will revile if the risk, at a certain time in a particular fund, has been in accordance with what could have been estimated given the historical risk.

2.1 Previous studies

There is a number of bachelor and master thesis that describe the phenomena of hedge funds. Most of them only describe the performance of the funds and compare different types of funds. One master thesis from Dahl & Forsgårdh (2005) at Lund's University analyzes the risk exposure of hedge funds compared to mutual funds. By using regression analysis of risk they conclude that different hedge funds exhibit quite different risk exposures and naturally also different risk exposure from mutual funds. These results strengthen the argument that hedge funds have a somewhat different risk structure than mutual funds, and validate the purpose of the study in this

[2] General knowledge in the hedge fund industry according to Eriksson and Bicér

thesis. Dahl & Forsgårdh's thesis have provided ideas and thoughts which has been helpful writing this thesis.

2.2 Hedge Funds

There is one category of funds where black-box trading is a part of the culture and not at all questioned by the investors. The claim that these funds are generally making is that this secrecy is needed for the fund to obtain freedom to operate without the investors being concerned about the strategy (Hedges, 2005). Funds with these characteristics are usually bundled together and called hedge-funds. The meaning of the word hedge is originally that the funds try in different ways to eliminate or reduce risk by investing money in different financial instruments with negative correlation. However this is not true for all funds in the hedge-fund category since hedge funds today comprise almost every type of fund that deals with technical analysis or operates under more or less black-box circumstances. The secrecy and black-box trading, that places the investor in a situation where historical performance and risk is the only evaluation tools, is what makes hedge funds a specially important candidate for the analysis performed in this thesis.

The concept of hedge funds has been used since 1940's but there is no general definition and no clear distinction between hedge funds and other types of investment (McCrary, 2002). McCrary however cites the definition that The President's working group on Financial Markets uses: "a pooled investment vehicle that is privately organized, administered by a professional management firm, and not widely available to the public." This definition is somewhat out of date due to the new opportunities for small investors to invest in hedge funds or part of hedge fund contracts through the use of internet traders.

Among investors, hedge funds is becoming a more and more appreciated way of introducing assets in the portfolio, that are not correlated with the stock market. Even if the concept is almost 60 years it is a fairly new market in Sweden, after the first hedge fund Albert Wislow Jones that was introduced in 1949 in USA it took almost 50 years until Brummer and partners introduced the first Hedge Fund *Zenit* on the Swedish market in 1996. (Brummer & Partners, 2007). Since then the number of hedge funds on the Swedish market have had a rapid growth in numbers and today there are 189 funds listed on Morningstar (www.morningstar.se) that belongs to the category and in 2005 there where over 7500 hedge funds globally and that number is ever increasing (Hedges, 2005). The growing interest among the general public have also made the funds more available to smaller investors i.e. the required minimum investments have drastically gone down from around one million dollars to SEK100, through e.g. internet portfolio managers such as Avanza, that offers parts of hedge funds to their clients.

2.3 What is a Hedge Fund?

Even though the category of hedge funds is very wide there are some characteristics that define most of the hedge funds on the market. Hedge funds try to create leverage, often by borrowing and investing in a narrow class of assets (Hedges, 2005). They often invest both in long positions[3] and in short positions[4], i.e. they aim to make profit both when the asset price goes up and down. While an ordinary fund would aim to make relative return, e.g. performing better than a stock index, a hedge fund aim to create absolute return, something that requires more flexibility than regular stock-based funds has. Hedge funds also have the possibility to use arbitrage opportunities[5], derivates[6], and take on debt to finance the different investments (Fahlin, 2000).

The fees that hedge fund managers charges from the investors are usually made up of a combination of a fixed fee and an incentive fee. The latter is often based upon how much the fund outperforms for example an index. To be able to estimate the incentive fee, the value of the hedge fund must be published regularly; this can be done either each day or each month. Another common feature of hedge funds is that they are usually only traded once every month, which means that the investor's money is locked during this time. This is done since the fund needs a certain level of stability and freedom, a hedge fund is exposed to a lot of risk and the value of the fund often fluctuates a lot, by locking the money they manager prevents the investors from making irrational decisions.[7]

Since most of the savings, other than the assets placed in purely interest bearing accounts, are placed in stock, most investors are very sensitive to movements on the stock market. The nature of a hedge fund is that it tries to have positions that allow it to make positive returns no matter in which direction the markets move. Hence, a fund on a general level tries to have as low market correlation[8] as is possible to create stabile returns. By introducing hedge funds with low market correlation in a stock based portfolio the total market correlation goes down and the returns get less volatile. This reduces the importance of timing when it comes to buying and selling parts of the portfolio and thus the capital stock of the investor becomes more constant.

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[3] Long positioning means holding an asset such as a stock and profiting from it if going up.
[4] Short selling can be done either by borrowing a security, selling it, waiting for the price to go down, and then buy it back and return it, or through the use of a derivate such as a put option.
[5] Arbitrage opportunities arise for temporary error in pricing in any asset in a market. One example could be the situation when a stock is traded at two different markets in different prices. Then one can easily buy it on one market selling it on the other the second after. In an efficient market there are no such possibilities and even with semi strong market efficiency the differences are very small.
[6] Derivates are contracts which are determined by an underlying asset. The use of derivatives can both increase the leverage vastly and also protect against the market going down. Taking on debt also increases the leverage but might increase risks quite a lot. This implies increasing the size of the whole portfolio giving larger opportunities for profit. Due to the flexibility hedge funds could both be used to both reduce and increase risks.
[7] Superfund, 2007. Interview with Superfund March 16 2007. Johan Ericsson and Roni Bicér
[8] Correlation is how interdependent different factors are with each other, and in this case with the market i.e. the stock exchange index.

2.4 The different categories of hedge funds

Based on the list presented by McCrary (2002), the following 14 are the most common categories of hedge funds i.e. the different assets that they invest in.

- Long/Short Equity
- Equity Arbitrage
- Equity Pairs Trading
- Equity Market-Neutral Funds
- Risk Arbitrage or Merger Arbitrage
- Event-Driven Strategies
- Convertible Bonds
- Emerging Markets
- Distressed Securities
- Global Macro Funds
- Futures Funds
- Funds of Hedge Funds
- Mortgage Arbitrage
- Fixed-Income Arbitrage

Since not all of theses definitions are clear and many of the existing funds use combinations or somewhat altered strategies, the thesis work is focused on the three most common strategies in Sweden: Long/Short Equity, Managed Futures and Funds of Hedge Funds. Selecting, presenting and comparing these three strategies both internally and with each other brings more depth to the analysis and offers the reader a better understanding of the how hedge funds really operate.

2.4.1 Long/Short Equity

Long short equity is a strategy that is based on the movements on the stock market. The trading is usually done only on technical terms and most common trading strategies are based on some kind of trend following. The basis for the strategy is that the fund manager tries to go into long positions in stocks that the strategy estimates will increase in value and sell or go into short positions that the strategy estimates will decrease in value. The long/short equity strategy is the most common strategy in Sweden (www.morningstar.se, 2007) and in the World (McCary, 2002) and is the strategy that most people associate with hedge fund trading (Alfred Bergs, 2000).

2.4.2 Managed Futures

"A Forward Contract is an agreement negotiated between two parties for the delivery of an asset (e.g. oil or gold) at a certain time in the future, for a certain price fixed at the inception of the contract"[9]. The history of such contracts can be traced all the way back to the First Babylonian Dynasty[10] (Kolb and Overdahl 2006) and they where primarily created as a type of insurance, guaranteeing that the seller will get a certain price for his goods and the buyer will not have to pay more that that upon delivery. Even though forwards contracts have been available almost 4000 years it is only in the last 40 that the trade has really grown to represent a large part of the total trade on the worlds exchanges. In 2003 the number of contracts traded on the US exchange passed one million and it is continuing to grow rapidly (Kolb and Overdahl, 2006). There are three different kinds of actors trading with forwards: hedgers, speculators, arbitrators and spread-traders, of these the hedgers are the most important once. A typical hedger is a person that also

[9] Definition from Kolb and Overdahl 2006
[10] 1894 BC to 1595 BC

trades in the underlying commodity (e.g. a farmer), and uses the forwards contract to reduce the risk of the trading, much like an insurance (Fabozzi and Modigliani, 1996). A Future is a Forward Contract that is standardized, meaning that the batch size and quality of the good is specified and regulated by a third party. This third party is called a Clearing House. The Clearing House handles the transaction and offers a guarantee that the traded commodity is of the promised quality and that the parties fulfils their part of the transaction. The use of a Clearing House reduces the credit risk and the guarantee of the standardized commodity increases the liquidity and thus reduces the spread (Ljunggren and Pappila, 2001). The futures must be traded on an organized exchange such as the New York Mercantile Exchange or the Chicago Board of Trade. In these organizes exchanges there are a limited number of seats and having a seat is prerequisite for trading on the exchange; hence most members with a seat are trading futures for a lot of clients. Since every member takes a share of every trade that the member is a part of, the seats are a valuable asset which are bought and sold, the price of a seat is determined by the number of seats available and the volume traded on that particular exchange.

Managed futures investing, is trading in futures contracts in several commodities and financial derivates on a number of different markets. Managed Futures is an efficient way of introducing commodities in the portfolio without having to get the extensive knowledge that such trading requires (Hedges, 2005). The Managed Futures Funds trades through a Commodity Trade Advisor (CTA) who holds a seat on the exchange. The advantages of Managed Futures includes: low to negative correlation[11] with the stock market, negative correlation in poor performance, diversifying opportunities and substantial liquidity, i.e. the assets are easy to sell. (Hedges, 2005)

2.4.3 Funds of hedge funds

Fund of hedge funds does not have any technical strategy of their own; they only own parts of other hedge funds. This lifts the level of abstractness further and becomes a black-box of a black-box, which is even harder for the individual investor to analyse. The objective of the fund of hedge funds is to get the benefits of the hedge fund with an even lower risk due to the diversification. The general interest for funds of hedge funds have increased the last couple of years and today more than ten funds exists in this category (www.morningstar.se).

2.5 The strategy of trend following

Apart from the differences in strategies connected to the kinds of assets that the funds invest in, it exists multiple strategies connected to how the fund operates i.e. how they buy and sell these assets. Almost all of the hedge funds trading strategies are based on some form of technical analysis and the dominating strategy is called trend following and as much as 58% of all funds use this as the basic strategy (Alfred Bergs, 2000).

The market is the place that connects buyers with sellers and for every transaction settled there is one seller and one buyer. The most crucial factor in the transaction is the price; the price is also

[11] See footnote 8

the thing that the buyers and sellers always have in common. No matter what the person believes will be the future of the traded commodity the price on the market today is the price of that (Covel, 2006). Price is the only thing that a Trend Follower cares about, Trend Following is a purely technical way of looking at the market and all fundamental information is disregarded.

There are probably as many different Trend Following strategies as there are Trend Followers (Covel, 2006) but there are a number of different concepts that builds up the basics of Trend Following. In particular there are two such concepts, moving averages and Donchian Channel. Moving averages is the most common technical indicators in use today (Covel, 2006), and it is a technique for filtering out a longer trend in the volatile market price.

To determine the moving average, an interval must be established. The most common intervals used in Trend Following are 50 and 100 days, the shorter the interval, the faster the reaction of the moving average and a strategy is usually made up of several such moving averages.

Mathematically the average($\overline{P}$) for an interval can be written as:

$$\overline{P} = \sum_{i=1}^{h} \frac{P_i}{h} \qquad \textit{Equation 1}$$

Where P is the price of the asset and h is the number of observations.
When the interval becomes smaller i.e. $h \to \infty$, $\overline{P} \to P$

For this reason the average must be measured over an interval of substantial length to be used as an identifier of a trend. The trading is then typically done when the price hit certain pre-decided levels that supposedly indicate that the trend is moving in some particular direction. Trends can be established in both bull and bear markets[12] and trend followers use the trend to either go long or short in the instruments traded.[13]

[12] Bull market is an upwards going market, whereas a bear market is a downwards going market.
[13] See footnote 5 and 6.

3 Problem discussion

It has become a tradition in the business of hedge fund management that the secrecy of the investment strategies must be kept. The risk of hedge funds have therefore historically been very hard for investors to evaluate in any other way than looking at historical returns, which also is the most commonly used evaluation method.[14] Most hedge funds use their stabile returns and low correlation with the stock market as their advantage over investing on the stock market (Hedges, 2005), which would imply that the hedge fund have more predictable returns and thus the historical returns would serve as a good indication of how risky a certain fund really is. Even if some hedge fund managers have disclaimers like: *The value of the fund can both go up and down, the historical returns is no certain indication of the future return of a fund.* (www.seb.se, 2007), their historical return and return in relation to volatility is their primary source of marketing.[15] One practical problem that arises when evaluating risk by looking at the historical returns is that many hedge funds on the Swedish market are very young and thus have a very short history which makes the statistical interval for expected returns considerable, especially if the first years of the fund have been very volatile. This would not only mean that older hedge funds have a longer history of returns to use in marketing, it would also mean that the older funds appear less risky than younger funds based only on their age, something that doesn't necessarily make them a more secure investment. This problem is common knowledge in the entire industry of fund management and older funds has got a considerable advantage when it comes to marketing since most investors use historical returns as the primary source of evaluation, especially when it comes to funds that uses black-box trading.[16]

Using statistical theory, the above discussed hypothesis, that the risk of hedge funds is in accordance with what could be expected from their historical performance, is possible to test. In this thesis such a test method will be developed and the test will be conducted, which will create an unbiased comparison factor of risk in different hedge funds.

4 Purpose

The purpose of this thesis is to statistically analyze if the risk[17] of hedge funds is in accordance with what could be expected from their historical performance[18]. Further, the most common evaluation criteria used in the industry, i.e. Return to Risk and Sharpe ratio, will be evaluated and compared with the results of the model created in this thesis.

[14] Personal comment Johan Eriksson, Superfund
[15] Personal comment Johan Eriksson, Superfund
[16] Personal comment Johan Eriksson, Superfund
[17] See definition in 5.2
[18] See footnote 1

4.1 Limitations

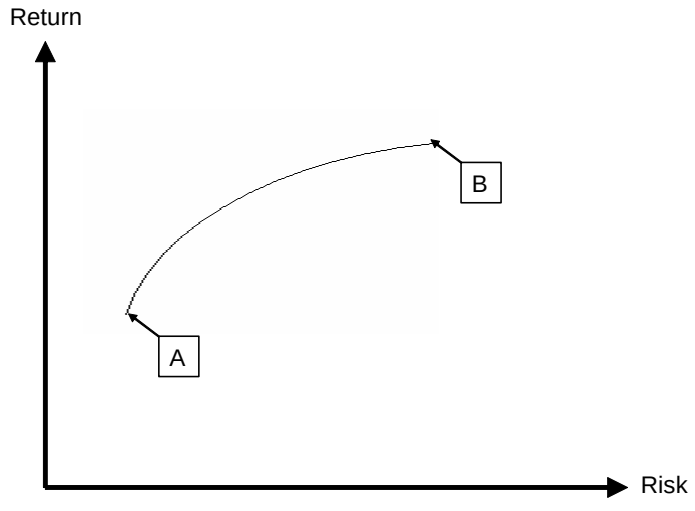
The Swedish fund market is growing every day and in writing moment Sweden's leading fund observer Morningstar is watching 4171 funds (www.morningstar.se). To make a total analysis of this market would be a task much to large for the scope of this thesis which makes it necessary to make limitations. The scope of this thesis will therefore be limited to look at the performance of 17 of the largest funds in the three most common strategies Long/Short Equity, Managed Futures and Funds of Hedge Funds.

5 Theory on funds

5.1 Funds and Markowitz and MVA

In 1952 Harry Markowitz wrote an article on Portfolio Selection in the Journal of Finance. This article is today considered by many to be the foundation of modern portfolio theory, for this he received a Nobel Prize in 1990. A fund is a way of creating a portfolio with certain characteristics and the basic theories of portfolio selection formulated by Markowitz are therefore applicable to funds. The most common reason for investing in a fund instead of in single assets is the diversification of the risk that the fund offers. Before Markowitz wrote this article there was no real way of measuring or pricing risk, which resulted in considerable uncertainty and difficulties in evaluating the performance of different investment options (Lindblom, A, 2001). The basic assumption that Markowitz does is that every investor wants to maximize his or her profit given a certain level of risk, or minimizing the risk given a certain demanded return (Markowitz, 1991). By quantifying risk to standard deviation Markowitz was able to plot the return of portfolios against their risk and by doing so he was able to create an efficient frontier of optimal portfolios that runs from the minimum variance portfolio (A) to the maximum return portfolio (B) (Cf. Copeland, Weston, Shastri, 2005). Every portfolio on this line is an optimal portfolio and every portfolio underneath needs further optimizing.

Figure 1



5.2 Definition of Risk in a Hedge Fund

Risk from a hedge fund perspective is measured by the historical variance in the returns, which is calculated on a day to day basis by comparing the market value of the fund to the value the day before (Hedges, 2005). Since most hedge funds use some kind of strategy that is not publicly available for evaluation the investors have little or no other choice than to rely on the variance as a measure of risk. The variance is a measure of how much the return deviates from the average return over the measured period i.e. the squared distance between an average over a specific time and the true value, and the standard deviation is the square root of the variance i.e. the absolute distance between the average and true value. Using mathematical formulas the variance (V) equals the true value R minus the average value $\overline{R}$, squared. [19]

$$V(R) = E[(R - \overline{R})^2] \qquad \textit{Equation 2}$$

The standard deviation and the variance is two measures of the same thing, the standard deviation is the real distance from an observed value to an average which makes the standard deviation somewhat more obvious and understandable. The standard deviation is the root of the variance.

$$\sigma = \sqrt{V} \qquad \textit{Equation 3}$$

6 Theory on the measures used by funds

Due to the importance of historical returns and variance in hedge-fund management several performance measures related to risk and return exists. The two most commonly used is the Return to Risk Ratio and the Sharpe Ratio. These ratios will be the foundation for the comparison analysis that will be performed linking the risk and return ratios to the conclusions that is drawn using the model developed in this thesis work.

6.1 Return to Risk Ratio

The Return to Risk ratio is a ratio that reveals the average historical returns in relation to the standard deviation of those returns, this ratio is also known as the information ratio (Culp, 2001).

$$\frac{\overline{R}_j}{\sigma_j} \qquad \textit{Equation 4}$$

The denominator represents the average of the return on portfolio j and σ is the sample standard deviation over the same period. This is one of the simplest measures of risk vs. return, wherein

[19] Definition from Milton, J and Arnold, J, 2003

the risk is defined as the standard deviation of the actual returns. What the ratio produces is a measure of return per unit of risk i.e. the portfolio risk is presumed to be evaluated by only looking at the variance in the actual returns.

6.2 Sharpe Ratio

The Sharpe ratio is a measure similar to the Return to Risk ratio, with the difference that the Sharpe ratio reveals the excess returns per unit of risk, i.e. the returns in excess of a presumably risk free rate (Culp, 2001).

$$\frac{\overline{R}_j - \overline{R}_F}{\sigma_j} \qquad \textit{Equation 5}$$

Where $\overline{R}_F$ is the average risk free rate over the sample time, e.g. a long term Treasury bill.

The Sharpe ratio is widely used to evaluate hedge funds because it removes the market fluctuations in the risk free rate and is hence an unbiased measure of a funds historical performance. A considerable weakness with Sharpe ratio is, just as with the Return to Risk ratio that it sees portfolio risk as a product of historical variance in returns both upwards and downwards. This result in profitable portfolios being considered much riskier than portfolios that does not perform at all given that they do so without variance.

7 Method

This chapter will explain how this study has been performed and how data has been collected. The purpose was to find a method that could tell whether hedge funds risk was in accordance with their historical data or not. The aim of such a method was to analyze how the funds have performed the last year compared to what one could expect from looking at the historical data. In order to do that, basic statistical models have been found in statistics literature. The models that will appear to be of most usage are prediction intervals combined with linear regression.

7.1 Statistical theory

First there will be an explanation of the concept of predicting a new response from historical data for the simple Center + Error model. Then predicting a new response from historical data for the linear regression model will be presented. The following chapter is from Petrucelli et Al (1999).

7.1.1 The simple C+E Model and prediction of a new observation

When knowing the distribution of a population, a likely range of values for the parameter being estimated is called confidence interval. Whereas confidence intervals are built upon the true population mean and standard deviation, a prediction interval predicts the distribution of future observations based on historical data.

The simple model C+E (Center + Error) is based on the formula Y = μ + ε, where μ is the mean value and ε the error term. In such a case, at a level L[20] the classical prediction interval for a new observation is

$$\left(\hat{Y}_{new} - \hat{\sigma}(Y_{new} - \hat{Y}_{new})t_{n-1,(1+L)/2}, \hat{Y}_{new} + \hat{\sigma}(Y_{new} - \hat{Y}_{new})t_{n-1,(1+L)/2}\right) \quad \textit{Equation 6}$$

Where $\hat{Y}_{new}$ is the predicted new observation based on $\hat{\mu}$, the expected mean value.

$Y_{new} = \mu + \varepsilon_{new}$ where Y_{new} is the new observation and ε_{new} is the random-error term and

n is the number of historical observations

$\hat{\sigma}(Y_{new} - \hat{Y}_{new})$ is the standard deviation which can be calculated like this:

$$\hat{\sigma}(Y_{new} - \hat{Y}_{new}) = S\sqrt{1 + \frac{1}{n}} \quad \textit{Equation 7}$$

S^2 is the sample variance, i.e. the variance for the historical observations.

$t_{n-1,(1+L)/2}$ is the t distribution for n-1 degrees of freedom. It is (1+L)/2 because it is a two-tailed distribution, i.e. for a 95% prediction interval, 2,5% is above the upper limit and 2,5% is below the lower limit. Thus to get the real t-value from a t-distribution table, the value must be read for (1+0,95)/2=0,975 and not for 0,95.

7.1.2 Simple linear regression, the C+E Model and prediction of a new observation

Linear regression is used when having observations in one variables and trying to establish a relation to another variable through a straight line. In this model linear regression is used to get the best approximation of a straight line. The formula for the simple linear regression model is:

$$Y = \beta_0 + \beta_1 X(Z) + \varepsilon \quad \textit{Equation 8}$$

The fit is best in the sense that β_0 and β_1 are chosen so that the sum of the squares of the residuals[21] is minimized. In the case of predicting a new response:

$$\hat{Y}_{new} = \hat{\beta}_0 + \hat{\beta}_1 x \quad \textit{Equation 9}$$

Where x is the number of the new month, and the prediction interval at a level L[20] for a new response is:

[20] For example at a level of 95% it means that 95% of the points will lie within the interval

[21] Residual is the distance from a point to the regression line

$$\left(\hat{Y}_{new} - \hat{\sigma}(Y_{new} - \hat{Y}_{new})t_{n-2,(1+L)/2}, \hat{Y}_{new} + \hat{\sigma}(Y_{new} - \hat{Y}_{new})t_{n-2,(1+L)/2}\right) \quad \textit{Equation 10}$$

Where n is the number of historical observations

$$\hat{\sigma}(Y_{new} - \hat{Y}_{new}) = \sqrt{MSE\left[1 + \frac{1}{n} + \frac{(x - \overline{X})^2}{\sum(X_i - \overline{X})^2}\right]} \quad \textit{Equation 11}$$

MSE[22] is the average squares of the residuals using the formula

$$MSE = \frac{1}{n-2}\sum_i^n e_i^2 \quad \textit{Equation 12}$$

$t_{n-2,(1+L)/2}$ is the t distribution with *n-2* degrees of freedom.

X_i is all X values (month numbers) for the historical data, i.e. 1,2,3…

$\overline{X}$ is the average X value for the historical data

Körner & Wahlgren (2006) presents an example application where they see a relationship between the how old a car is and its price. So with ages (in years) as X and price as Y the linear relationship (using equation 9) would be:

$$\text{Price} = \hat{\beta}_0 + \hat{\beta}_1 * Age \quad \textit{Equation 13}$$

The slope of the curve, i.e. $\hat{\beta}_1$ will most likely be negative since the price goes down with increasing age. Then it is possible to make a prediction interval of the price for a specific age.

7.2 The overall idea with the outside-value method

A method called the outside-value method has been developed from the statistical framework presented above. Months are represented on the X-axis of the graphs, and runs from the starting month with value 1. The last month used for historical observations is March 2006[23]. The performance is represented on the Y-axis. Using the historical observations a linear regression is made on the form $Y = \beta_0 + \beta_1 x$, representing the estimated average return of the particular fund. Using the historical standard deviation a 95% prediction interval for each of the remaining months is built up until March 2007. The analysis conducted then takes the real performance values for each of the twelve months and counts how many that lie within the prediction interval. The study comprise of 17 funds with 12 values and prediction intervals respectively, which gives

[22] Mean Square Error

[23] March 2006 will of course have different month numbers for different funds since there are different amount of historical data for different funds

a total of 17*12 =204 values. If the prediction is correct, 95% of the values, i.e. 194 should lie within the prediction interval. Using this, a conclusion about the question, whether funds' risk can be predicted from their historical performance or not, might be possible to make.

7.3 General discussion about the outside-value method

The method is built up on the hypothesis that 95% of all points the last year should lie within the prediction interval. Hypothesis-trying studies assumes, according to Patel et Al (2003), that there is so much knowledge that it is possible to derive a relationship between assumptions and reality, such as, if a certain requirement is met, then the assumption is true. Since this kind of test is suitable for this particular study, there is good knowledge of the statistics used and good data from the funds' performance, a hypothesis-trying study was chosen for this thesis.

This study is clearly a quantitative research since it uses statistical tools to analyse the performance of hedge funds based on numerical data. Qualitative research is on the other hand focused on more "soft" values, for example through qualitative interviews that cannot be measured but that are subject to interpretation (Patel et al, 2003). Including soft values, such as interviews has been considered, but after limiting the research question almost everything in this thesis stems from quantitative analysis.

For quantitative studies such as this one, the positivistic approach is often used and it has roots in natural sciences and empirical studies. The knowledge should be real and the same for all different persons trying to understand it. It is based on the principle of verification, i.e. every theoretical statement should be able to be translated to observations which could be verified by anyone. (Patel et al, 2003). This is something that has been attempted through thoroughly explaining how the method works enabling anyone to verify the results.

Since a positivistic approach has been chosen, an attempt to relate theory to empirical data must be made. Patel et al (2003) lists three different techniques for relating theory to empirical data: deduction, induction and abduction. The inductive approach is when a theory is formulated from empirical data whilst with a deductive approach, conclusions are made from already existing theories and generally accepted principles. Since this particular study leaves little room for subjective opinions due to the quantitative data used, that would indicate a deductive approach. A deductive approach is considered to contribute to the objectivity of the study since the conclusions are derived from already accepted theories; therefore the objectivity of the study is high.

7.4 Example calculations to explain the outside-value method

Helios hedge fund will be used as an example. Recall equation 10 for the prediction interval:

$$\left(\hat{Y}_{new} - \hat{\sigma}(Y_{new} - \hat{Y}_{new})t_{n-2,(1+L)/2}, \hat{Y}_{new} + \hat{\sigma}(Y_{new} - \hat{Y}_{new})t_{n-2,(1+L)/2}\right) \qquad \textit{Equation 14}$$

Also recall equation 11:

$$\hat{\sigma}(Y_{new} - \hat{Y}_{new}) = \sqrt{MSE\left[1 + \frac{1}{n} + \frac{(x - \overline{X})^2}{\sum (X_i - \overline{X})^2}\right]} \qquad \textit{Equation 15}$$

For explanations of the variables, please see chapter 7.1.2. The data for Helios can be found in appendix 14. All funds are presented in the same way in the appendix. The historical data is presented with the columns

- Month no (Xi) – First month with data gets value 1, second month number 2 and so on
- Accumulated Value – Month 0 has value 100 and is then adjusted with the monthly growth
- Performance in per cent (monthly growth).
- Squared error from the regression line – Error is calculated by taking the Performance minus the value that the regression line has.
- *(Xi-X.av.)^2 – Xi* is Month number and X.av. is the average of all Month numbers

Explanation of the figures in the appendix heading:
n is the number of months with historical data, Helios has got historical data from April 2002 (month 1) to March 2006 (month 48) which result in *n* = 48.

Concerning the regression, if y = Performance and x = Month, the regression for Helios is:

$$y=-0{,}00008*x+0{,}01049 \qquad \textit{Equation 16}$$

MSE is calculated by summing the squares of the difference in each observation from the regression line and then dividing with *n* – 2 where *n* = 48 in this example (recall equation 12)

$$MSE = \frac{1}{n-2}\sum_{i}^{n} e_i^2 \qquad \textit{Equation 17}$$

$MSE = 0{,}000145805$

S is the sample standard deviation which is the square root of the MSE.
In this case S= 0,01207497

X.av is the average X value of the historical data, with *n* months this is 24,5.

Making the prediction intervals for month 60 (March 2007) the *Data Last Year* part of the appendix shows the following columns:

- Month no – the same as for the historical data
- Accumulated Value – the same as for the historical data
- Monthly growth – the same as for the historical data
- Standard deviation, according to equation 11

$$\hat{\sigma}(Y_{new} - \hat{Y}_{new}) = \sqrt{MSE\left[1 + \frac{1}{n} + \frac{\left(x - \overline{X}\right)^2}{\sum\left(X_i - \overline{X}\right)^2}\right]} \qquad \textit{Equation 18}$$

$\left(x - \overline{X}\right)^2$ is in this case (60 – 24,5)^2 = 1260,25 since the month is number 60 and the average X value is 24,5.

$\sum\left(X_i - \overline{X}\right)^2$ Is calculated by summing the squares of the difference between each X and the average X value (column "(Xi-X.av.)^2 " in the historical data), so for month 1 as an example the calculation will be (1-24,5)^2= 552,25. And a total sum of 9212.

So, $\hat{\sigma}(Y_{new} - \hat{Y}_{new}) = \sqrt{0{,}000145805\left[1 + \frac{1}{48} + \frac{1260{,}25}{9212}\right]} = 0{,}01299$

Which then can be read in Data Last Year part of the appendix under column St.Dev. and month 60

- Tdistr is the t-distribution. For n-2 degrees of freedom to a 95% prediction interval is 2,0129 (can be read in a table or found by using the TINV function in excel).
- Y_{new} is calculated from the regression line, calculating for month 60: Y_{new}= y =-0,00008*60+0,01049 = 0,00569
- Pint.Low = The prediction interval's lower level, which is Ynew-Stdev*Tdist, here 0,00569- 0,01299*2,0129 = -0,02
- Pint.High = The prediction interval's higher lever, which is Ynew+Stdev*Tdist, here 0,00569+0,01299*2,0129 = 0,032
- Outside interval, whether the accumulated value lies outside the prediction interval (1 = yes) or not (0 = no)

This gives the following prediction interval for month 60 (i.e. march 2007):
(-0,02*;* 0,032*)*

Table for Helios last twelve months:

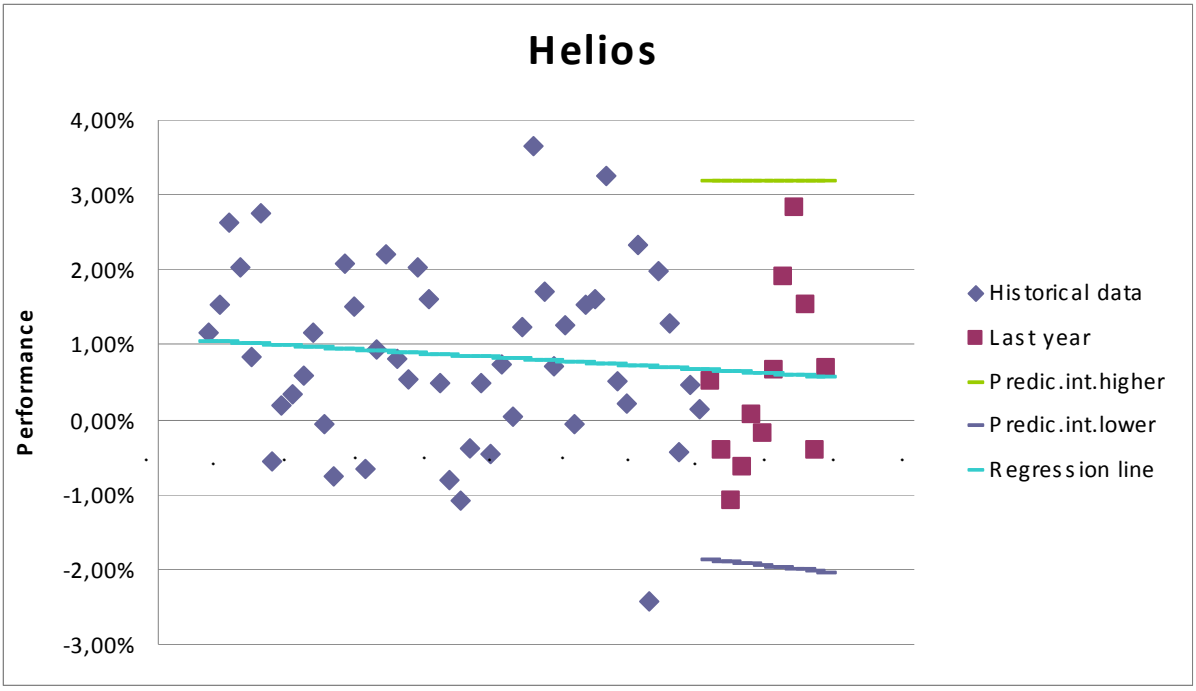
	Month nr.	Acc. Value	Mon. gr.	St.dev	Tdist	Ynew	PInt. Low	PInt. High	Outside Interval 1=yes 0=no
apr-06	49	150,5351	0,0051	0,012583	2,012896	0,006549	-0,01878	0,031878	0
maj-06	50	149,9179	-0,0041	0,012615	2,012896	0,006469	-0,01892	0,031861	0
jun-06	51	148,2988	-0,0108	0,012647	2,012896	0,006388	-0,01907	0,031846	0
jul-06	52	147,3497	-0,0064	0,012681	2,012896	0,006308	-0,01922	0,031834	0
aug-06	53	147,4381	0,0006	0,012716	2,012896	0,006227	-0,01937	0,031824	0
sep-06	54	147,1579	-0,0019	0,012752	2,012896	0,006147	-0,01952	0,031816	0
okt-06	55	148,1439	0,0067	0,012789	2,012896	0,006066	-0,01968	0,03181	0
nov-06	56	150,9734	0,0191	0,012828	2,012896	0,005986	-0,01983	0,031807	0
dec-06	57	155,246	0,0283	0,012867	2,012896	0,005906	-0,01999	0,031806	0
jan-07	58	157,6368	0,0154	0,012908	2,012896	0,005825	-0,02016	0,031807	0
feb-07	59	156,9747	-0,0042	0,012949	2,012896	0,005745	-0,02032	0,03181	0
mar-07	60	158,0421	0,0068	0,012992	2,012896	0,005664	-0,02049	0,031815	0
	61					Total number of outsiders			0

Table 1 Helios hedge fund

As can be seen in the table, the prediction intervals grow larger as the month number increases.

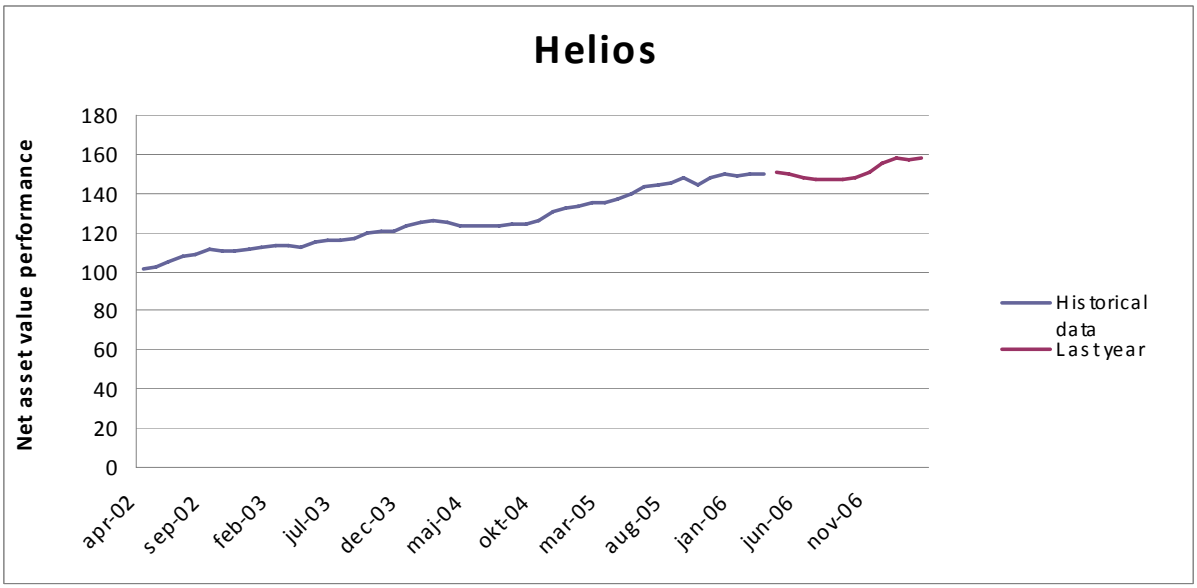
Plotting the historical performance, the regression line and the prediction interval for the last twelve months, the graph looks like this:

Figure 2



As can be seen in both the table and the diagram, no points of the twelve are outside of the prediction interval, which means that the fund has performed in accordance with what was expected. Underneath is the accumulated performance of the fund over the same period. This aims to clarify what actually happened with the value of the fund. What can be seen is that since the average performance of the fund is positive the accumulated performance is upwards sloping.

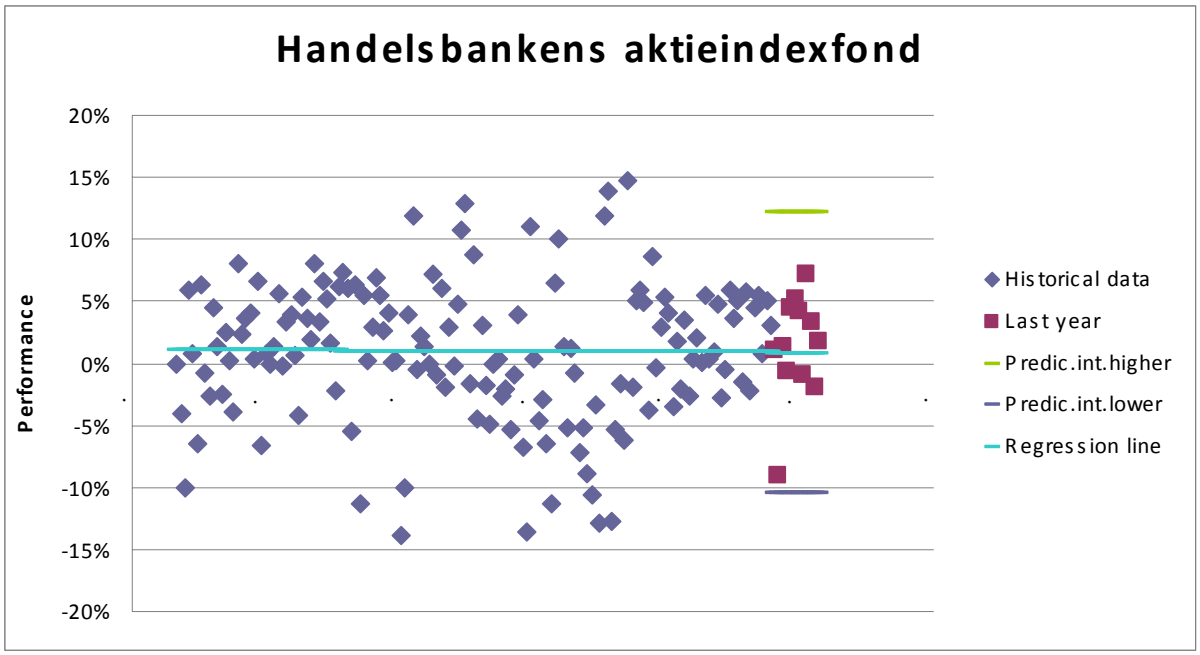
Figure 3



7.5 Testing the model on a ordinary stock market fund

This essay's main question is how hedge funds performance is possible to predict with the model developed in this thesis. The outside-value method is of course applicable to all kinds of funds, not only hedge funds. To see how the model works on an ordinary stockholding fund, data for Handelsbankens aktiefond has been analyzed with the following graph as result:

Figure 4



The difference between stockholding funds and hedge funds is often claimed to be that hedge funds generate absolute return, i.e. go up even in recessions. Concerning risk, it can be seen in the example above that quite large fluctuations naturally result in a large prediction interval. The fluctuations however are not as large as some of the hedge funds in the appendices. In any case, this model is applicable to all kinds of funds.

7.6 Statistical evidence against the hypothesis

If the hypothesis is that the model's prediction, based on historical data, is true, observations can provide evidence to reject this hypothesis. Focusing on the value of Helios in December 2006, which is almost outside the prediction interval an estimation on how likely it is that the value is so far away from predicted value by chance can be made.

The t-value is calculated accordingly (modified equation from Petruccelli et Al):

$$t = \frac{OutsideValue - Ynew}{\hat{\sigma}(\overline{Y})} \qquad \textit{Equation 19}$$

$$t = \frac{0{,}0283 - 0{,}0059}{0{,}0129} = 1{,}7364$$

OutsideValue is that specific value which seems to lie very much outside the interval
Ynew is the expected value of the regression line
$\hat{\sigma}(\overline{Y})$ is the standard deviation.

To find the p-value, the Excel function TDIST(X ; Degrees of freedom ; one-tail or two-tail) is used. X = 1,7364 here, degrees of freedom = n-2=48-2 = 46 and it is two-tailed since the values must be neither below lower prediction level nor above higher prediction level.
TDIST(1,7364;46;2) = 0,08918695 which is the p-value. It can be interpreted as following:
If the prediction is true, values as far from the line as 0,0283 or more would be observed in 8,92% of all possible cases. Looking at this value in this example, it's not possible to say whether the prediction is true or can be rejected.

A general interpretation of p-values:

If the p-value is less than	The evidence against the hypothesis:
0.100	Borderline
0.050	Reasonably strong
0.025	Strong
0.010	Very strong

Table 2 (Petruccelli et Al (1999, p 292))

7.7 Comparison with the ratios used by the hedge fund industry

The ratios Sharp Ratio and Return to Risk Ratio are ratios which measure risk in relation to return whilst the method developed in this thesis is focused on risk. Thus it is interesting to compare this method with at least one of the ratios used in the industry.

The Sharpe Ratio is dependent upon a risk free rate which is not clearly defined, Brealey et. al. (2004) defines the risk-free rate as the yield of treasury bonds which is different in different countries and according to Johan Eriksson at Superfund the risk-free rate is calculated in different ways by different hedge fund managers. Further the reduction of the performance with the risk-free rate is done in absolute terms which mean that low-risk funds with low performance is affected a lot more by this reduction that high-risk funds, which becomes a real disadvantage for the low-risk funds. Based on these built in problems with the Sharpe ratio the Return to Risk ratio will be used for comparing and evaluating the funds.

7.8 Scientific requirements: reliability and validity

To perform a good study, reliability and validity must be considered. Reliability is defined as the absence of random or unsystematic errors. Since the figures collected in this study are exact, this is not a problem. Validity concerns that the study is valid, i.e. that what is intended to be measured really is measured and it can also be defined as the absence of systematic errors. Validity can then be divided in external validity and internal validity. External validity is concerned with how well the results correspond to reality and internal validity is concerned with how good a study measures what is intended to measure (Esaiasson et al, 2007). Hedge funds in general is a new phenomena in Sweden which make all kinds of statistical analysis less valid, due to the short time of collecting data.

7.9 Criticism of the model

Making a linear regression, the assumption is made that the observations are independent and without systematic errors such as variations due to season or cycles in the economy. The hedge funds claim to be independent both of the movements on the stock markets and variations due to cycles of the economy, which makes them particularly suitable for the outside-value model. If this is perfectly true is something that is possible to discuss. As explained in the example with the stock market fund, that kind of fund has clear variations due to the cycles of the economy which doesn't make them suitable for the outside-value method. The assumption that the observations are independent is also questionable, since most of the funds uses trend following one could assume that they manage to find trends from time to time. If a trend exists this would mean that the values are somewhat dependant. However, this dependence gets less and less relevant the longer time that runs between the observations[24], using points with large enough distance for the points to be independent at the same time as the number of data points are enough to make a regression with some kind of validity is therefore an important issue. The dependence of the points can be assessed by calculating the AutoRegressive Conditional Heteroskedasticity (ARCH).[25] ARCH is an econometric term describing the variance of one error term as a function

[24] Personal comment Oscar Hammar PhD. Mathematical Statistics
[25] For a comprehensive explanation see Gujarti (2006)

of the variances of the previous error terms. In the case of this study some ARCH would most probably be possible to point out, the analysis concerning whether or not this would be too much for the results of the study to be valid is outside the scope of this thesis, but certainly something that should be analyzed if this model is to be taken any further in future research.

The measuring of statistical significance of the model, as is done for separate values, is drastically improved if the residuals are normally distributed. This is not always the case in hedge funds, according to a study made by Dahl and Forsgårdh (2005) only 7 out of 20 Swedish hedge funds have normally distributed residuals. The test of statistical significance is not as correct if the residuals are not normally distributed because of the affect that the distribution has on the p-value (Dahl and Forsgårdh, 2005), however this does not mean that the test is irrelevant, only that the result is somewhat more uncertain.[26]

The elimination of extreme outliers is sometimes done to achieve a better regression; in this study the number of extreme outliers was fairly modest. The result of removing the outliers is that the prediction interval would become smaller, hence more values would end up outside of the interval, whether or not this would have any important effect on the results of the study will not be elaborated upon. However an example showing that the elimination of outliers does affect the results is shown in appendix 19. In this example the elimination of three of the most extreme values results in that two values instead of one falls outside of the interval, however the point that ended up outside after the elimination was very close to the interval before and thus would the affect of the entire study probably not be as big as in this particular case.

7.10 Data

7.10.1 Choice of funds

The objective with the choosing of funds was to get a representation of the most important funds on the Swedish hedge fund market. This has been done by assessing the volume and market recognition of the funds. In the assessment of the market recognition of the funds the author's personal opinions together with the opinions of colleagues and friends plus Johan Eriksson and Roni Bicér at Superfund, have played a large role. After making a preliminary choice of funds based on the above stated criteria some changes have been made due to some problems with obtaining data on certain funds. In the case where a fund has been skipped the next in a rank on the same criteria have been selected. The problem with obtaining data stems from the necessity of having enough historical data, which is sometimes limited due to differences in the requirements of reporting in different countries. Furthermore, the model requires monthly performance data.

[26] For a comprehensive explanation see Hill et Al (2001)

7.10.2 Data Collection

Data can be divided into primary data which is data that is collected by the authors and secondary data which is data collected by someone else. In this study primary data have been collected only through interviews with Superfund's staff and statisticians, all other material is secondary data. The information obtained from the interviews with Johan Eriksson and Roni Bicér at Superfund has mainly been used to get general comments from inside the hedge fund industry. Their opinions have not intervened with the construction of the model nor with any of the analysis of the results. Esaiasson et al (2007) have three criterions to use when evaluating sources. One is tendency and a source might be tendentious or biased when the sources have interests in this matter and might modify the truth. Superfunds primary goal is of course marketing of their funds which makes keeping the distinction between information received from them and the academic report vital. Furthermore, the independence of Johan Eriksson and Roni Bicér can be questioned. According to Esaiasson et al (2007) independence is another important criterion to use when evaluating sources. Two sources could be dependent if they for example have used the same data for their conclusions. Contemporaneousness is the last criterion Esaiasson et al (2007) mention and is concerned with how old the source is. The older the source is, the less reliable it is since there might be faults in remembering, reconstructions etc. This seems to be a small source of error in this study. The interviews with statisticians have given insight to the statistical theory and the method used in this thesis.

All information of the performance of hedge funds has been collected directly from sites on the Internet. As already mentioned, the frequency of the data is one month. The accessibility of these data vary a lot between different managers, for some it is necessary to obtain a login to access the data, and some only supply the monthly data in the yearly rapports that are available in PDF format, something that makes the process of getting the data in form manageable by the model a lot more time consuming. In some cases the daily data was all that was available and then the last day in each month has been selected as that month's value.

The fact that most information is collected from the companies managing the different hedge funds is of course not optimal from form an independence standpoint. However, the Swedish Finance Inspection have the requirements that funds should present performance data in accordance with specific principles, something that heavily reduces the risk of wrong representation or differences in the way performance is presented.

Other sources of information have been scientific publications, books, newspaper articles and older thesis. Some material has also been received from Superfund and as explained above, that must be handled with extra concern to maintain the objectivity of the study. Some material has been found in the Economics Library at Handelshögskolan in Gothenburg with the assistance of librarians. Some material has been found on the internet in periodicals and some material comes from business news. To as large extent as possible the information has been double checked in order to achieve greatest credibility.

8 Analysis

Summing up the number of outside values from the appendices to a list for the respective funds give a table as shown below. The average value is the average in that particular fund category according to the distinction made in *Background*.

FUND	***Nr. Of outside values***
Managed Futures	*Average: 0,142857143*
Estlander & Rönnlund	0
Lynx	0
Man Investment (AHL diversified plc)	0
Superfund A EURO SICAV	1
Superfund GCT EUR	0
Superfund Q-AG	0
Winton futures	0
Long/Short Equity	*Average: 1,2*
Amplus	4
Carnegi world	1
Dexia wld	1
Mangold Edge	0
Zenit	0
Funds of Hedge Funds	*Average: 0,2*
Cicero hedge	0
Helios	0
Key Hedge Plus	1
OPM Alfa	0
SEB Multihedge	0

Table 3 – For all funds, number of outside values are plotted together.

The hypothesis is that no more than 10 values should be outside of the interval and the total number of outside interval points is 8. i.e. about as many as would be expected if the hypothesis was true.

8.1 Statistical significance for separate values

If looking for further evidence of the hypothesis being false, we can use the method of finding how likely it is that a specific value actually can lie so much outside the prediction interval. Take for example the outside value for Amplus in maj 2007 (see appendix 8) which seems to be very far away from the prediction interval. Using the method in chapter 7.6 with equation 19

$$t = \frac{-0{,}0507 - 0{,}0212}{0{,}0137} = -5{,}248$$

Degrees of freedom = 23-2=21
TDIST(5,248;21;2) = 3,34499*10^-5 which can be interpreted as:
If the prediction is true, values as far from the line as -0,0507 or more would be observed in 0,00334499% of all possible cases. Having such a small p-value is according to Table 2 very strong evidence against the prediction that the historical data gives us.

8.2 Comparison with the ratios used by the hedge fund industry

This table compares the results of the outside value model with the Return to Risk ratio according to the method describe previously.

FUND	***Nr. Of outside values***	***Return to Risk ratio***
Managed Futures	*Average: 0,142857143*	
Winton futures	0	1,16
Lynx	0	1,13
Superfund Q-AG	0	0,76
Estlander & Rönnlund	0	0,33
Superfund GCT EUR	0	0,02
Superfund A EURO SICAV	1	-0,14
Man Investment (AHL diversified plc)	0	
Long/Short Equity	*Average: 1,2*	
Zenit	0	1,68
Carnegi world	1	1,27
Mangold Edge	0	0,83
Amplus	4	
Dexia wld	1	
Funds of Hedge Funds	*Average: 0,2*	
OPM Alfa	0	3,43
Helios	0	2,38
SEB Multihedge	0	1,87
Cicero hedge	0	1,6
Key Hedge Plus	1	1,36

Table 4

Comparing the Return to Risk ratios with the number of outside values calculated using the model does not reveal any evident correlation. The fund with most outside values Amplus (4 outside) does end up at the bottom of the segment of Funds of Hedge Funds, but given the size of the material this is not at all evidence that Return to Risk ratio has any correlation with the outside value method. The reason for this is that the model using the number of outside values as evaluation criteria is independent on how well the fund performs in absolute terms i.e. a fund can have negative performance and still perform in perfect accordance with what is expected, i.e. outside value model is only a measure of if the risk of buying the fund today is the same as the level of risk that the fund have had historically. The Return to Risk ratio on the other hand is equally dependant upon risk as on return which gives funds performing very poorly extremely

small Return to Risk ratios. This principal difference makes a comparison of the model with the performance ratios somewhat like comparing apples and oranges.

8.3 Conclusion

204 points has been plotted in the 17 different graphs, using a 95% prediction interval this means that approximately 10 of the points should have ended up inside of interval boundaries. In this study 8 points ended up outside this interval, which is close enough for the hypothesis to be true. Even if this is the general conclusions there are still single outside values in the model that occurs with probability as low as 3,34499*10^-5, which may lead to questioning the overall results.

As is stated in the beginning of the text historical performance is by far the most used marketing argument for any type of fund. Hedge funds especially use stable and absolute performance in accordance with the historical standard deviation as the argument to introduce hedge funds as an alternative asset in a stock based portfolio. What has been proven with the outside value model is that historical return for a hedge fund is a rather good estimation of the future risk. However, the question is if the statistical interval achieved is narrow enough for this analysis to be of any value for an investor. Further it could be observed that the outside values differ a lot between different funds with everything from 0 to 4 values outside the interval.

When it comes to the average number within a specific strategy of hedge funds the differences are not large enough to determine if there are such differences. For such a study to be made a much larger material would be required which would require that funds not established in Sweden where added to the study.

The conclusion that can be made on the comparison analysis with the performance ratios used by the industry is that there is no generally used measure that assesses the risk in relation to what could be expected from history. The ratios commonly used are only quantifying the historical data into a number and does not make any predictions of the expected future performance of the found. The information on whether or not the risk until present time was expected is a something that is lacking in the information that an investor normally receives from the managers of hedge funds as well as managers of other types of funds. There is no obvious correlation between the results of the outside value method and the Return to Risk ratio, since the outside value method only considers risk[27]. It is further impossible to draw any comparative conclusions of the differences between the three strategies, since the differences in results are too small in comparison to the number of observations, such conclusions would require a study of much larger scale.

[27] Elaborated upon in “method”

9 Further Research

The information of the expected returns of a fund using the outside value model could be used to introduce a new risk measure that uses the historical risk and ads the predictability of that risk up till present time. What would be obtained using this model is a statistical measure of the future risk, instead of only a measure on historical standard deviation which is what is used today. Making this analysis in ten years with more data would enable the test to be made in many steps getting perhaps ten different measures on predictability, which then can be averaged into a general over-time measure of how predictable the returns of a fund has been. It would also be possible to make this study as a moving average predictability i.e. it could be the predictability of the last 12 months or any other interval and continuously move on monthly weekly or daily basis to obtain a constantly updated predictability measure.

A study incorporating a lot more funds that are grouped together would also be interesting. This kind of study could revile if there are any differences between different strategies.

10 General discussion

Predicting the future is what every fund manager struggles with every day, and statistics is a rather good way to do that. In reality the outside value method only reveals how predictable a fund has been historically, which to some extent can be used to predict the future performance of a fund. The two measures that the funds use to explain their characteristics are performance and standard deviation; however the focus of this thesis has only been the measure of risk, the standard deviation. This analysis alone is not very useful since it is the return that the investors is looking for, the method should therefore be seen as strictly complementary to existing evaluation methods.

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Petruccelli, Joseph, D, Nandram, Balgobin, Chen, Minghui (1999) *Applied statistics,* Prentice Hall, New Jersey

11.2 Papers

Dahl, Andreas and Forsgårdh, Lotta, *Hedgefonder och aktiefonder* Magisteruppsats i finansiering, Företagsekonomiska institutionen, Lunds Universitet.

Fahlin, H, VD, Alfred Berg Kapitalförvaltning AB (2000), *Hedgefonder som alternativ investering,*

Lindblom, Andreas (2001) *Optimal placeringsstrategi för val av premiepensionsfonder: En tillämpning av Markowitz portföljteori,* Handelshögskolan vid Göteborgs Universitet, Göteborg

Ljunggren, P, Pappila, M, (2001) *Finansiella Futures,* Handelshögskolan vid Göteborgs Universitet

Svetlik, C., Nilsson D (2004) *Svenska hedgefonder*, Handelshögskolan vid Göteborgs Universitet

11.3 Internet sources

http://www.morningstar.se

http://www.seb.se/pow/wcp/index.asp?ss=/pow/wcp/templates/sebarticle.cfmc.asp%3Fduid%3DDUID_F4C54664F8823542C1256F2B002C9D61%26sitekey%3Dseb.se
Collected 2007-05-02

11.4 Sources for the ratios

All of the below where collected 2007-05-16

Estlander & Rönnlund
http://www.estlanderronnlund.com/disclaimer.asp?hostid=globalmarketsperformance

Lynx
http://www.lynxhedge.com/

Man Investments (AHL diversified plc)
http://www.maninvestments.com

Superfund A EURO SICAV
http://www.superfund.com/db/start.asp?InitVal=1&initetr=1&country=RW&lg=EN

Superfund GCT EUR
http://www.superfund.com/db/start.asp?InitVal=1&initetr=1&country=RW&lg=EN

Superfund Q-AG
http://www.superfund.com/db/start.asp?InitVal=1&initetr=1&country=RW&lg=EN

Winton futures
http://www.turtletrader.com/ctas/winton.html

Amplus
http://swedsec.vinnia.se/index.php?option=com_docman&task=doc_download&gid=77.

Carnegi world
http://www.avanza.se/aza/fonder/fondguiden.jsp?orderbookId=620

Dexia wld
www.dexia.com

Mangold Edge

http://www.mangoldfonder.se/pdf/faktablad_edge.pdf

Zenit
http://www.brummer.se/default.asp

Cicero hedge
http://www.cicerofonder.se/pdf/faktablad-hedge.pdf

Helios
http://www.brummer.se/default.asp

Key Hedge Plus
http://www.keyhedge.com/user/nav/KeyHedgeFundPlusInc/42007KeyHedgePlus(USD)0307.pdf

OPM Alfa
http://www.optimized.se/swe/pdf/Fact%20Sheet/OPM%20Alfa%20SEK%20Eng.pdf

SEB Multihedge
http://www.seb.se/pow/content/fonder/hedge/multi/rapporter/rapport0703.pdf

11.5 Sources for the monthly performance data

All of the below where collected between 2007-04-24 and 2007-05-12

Estlander & Rönnlund
http://www.estlanderronnlund.com/default.asp?id=globalmarketsperformance

Lynx
http://www.lynxhedge.se/vardeutveckling.asp

Man Investment (AHL diversified plc)
https://www.maninvestments.com/products/funds/adpfund/performance/performance.jhtml

Superfund A EURO SICAV
http://www.superfund.se/db/popupFacts.asp?Mask=524288

Superfund GCT EUR
http://www.superfund.se/db/popupFacts.asp?Mask=4

Superfund Q-AG
http://www.superfund.se/db/popupFacts.asp?mask=1

Winton futures
http://www.turtletrader.com/ctas/winton.html

Amplus
http://80.252.177.182/utveckling.html

Carnegi world
http://193.235.27.51/funds/fundStat.asp?currFond=124&period=2003-06-24;2007-05-19&country=SE

Dexia wld
http://www.dexia.com/e/services/sicav_dexia.php?sethi=0&lang=en

Mangold Edge
http://www.mangoldfonder.se/pdf/fondblad_edge.pdf

Zenit
http://www.brummer.se/swe/common/streamer.asp?lngReportId=1650

Cicero hedge
http://www.cicerofonder.se/kurs/kurs_cicero_hedge.html

Helios
http://www.brummer.se/swe/common/streamer.asp?lngReportId=1663

Key Hedge Plus
http://www.keyhedge.com/user/nav/KeyHedgeFundPlusInc/42007KeyHedgePlus(USD)0307.pdf

OPM Alfa
http://www.optimized.se/swe/pdf/Fact%20Sheet/NAV.xls

SEB Multihedge
http://www.seb.se/pow/content/fonder/hedge/multi/rapporter/rapport0703.pdf