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Hedge Funds

A study of factors and risks that influence the return during the financial crisis 2008

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ABSTRACT

The purpose of this thesis is to analyse what drives the Swedish hedge fund returns and how the funds perform during volatile times. We use Fung & Hsieh Asset Based explanatory variables and estimate seven models for Swedish hedge funds return during period 2005-2007. Further, we estimate seven new models in order to test for parameter stability over the initial stages of the sub-prime crisis during 2008. The result showed that the estimated models predict the returns to be less volatile than the actual returns were in 2008. Our explanatory factors give a fairly good picture of what happened and we conclude that four of the seven models proved to be the same model in both period.

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1. Introduction

1.1 Background

In 1949 an Australian named Alfred Winslow Jones founded the first Hedge Fund. Jones combined two investment strategies; leverage and short selling. By holding a basket of shorted stocks to hedging against a market decline and eliminating the market risk, he could invest in the stocks he thought were undervalued. His technique is similar to the one we today refer to as "long/short equity which is the most fundamental sort of hedging technique. (Anderlid et al, 2003)

Both the capital and the number of hedge funds have rapidly increased after Mr Jones introduced his trading strategy. In 2005, after a mean growth rate of twenty percent per year since 1990, there were over 8500 different hedge funds in the world, which in total handled over one trillion dollars. With falling investment fees, hedge funds have become an interesting alternative for investors who want to diversify their portfolios. There are numerous types of funds that are allowed to legally call themselves hedge funds and therefore there is no clear definition of what a hedge fund actually is. From the beginning, hedge funds were solely defined as a fund with the purpose to lower the market risk by combining long and short positions. Today, hedge funds are generally regarded as an investment vehicle that should generate an absolute return measure regardless of the market conditions. By having loose regulations and flexible investment strategies, hedge funds can utilize a wide range of investment strategies such as short positions, leverage and derivatives. This allows them to take advantage of "all" market conditions and generate favourable returns. To promote and induce confidence in investor it is common for the fund managers to hold a strong position in their fund (Anderlid et al, 2003).

In 1996 Brummer & Partners launched the first Swedish hedge fund (Brummer). Although, it was not until four years later the fund market began to expand. This was partly due to the limited knowledge about hedge funds together with the favourable market conditions; therefore, the demand of hedging an investment was slim. Another reason was that hedge funds initially required a large initial investment, which made the target group limited to institutional and wealthy investors. A normal initial investment requirement is usually amounted as high as SEK 500 000 to 1 000 000. During the recent years the hedge funds has lowered the investment requirement to broaden their target groups (Riksbanken) which in 2003 grew the Swedish hedge fund industry at a faster pace than the global industry, seen from an international perspective. In 2006 hedge funds represented around 6% of the total capital in funds registered

in Sweden (Nyberg 2006). And in 2008, the Swedish market had around 70 hedge funds with a total asset in portfolio management of SEK 71 billion (Fondbolagen).

After a long period of almost constant upturn on the stock market, the subprime crisis hit the world investment institutions in the beginning of 2007. Later, the collapse of Bear Sterns in March 2008 was the start of the financial crisis and the global recession that we now in 2010 still are experiencing. This has made a trend by investors to seek more safe investments that provides more protection against a fall in the stock market. The features of hedge funds offers a possibility to fund managers and banks to present the alternative that will protect their capital and generate noticeable rate of return. In the general investment theoretical literature, the most prominent relationship is the one between risk and return. With the strong previous performance of the Hedge Funds there have also been several concerned voices who do not advocate Hedge Funds as safe investment. One of those where The European Central Bank (ECB) who raised their concerns in the 2006 ECB Financial Stability Review about their increasing impact of hedge funds. The ECB meant that hedge funds had created a major risk to global financial stability. The event of a potential collapse of a key hedge fund like the LTCM or cluster of smaller hedge funds was ranked in the same category of disaster as a possible outbreak of a bird flu pandemic. Such event is the type of shock that could trigger fresh disruption in financial markets (Financial Times, 2006).

The Swedish Central Bank (Riksbanken) had a less severe opinion regarding hedge funds. Riksbanken did not see a need for stricter regulations for hedge funds, but welcomed the contribution to new flexible investment strategies and the diversity of risks that hedge funds have brought in. The Swedish Financial Supervisory Authority who requested higher transparency regarding the hedge funds activity and return opposed this however. This request was met in the beginning of 2006, when hedge funds reporting changed from a loose requirement to strict regular monthly reporting and risk measurement. (DI, 2006)

The past development in the market and the question raised by ECB has induced some interesting questions as to what actually drives hedge fund return. Furthermore, will the unstable market condition make hedge funds a risky investment?

1.2 Purpose of the Thesis

The purpose of this thesis is to contribute to an increased understanding of how hedge funds perform during volatile times. We were initially interested in examine the zero beta prospect, which is the very fundamental in Hedge Fund theory. Many studies have already proven the beta to be significant different from zero which in our mind rose the question to what this different

consist of and if it will be more significant in times where the stock market fluctuates more. Other papers have also tried to give a model to determine what affects Hedge Fund performance although many have ended up with low significance level. In the world of hedge fund studies a good benchmark is to reach an R square around 40 percent with a Fama & French model, this is the best fit so far. The reason that Hedge Fund performance is so hard to capture within a model is, as elaborated on before, the very different characteristics which all goes under the name of hedge funds. If the fundamental drivers of the Hedge Fund performance for the Swedish market can be find it will be an interesting contribute to current literature. The next step of our thesis is to see if these factors still can explain the return in times that are more volatile and the event of 2008 offers an opportunity to test this. More concretely, the study aims to explain the performance of Hedge funds during 2008 with help from an estimated model based upon data from the period 2005-2007. The Fung & Hsieh asset based style factor model will be tested for the return of Swedish hedge funds, the data will for the estimated model will range from 2005-2007. From that we will develop asset based models that would explain return in an upturning market and then predict the outcome for 2008. We will compare the predicted return with the actual return. The basic concept we set out to examine is that pending on the general definition of Hedge funds a model estimated over an upturning market should as well be able to describe return in the downturn market. If this concept should not hold Hedge funds do not keep perfect hedges and are exposed to various risk factors. Though this concept address a very theoretical perspective we foremost aim to broaden the understanding of how sensitive Hedge funds are to market movement and where are their weakest points.

1.3 Relevance

The reduced investment requirement for the hedge funds and the unstable financial market has increased the public interest for alternative investment. Hedge fund is a popular choice since they are marketing themselves with absolute return disregarding the state of the market and that they have a low correlation to traditional asset classes. This has lead to that many Swedish investors have invested in hedge funds (Aktiespararna). Furthermore since the lowered fees have made it possible for new investor to engage in hedge funds the features of this investment vehicle should be investigated further. The problem with hedge funds is their great variety of goals, risk, flexible investment strategies and debt to equity ratio. Since the only feature many of the have in common is the objective of an absolute return there is few sufficient index to use as a comparison.

With the possibility of taking short contracts, hedge funds should theoretically display the same return when the stock market fluctuates, i.e. it should be uncorrelated towards the market. To be able to evaluate the performance of hedge funds towards other investments it would then be

necessary to use a time period that contains both a negative and a positive development of the stock market. The different levels of risk are also something that separates hedge funds and must be taken into consideration. As shown, there are a large variety of different hedge funds, all gathered under the same label. This thesis wants to study what factors can explain the return of Swedish Hedge Funds and what type of risks are hedge funds expose to.

1.4 Definitions and Classifications

In this thesis we will identify some representative hedge funds for the Swedish market, to be able to identify Hedge Funds, that will be applicable we use the following definition:

- The fund must have absolute return.
- The fund must have the Swedish risk free rate, STIBOR or equivalent index.
- The fund must be classified as a special fund and be under the law of special funds.
- The fund must have reported its monthly return during the sample period, from January 2005 to December 2008.
- The find must have at least SEK 5M in asset in portfolio management.
- The fund cannot be a direct function of another fund or a fund-in-fund.

The first element is the most basic definition of an hedge fund and is also the most loose, it means in contrary to other investment that it will measure what it perform regardless of market condition – there are no excuses for bad performance. The index rate and law of special fund criteria ensure us that it will fit all the formal requirements for hedge funds. Furthermore, we have limited our sample period ranging from January 2005 to December 2008. This is limited by the reporting standard changes where monthly data reporting became a requirement in 2005 and we therefore can follow the hedge funds more accurate. The upper limit is set by the end of 2008 when the early stages and first wave of the financial crisis created large fluctuations in the stock market. As this thesis took its start in spring 2009 we regarded December 2008 to be a good closing point. The minimum asset requirement ensures us that the fund is traded by a professional management and that there are significant stakeholders that demand a positive return measure. Finally, we want to make sure that the hedge fund accounts for its own risk and returns and not as a contribution to a portfolio.

There are several types of hedge funds; here we present four classifications which we will come in contact with in this thesis. The classifications structure is the same as Hedge Nordic use for their index, which has determined its classification structure based on the instruments traded by the fund manager. The classifications are:

- Equity Strategies
- Fixed Income Strategies
- Multi Diversified Strategies
- Managed Futures/CTA's

The most common hedge fund strategy is equity based which means that a large proportion or the entire invested capital will be in various equity derivatives. Funds pursuing a Fixed Income strategy are often searching for swap-spread arbitrage using the swap and treasury market. Multi Strategy and Managed Futures are both trend following strategies where the Multi strategy have less than 80% of fund investment coming from one particular asset class. Managed Futures uses the future market in commodity and exchange rate derivatives. (Hedge fund Nordic)

1.5 Outline

This thesis will be structured in seven sections. The following section will outline the theoretical framework. The return of hedge funds will be characterised against other asset classes, and also the empirical work which asses the intra relationship between hedge funds and their return aspects will be described. In section three, the relevant hypotheses are stated. In section four we will describe our data sample, with focus on the hedge funds that we will study and the explanatory variable. We will go through the expectation and development under the examined period. Section five goes through the methodology we use for data structuring, relevant tests and analysis. The final two sections will give the results with discussion, and at lastly conclusion.

2. Theoretical Framework

2.1 Hedge Funds and Stock Market

Ackermann, McEnally & Ravenscraft (1999) analyse a sample of 547 hedge funds performance using monthly observations for the period 1988 to 1995 in the USA, although they could not find evidence that hedge funds have outperformed standard market indices they found that hedge funds have been able to systematically outperform mutual funds. Brown et al. (1999) analyse the performance of 399 offshore hedge funds for the period 1989 to 1995. They concluded in contrary to Ackermann et al. that hedge funds for this period have indeed been able to outperform the S&P 500 index in terms of higher Sharpe ratios and positive Jensen alphas. Furthermore, they confirm their conclusion using various self-determined benchmarks based on industry classifications.

2.2 Hedge Funds and Mutual Funds

Fung & Hsieh (1997) compared the differences between hedge funds and mutual funds on the American market. The results indicated major differences between mutual funds and hedge funds in line with Ackermann et al (1999) findings. The former showed a strong positive correlation with the stock market while hedge funds indicated low levels of, or even negative, correlation. Moreover, their results proved that hedge funds were more flexible in their investment strategies compared to mutual funds.

Liang (1998) studied the differences between hedge funds and traditional mutual funds in the United States between 1992 and 1996. The author analysed a sample of 1163 hedge funds and in all over 7000 funds were used. In the study, they classified 16 various funds and analysed the expected risk and return. The conclusion was made that hedge funds in general have a relatively higher standard deviation in combination with a lower beta compared to traditional mutual funds. Also, Liang found that hedge funds have a lower correlation with the market index compared to the highly correlated mutual funds, and hedge funds with the performance based fee structure and high watermark performed better than hedge funds without which can be seen as managers perform better when they have incitement to act in the interest of the investors. Also, the hedge funds showed that they had a low correlation towards traditional asset classes and between the different hedge fund strategies, which means that a portfolio with hedge funds gave a better risk adjusted return then a portfolio that consisted of traditional mutual funds.

2.3 Hedge Fund Classes

Naik et al (1993) attempted in their paper to shed light on the 'black-box' called hedge funds via style analysis technique developed by Sharpe (1992). The conventional style analysis cannot be

directly applied to hedge funds as it imposes two constraints: first, the style weights have to be nonnegative and second, they have to add up to a hundred percent. In addition, the conventional style analysis does not provide any information about the statistical significance of the style weights. In this paper, the authors conduct a generalised style analysis for various hedge fund strategies by relaxing the constraints of the conventional style analysis, and examine the significance of style weights, a la Lobosco and DiBartolomeo (1997). They find that the generalised style analysis approach is more robust for estimating the risk exposures of hedge funds that take short positions in various asset classes and typically hold significant part of their portfolio in cash.

Traditional funds usually have a relative return goal and the managers' performance is measured against a benchmark. For equity funds, a benchmark would be an equity index such as S&P. Hedge funds has often absolute return goals where the funds are expected to always generate a positive return. Consequently, there is no direct benchmark for hedge funds. Cupta, Cerrahoglu and Daglioglu (2003) point out that it is important to understand that it does not mean that hedge funds are completely dependent by the manager's skills and knowledge, but the return of a hedge fund is dependent on the changes in different market factors and the managers' skills (Gaupta, Cerrahoglu and Daglioglu, 2003).

2.4 Classical Measures for Return

In the CAPM model, the expected return is calculated on a financial instrument and its relation towards the market. Many hedge funds strategies have very low or non-linear correlation with market and therefore CAPM is a poor measurement. Instead, multi factor models have become the foundation for studies on the return of hedge funds. The model can according to Agarwal & Naik either be based upon data from the manager of the hedge fund or on historic data of the return of the hedge fund (Agarwal et al, 2002).

Sharpe used twelve different traditional asset classes to explain the return of traditional American funds. In his model, return of an active portfolio is described as a linear combination of different long strategies. In the multi factor model, the alpha value is equivalent to Jensen's alpha in CAPM and also a measurement on the managers' skills. The quality of the model is decided by the explanatory power, R square, which describe how large parts of the total variation that can be explain by the model. Sharpe showed an extreme high explanatory power, over 90 %, for his model. Therefore, Sharpe could explain the return of several traditional American investment funds with a number of asset classes. Because of this, the model became a very popular instrument for analysis of funds return and to decide the funds' investment strategy (Sharpe,

1992). Fung & Hsieh tested Sharpe's model on the returns from 409 hedge funds and found that 50 percent of the hedge funds had a R square value lower than 25 percent. Further, they found that no particular asset class was dominant when it came to explain the hedge funds' return. Also, the author studied a couple of hedge funds' strategies and found that the return from these funds could be correlated with the return from traditional asset classes but that the correlation was not linear. They showed that the return of the trend following hedge funds were similar to the return of a bought straddle on American equities. Fung & Hsieh found that other hedge funds' strategies also had a return similar to an option and concluded that hedge funds showed a non linear relation to traditional asset classes and that traditional linear factor model for that reason could be used to evaluate a hedge funds performance (Fung & Hsieh, 1997). The result pointed out the difficulties of identifying a relevant hedge fund benchmark and has laid ground for further studies on hedge funds. Even though the Sharpe multi factor model could be used in the same on hedge funds as on traditional fund, it has worked as a starting point for further analysis on hedge funds performance. Other studies have come up with different factor models to analyse the return of hedge funds. The models are built according to the same principal as Sharpe model but uses different explanatory factors and variables. Alexander & Dimitriu (2004) means that the large number of models used on hedge funds and the fact that no model has shown to be superior can be explained by the wide differences in investment strategies.

2.5 Option-Based Factor Model

Previous research have motivated the introduction of new regressors with non-linear exposure to standard asset classes to capture the non-linear dependency of hedge fund returns with respect to systematic underlying risk factors. In this context, there is a key distinction between the two following approaches: i) heuristic attempts to introduce ad-hoc option portfolios to improve the performance of a hedge fund factor model; and ii) statistical models whose aim is to extract implied option payoffs from hedge fund return observations. Although it is insightful and can improve the in-sample performance of factor models of hedge fund returns (see the introduction for a literature review, as well as Fung and Hsieh 2004 for a detailed summary of this particular literature), the first approach suffers from one major shortcoming: concern over the efficiency of heuristic option portfolios in hedge fund return modelling. Hence, even if the introduction of arbitrary option portfolios can improve the in-sample explanatory power, nothing guarantees that the chosen underlying assets and levels of moneyness accurately represent the true state-dependent factor exposure of hedge fund managers. As an alternative, the second approach introduced in a recent paper by Diez de los Rios and Garcia (2007) suggests that suitably designed statistical techniques can be used to estimate implicit option positions in hedge fund returns. The authors argue that suitably designed statistical techniques can be used

to (a) determine the portfolio of options that best approximates the returns of a given hedge fund, (b) use options on any benchmark portfolio deemed to best characterise the strategies of the fund (and not simply traded options on an equity index). Lastly, (c) estimate the corresponding moneyness of the options that best characterise the returns of a particular fund, and (d) assess whether the presence of the estimated non-linearity is statistically significant.

2.6 Fung & Hsieh's Asset-Based Style Factor Model

In the paper of Fung & Hsieh (2004), they use a seven factor model which explains some 90 percent of the monthly return variation for a well diversified hedge fund portfolio. The factors used in the model are called asset-based style factors and are made up by the return from a portfolio consisted of traditional asset classes. According to the model, funds within different hedge funds categories are assumed to have exposure towards different ABS-factors. Equity long/short hedge funds are assumed to have some systematic exposure towards two equity market related risk factors. Interest rate hedge funds are assumed to have some systematic exposure towards two interest rate related risk factors and trend flowing hedge funds are assumed to have some exposure towards the return from three options based portfolios.

3. Hypotheses

The aim of this paper is to examine if we can get more understanding for how Swedish hedge funds perform. There are several ways to examine this, but the event of the recent recession will give some depth to this analysis as we can compare performance both in good and bad market conditions. Though this could have been done over earlier recessions the availability of data due to the regulation have inspired us to do this analysis. During the financial crisis we expect the volatility as a key derivatives of which hedge funds invest in to increase, we hope to find trace of changing exposures to the risk factors. We aim to construct good models for explaining hedge funds return in the period 2005-2008. Very much in line with Fung & Hsieh, we want to use the classification of the funds to estimate true risk factors. Using their framework on Swedish data we formulate the following initial three hypotheses regarding to expected exposures.

Hypothesis 1a: The returns of our Swedish hedge fund index do not have any dominant systematic risk exposures.

Hypothesis 1b: The returns of Swedish hedge funds with an Equity Strategy have systematic exposure toward the Equity market related risk factors.

Hypothesis 1c: The returns of Swedish Hedge funds with a Multi strategy are exposed to risk factors from different classes.

Hypothesis 1d: The returns of Swedish hedge funds with a Managed Futures strategy have

systematic exposure to option based risk factors.
Hypothesis 1e: The returns of Swedish hedge funds with a fixed income strategy have systematic exposure toward the interest rate related risk factors.

The last four follow directly the empirical finding of Fung & Hsieh. Hypothesis 1a is regarding the composed index. We do not expect the index to have any dominant exposure since it will be the average of various hedge fund classes. A typical indication of a good model is the models ability to predict future return. The second hypotheses suggest that the models can show that hedge funds are exposed to the same factors in both bear and bull markets.

Hypothesis 2a The estimated model for the Swedish hedge funds index can predict return 2008.
Hypothesis 2b The estimated model for the Swedish equity hedge funds index can predict return in 2008.
Hypothesis 2c The estimated models for the Swedish Multi Strategy hedge funds can predict the return for 2008.
Hypothesis 2d The estimated models for the Swedish Managed Futures hedge funds can predict the return for 2008.
Hypothesis 2e The estimated models for the Swedish Fixed income hedge funds can predict the return for 2008.

Several models are used in order to answer our stated hypothesis, in next section we will present the data that will be used and after that the method will give some structure to how the analysis will be performed.

4. Presentation of Data

4.1 Dependent Variables

The data has been collected from several different sources. In order to specify which hedge funds to include in the analysis, Nordic Hedge's strategy classification was used. Out of that we could select the Swedish hedge funds that met our classification. Further, by taking into account our other criteria's' this sample resulted in 51 hedge funds.

To gather data on the return of hedge funds, Six Edge was used (Six, 2009). Six Edges presents post-fee quotations (NAV-quotations) on a daily basis, which later was used in order to calculate the monthly returns for the funds. When calculating the monthly returns, the quotation data on the last trading day of the month was put in relation to the corresponding value the previous month according to the following formula, where i denotes each Swedish Hedge fund and t denotes last day of the month:

$$R_{i,t} = \frac{p_{i,t}}{p_{i,t-1}} - 1 \qquad (1)$$

Out of the original sample of 51 only 21 hedge funds had reported return in the 48 month studied period 2005-2008. All of the valid hedge funds are presented in appendix. To handle the data we construct two hedge fund indices, one for the whole set of 21 hedge funds and one with the equity related hedge funds as that is our largest class. In next section we will further explain in which way this was computed. As the other classes are only represented by a few funds we will regress those separately and use the results for a comparison analysis within the classifications. We will be able to construct seven different models for the various hedge fund returns, some of our single funds could not be explained by the explanatory variables that we used for this study and were excluded. Those we did use are summarized in the graph and table below.

Table 4-1 Summary of Dependent variables

Table show each of the explanatory variables used in this study, where there are two index composed by the whole sample of 21 selected hedge fund and by the equity funds respectively. The other five hedge funds are displayed with the related asset classification and managed capital.

	HF	EHF	BH	GMM	Excalibur	LYNX	AMDT
			Multi	Multi	Fixed	Managed	Managed
Asset Class	Index	Index	Strategy	Strategy	Income	Future	Future
Invested (MSEK)	43486	36370	557	33	594	1162	82

The time period studied has been limited to 4 years where observations correspond to monthly data between 2005-01-01 and 2008-12-31. A longer time period would have given us a smaller

sample of hedge funds due to their short existents on the market. We expect the first years to be characterised by quite normal market conditions, while the last 12 months are characterised by the financial crisis and large insecurity on the market.

Looking at the graphs of the dependent variables on the following page, it will display a first indication of a slightly more volatile period after 2008 especially for the two indices. From the descriptive table hedge funds have over the defined stable market condition managed to have a mean positive return where the Managed Futures fund LYNX have been giving the highest summarized return. This is though in association with a high standard deviation. The Index hedge funds show a more stable return and have a lower standard deviation; this is expected as they will benefit from being composed by the return of several hedge funds. Seemingly the worst performing hedge funds over this period are Excalibur and GMM based on the lowest minimum/maximum values and a minus summarized return over the whole period.

Table 4-2 Descriptive data for Dependent variables in 2005-2007

In table the seven return of the seven dependent variables during the time period 2005-2007 are summarized. In the first row the funds are classified, apart from index, using Hedge Fund Nordic definitions. The index are composed by the whole sample or by equity funds respectively.

2005-2007	INDEX		Multi-Strategy		Managed Futures		Fixed Income
	HF	EHF	BH	GMM	AMDT	LYNX	Excalibur
Mean	0,003	0,002	0,003	0,001	0,003	0,008	0,000
Standard Error	0,09%	0,10%	0,24%	0,38%	0,12%	0,72%	0,29%
Median	0,004	0,003	0,005	0,001	0,004	0,006	-0,001
Standard Deviation	0,55%	0,57%	1,43%	2,23%	0,74%	4,27%	1,70%
Range	0,024	0,027	0,056	0,087	0,034	0,189	0,088
Minimum	-0,009	-0,011	-0,030	-0,032	-0,015	-0,079	-0,034
Maximum	0,014	0,016	0,026	0,055	0,019	0,110	0,054
Sum	0,097	0,080	0,111	0,036	0,113	0,289	-0,014

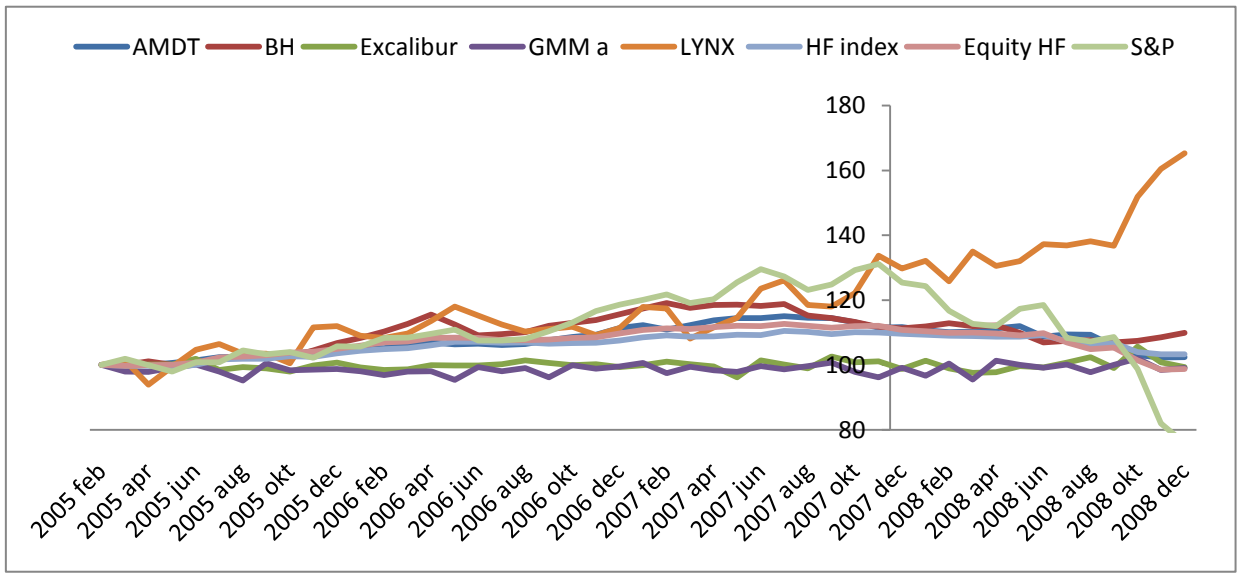
For the 2008 period there is a definite change in the median values where four out of the seven funds that we will examine display a negative mean value, on average the hedge funds are not performing their absolute target during the 12 months in 2008. Also the standard deviation is larger than for the first period. The higher standard deviation induces a first idea for an something happening in 2008 which change the exposure of the hedge fund sample. The indexes are performing a lower range than in the first period. However for the poor performing funds from the first period both Excalibur and GMM have a higher return range.

Table 4-3 Descriptive data for Dependent variables in 2008

In the table the seven returns of the seven dependent variables during the 12 month time period in 2008 is summarized. In the first row the funds are classified, apart from index, using Hedge Fund Nordic definitions. The indexes are composed by the whole sample or by equity funds respectively.

2008	INDEX		Multi-Strategy		Managed Futures		Fixed Income
	HF	EHF	BH	GMM	AMDT	LYNX	Excalibur
Mean	-0,003	-0,002	-0,001	0,000	-0,007	0,021	0,001
Standard Error	0,34%	0,40%	0,35%	0,92%	0,42%	1,28%	0,88%
Median	0,000	0,003	0,003	-0,001	-0,003	0,015	-0,001
Standard Deviation	1,16%	1,39%	1,21%	3,20%	1,44%	4,45%	3,04%
Range	0,045	0,046	0,040	0,110	0,041	0,158	0,113
Minimum	-0,030	-0,031	-0,027	-0,050	-0,032	-0,048	-0,046
Maximum	0,015	0,015	0,013	0,061	0,009	0,110	0,067
Sum	-0,036	-0,028	-0,012	0,005	-0,085	0,256	0,010

Over the whole period all of our sample funds have still proven a total positive return even though there are some funds that have suffered in the last approximately 12 month and barely made the base value from 2005. Still though, entering the performance of S&P 500 Index it is clear to see that the stock market suffer much more severe than any of the Swedish hedge funds in our sample. There is a cluster of AMDT, BH and the Indexes who have been performing stable positive, although low return over the first period who suffered in the same table way in the



Graph 4-1 Return of Dependent variables and S&P during the period 2005-2007

In the graph the dependent variables are compared by transforming the returns to an index starting at Januarey 2005. All the dependent variables are plotted. S&P 500 have also been included to be used as a benchmark

second. Interestingly, there is a contrary cluster consisting of GMM and Excalibur who underperform the other hedge funds, nevertheless still generating close to zero return. These two cluster are creating a gap but seam to converge in the end of 2008 period. Still the most interesting case is the LYNX fund who to a great extend outperform all other funds actually achieving a growth in the 2008 market downturn. From the scope of this paper and the focus of analysis there might not be a good explanation for the single performance of LYNX, but an interesting case to examine in another forum.

4.2 Explanatory Variables

The Fung & Hsieh (2001, and 2004) models are the most prominent explanatory models to date. In Fung & Hsieh original model seven hedge fund risk factors were assessed. Later on, the authors added another three risk factors, two trend following risk factors and one emerging market factor. They characterise the funds as equity, trend-following and fixed income.

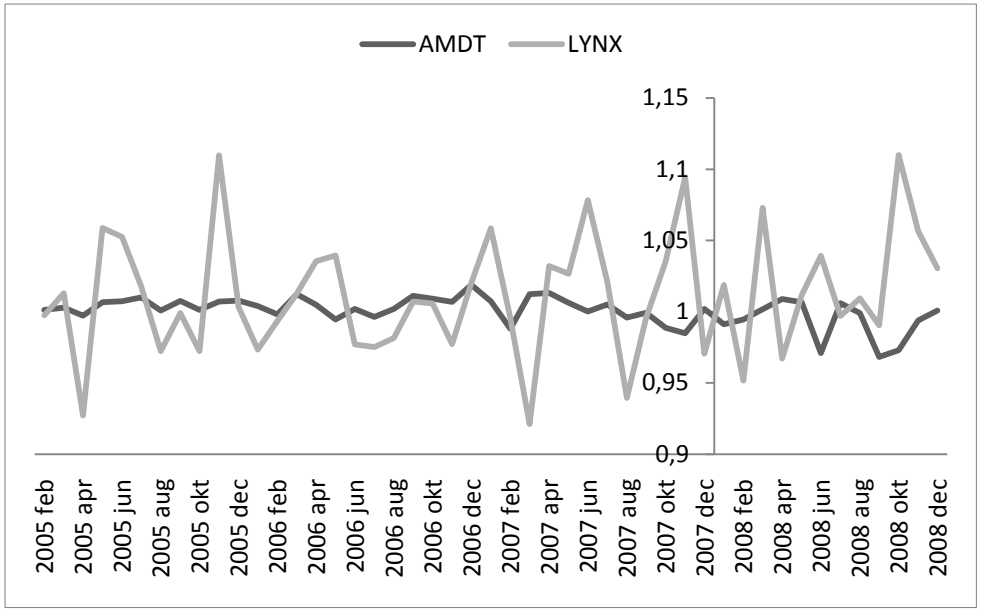
Trend-following hedge fund are regarded to be exposed to the risk factors based on the monthly returns of portfolios with look back options. Fung & Hsieh (2004) base their theory on Merton (1981) who suggests that trend followers make money in volatile market condition as they in association with option buyers are trying to capture the big movement in the market. In the 2001 paper Fung and Hsieh constructed options for long-term bonds, foreign exchange, commodities, short term interest rates and stock index. They generally found positive exposure to all the option except for the bond option. We have used their constructed options in our analysis (http://faculty.fuqua.duke.edu/~dah7/DataLibrary/TF-FAC.xls), the following notation will be used;

Table 4-4 Definition of Fung & Hsieh look-back options

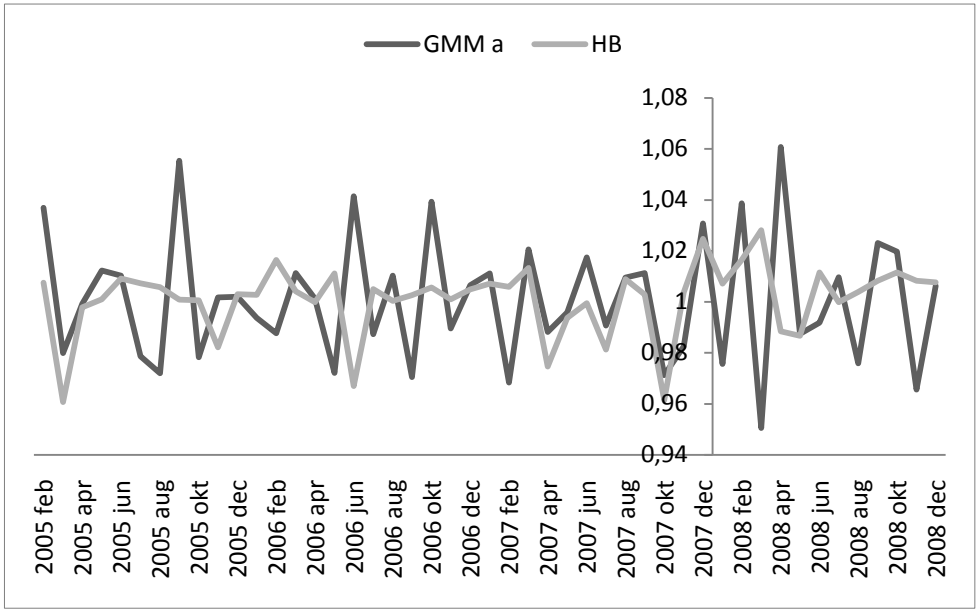
In the table below are the first five explanatory factors used for the return regression, the values are computed by Fung & Hsieh and are constantly generated by their model. Here are the definitions of them summarized.

Bond Option	Return of a portfolio of look-back straddles on bond futures
FX Option	Return of a portfolio of look-back straddles on currency futures
Commodity Option	Return of a portfolio of look-back straddles on Commodity futures
IR Option	Return of a portfolio of look-back straddles on interest rate futures
Stock Option	Return of a portfolio of look-back straddles on stock futures

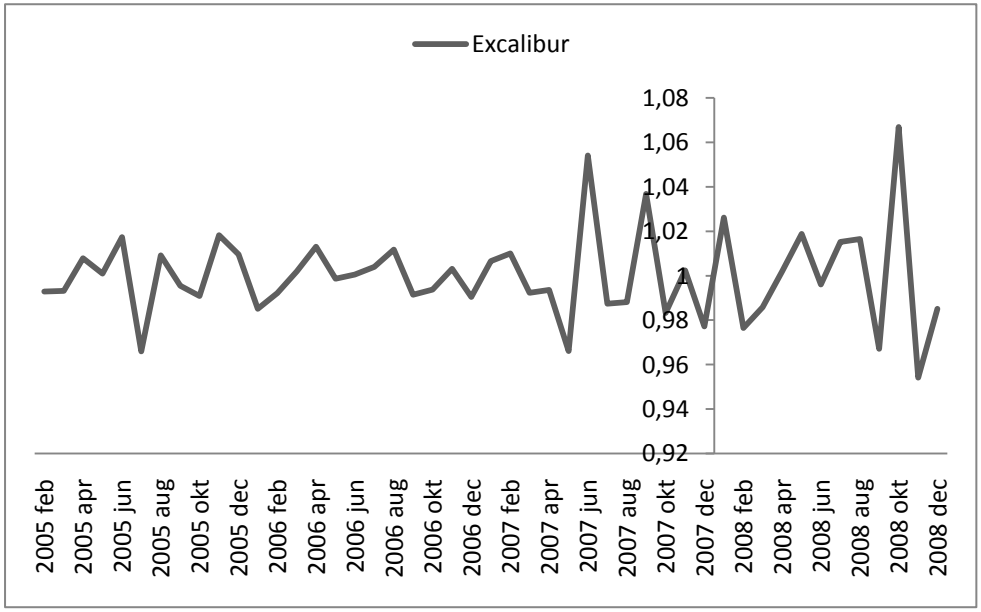
In the graphs where the trend following options are plotted we can find the values for the options over the studied time period. Of the explanatory variables IR, FX and commodity options are seemingly more volatile during the last period. A good reason for the very large deviation for



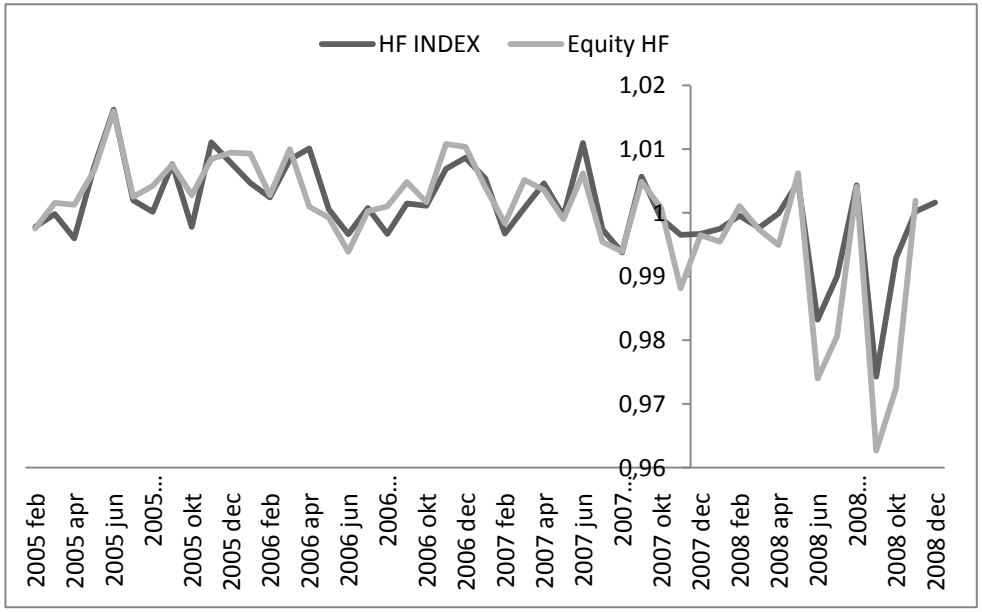
Graph 4-3 Return for Managed Future funds AMDT and LYNX 2005-5008



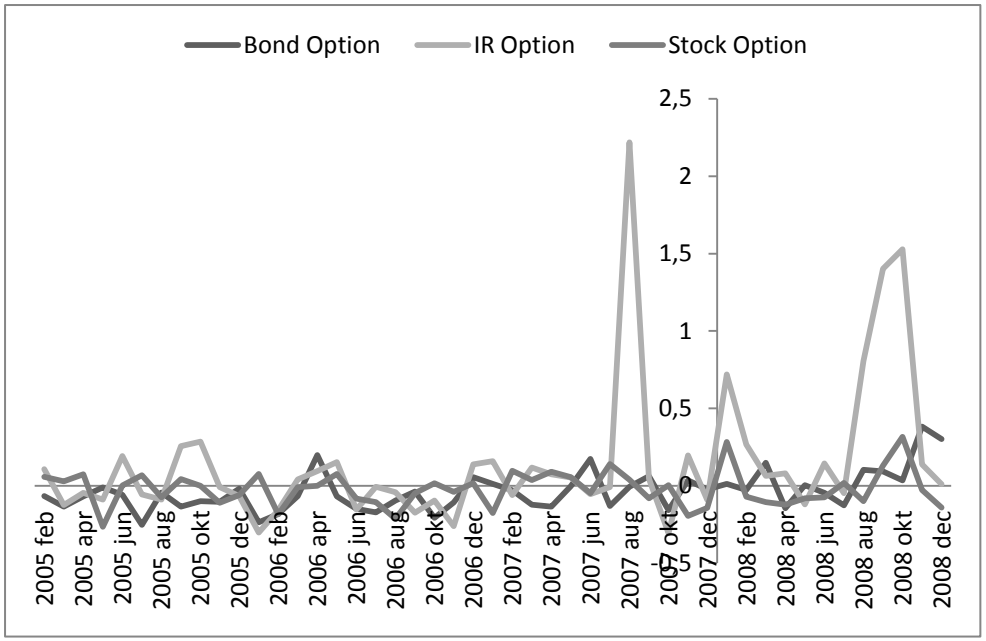
Graph 4-2 Return for Multi Strategy funds GMM and HB 2005-5008



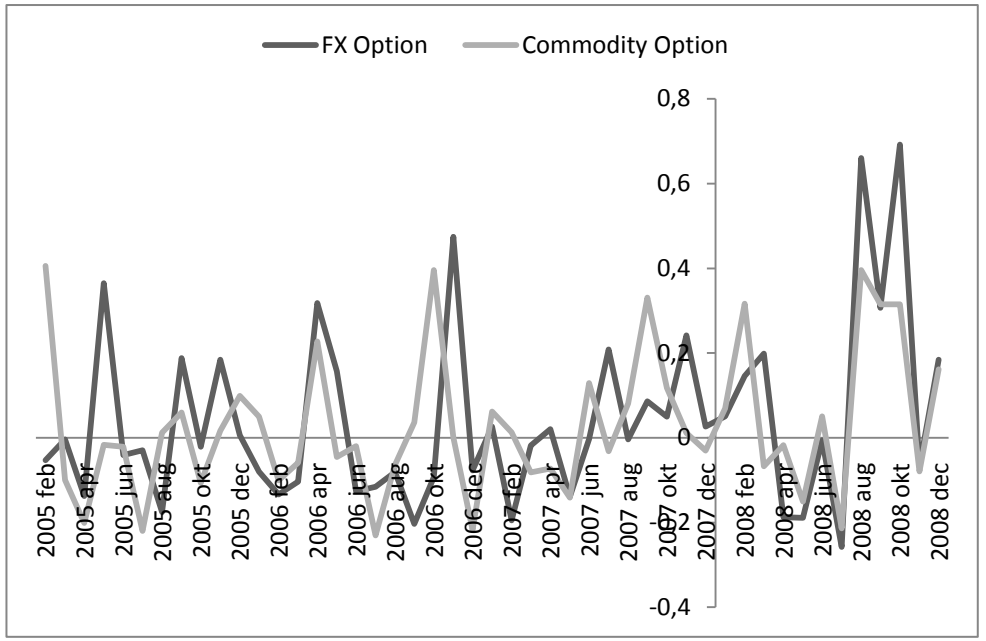
Graph 4-5 Return for Fixed Income fund Excalibur 2005-2008



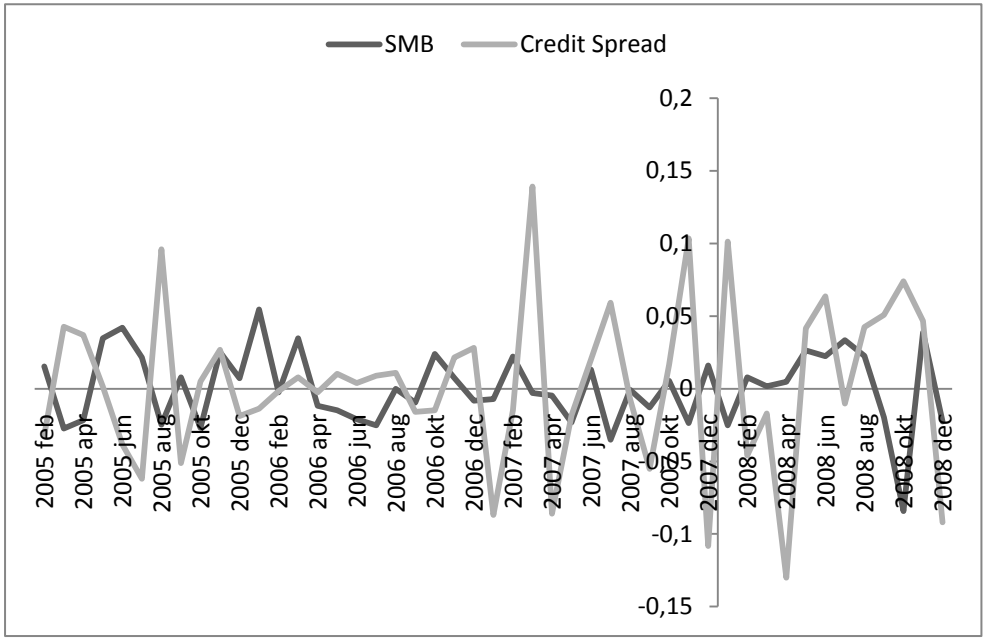
Graph 4-4 Return for HF and Equuity HF index 2005-2008



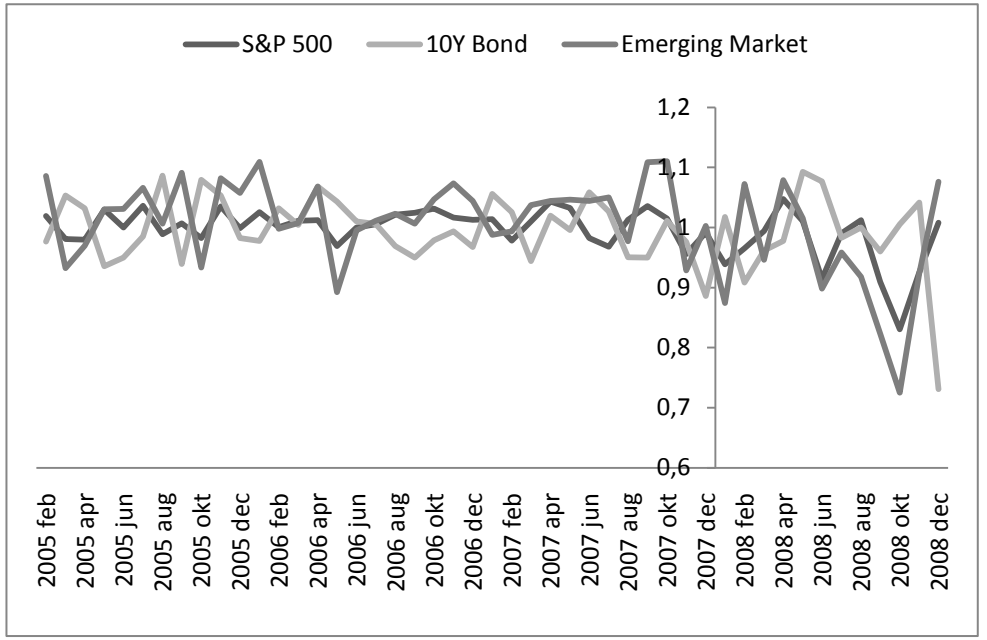
Graph 4-7 Retrieved values for Bond, IR and Stock Options under the period 2005-2008



Graph 4-8 Retrieved values for FX and Commodity Option for 2005-2008



Graph 4-9 Computed values for SMB and Credit Spread factor under the 2005-2008 period



Graph 4-6 Changes in return for S&P, ten year bond and Emerging Market factors

the IR option is the development of subprime derivatives. We do expect both the Multi Strategy and foremost Managed Future hedge funds to have a large exposure to the options. As described by Merton (1981), they should also be able to perform well in the second period market conditions.

Fixed income hedge funds are according to Fung and Hsieh (2004) typically exposed to interest rate spreads as it is mainly trading on finding the low rated opportunity and short the treasury risk equivalently using liquidity by going short in a liquid asset and buy the contrary bond.

$$10Y\ Bond_t = y_{Fed\ 10Y\ Bond\ t} - y_{Fed\ 10Y\ Bond\ t-1} \tag{2.1}$$

$$Credit\ Spread_t = \left(y_{MoodyBaa\ t} - y_{Fed\ 10Y\ Bond\ t}\right) - \left(y_{MoodyBaa\ t-1} - y_{Fed\ 10Y\ Bond\ t-1}\right) \tag{2.2}$$

Though this is a common strategy the gain is seldom high and the losses might be big, especially since the crisis. Furthermore, the position is often highly leveraged and the risk largely depends on the overall liquidity on the market. In the development over the last couple of year, a strategy like this should suffer. To examine exposure in the fixed income market Fung & Hsieh used the two risk factors in equations 2.1 and 2.2.

In the equations y denotes return, $Moody\ Baa$ corresponds to end month quotation of Moody bond index medium rating and *Fed 10Y Bond* is the end month return of Federal Reserve's 10Y Bond with constant maturity yield. The rational is when credit spread increase the return of the hedge fund will decrease. This will be expected in volatile times (Fung & Hsieh, 2004). For the regression in the same paper the author received a negative exposure to both the ten year bond and credit spread factor.

There are two factors of the equity long/short style; those are the market (namely the S&P 500) and the spread between large cap and small cap stocks. In the TASS[1] database (respectively HFR), these 7 asset-based style factors are found in 57% (37%) of the hedge funds.
For the equity market factor, return from S&P 500 is used as a proxy for the market portfolio. The factor is supposed to show a possible systematic exposure towards the equity market portfolio.

The second factor used is the size spread factor, which is a factor made up by the differences in return between an equity index of Small Corporation and a index of large corporation. A hedge

[1] TASS and HFR are both Hedge Fund databases

fund that has as a strategy to go long in undervalued small caps equity and hedge against market risk by going short in large corporate equity will have a positive exposure towards this factor.

$$S\&P\ 500_t = y_{S\&P\ 500_t} \tag{2.3}$$

$$SMB_t = y_{Russell\ _t} - y_{S\&P\ 500_t} \tag{2.4}$$

Russell corresponds to the Frank Russell 2000 index measuring the 2000 smallest firms in the Frank Russell 3000 index. This index is most commonly used as a benchmark index for small cap. A hedge fund that has as a strategy to go long in undervalued small caps equity and hedge against market risk by going long in large corporate equity will have a positive exposure towards this factor. Significant for long/short equity funds strategy are that they have very low degree of leverage. The volatility and risk is less than for normal equity funds, assuming that the hedge funds are not too concentrated.

The final factor Fung & Hsieh added was the Emerging Market factor corresponding to the index of MSCI *Emerging Market* taking the monthly return. Emerging markets are considered relatively risky because they carry additional political, economic and currency risks. An investor in emerging markets should be willing to accept volatile returns - there is a chance for large profit at the risk of large losses. An upside to emerging markets is that their performance is generally less correlated with developed markets. As such, they can play a role in diversifying a portfolio (and thus reducing overall risk). This will be the 10th explanatory variable that we will use.

Using the Fung & Hsieh (2004) explanatory variables will help us to get around some of the robustness of the regression. The authors explain for instance the restricted number of factors by the fact that the potential additional factors might add multicolinearity to the current factors. As most derivatives are traded over an international market we assume that market opportunities will arise and be captured on a global trading floor. The selected funds operate in this market and therefore we have chosen to use the same variables in the Fung & Hsieh model to explain the return for Swedish hedge funds.

4.3 Potential Biases

Following previous literature, Edward & Caglayan (2001) and Fung & Hsieh (2000), hedge funds are potentially subject to a number of data biases associated with reported hedge fund returns, namely; survivorship bias, instant history bias, selection bias and a multi-period sampling bias.

A survivorship bias might be present if non-surviving funds are excluded from the sample. To explain this bias we distinguish between surviving funds and defunct funds. Surviving funds are still operating and report return data as opposed to defunct funds that has stopped their reporting for various reasons. These might be bankruptcies, liquidations, mergers, name change or voluntary stoppage of reporting. If the main reason for defunct is poor performance the returns of the reported sample will be biased upwards. Fung & Hsieh (2000) estimated the survivorship bias to 3% annually from 1994 to 1998 whereas Edwards & Caglayan estimated it to be between 0, 36% and 3, 06% depending on strategy in their 2001 article.

An instant history bias potentially exists, due to the fact that when data vendors add a new hedge fund to their records, historical returns may be back filled. The rationale behind this bias is that only funds with good instant history track records are interested in starting to report their returns. Edwards & Caglayan (2001) estimates this bias to about 1% of annual hedge fund returns.

There might be a selection bias present if only funds with good performance choose to report their returns. In this case the returns of the observable hedge funds will overstate the true returns on the entire population of hedge funds. In contrast, Edwards & Caglayan (2001) report that anecdotal evidence point out the fact that very successful funds choose not to disclose their performance as they are already closed to new investors. If this is the dominating force it will lead to a downward bias in returns. In conclusion, this bias may be either upwards or downwards. In either case Fung & Hsieh (2000) argue that the bias should be very small, if it exists at all.

The last bias, multi-period sampling bias, deals with a requirement that a fund needs a sufficient return history before it can be included as a sample in a study. Fung & Hsieh (2000) argue that if investors typically require 36 months of return history before investing in a fund, estimates of returns based on shorter time-periods might be misleading to those investors. However, the authors concluded that this bias appears to be very small if it exists at all. Fung & Hsieh (1997a) required a 36-month return history to ensure sufficient degrees of freedom in their regressions. Edwards & Caglayan (2001) settles for 24-months. Both articles mentioned above agree that this bias appears to be very small.

Due to a very limited number of hedge funds with domicile in Sweden and a sufficient return history, we have made no attempt to adjust our data sample to account for these biases. Nevertheless, we are fully aware of the potential impact from especially the survivorship bias

and the instant history bias. Consequently we will consider these biases when we interpret the results from our regression.

5. Method

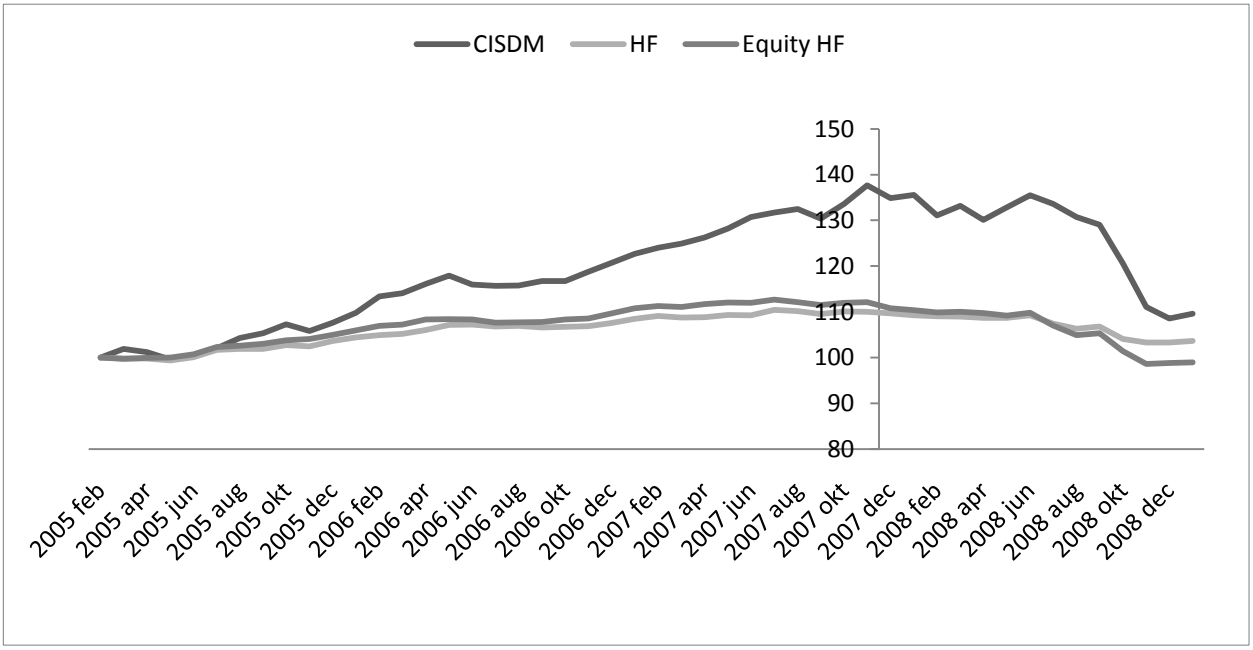
5.1 Creating Index

There are several challenges involved in creating an index for measuring hedge fund return. In contrast to a commonly traded asset the characteristics and variety of the broad sample we call hedge funds makes them incomparable with each other and therefore normal method such as equally-weighted, value-weighted and price-weighted indices might not capture the true return. For this purpose where the sample is small (n=21) and asset are of largely varying size, a value weighted index would put large impact on the heaviest fund which might not be representative for the whole sample. Fung and Hsieh (2003) found that using an average index composing method gave a significant positive exposure to both the market portfolio factor and SMB factor, Agarwal & Naik found the corresponding risk exposure. In other hedge fund studies, there have also been emphases on the management fee, the invested capital by the manager or simply the activeness in trading. Those are all factor that might diminish if you would do a equally weighted index. Though you can induce a management weigh scheme that measure rate of return by managers will incorporate leverage which will then hurt the underleveraged manager. Nevertheless, Fung & Hsieh found from regressing a model against both an equally and a value weighted index that not much differed. Since their sample of their regression is very much larger than our sample we have chosen to compose our indexes using an equally weighed method which is in line with most professional hedge fund indices. The hedge fund index will be the summarized using an arithmetic mean method for the total sample of 21 hedge funds, the monthly return is then;

$$y_{HF,t} = \frac{\sum_{i=1}^{21} y_{i,t}}{21} \tag{3}$$

Where t is for every observed month in the 46 month period and i is each hedge fund. The same method is used when composing the Equity based hedge fund index where the total numbers of hedge funds are 13. In the Graph below the composed index for hedge fund and equity hedge funds are plotted against CISDM[2] hedge fund index.

[2] CISCM stands for Center for International Security and Derivatives Markets



Graph 5-1 Constructed index return compared to CISDM return under 2005-2008

Comment: CISDM index have had a higher return during period june 2005 to august 2008. After that point the index have suffered mroe that the composed index fro the Swedish hedge fund this paper.

5.2 Regression Model

To analyse the data we have regressed the hedge fund index, equity index and the single hedge funds in the other classes for the time period 2005-2007. We have used the OLS regression method. The goal with a regression analysis is to generate a function that in the best way possible describe the observed the dependent variable. The estimated linear equation has the following form:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} \ldots + \beta_n X_{nt} + \varepsilon_t \quad (4)$$

The β_0 is the models intercept. All X variables are the explanatory variables and the beta values explain how much the dependent variables change by a change in the explanatory variables. To decide whether or not the estimated beta values are significant; we have used backwards elimination, where the explanatory variable with lowest significance was eliminated for each round of regression. The rounds were continued until we have all or most of the parameters meeting our required significant level with a highest tolerance of 10%. The important parameter that will indicate how good the model is will be the R square measure as well as the adjusted R square, this will explain how much the explanatory variables will jointly explain the return of the dependent variable. Previous hedge fund studies part from the Sharp study or Fung & Hsieh have not been able to achieve very high R square. We will consider a R square around 0,30 to be sufficient and 0,5 to be a good model. We will only apply the OLS Regression method for the 2005-2007 as the sample of 2008 only contain 12 entries for each variable. Testing 12

observations for 10 explanatory variables will be a severe violation of the OLS assumption, as it will assumingly contain large biases. There is a large risk to over fit the model, we will therefore perform post-sample tests.

5.3 Test of the Model

Initially we will use the model for prediction, using the 2005-2007 model we will predict the value for 2008. In a graphical way we will show the predicted return for 2008 compared to actual return. We will present a confidence interval for 50% of variation and compute how much of the true values that are within this interval.

To test the model statistically we have used two models for post sample predictive test. Firstly we will test if the error term for the sample period will be the same in the post sample period. To conduct this test we first need to assume that the first model is the true model (Gujarati, 2003). Furthermore the variance of the error term and beta values are assume to be normal. If this is the case also the error term of the post sample should be normal we can therefore test;

$$\chi_p^2 = \frac{\sum_{j=1}^{p} \hat{u}_{n+j}^2}{\hat{\sigma}^2} \tag{5}$$

Where the estimated u_{n+j} is the error term for the true value for the prediction month and the predicted value, those are then summed and squared. The test in one-sided chi-square with p degrees of freedom, p corresponds to the number of estimated observation which will be 12. The test statistics is rejected if the observed value is larger than the test statistic. We will test the following hypotheses;

H_0: The observations in the sample and the post-sample period are generated by the same, true, model

H_1: The observations in the sample and the post-sample period are generated by different models (structural change) and/or the model fitted to the sample period is miss-specified.

Second, we are using a Chow-test with dummy variables to examine 2005-2007 model for parameter stability when the sample is increased to 2008 (Gujarati, 2003). This test is conducted by using the original model (Equation 4) and then creating dummy variables who will take on value one for the post sample period, below you will see the extended equation.

$$\begin{aligned} Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} \ldots + \beta_n X_{nt} \\ + \alpha_2 D_t + \beta_{n+1} D_t X_{1t} + \beta_{n+2} D_t X_{2t} \ldots + \beta_{n+m} D_t X_{n+m,t} + u_t \end{aligned} \tag{6.1}$$

In the regression $D_t = 0$ for the time period 2005-2007 and $D_t = 1$ for 2008. If there is a structural change in the parameters the beta values for the dummy affected variables will be significantly different from zero. If that is the case for all elasticises in equation 6.1 are significant the following model should be true for explaining the return of 2008.

$$Y_t = (\beta_0 + \beta_{n+1}) + (\beta_1 + \beta_{n+2})X_{1t} + (\beta_2 + \beta_{n+3})X_{2t} \dots + (\beta_n + \beta_{1n+m})X_{nt} + \varepsilon_t \qquad (6.2)$$

An F-test will be used to test the hypotheses. Where the null hypothesis suggests that all elasticises for the second period will be equal to zero, while the alternative hypothesis suggest that at least one of these parameters are not zero. If the null hypothesis is rejected the parameters are assumed not to be stable over time and another model for the second period should be estimated. The Hypotheses are summarized below

H_0: $\beta_{n+1} = \beta_{n+2} = \cdots = \beta_{n+m} = 0$

H_1: At least one $\beta_{n+1}, \dots, \beta_{n+m} \neq 0$

$$\text{Test statistics: } F = \frac{(RSS_R - RSS_{UR})/m}{RSS_{UR}/(n-k)} \qquad (7)$$

Where RSS denotes the Residual Sum of Square and the unrestricted model is the extended model (Equation 6.1). The restricted model is the original model (Equation 4) including the dummy variable for changing intercept. The decision rule is to reject the null hypothesis of no structural changes over time if the observed F value is larger than the critical F value. The critical F value is $F_{m,n-k}$. The test will be made for 10%/5%/1% levels of significance.

6. Results

6.1 Regression Results

We have initially performed regressions on the two index and seven other models for the single hedge funds in minority asset classes form the sample. For three of those hedge funds no sufficient model could be created using the defined explanatory variables from Fung & Hsieh and therefore we excluded those from our analysis. The complete regression results with standard error and significance level is displayed in the appendix.

Running the regression for the HF index, the model that best explains returns for our sample is the following;

$$HF_t = 0{,}841 + 0{,}021BondOption_t - 0{,}009CommodityOption_t - 0{,}005IROption_t + 0{,}129S\&P500_t + 0{,}086SMB_t + 0{,}003\ 10YBond_t \qquad (8.1)$$

The main index was composed by weighting the return of the hedge funds equally for each time period. As the hedge fund index was estimated using over 60% equity hedge funds (which was our base sample) the equity exposure will have a certain dominance of the sample. The obtained model has evidently its largest exposure to the stock market with the SMB factor showing the second largest exposure. The fact that the two equity related factors are showing significance positive impact on the index is in line with our expectations. The Hedge fund index also shows some exposure to bond, commodity and interest rate options however the exposure is very low. The R square measure is seemingly high and corresponds to 0,582. Nevertheless, in hedge fund theory this is a relatively good model as similar studies are able to explain approximately the same rate.

For the equity based index the return is largely exposed to the same explanatory variables, however the equity model lack the S&P 500 factor, which we did not expect. For the other variables the same sign as the hedge fund regression is noted.

$$EquityHF_t = 0{,}941 + 0{,}011BondOption_t - 0{,}016CommodityOption_t - 0{,}003IROption_t + 0{,}050SMB_t + 0{,}061\ 10YBond_t \quad (8.2)$$

Risk factors for the trend following hedge funds are designed to reflect the maximum return for a hedge fund with a trend following strategy and as we reasoned before we expect them to show high exposure to the constructed look back options. Below are the equations for the Multi strategy funds BH, GMM and for the Managed Futures, AMDT and LYNX. Generally we would expect the Multi strategy to have a wider exposure as they per definition use several strategies.

$$BH_t = 0{,}829 - 0{,}010IROption_t + 0{,}085\ 10Y\ Bond_t + 0{,}087\ Emerging\ Market_t \quad (8.3)$$

$$GMM_t = 1{,}203 + 0{,}051CommodityOption_t - 0{,}203\ 10YBond_t \quad (8.4)$$

$$AMDT_t = 0{,}804 - 0{,}012CommodityOption_t + 0{,}198S\&P500_t \quad (8.5)$$

$$LYNX_t = 0{,}702 + 0{,}114BondOption_t + 0{,}087FXOption_t + 0{,}641SMB_t + 0{,}312\ 10YBond_t \quad (8.6)$$

It is hard to conclude something from these models, though we were able to find significant parameters we could only achieve a R square raging form around 0,3 to 0,35 for all these models. In general the explanatory variables have the same sign over all six models except for GMM who show a positive exposure to commodity option and a negative towards the bond variable this is actually the only regressed model that show the same sign towards the explanatory variables estimated by Fung & Hsieh. As for the two different classes the BH model capture risk factors across the asset classes with negative exposure to the interest rate option,

positive exposure for the ten year bond and a positive exposure to emerging market. Neither Managed Futures funds AMDT and LYNX show any indication of having a dominating exposure to the look back options.

We have also looked at one Fixed Income fund; unfortunately the two other Fixed Income fund from our original sample could not be explained by the asset based risk factors and were excluded. For the remaining fund Excalibur, the following model was estimated.

$$Excallibur_t = 0{,}872 + 0{,}085BondOption_t - 0{,}040StockOption_t + 0{,}208SMB_t + 0{,}132\ 10YBond_t \quad (8.7)$$

In this case we had expected high explanatory value form the ten year bond and the credit spread where we can see the ten year bond having the second highest beta value while credit spread did not proved significant, neither for this nor for the other regression models. Once again the sign of the regressors do not correspond to our benchmark paper. The main explanation is that the Fung & Hsieh models were tested for a very large sample and it is more likely than not that single event or strategies will change the exposure for the Fixed Income fund as well as for the Multi Strategy and Managed Future funds.

6.2 Predictive Tests Results

To get an indication of how well the model are able to predict the outcome of 2008 we created prediction intervals. The intervals were constructed to fit 50% of variation based on the first period estimation. For a short comparison we calculated for the estimation period and the post sample period how many of the observation that fit the predicted interval. The results are summarized in the table below.

Table 6-1 Count for the obervations within the 50% Confidence interval under 2005-2007

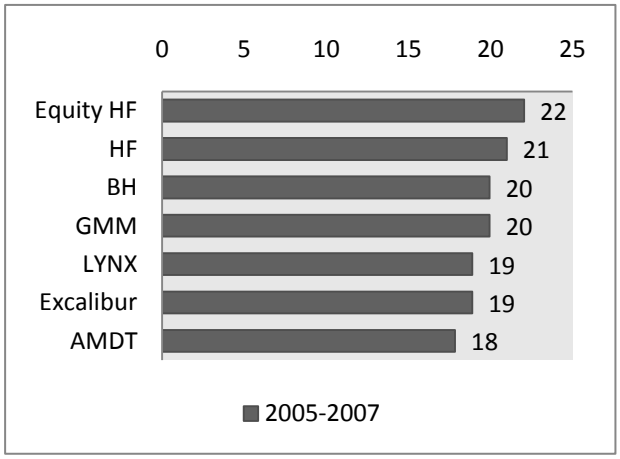
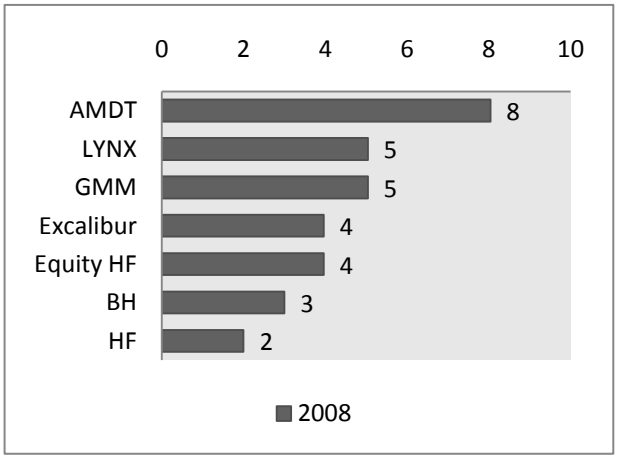


Table 6-2 Cound for the observations wirthin the 50% Confidence interval under 2008



The tables display how many observations that were within the predicted confidence interval when using the estmated model for each fund. For the first table the total observation were 36 and for the second only 12. Expected value for the models are 18 and 6 respectively

As the estimation was made from the 2005-2007 period more than 50% of returns should be within the interval. Out of the 36 observations 50% corresponds to 18, this condition is satisfied. For 2008 the count varies a lot for the different models, this is mainly due to the small sample size with only 12 observations and does not necessarily mean that the model cannot predict. Nevertheless, we can conclude that the hedge fund index (who according to the first model had large S&P exposure) did not follow the predicted values in 10 out of 12 observations while AMDT followed the model better than expected with 8 out of the 12. These findings will be examined further in the results. Furthermore, we also conclude that all other variables in general were outside the 50% interval for the predicted values. The plotted Prediction intervals as well as the actual return are displayed in appendix.

To apply the statistical analysis we use the Chi-square test for the stability in error terms (Gujarati). The observed test value will be rejected if it is higher than the critical value. Table 6-3 show critical value for the Chi-Square statistics using p=12 degrees of freedom and the observed values are summarized below. The null hypotheses of the observation in both sample and post sample period are rejected for both indices and GMM on all significant level. This indicates that, either the model was miss-specified or that the observations in the two periods are generated by different models. Fixed Income fund Excalibur can only be accepted in a 10% significance level.

Table 6-3 Critical values for Chi-Square distribution

Chi-Square distribution for 12 degrees of freedom		
10%	5%	1%
26,12	21,3	18,5

Table 6-4 Observed values for the Chi-Square test

INDEX		Multi-Strategy		Managed Futures		Fixed Income
HF	EHF	BH	GMM	AMDT	LYNX	Excalibur
32,41	50,86	6,27	28,55	11,77	6,11	23,76

Knowing this, it is interesting to further examine if the models are suffering from structural changes over time. In this paper we use Chows Test (Gujarati et al) for structural changes over time. By using dummy variables who take value 0 for the estimation period and value 1 for the post sample period we can see if the beta for the explanatory variables will change significantly. For the HF index model the extended model will look like equation 9 displayed below.

$$HF_t = \beta_0 + \beta_1 BondOption_t + \beta_2 CommodityOption_t + \beta_3 IROption_t + \beta_4 S\&P500_t + \beta_5 SMB_t + \beta_6 10YBond_t + \alpha_2 D + \beta_7 D\_BondOption_t + \beta_8 D\_CommodityOption_t + \beta_9 D\_IROption_t + \beta_{10} D\_S\&P500_t + \beta_{11} D\_SMB_t + \beta_{12} D\_10YBond_t \quad (9)$$

For instance the term $\beta_7 D\_BondOption_t$ can be broken down to two parts. Where the beta value will indicate the impact and direction of the 2008 exposure to bond option and the *D_BondOption* simply is the dummy variable multiplied by the bond option observation for the whole period.

Below is the computed F observation value from comparing the residual sum of square of restricted model containing only a dummy for the intercept against the unrestricted model (Equation 6.1). The F test is rejected if the observed value exceed the test statistics, we have made the dummy regression for all the seven models and can conclude the following;

Table 6-5 Observed F test value and critical values

	INDEX		Multi-Strategy	Managed Futures		Fixed Income
	HF	EHF	BH	GMM	AMDT	LYNX	Excalibur
test	2,691	1,031	4,269	0,893	0,108	1,877	7,703
10%	1,980	1,997	2,226	2,490	2,490	2,091	2,091
5%	2,421	2,450	2,839	3,232	3,232	2,606	2,606
1%	3,473	3,514	4,313	5,179	5,179	3,828	3,828

Equity HF, GMM, AMD and LYNX can all be accepted at the defined significance levels. This means that the parameters do not change over time. Apart from the Chi-Square test the parameters in GMM is now accepted to be stable over time. This might indicate that the original model fitted for GMM can be miss-specified. Remembering the model for GMM only two to explanatory variables remained when optimising the regression model. With an R square around 0,30 this is most likely true. Looking at HF, BH and Excalibur, the last fund will reject the null hypothesis on every significance level while HF and BH are significant only at the last level. Rejecting the null hypothesis we know that at least one of the parameters are not equal to zero. Having a closer look at the three models, we estimates the following new models

$$HF_t = 0{,}841 + 0{,}021 BondOption_t + (-0{,}009 + 0{,}051) CommodityOption_t + (-0{,}005 - 0{,}014) IROption_t + 0{,}129 S\&P500_t + (0{,}086 - 0{,}296) SMB_t + 0{,}034\ 10YBond_t \quad (10.1)$$

$$BH_t = (0{,}829 + 0{,}232) - 0{,}010 IROption_t + (0{,}085 - 0{,}159) 10YBond + 0{,}087 Emerging\ Market_t \quad (10.2)$$

$$Excalibur_t = 0{,}872 + (0{,}085 - 0{,}155)BondOption_t - 0{,}040StockOption + (0{,}208 - 0{,}800)SMB_t + 0{,}132\ 10\ Y\ Bond_t \quad (10.2)$$

For the HF, the beta for commodity options and SMB during the past sample period were significant at the 1% level. Interestingly adding the changed exposure to the estimated regression model the two variable change sign where commodity option now in total will have a positive impact while the SMB factor will affect the hedge fund index negatively. According to fundamental economical framework volatile time will increase the value options therefore the new positive exposure to commodity option could have a rational, returning to the graphs in the data section commodity options will have a volatile development. A positive exposure to SMB is in line with the finding by Fung & Hsieh (2004). However, the event of 2008 had a negative impact on the explanatory a reason for this might be an overall downturn that hit the small firms at the same force as the large.

Banco Hedge (BH) is characterised as a multi strategy fund, for the 2008 period the regression proved change in the intercept and in the exposure to ten year bond. The intercept seams to increase. This should be an indicator of the fund manager proving a good ability to generate excess return. Having a look at the graph over all hedge fund return we can conclude that after a slightly hard first half of 2008 they turn the curve and manage to perform. We can also see that the sign of ten year bond exposure change from a positive to negative value. This is more in line with theory as the fund managers who use bond as a derivative tend to short the long term bond and bet on short term movement.

Thirdly we look at Excalibur which is a fixed income fund. The suggested new model will change sign in both bond option and SMB where both become negative. Following the previous rationale of the Fung & Hsieh 2004 paper a negative exposure towards bond option are to be expected and a positive towards the SMB factor. As already suggested this could have its explanation in a the general downturn.

Although the test for parameter stability gave some interesting results, it is important to remember that the F statistic for both BH and the hedge fund index could not completely reject the null hypothesis on all levels.

6.3 Analysis

As stated in the beginning of this section, since the hedge fund index was estimated using over 60% equity hedge funds, the equity exposure will have a certain dominance of the sample. When

we look at the variables for the index we find a positive exposure the IR option, Ten year bond and bond option. We believe this can be explain that by hedge funds investing in these kind of assets as a complement, since we only have one fixed income hedge fund in the sample. Further on, we feel comfortable with our SMB and S&P 500 variable which are equity based factors but we question the significance of the S&P 500 factor since it is not significance in the Equity index. The interpretation of this might have vague explanatory power. For example, equity hedge funds with long or short shares strategies generally take short position in market portfolio to invest in those firms they believe will beat index. However, the complexity of the investment strategy for each fund where some even might use the market portfolio as a long investment under upturning market makes it hard to draw conclusions on this particular exposure. Moving on, our index has a negative exposure towards the commodity option, which could be an indication that the strategy used by the managers is wider and/or that our sample or model might be incorrect or wrongly specified. Also, it could be a sign that during this time, with a rapid growth in the market and than an equal rapid down turn, manager went beyond their original strategy to achieve higher returns.

The model has an R square of 0.582 and the predictive test confirms that the model is a good estimate for the index return in the period 2005 to 2007. However, when it comes to the predictive return for 2008, the model does not give an accurate picture of what happened. The Chi-square test confirms the result which indicates the model can be incorrect or that the observations in the two periods are generated by different models. This must be compared to the Chow test which says that the parameters do not change over time at 1% significance level (although changes at the other levels).

The new estimated model leaves us with new and different results comparing to above. The commodity option factors have a positive significance exposure on the return of the index and the SMB factor has a negative significance exposure toward the index. A reasonable explanation could be that during 2008 the market was more volatile than in the previous years and as a result the commodity option factor changed sign. A positive exposure to SMB is in line with the finding by Fung & Hsieh 2004. However, the event of 2008 had a negative impact on the explanatory factor. The result can be interpreted as when the financial turmoil hit the markets, the small firms were more vulnerable than the large firms.

Hypothesis 1a The returns of our Swedish hedge fund index do not have any dominant systematic risk exposures

The index showed in fact exposure to several risk factors. Nevertheless the return had a dominant exposure to the equity market and the first hypothesis is rejected.

Hypothesis 2a The estimated model for the Swedish equity hedge funds index can predict return in 2008.

As seen in our analysis, our estimated model for the Hedge fund index was reject and replaced by a new model, therefore, we reject this hypothesis.

When we look at the variables for the Equity based index we find that the negative exposure from the IR option (although small). We believe this can be explain that when equity funds invest in long or short shares strategies they also want to diversify their risk and as a complement invest in another type of assets, as interest rates. Those that have invested a large part of their funds in long/short equities during 2008 have struck hard when the market turned and the market also turned illiquid. Before the crisis struck, it was a huge surge in the market and many managers may have been tempted to take long positions and thus be more exposed to a downturn in the market. On the other hand, those managers that took short positions in the market during the financial turmoil have profit from it. This could also explain the positive exposure towards the 10y Bond factors and the bond option factors since they are positive related to the return of our index, Further on, we feel comfortable with our SMB variable which is an equity based factor but we question the lack of significance of the S&P 500 factor. Going on, our index has a positive exposure towards the commodity option, which could be an indication that the strategy used by the managers is wider and/or that our sample or model might be incorrect or miss-specified. Also, it could be a sign that during this time, with a rapid growth in the market and than an equal rapid down turn, manager went beyond their original strategy to achieve higher returns.

The model we see is good with an R square of 0.582 and the predictive test confirms that the model is a good estimate for the index return in the period 2005 to 2007. However, when it comes to the predictive return for 2008, the model does not give an accurate picture of what happened. The Chi-square test confirms the result which indicates the model can be incorrect or that the observations in the two periods are generated by different models. This must be taken in contrast to the Chow test which says that the parameters do not change over time.

Hypothesis 1b: The returns of Swedish hedge funds with an Equity Strategy have systematic exposure toward the Equity market related risk factors.

According to our analysis we could find evidence that one of the two equity market related risk factors showed a significant exposure towards the equity index. As a result, the hypothesis is rejected.

Hypothesis 2b: The estimated model for the Swedish hedge funds index can predict return in 2008.

Although some test indicated that the model could be incorrect, we find the parameters stable over time for all significance level and therefore we cannot reject the hypothesis.

We have two hedge funds in our sample that are classified Multi Strategy. Our models show that they do not respond to the same variables and have obviously different approaches and strategies.

Banco hedge invest in long/short positions on the Swedish and foreign stock markets and in foreign exchange derivatives in both Sweden and aboard. Very true to this the Banco Hedge model shows a positive exposure from the 10y Bond and Emerging market while the IR Option has a negative exposure. As stated above, we the IR factor could be explained be the same reasoning. We find the exposure towards the emerging market factor interesting since in general the global emerging market performance are generally less correlated with developed markets. As such, they can play a role in diversifying a portfolio. This model had the lowest R square, 0.290. Remember that an R square of 0.3 is acceptable for a hedge fund index we do question the certainty of the variables we have found significant. Even though the predictive test shows that the model is a good estimate for the index return in the period 2005 to 2007 we also see that the model is not a good model for predicting the return of the hedge fund in 2008. On the other hand, the Chi-Square test tells us that this model is correct specified and the result from the dummy test confirms, at 1% significance level, that the parameters are stable over time. Even so, we do believe, due to the low R-square that this model only explain a part of what is contributing the hedge funds' return.

The new estimated model leaves us with new results, a change in the intercept an in the exposure of the 10y bond factor. We interpret the increase in the intercept as an increase in excess return for the hedge fund which could be contributed by several causes. The 10y bond factor has a negative impact on our return which could be explained by that fund invest in bond as a derivative tend to short the long term bond and bet on short term movement.

In the model for GMM, the commodity option has a weak but positive exposure towards the fund. The commodity option could have captured the macro financial effects that were occurring on the global market during this time period, as for example the volatile foreign exchange rates, and therefore affect the return of GMM a hedge fund. The positive exposure from the 10y Bond tells that the hedge funds return to a larger part can be explained by the hedge fund having invested in the bond market. This model has also a low R square value, 0.335, compared with the other models, 0.335.

The predictive test for the models estimations of the return during 2005-2007 confirms that the model can estimate the return. As we seen before, the model shows an inaccurate picture of the hedge funds return during 2008. The Chi-square test confirms the result which indicates the model can be incorrect or that the observations in the two periods are generated by different models. The Chow test tells otherwise and shows that the models parameters are stable over time. The mixed results could indicate that the original model fitted for GMM can be miss-specified.

Hypothesis 1c: The returns of Swedish Hedge funds with a Multi strategy are exposed to risk factors from different classes.

Some of the hedge funds had an option based portfolio risk factor that showed significant exposure towards them and some had not. That concludes that the hypothesis is rejected.

Hypothesis 2c The estimated models for the Swedish Multi Strategy Hedge funds can predict the return for 2008.

As seen in our analysis, our estimated model for the Hedge fund index was reject and replaced by a new model, therefore, we reject this hypothesis.

Looking at our model for Managed Future fund AMDT, we see that S&P 500 has a positive exposure and the commodity option a negative exposure. AMDT generally invest in OMXS30 derivatives and are therefore exploit the movement on the OMXS30 according to fund description. AMDT is based on volatility, the fund performance the best when the stock market is volatile. We are not surprised to see that S&P500 can explain some of the return. Stated in introduction, these types of funds also use commodity futures which justify the exposure from the commodity option. This model has an acceptable R square of 0.353 but to know more about our model we rely on the result from the predicted test which shows. The predictive test as well as the Chi-Square test for the models estimations of the return during 2005-2007 and 2008 confirm that the model is correct specified and give a good estimation of the return. The result from the dummy test confirms the view that the parameters are stable over time.

The model for LYNX shows positive exposure from bond variable, FX option, SMB and ten year bond towards the hedge fund where bond option and FX option goes in line with this type of hedge funds investment strategy. This model has an acceptable R square of 0.342 but to know more about our model we rely on the result from the predicted test which shows that the model is a good estimate for the hedge fund return during the period 2005-2007. Opposite to AMDT, the model cannot give an accurate prediction of the hedge funds return during 2008 which is interesting. The graph over return tells us that LYNX was the best performing fund during 2008.

We do not know much more about the specific exposure, both the Chi-Square and the Dummy test tell us that the model under 2005-2007 should have a reasonable good explanation to the model under both periods. Theoretically, option strategies should benefit from volatile times and the exposure to bond option ant FX option might explain some of the return. In general we cannot draw any conclusions that explain this growth from our study other than suggest that fund management put their bets right.

Hypothesis 1d: The returns of Swedish hedge fund with a Managed Futures strategy have systematic exposure to option based risk factors.

Once again it is proved that the funds are exposed to some of the factor but not in a way that is significant enough for us to accept the null hypothesis. The hypothesis is once again rejected.

Hypothesis 2d: The estimated models for the Swedish Managed Futures Hedge funds can predict the return for 2008.

Although some test indicated that the model could be incorrect, we find the parameters stable over time for all significance level and therefore we cannot reject the hypothesis.

For the Fixed Income fund the positive exposure towards the 10y bond and SMB can be interpreted in several of ways. The managers or Excalibur comments that the fund did forecast the ongoing financial turmoil based on their macroeconomic timing indicators (Excalibur 2009-11-02). With its management of positions in highly liquid and creditworthy segments of the fixed income markets results were derived from exploiting spreads between government markets, between government yield and swap yield curves, from expected changes in the shape of individual yield curves and from market developments in short rate. This explain why we have a positive exposure towards ten year bond and SMB in the first period. We also believe this strategy support the negative exposure of the stock option. The positive exposure towards the 10y bond as well as the bond option goes in line with the strategy of the hedge fund. Even though we feel our model explain the return for 2008 fairly well (R square of 0.452), as the other model, the return is not as volatile as it was during 2008. The predictive test confirms that the model is a good estimate for the hedge fund return in the period 2005 to 2007 also according to the Chi-Square test we cannot however reject the null hypotheses at 10% significance level. The result support that the model is correctly specified and that the observations in the two periods are generated by the same model. Although, the Chow test show that at least one parameters of the model is not stable over time. The estimated new model shows that the bond option factor and SMB factor have a negative exposure towards our fund. This might indicate a shift in strategy.

Hypothesis 1e The returns of Swedish hedge funds with a fixed income strategy have systematic exposure toward the interest rate related risk factors.

Also in this category of hedge fund, only one hedge funds' return could be explained by our model and that model lacked the credit spread factor. Therefore, we have to reject this hypothesis.

Hypothesis 2e The estimated models for the Swedish Fixed income Hedge funds can predict the return for 2008.

As seen in our analysis, our estimated model for the Hedge fund index was reject and replaced by a new model, therefore, we reject this hypothesis.

6.4 Discussion

Looking at the result above and together with the findings from the analysis it has become apparent that most hedge funds correlated with the market in 2008. Of course one explanation is that the financial turmoil hit in several of markets, industries and countries. One other possibility is that after the financial crises in the beginning the 2000th which was followed a long boom which has high yields and returns on stocks and hedge funds had a difficulty in matching those returns. And therefore could it be that several of hedge funds had taking long positions, which struck hard in the financial turmoil. Hedge funds are largely affected by the liquidity situation on the financial markets. To use leverage is a natural and important part of a hedge funds strategy and survival. The financial crisis has decreased the leverage in all financial markets. Since hedge funds are particular dependent of being able to borrow capital to fund themselves, this most certain has had an effect on the return of the hedge funds. Hedge funds that have the highest liquidity risk are hedge funds with interest rate arbitrage and convertible arbitrage. In our sample, we have not a single hedge fund classifies with these strategies. Since the strategies can change during time, it could be that out sample have had some exposures towards this segment after all. Another factor that might explain the hedge funds performance during 2008 is the risk premium. During normal circumstances, hedge funds get a premium when they take on credit risk, tenor risk and liquidity risk. These risk premiums are a large part of the hedge funds excess return. The higher risk premiums could not fully compensate for the losses that the hedge funds did during 2008. Many hedge funds generated excess return during 2001-2003 by diversifying their portfolios with real estate and commodities. Nevertheless, during this current crisis, investors have become more unwilling to take on risk and have decreased their leverage in their portfolios by selling assets. As a result, this has decreased the prices on almost all asset classes, including commodities and real estate, which has taken away

the positive effects of the diversified hedge funds that have exposure towards these classes. So what was considered a good and safe investment a couple of years ago has become useless during 2008, since the diversification has been reduced. It might not be that the hedge funds in our sample have had a large exposure towards a few variables or segments. It could be that the hedge funds in our sample, particularly the ones with less capital, have become a victim for this type of affect.

Our original thoughts were to examine a general model for the hedge fund return corresponding to the composed index. However we then extended the model to more closely follow the Fung & Hsieh structure and findings regarding the factors. Although we had a small sample of the Multi Strategy, Managed Future and Fixed income funds we were curious to find out if these could be explained to be exposed to the factors found in Fung & Hsieh. Our sample is exposed to some limitations. One of them is the way the models are analysed; we wanted to use statistical models while the small sample would benefit from a qualitative analysis regarding the way the fund was traded over the period. Furthermore, is that the explanatory factors we use are global factors. Combining the previous limitation a more qualitative approach for the hedge fund with available data could suggest a regression with the exact corresponding variables. This is a suggestion for further research.

7. Conclusion

The purpose of this thesis has been to contribute to an increased understanding of how Swedish hedge funds perform during volatile times. More precisely the study has aimed to explain the performance of Swedish hedge funds during 2008. We performed regression for the pre-crisis period and compared the model for 2008. Following Fung-Hsieh risk factors on a Swedish sample we aimed to understand the factors that affect the various strategies. Suffering from a small data set the quantitative analysis was not sufficient to give a general understanding and statistically significant results.

We did conclude that four of the seven models seemed to have stable parameters over time where the model used during the boom market conditions also could explain the hedge fund return throughout the crisis. Excalibur was the only hedge fund that the parameter were assumed to change over time when testing for all significance levels. The exposure towards bond and SMB gives economical sense though we have reason to believe that the return could have more explanations.

In general, both the hedge fund index and the equity hedge fund index show exposure towards some equity market factors. The fact that the indexes show similar exposure can be explained by the hedge fund index is composed by a large fraction of equity hedge funds. However, the fact that equity hedge fund index are not exposed towards S&P 500 display a potential weakness in the index models.

Out of our ten hypotheses we could only accept two. We conclude that we could not, using the Fung and Hsieh factors create sufficient models that could explain the true factors of return for the seven Swedish hedge fund classes that we looked at.

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Databases

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Six Edge

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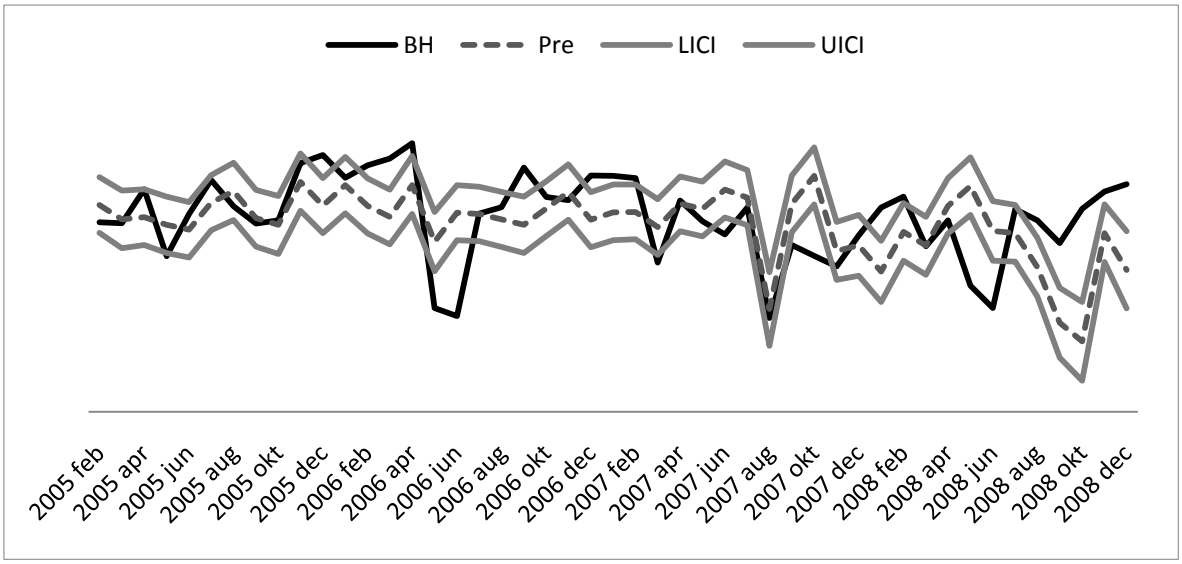
Appendix

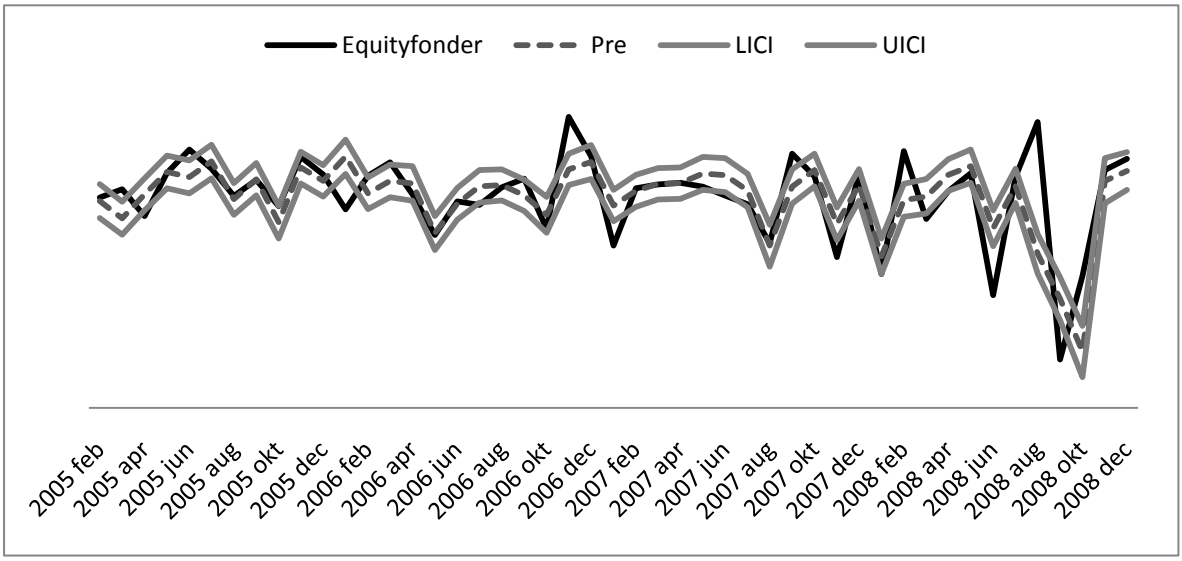
Table 0-1 The Hedge Funds' strategy and asset/capital in portfolio management of our sample.

Notation	Fund	MSEK	Classification
AAG	Aktie-Ansvar Graal	11876	Equities
CAT	Catella Hedgefond	8165	Equities
EIKOS	Eikos	4609	Equities
RAM	RAM ONE	4087	Equities
Nordea	Nordea European Equity Hedge Fund	2487	Equities
HB	Handelsbanken Hedge Selektiv	1001	Equities
CON	Consepio	978	Equities
EP	Erik Penser Hedgefond	945	Equities
STELLA	Stella Nova	918	Equities
EDGE	Edge	867	Equities
DnB	DnB NOR Aktiehedgefond Primus	313	Equities
EXPL	Explora	103	Equities
CIE	Cicero Hedge	21	Equities
SEB	SEB Hedge Fixed Income	4515	Fixed Income
EXCAL	Excalibur	594	Fixed Income
ABN	ABN Amro Penningmarknad Plus	156	Fixed Income
LYNX	LYNX	1162	Managed Future
AMDT	AMDT hedge	82	Managed Future
SHEP	Shepherd Energy Fund	17	Managed Future
BH	Banco Hedge	557	Multi Strategy
GMM	GMM a	33	Multi Strategy

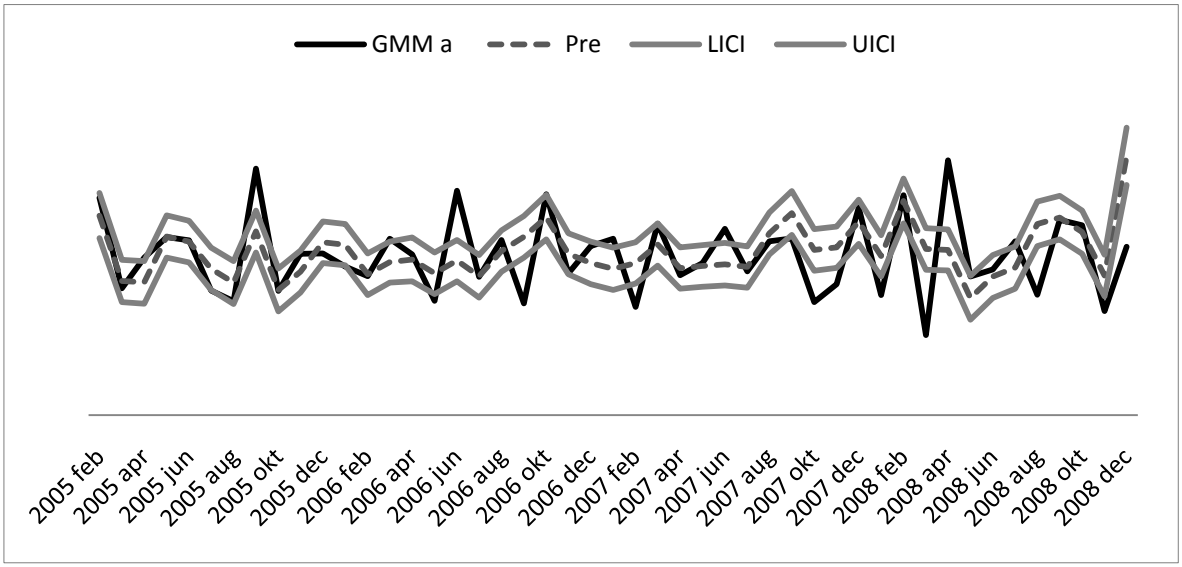
All hedge funds in the sample, the notation in the left column is the one that will be used throughout this paper. In the second column the managing firm is listed. The total managed value is listed per June 2009 and the classifications are taken form Hedge Nordic.



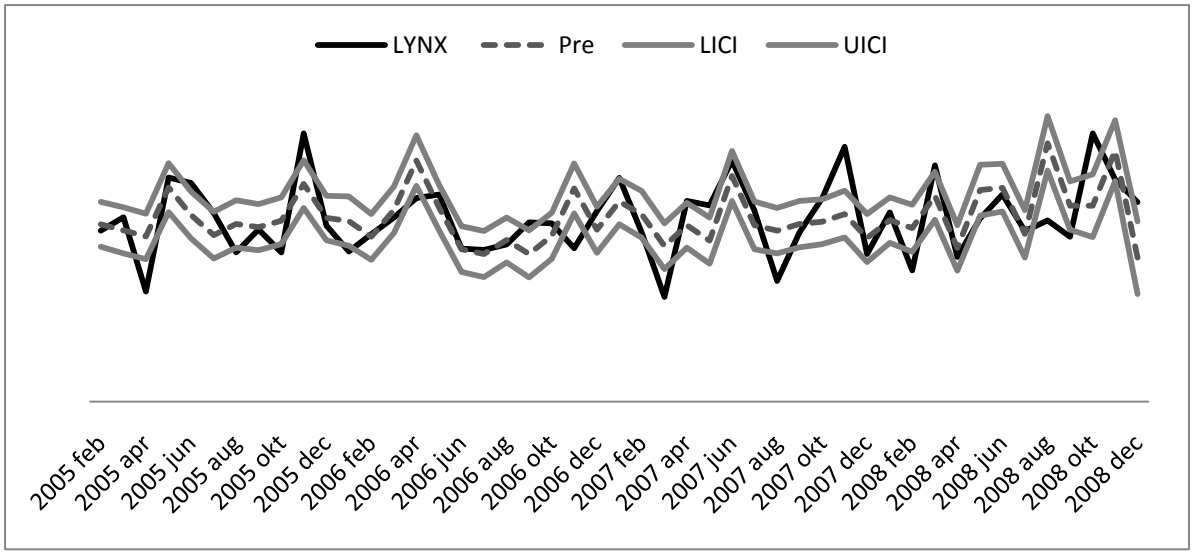
Graph 0-3 Prediction interval for Banco Hedge



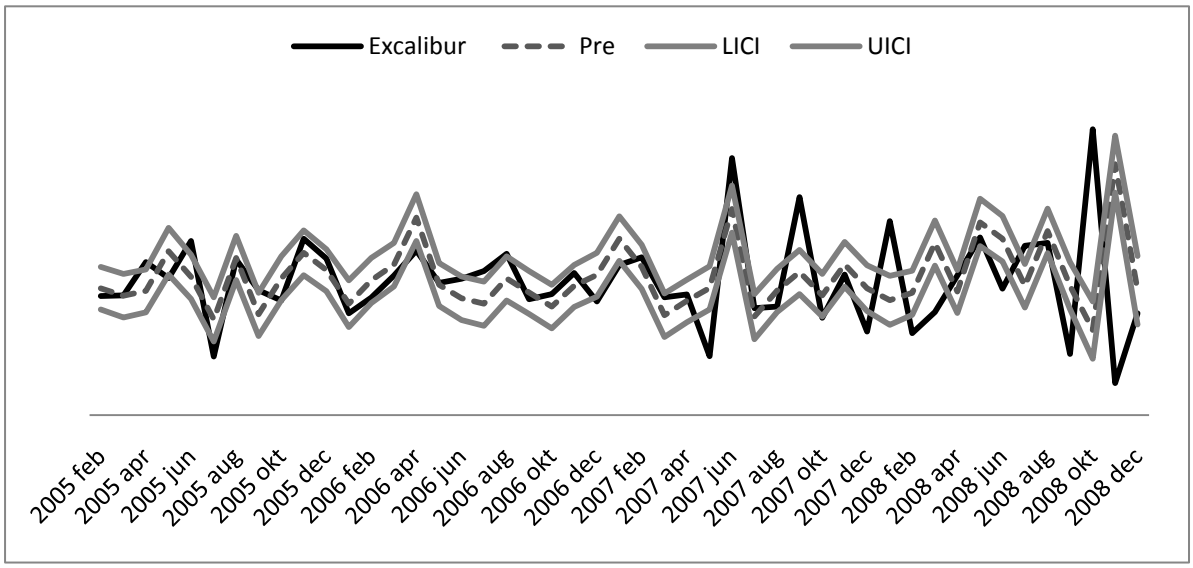
Graph 0-2 Prediciton interval for Equity HF



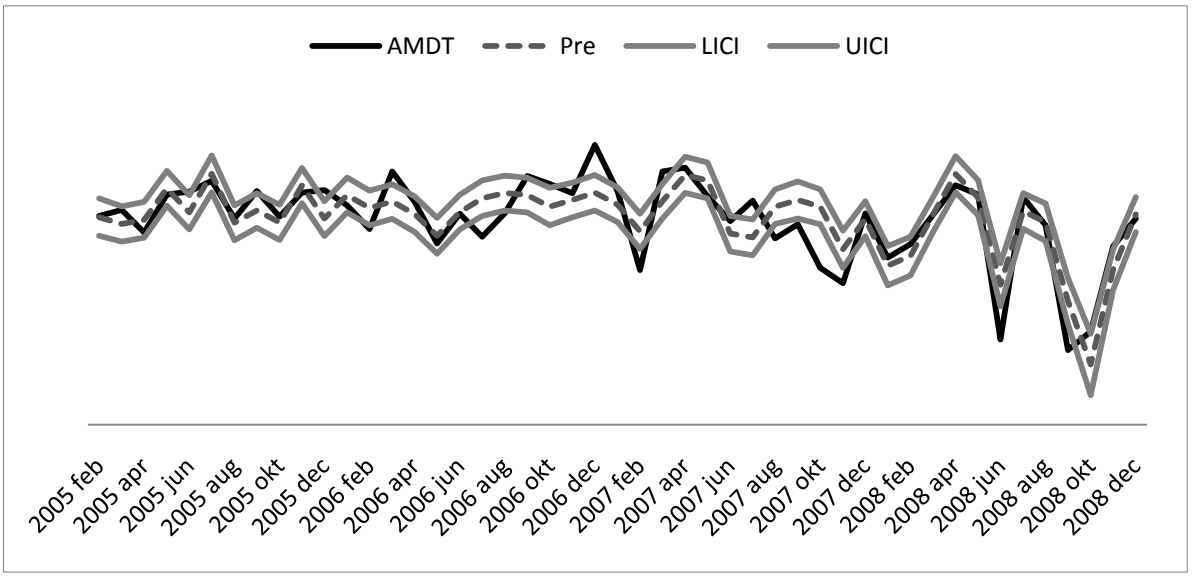
Graph 0-1 Prediciotn interval for GMM



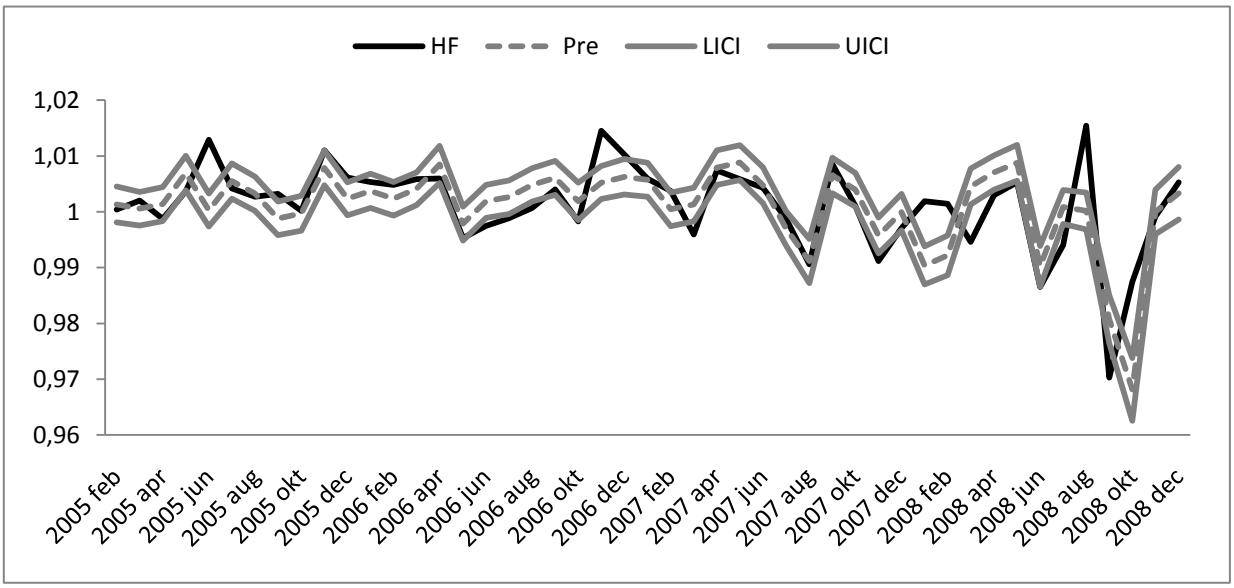
Graph 0-5 Prediciton intervals for LYNX



Graph 0-4 Prediciton intervals for Excalibur



Graph 0-6 Predition interval for AMDT



Graph 0-7 Prediction interval for HF index

Table 0-2 Complete table over the seven hedge fund models

The graph show a summary for all of the seven models tested in this paper. The models are classified, see first row, by four categories that except for the Indexes follow the notation of Nordic Hedge Fund Index. The explanatory variable in the first column are the same variable Fung & Hsieh uses in their 2004 paper. The exposure are summarized by each hedge fund and correspond to the values in each column. Standard errors are within the parentheses. The two last row gives the obtained R square values for the models.

	INDEX		Multi-Strategy		Managed Futures		Fixed Income
	HF	Equity HF	BH	GMM	AMDT	LYNX	Excalibur
Constant	0,841 (4,082)***	0,941 (1,759)***	0,829 (7,716)***	1,203 (6,860)***	0,804 (4,872)***	0,702 (14,658)***	0,872 (5,396)***
Bond Option	0,021 (0,738)***	0,011 (0,806)				0,114 (6,560)*	0,085 (2,379)***
FX Option						0,087 (4,001)**	
Commodity Option	-0,009 (0,481)*	-0,016(0,565)***		0,051 (2,095)**	-0,012 (0,697)*		
IR Option	-0,005(0,174)***	-0,003 (0,195)*	-0,010 (0,568)*				
Stock Option							-0,040 (2,381)*
S&P 500	0,129 (3,456)***				0,198 (4,841)***		
SMB	0,086 (3,597)**	0,050 (3,808)				0,641 (31,160)**	0,208 (11,309)*
10Y Bond	0,034 (1,161)**	0,061 (1,712)***	0,085 (4,923)*	-0,203(6,857)***		0,312 (14,624)**	0,132 (5,370)**
Credit Spread							
Emerging Market			0,087 (4,407)*				
R Square	0,582	0,582	0,290	0,335	0,353	0,342	0,452
Adjusted R	0,493	0,493	0,222	0,294	0,312	0,255	0,379

Note: Significance level 10%/5%/1% is indicated by *//*****

Table 0-3 The complete data for the seven hedge fund models including dummy variables for structural changes in the post sample period

The graph show a summary for all of the seven extended models tested in this paper. The models are classified, see first row, by four categories that except for the Indexes follow the notation of Nordic Hedge Fund Index. The explanatory variable in the first column are the same variable Fung & Hsieh uses in their 2004 paper extended with the values for 2008 by using a dummy variable method. The exposures are summarized by each hedge fund and correspond to the values in each column. Standard errors are within the parentheses. The two last row gives the obtained R square values for the models.

	INDEX		Multi-Strategy		Managed Futures		Fixed Income
	HF	Equity HF	BH	GMM	AMDT	LYNX	Excalibur
(Constant)	0,841 (0,055)***	0,940 (0,027)***	0,829 (0,075)***	1,203 (0,083)***	0,804(0,050)***	0,702 (0,145)***	0,872 (0,065)***
Bond Option	0,021 (0,010)**	0,011 (0,012)				0,114 (0,065)*	0,085 (0,028)***
FX Option						0,087(0,040)**	
Commodity Option	-0,009 (0,007)	-0,016 (0,009)*		0,051 (0,025)*	-0,012 (0,007)		
IR Option	-0,005(0,002)**	-0,003 (0,003)	-0,010 (0,006)*				
Stock Option							-0,040 (0,029)
S&P 500	0,129 (0,047)***				0,198 (0,050)***		
SMB	0,086 (0,049)*	0,050 (0,058)				0,641 (0,308)**	0,208 (0,136)
10Y Bond	0,034 (0,022)		0,085 (0,048)*	-0,203 (0,083)**		0,312 (0,144)**	0,132 (0,065)**
Emerging Market		0,061 (0,026)**	0,087 (0,043)**				
D	-0,083 (0,082)	0,010 (0,053)	0,232 (0,133)*	-0,132 (0,113)	0,011 (0,060)	0,058 (0,195)	0,021 (0,098)
D_BondOption	0,006 (0,016)	0,003 (0,018)				0,064 (0,102)	-0,155 (0,044)***
D_FX						-0,090 (0,062)	
D_Commodity	0,051 (0,016)***	0,037 (0,022)		-0,020 (0,043)	-0,005 (0,012)		
D_IR	-0,014 (0,008)*	-0,006 (0,013)	0,015 (0,014)				
D_StockOption							0,029 (0,0625)
D_S&P	0,034 (0,064)				-0,012 (0,060)		
D_SMB	-0,296 (0,103)***	0,025 (0,101)				-1,412 (0,530)**	-0,800 (0,292)***
D_10Ybond	0,053 (0,037)		-0,159 (0,070)**	0,128 (0,114)		-0,055 (0,196)	-0,018 (0,098)
D_Emerging		-0,011 (0,052)	-0,078 (0,084)				
R Square	0,672	0,561	0,320	0,247	0,678	0,424	0,518
Adjusted R Sqare	0,542	0,423	0,198	0,155	0,639	0,284	0,401

Note: Significance level 10%/5%/1% is indicated by *//*****