UNIVERSITY OF AGDER
SCHOOL OF BUSINESS AND LAW

# Norwegian Mutual Funds

A Study of 18 Norwegian Mutual Funds and Their Performance During the Period 1997-2013

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*This master's thesis is carried out as a part of the education at the University of Agder and is therefore approved as a part of this education. However, this does not imply that the University answers for the methods that are used or the conclusions that are drawn.*

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# Abstract

In this study I have analysed 18 Norwegian mutual equity funds during the period 1997-2013. All of the mutual funds are registered at the Oslo Stock Exchange as of December 2013. The purpose of the study was to analyse the performance of these funds, and find whether or not the funds were able to outperform their benchmark, both for the whole period and for shorter periods during the 17-year sample period. By dividing the whole period into shorter periods I have evaluated the mutual funds during periods of bull and bear markets. I wanted to see if there exists a connection between different stock market cycles and mutual funds excess return.

Using linear regression and calculation of three well-known performance measures, the Sharpe ratio, the $M^2$ measure and the information ratio, I have evaluated the mutual funds performance through the research period. Both the linear regression and the performance measures evaluate the mutual funds against a benchmark index, and in my research I have data from the Oslo Stock Exchange Mutual Fund Index (OSEFX).

Based on the regression analysis and the performance measures I have ranked the mutual funds. When not taking any risk measures into account, an equally-weighted portfolio of all my mutual funds had lower total return than OSEFX. However, individually 50% of the funds showed higher total return than OSEFX. When adjusting for risk, using performance measures, there were both mutual funds outperforming and underperforming OSEFX. However, in the calculations of both risk-adjusted and clean return-based measurements the highest ranked mutual funds based on one measure seemed to repeat and rank high in other measurements as well. When analysing the shorter periods, the results were not as consistent. Outperforming OSEFX in periods of upswing did not necessarily imply outperformance of OSEFX in periods of recession and vice versa.

From the regression analysis I cannot conclude that the funds have significant alpha values, and therefore no significant risk-adjusted excess return. However, based on the performance measures and excess return some of the funds did beat their benchmark.

## Acknowledgements

This master thesis is the final part of a Master degree program in Financial Economics at University of Agder, Kristiansand.

The main subject for my thesis is an analysis of performance of Norwegian mutual funds. I want to see if the mutual funds are able to beat their benchmark, and in addition analyse their performance during bullish and bearish stock market cycles.

I want to thank my supervisor Steen Koekebakker for valuable guidance and constructive criticism leading to this thesis. I will also thank Truls Henrik Hollen at Oslo Stock Exchange Information Services for providing me with all the data I needed.

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# 1 Introduction

## 1.2 Motivation

In the field of investments, the never-ending discussion for investors is whether to buy active or passive managed securities. Ever since the first Norwegian mutual funds were established, the question of whether the portfolio managers outperform their benchmark index or not have been asked. Are the stock pickers (active portfolio managers) deserving the management fees and producing higher returns than the significantly cheaper passive managers?

In this thesis I have chosen a sample of Norwegian mutual funds with low minimum investments. The purpose of this is to evaluate the mutual funds that are available and investable for ordinary people. Even though historical returns and performance is no guarantee for future performance, it might be a useful guide when deciding where to invest.

This is why I wanted to do my research on this subject; both for scientific reason but also as a practical guide to private investors. I simply want to learn more about investments in mutual funds, compare active managed funds with their benchmarks, and try to figure out if it is worthwhile to pay for stock picking.

## 1.2 Research Question

I have chosen to focus on the period 1997-2013. In this period I want to analyse and evaluate the performance of my chosen sample of Norwegian mutual funds.

The evaluation is based on regression analyses and performance measures. The mutual funds are compared to a benchmark with the purpose of finding excess return of the funds relative to the benchmark. The goal is to find whether it is active or passive management that yields the highest returns and if the funds are able to outperform their benchmark. Based on the estimates from the regression analyses and the calculations of the performance measures, I will rank the funds and find which fund would have been the optimal investment choice in 1997.

In addition, I want to analyse the performance of my sample of mutual funds during different cycles in the stock market during my period of research. I will look at how the mutual funds

perform during bull and bear markets, and whether they manage do generate excess return in both kinds of business cycles. How do they perform compared to their benchmark index?

## 1.3 The Structure of the Thesis

This thesis is divided into 6 chapters. Chapter 2 gives a description of the mutual fund market, the importance of indices and an investor's decision of passive or active management. In chapter 3 I give a presentation of bull and bear markets, and define the periods of bull and bear I use in my study. Chapter 4 is a theoretical chapter describing the theories underlying the practical research. I also present the different performance measures used to compare the funds against each other and to their benchmark. In chapter 5 I describe the data I have used including justifications of the funds I chose to do the research on, and the choice of a relevant benchmark. The chapter also includes all my empirical results, both for the whole period and for the periods of bull and bear market. In the end of chapter 5 I rank the funds based on the previous results, trying to determine which fund had the best performance. Finally, I sum up and conclude from the results I have found during the study in chapter 6.

# 2 Funds and Indices

## 2.1 Norwegian Mutual Funds

A mutual fund is a business that receives capital from investors and savers, and then invests the capital into different kinds of securities. The Act on securities funds regulates this type of business in Norway. The Act on securities funds (2011) §1-2 defines a mutual fund as:

> *"Securities fund: an independent body of assets essentially comprising securities deriving from deposits of capital from an indefinite range of participants."*

There has been a sharp growth in the number of Norwegian mutual funds over the last decades. The first Norwegian mutual fund was established in 1981 (Nordea, 2015a), and ever since, we have seen an increasing interest for mutual funds, from both institutional investors and private savers. In my research I will not go all the way back to 1981, but look at the period 1997-2013. The reason for choosing this period is both due to availability of data, a sufficient number of funds with long enough performance history, and also the fact that the period is long enough to observe fund performance both through upswings and downswings in the stock market.

There are several types of mutual funds traded at the Oslo Stock Exchange (Hegnar.no), and their risk and return profile are shown in figure 1:

i) Equity mutual funds
ii) Money market funds
iii) Bond funds
iv) Balanced funds

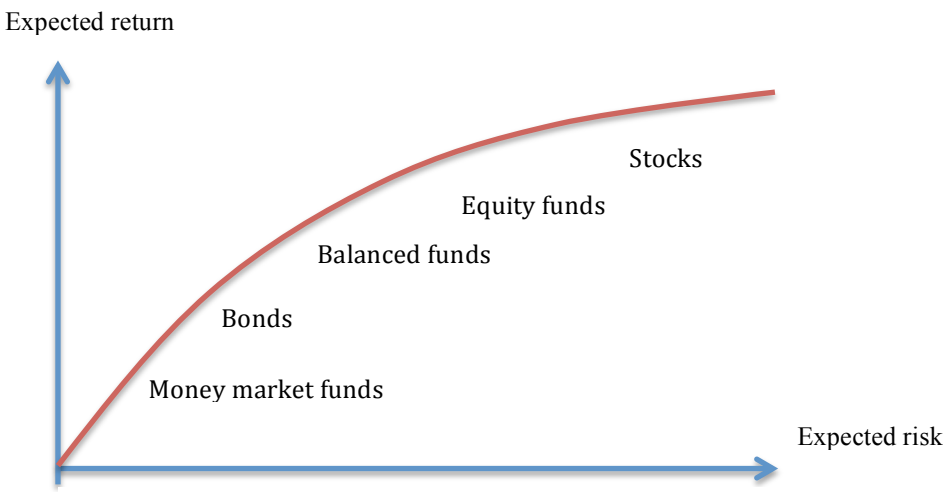


Figure 1 Risk and return profiles for securities

### 2.1.1 Mutual Equity Funds

In my study, I will discuss only mutual equity funds, more specifically Norwegian equity funds. Equity funds are the most common fund product in the universe of mutual funds. These are funds where 80-100% of the capital is invested in the stock market. An equity fund must consist of a minimum of 16 different stocks (Morningstar, 2003), but in practice we see that the portfolios consists of a larger number of stocks. In the long run one can expect higher returns through savings in an equity fund than saving in a balanced fund or a money market fund. Meanwhile, as the risk is higher, one must be prepared to experience higher volatility. However, by a long investment horizon, there are strong scientific evidence that prices increase more than they decrease (a. n. Verdipapirfondenes Forening).

Mutual equity funds are divided into different subgroups related to geographical areas and different sectors of the market. The subgroups are classified by different criteria, and these are the most important criteria (Verdipapirfondenes Forening, 2012a):

i) There must be at least five funds within the same category for a group to be established.

ii) For a fund to be classified within a group it must have at least 80% of the funds assets exposed within the investment universe the group belongs to.

iii) For geographically classified groups the investment universe is restricted to only equity instruments listed on the stock exchange in that particular geographical area.

An investment universe can be geographically restricted, such as a Norwegian equity fund or a European equity fund, sector restricted or a combination of these.

### 2.1.2 Money Market Funds

A money market fund places the investors capital in money market instruments and certificates, to achieve higher return than by traditional bank deposits. Such funds invest in short-term securities and fixed income instruments, and they cannot invest in fixed income securities where the maturity exceeds one year. There are three different types of money market funds; money market funds with low risk, money market funds and international money market funds. The criteria to be placed in a certain classification of money market funds consists mainly of the funds interest rate sensitivity and the funds weighted average

maturity (Verdipapirfondenes Forening, 2012b). A funds interest rate sensitivity describes how the funds price change when there is a percentage change in the funds investments. The lower interest rate sensitivity, the lower risk the fund faces. The funds weighted average maturity is defined as the weighted average time until the cash flow of the loans included in the funds portfolio is repaid. In a low risk money market fund the weighted average maturity must be less than one year, and in a money market fund the weighted average maturity must be less than one and a half year.

### 2.1.3 Bond Funds

A bond fund invests the capital in bonds. As with a money market fund a bond fund invest in fixed income securities, but without the duration requirements. Bond funds have higher risk related to changes in the interest rates than money market funds (a. n. Verdipapirfondenes Forening). Due to the higher risk, one can also expect higher returns than you can expect with a money market fund. The longer maturity the fixed income securities have, the higher expected risk. Bond funds are divided into subgroups reflecting how long the maturity of the fixed income securities are, which reflects the funds interest rate sensitivity relative to the benchmark index.

There are also other kinds of fixed income funds that invest in different kinds of securities with higher risk related to credit risk. This category is often called “high yield” bonds or “junk” bonds.

### 2.1.4 Balanced Funds

A balanced fund is a fund combining investments in the stock market and in the money market. The allocation between stocks and interest rates in a balanced fund varies between funds, but it can also vary inside the fund. The risk in a balanced fund will depend on the allocation between bonds, interest rates and stocks. The larger share of stocks in the fund, the higher risk and higher expected return. Similar to an equity fund, balanced funds are classified according to the investment universe the fund will invest within. There are three main subgroups of balanced funds (a. n. Verdipapirfondenes Forening):

1. Norwegian balanced funds where the fund must consist of at least 80% Norwegian securities.
2. International balanced funds that have an international mandate.

3. Life cycle funds; a classification indicating that in the start of the funds life, the proportion of stocks in the fund are high, while later in the life cycle the fund increases the proportion of bonds and fixed income securities. The reason is to reduce the risk, as investors want to redeem their shares of the fund.

## 2.2 Indices

A stock market index is the measurement of a selection of stocks representing certain geographies, sectors or categories of listed companies. The goal of an index is to as accurate as possible reflect the risk and return profile of a specific investment universe without necessarily containing all stocks in that specific universe in the index (FTSE, 2015). This is why we call an index a representative for a certain market. The purpose of an index is both to provide a representative picture of the movements in average market values, and also to be used as a benchmark for investors to measure their performance against. Active managers seek to outperform their benchmark index, whereas at the same time pay attention to the risk their portfolio faces versus the index´ risk. The most known indices today are MSCI World Index, The Dow Jones Index, the S&P 500 and Nikkei 225. Over the years, several new indices have been established along with the development of new markets, technologies and sectors.

It would be both expensive and time consuming for a single investor to invest in all stocks existing in a market or an industry. This is why indices are also practical for investment purposes. In the market place you can find different products (funds, ETF´s, futures, options), which replicate indices making it both convenient and cheap for investors to be able to efficiently get market exposure and follow the trends in selected markets.

By 20.03.2015 there existed 72 different indices at Oslo Stock Exchange which each represent a different investment universe (Oslo Børs, 2015a). The Norwegian indices are divided into three groups; indices containing stock listed at the Oslo Stock Exchange, indices containing stocks listed in Oslo Axess and indices containing stocks listed on both the Oslo Stock Exchange and Oslo Axess. Stocks listed in the Oslo Stock Exchange are typically large companies with a long history and a large shareholder base. In Oslo Axess smaller companies can get listed at an authorized and regulated market place and achieve the benefits this provides, such as liquidity and financing. As a curiosity, the Oslo Stock Exchange is

launching a new index these days. The index will consist of medium sized companies and is called Oslo Stock Exchange Mid Cap Index (OSEMX). The launch date is June 1 2015.

There are many indices at the Oslo Stock Exchange, and I will now present the most important ones. The information is retrieved from the Oslo Stock Exchange (Oslo Børs, 2015b):

- Oslo Stock Exchange Benchmark Index (OSEBX) is an index holding a representative sample of all stocks listed at the Oslo Stock Exchange. The purpose of this index is to represent the overall movements at the Oslo Stock Exchange. The value growth of this index is an appropriate representative to show the overall growth in the Norwegian equity market. From 1997 to 2013 OSEBX increased its value by 243%. In chapter 5.8.1 I will see how this compares to the funds and to the funds benchmark index.
- The Oslo Stock Exchange OBX Index (OBX) consists of the 25 most traded stocks at the Oslo Stock Exchange. The most traded stocks are based on six months turnover rating. The index is tradable and offers both futures and options.
- The Oslo Stock Exchange All Share Index (OSEAX) includes all shares listed on the Oslo Stock Exchange.
- The Oslo Stock Exchange Mutual Fund Index (OSEFX) is a weight-adjusted version of OSEBX. The weight adjustments happen according to the UCITS requirements for mutual fund investments. One security cannot hold more than 10% of total market value in the index, and securities holding more than 5% of the market value cannot exceed a total of 40% of the index´ total value.

## 2.3 Active or Passive Management?

At the Oslo Stock Exchange there exists both mutual funds that are actively and passively managed. A common strategy for passive management is to invest in an index fund, and these mutual funds seek to match the performance of a specific index. An example of an index fund is the Vanguard 500 Index Fund, and this fund replicates the composition of the Standard & Poor´s 500 stock price index (Bodie, Kane, & Marcus, 2011). An index fund buys shares included in the market index in proportion to each security´s representation in the index. By investing in an index fund you achieve a low-cost passive investment strategy, without engaging in security analysis.

When a manager has an active management strategy he seeks to outperform the broad market represented by an index. The managers try to do this by predicting the future market movements and then pick the right stocks and the right proportion of the individual stocks for the mutual fund to hold. For the mutual fund to be able to create excess return relative to its benchmark index you either need a good portion of luck, information about the market that the other market participants does not have or an exceptional ability to pick the right stocks at the right time (Sørensen, 2009). I will revisit Lars Qvigstad Sørensens research results in chapter 5.7

Active managed mutual funds are more expensive to buy than index funds because of the management fees. Therefore, the managers have to deliver return for the mutual funds that both exceed the index return and the management fees. The average management fee in my sample of Norwegian mutual funds is 1,49%. This means that on average in my sample, the active managed mutual funds have to outperform the benchmark index by more than 1,49% to create excess returns.

# 3 Bull and Bear Markets in the Norwegian Stock Market

## 3.1 Bullish and Bearish Markets

In my research I want to find whether active managed mutual funds did or did not outperform the index during upswings and downswings in the Norwegian stock market. Do active managed mutual funds outperform the index in bullish markets or bearish markets?

Both in individual mutual funds and in different markets there are large variations in the price. These movements may vary from day to day, but there also exists trends in the market, in specific sectors or in geographic areas. Trends usually last for a longer period of time and may affect the whole market. Financial crises or strong growth in a country´s economy can lead to a bullish or bearish stock market. A stock market in an upward trend is called a "bull/bullish market", and when the market is declining over a longer period of time we say that we have a "bear/bearish market" (Oslo Børs, 2007). A bearish market represents pessimism and decreasing values in securities, and a bullish market represents optimism and increasing values.

## 3.2 Bull and Bear Markets in Norway Between 1997-2013

The market movements in Norway in the 17-year period between 1997-2013 have been influenced by both international and national circumstances. To spot the upward and downward trends in the stock market we have to look at indices representing the whole Norwegian market. As mentioned in chapter 2.2 OSEFX is a weight-adjusted version of OSEBX, and it is therefore suitable to discover movements in the market.

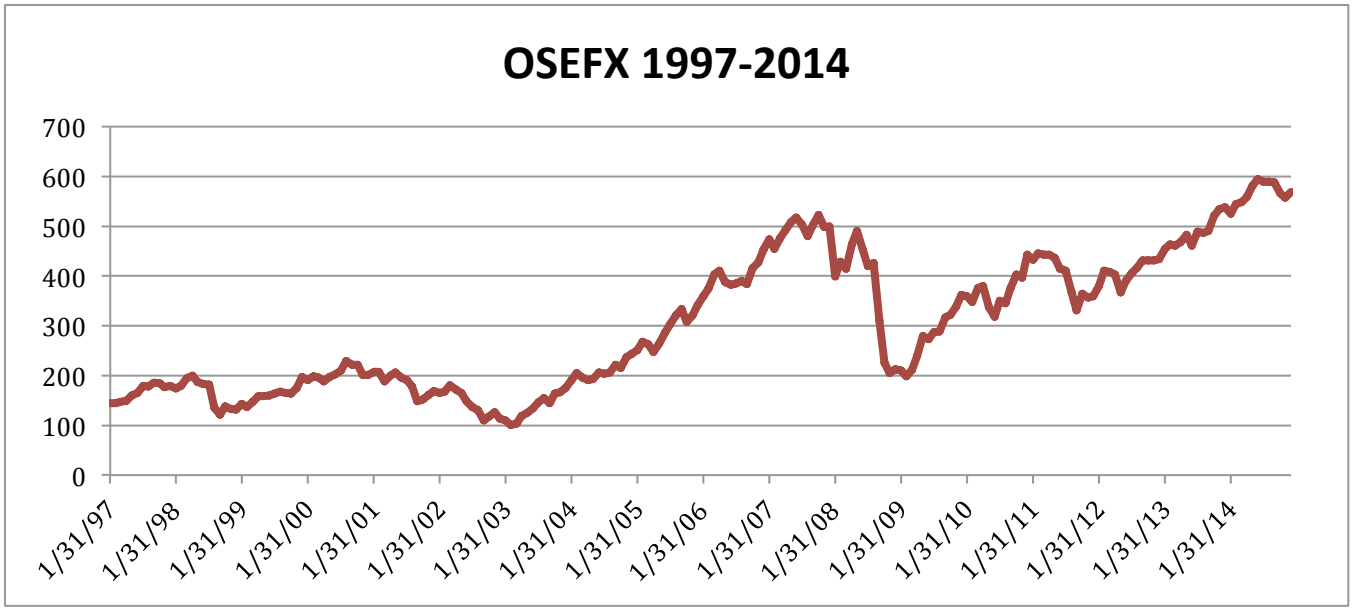


**Figure 2 Net asset values for Oslo Stock Exchange Mutual Fund Index**

Figure 2 shows the development of OSEFX from 1997 to 2014. This index is the benchmark index to all the active managed mutual funds I use in my research except one, and the index movements would therefore both reflect the overall movements in the Norwegian stock market and in the mutual fund market.

During the 17-year sample period the Norwegian stock market has experienced both bullish and bearish markets. These periods affect how investors behave, and the movements in the Norwegian stock market are affected by both national and international macroeconomic influences. Throughout the 17-year sample period, the movements in the Norwegian stock market may have been affected by the "dot.com bubble" (Madslien, 2010), strictly increasing housing prices in both the Norwegian housing market and on an international level (Larsen & Mjølhus, 2009), and the financial crisis affecting markets globally. Further on in my research I want to see how these macroeconomic factors affect the Norwegian stock market, and whether active portfolio managers are able to outperform their benchmark index in bullish and bearish markets. The periods I want to examine are:

- The bear market from 2000 to 2003 when the "dot.com bubble" burst.
- The bull market from 2003 to 2007 represented by increased housing prices and low interest rates.
- The bear market from 2007 to 2009 when the financial crisis was a fact.
- The bull market from 2009 to 2013 with global growth and financial recovery.

# 4. Theory

## 4.1 Modern Portfolio Theory

The modern portfolio theory was introduced by Harry Markowitz (1952) and is a theory describing how investors can construct portfolios to either optimize or maximize their expected return given a level of risk (Markowitz, 1952). The modern portfolio theory shows how to select a portfolio, done in two stages. In the first stage the investor observe, experience and form believes about securities future performance. The second stage is when the investor uses his believes about future performance to choose a portfolio. When choosing a portfolio, the theory of diversification is inevitable.

When you invest in a mutual fund you diversify your portfolio. The risk is spread over several single stocks, and this will decrease your unsystematic risk. Your sensitivity to a price drop in one single stock is decreasing when you invest in several other stocks. The theory of diversification is represented by mean-variance frontiers. The mean-variance frontier shows the best set of portfolios that you as an investor can have with respect to risk and return (Ang, 2014). Though, this frontier only considers means and volatility. The mean-variance frontier shows how to balance your portfolio with two assets to optimize it with respect to volatility and expected return. The optimal diversification strategy, the weights to each of the assets, is called the minimum variance portfolio.

Often you will see by holding two assets in your portfolio instead of only one will give you what is called diversification benefits. Owning an amount of both assets will protect you from a disaster if one of the assets is lost. This diversification benefits imply that we should not only consider assets alone and isolated (Markowitz, 1952). We need to know how assets behave together. Mutual funds are exploiting this advantage of diversification, not only by dividing between two assets, but also by investing in 20-50 different assets. The main goal of the managers of these funds is to maximize the returns and minimize the risk. By investing in assets where the returns are not perfectly correlated, you decrease the risk. Lets say that an oil company and a renewable energy company do not have perfect correlation. If the oil company performs well, the renewable energy company may perform badly and vice versa. Since you have invested in both assets, you will probably never loose your whole investment, because when one of the stocks fall, the other will either not fall as much or possibly increase in value.

If one of the stocks increases in value when the other stock falls, we say that the stocks are negatively correlated.

The diversification benefits are measured by covariance or correlations. When you want to exploit this benefit, you want to have as low correlations between the assets as possible. Low correlations means in this case low portfolio variance. When we are dealing with only two assets, it means that asset A is more likely to pay off when asset B is not doing so well. We say that the insurance value of asset A is increasing. When this is the case, and when the diversified portfolio performs better than the two assets isolated, we say that the individual assets are dominated.

Diversification has been called the only "free lunch" in finance. It may seem too good to be true, with greater returns and smaller risk than holding individual assets. In fact, diversification is a free lunch (Campbell, 2000), if all you care for are mean returns and variances. As the name tells us, mean-variance investing only considers means and variances. Most investors care about more risk measures than only the simple variance. Since diversification eliminates the unsystematic risk, the chance of a big win and high payoffs is limited. The degree of diversification is dependent on the investors risk preferences.

The Markowitz procedure of choosing a portfolio by finding the mean-variance portfolio demands a large number of estimates in the covariance matrix. To simplify the estimation of the covariance matrix, we can use index models. One suitable model is the single-index model (Bodie et al., 2011), using a broad weight-adjusted index. This index functions as a proxy for common macroeconomic factors. The single-index model is linear and therefore suitable to estimate the sensitivity coefficient of an asset on the proxy. This is done by linear regression, based on historical observations, and describes the relationship between a security´s excess return relative to the proxy index´ excess return. The regression equation, representing the single-index model is expressed as:

$$(r_p - r_f) = \alpha_p + \beta_p(r_m - r_f) + \varepsilon_{pt} \qquad (1)$$

- $(r_p - r_f)$ is the excess return of a security

- $\alpha_p$ is the intercept, representing the security´s expected return when the proxy index excess return is zero
- $\beta_p$ is the slope coefficient, describing the security´s sensitivity to the proxy index
- $(r_m - r_f)$ is the excess return of the proxy index
- $\varepsilon_{pt}$ is the security´s residual at time t, representing unexpected events that are firm-specific

The regression equation shows how we can estimate a security´s risk and return profile. To do this, the estimates of alpha and beta are necessary, and these will describe the total risk of a security. The risk of an asset or a portfolio is divided into two groups; firm-specific risk (unsystematic risk) and systematic risk. The systematic risk is represented by the security´s beta and can be expressed as:

$$\beta_p = \frac{Cov(r_p, r_m)}{Var(r_m)} \tag{2}$$

- $Cov(r_p, r_m)$ is the covariance between the return of the security and the return of the proxy index
- $Var(r_m)$ is the variance of the proxy index´ return

In the single-index model, the market index proxy´s beta is assumed to be equal to 1. If the security´s beta exceeds 1 the security is more volatile to movements in the market than the index. The firm specific risk, represented by the security´s alpha is often called the nonmarket risk premium (Bodie et al., 2011), and a large alpha (greater than zero) may be due to a underpriced security and hence a higher expected return. The alpha derived from the single-index model is also known as Jensens alpha, after its inventor (Jensen, 1967). The null hypothesis in the single-index model is that the security´s alpha is equal to zero. Based on equation (1) and the knowledge on the estimates of alpha and beta, we are now able to derive the total risk of a security:

$$Total\ risk = Systematic\ risk + Unsystematic\ risk \tag{3}$$

$$Var(r_p - r_f) = Var(\alpha_p + \beta_p(r_m - r_f) + \varepsilon_{pt}) \tag{4}$$

$$\sigma_p^2 = \beta_p^2 \cdot \sigma_m^2 + \sigma^2(e_i) \quad (5)$$

- $\sigma_p^2$ is the total variance of the return of a security
- $\beta_p^2 \cdot \sigma_m^2$ is the systematic risk of a security
- $\sigma^2(e_i)$ is the variance of the firm-specific unexpected events

Now that the total variance of the security is known, we can find the explanatory value of the regression equation. By using the estimates derived from the single-index model, we can find whether the variations in the return of the index can or cannot explain the variations in the return of the security. This measure is called the $R^2$ ratio and describes the relationship between the explained variance and the total variance of a security. This ratio ranges from 0 to 1 and a high $R^2$ represents a high correlation between the return of the index and the return of the security. The expression for the $R^2$ ratio is based on the estimates of the security´s variance:

$$R^2 = \frac{\beta_p^2 \cdot \sigma_m^2}{\beta_p^2 \cdot \sigma_m^2 + \sigma^2(\varepsilon_p)} \quad (6)$$

## 4.2 Capital Asset Pricing Model

The Capital Asset Pricing model (CAPM) is a part of the portfolio theory and was derived by William Sharpe (1964), John Lintner (1965), Jan Mossin (1966) and Jack Treynor (1961). The model is building on the principle of diversification and the modern portfolio theory. The overall goal of CAPM is to show how a risky asset is valuated in a perfect market. The model gives us a precise prediction of the relationship between the risk and expected return of an asset. CAPM has two key functions (Bodie et al., 2011):

1. Provide a benchmark rate of return when evaluating investments. For example if you want to find if the expected return for an asset is "fair" due to the asset´s risk profile.
2. For assets that have not been traded in the marketplace, the model gives a prediction of the expected return of the asset.

The single-index model is a practical model that makes it easy to estimate the necessary parameters, described as a linear regression equation. The leap from this model based on modern portfolio theory, to CAPM is not very large. CAPM is more of a theoretical model assuming a simplified world, making it easier to find the consequences or outcomes of a certain investment decision. The assumptions in CAPM are stated to make individual investors more alike. Investors have homogenous expectations regarding the relationship between risk and expected return, all investors have the same investment horizon and there exists no transaction costs in the market. In addition, the model assumes that all investors can borrow or lend money at the risk-free rate of return, there are no income taxes, no inflation, no information asymmetry and one individual investor cannot affect the price of an asset. The final assumption about CAPM is that all capital markets are in equilibrium, which means that there are no arbitrage opportunities (Jones, 2002). Equation (7) (Fama & French, 2003) gives us the model in formal terms:

$$E(r_p) = r_f + \beta_p[E(r_m) - r_f] \tag{7}$$

- $E(r_p)$ is the expected return on portfolio *p*
- $r_f$ is the risk-free rate of return
- $\beta_p$ is the measure of the contribution of portfolio $p$ to the variance of the market portfolio as a fraction of the total variance of the market portfolio.
- $E(r_m)$ is the expected return for the market portfolio

To describe portfolios that can be chosen when there exists only one risky asset and one risk-free asset, we use the capital allocation line (CAL) (Ang, 2014). The line shows all the risk-return combinations available to the investor. The capital allocation line can be expressed formally as:

$$E(r_p) = r_f + \frac{E(r) - r_f}{\sigma}\sigma_p \tag{8}$$

- $E(r_p)$ is the portfolios expected return
- $r_f$ is the risk-free rate of return
- $E(r)$ is the risky asset´s rate of return

- $\sigma$ and $\sigma_p$ is the standard deviation of the risky asset and the portfolio respectively

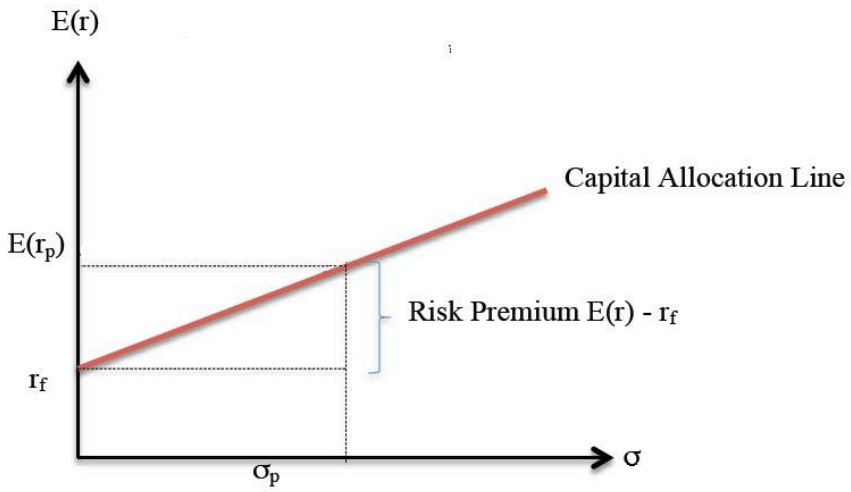


Figure 3 The Capital Allocation Line

## 4.3 Performance Measurements

To be able to assess and compare individual fund managers performance we have to use different performance measures. Performance measures are both important for the investor and for the managers. The investors have to choose which fund to invest in, and the managers have to justify why one should buy an actively managed fund rather than a passively managed fund. In addition, the managers have to show the importance of their role and justify the fees and expenses for investing in a actively managed fund (Knight & Satchell, 2002). Which performance measure the investor believes is the most important criterion for choosing a fund, depends on the investors risk preferences. For example, if total return were the investor's primary criterion for choosing a fund, he would probably think excess return is a more important measure than the Sharpe ratio. On the other hand, if the investor is more risk averse, he would probably think the performance measures considering risk is more important for choosing which fund to invest in. In this chapter I will present different performance measures used to evaluate and compare fund managers.

### 4.3.1 Sharpe Ratio

The Sharpe ratio is a performance measure named after William Sharpe, and is also called the reward-to-variability ratio. The ratio determine the excess return earned per unit of risk (Sharpe, 1994). The importance of the trade-off between excess return and risk is represented by the Sharpe ratio.

The capital allocation line (CAL) as mentioned in chapter 4.2 represents all the risk-return combinations an investor can face. The slope of the capital allocation line is the Sharpe ratio, because the slope equals the increased return per increased risk (Bodie et al., 2011). You use the capital allocation line to find the best combination of one risky and one risk-free asset to maximize the Sharpe ratio. The Sharpe ratio is expressed as (Knight & Satchell, 2002):

$$Sharpe\ ratio = \frac{r_p - r_f}{\sigma_p} \tag{9}$$

- $r_p$ is the average portfolio return
- $r_f$ is the average risk-free rate of return
- $\sigma_p$ is the standard deviation of the portfolio, representing the total risk

When holding a portfolio, or a mutual fund, the Sharpe ratio will improve by diversification. By comparing different funds Sharpe ratio, based on historical data, you can find the fund with the highest return relative to the funds risk. The fund with the highest Sharpe ratio has the best risk-adjusted return – the higher Sharp ratio, the better.

### 4.3.2 The $M^2$ measure

The $M^2$ measure (Modigliani-squared) is a ratio, like the Sharpe ratio, which focuses on total risk, and the $M^2$ measure is also a measure of the risk-adjusted performance of a portfolio. The measure compares the return of a risk-adjusted portfolio, consisting of a combination of risky and risk-free assets, and the return of the benchmark index. The risk-adjusted portfolio is constructed such that the portfolio and the benchmark index have the same standard deviation. In this way, we can compute the $M^2$ by comparing only the returns (Bodie et al., 2011):

$$M^2 = r_P^* - r_M \tag{10}$$

- $r_P^*$ is the risk-adjusted portfolio return
- $r_M$ is the return of the market portfolio

When comparing the $M^2$ measure with the Sharpe ratio, we see that both measures produce the same ranking of funds or portfolios. This means that the best fund according to the Sharpe ratio is also the best fund according to the $M^2$ measure (Knight & Satchell, 2002). The relationship between the $M^2$ measure and the Sharpe ratio can be expressed as:

$$M^2 = r_P^* - r_M = R_{p*} - R_M = S_P\sigma_M - S_M\sigma_M = (S_P - S_M)\sigma_M \quad (11)$$

- $R_{p*}$ is the excess return of the portfolio
- $R_M$ is the excess return of the market portfolio
- $S_P$ is the Sharpe ratio of the portfolio
- $S_M$ is the Sharpe ratio of the market portfolio
- $\sigma_M$ is the standard deviation of the market portfolio

The $M^2$ measure is more sensible in itself than the Sharpe ratio, because the $M^2$ measure computes how many basis points better or worse the portfolio has performed compared to the market portfolio (Modigliani & Modigliani, 1997), while the Sharpe ratio itself does not provide any information unless you compare it to other funds, portfolios or indices.

### 4.3.3 Tracking Error and the Information Ratio

Tracking error (also called active risk) measures the volatility of the excess return between a fund and its benchmark index (Morningstar, 2014d). A source of tracking error is when the managers try to outperform their benchmark index. The goal is to minimize the tracking error while maximizing the relative return, where the risk associated with tracking error is reflected as the volatility of the excess return (Hwang & Satchell, 2001). How consistent the funds excess return is, can be represented by the tracking error. The tracking error reflects how close a funds investments are to its benchmark index, hence the benchmark index has a tracking error of zero. It also describes how volatile the funds return is relative to the benchmark, and one can therefore say that the tracking error is a measure of excess risk. The tracking error tells us how much the excess return of the fund varies. Tracking error can be calculated as (Vanguard, 2009):

$$TE = \sigma_{(r_P - r_M)} \quad (12)$$

- $\sigma_{(r_P - r_M)}$ is the standard deviation of the excess return of the fund

Information ratio is a risk-adjusted measure focusing on the unsystematic risk (tracking error). It measures how much excess return the manager generated relative to the unsystematic risk. As stated in chapter 4.1 the unsystematic risk can be eliminated by diversification, and in principle when taking on such risk, the investor should get a reward reflected as excess return. Positive information ratio represents excess return created by the fund manager, and negative information ratio represents underperformance compared to the benchmark index (Morningstar, 2014a). High information ratio is generated when the funds are able to deliver high returns, when the benchmark index has lower returns and when the tracking error is low. The information ratio can be expressed as (Bodie et al., 2011):

$$IR = \frac{\alpha_p}{\sigma(e_p)} \tag{13}$$

- $\alpha_p$ is the funds risk-adjusted excess return
- $\sigma(e_p)$ is the funds unsystematic risk

When an active portfolio manager is restricted to invest in a certain investment universe, the same way my sample of mutual funds are restricted to invest at least 80% in stocks listed at the Oslo Stock Exchange, a different expression of the information ratio can be used. This is the case when the portfolio has the same level of systematic risk as its benchmark index, i.e. a beta equal to 1 (Goodwin, 1998). However, the two calculations of the information ratio would not have a large deviation if the portfolio betas were close to 1. In case of beta equal to 1, the information ratio can be expressed as:

$$IR = \frac{r_p - r_m}{TE} \tag{14}$$

- $r_p - r_m$ is the excess return of the fund
- $TE$ is the tracking error

The higher the information ratio, the more consistent is the manager. The information ratio is intended to reflect the amount of special information the active manager has obtained and how this is reflected by the excess return (Goodwin, 1998).

### 4.3.4 Excess Return

Excess return of a mutual fund is a term widely used when evaluating and comparing the performance of mutual funds. Excess return shows how a fund has performed versus a benchmark index over a specific period of time. It shows whether the fund has out- or underperformed the benchmark and the excess return can be either positive, negative or zero (Vanguard, 2009). A funds excess return is computed from the funds net asset value (NAV) and from the benchmark´s NAV. From the NAV´s we can compute the funds and the index´ return, and excess return can be expressed as:

$$Excess\ return = r_p - r_m \tag{15}$$

- $r_p$ is the fund return
- $r_m$ is the index return

NAV for a fund does not include the management fees demanded to hold an active managed fund. This means that the excess return shows explicitly if the fund is out- or underperforming the benchmark index. Excess return is not risk-adjusted and does not say anything about the funds risk profile.

### 4.3.5 Total Shareholder Return

Total shareholder return (TSR) is a performance measure representing the aggregated return to the shareholder measured as the value growth in a portfolio (Nordea, 2015b). Total shareholder return is a measure best fitted for evaluating long-term value creation in markets that are often short-term orientated, like the stock market. The measure can be positive or negative; a positive TSR represents a growth in the funds net asset value from the time of the initial investment, and a negative TSR represents a decrease in the net asset value. TSR is expressed as a percentage change in net asset value, and Morningstar uses this measure to explain mutual funds value growth versus the value growth of the fund´s benchmark index (Morningstar, 2015a). TSR can be expressed formally as:

$$TSR = \frac{NAV_t - NAV_0}{NAV_0} \tag{16}$$

- $NAV_t$ is the value of the fund at the end of the period
- $NAV_0$ is the value of the fund at the beginning of the period

In chapter 5.15 I will show how total shareholder return can give us the ending value of an initial investment of 1000 kr of each fund.

# 5 Empirical Analysis

## 5.1 Data Sets

The data sets I have used in this study are monthly net asset values for all of the mutual funds and for the benchmark index. The net asset values are from January 1997 to December 2013. Four of the funds included in this study were launched after 1997, and for these funds I have data from their start date to December 2013. When studying the periods of bullish and bearish markets, determined in chapter 3.2, I include those funds that have existed the whole period to achieve the most accurate results. I received the data sets with the net asset values from Truls Henrik Hollen at Oslo Børs Information Services.

## 5.2 Choice of Funds

The basic idea when choosing funds for my research was to choose the funds individual investors invest in. There exist a lot of Norwegian mutual equity funds, but not all of them are suited for a regular person to invest his savings in. This is substantially because of the different minimum investment criteria each fund has. A regular person with a regular salary would probably not invest in a mutual fund that demands a minimum investment of 10 million NOK. When I chose the funds to research, I had five criteria for each fund:

- The fund has to be a Norwegian mutual equity fund following the classification rules described in chapter 2.1.1.
- The fund is actively managed, i.e. not an index fund
- The fund has not closed during the research period
- The minimum investment does not exceed 100 000 NOK
- The fund is a UCITS fund

The funds included in this research are presented in Appendix 1. UCITS stands for "Undertakings for Collective Investments In Transferable Securities" and UCITS funds are subject to the EU funds directive. The UCITS directives are implemented in Norway through The Act on securities funds, where §1-2 says that UCITS funds are funds following the regulations in The Act on securities funds chapter 6 (Verdipapirfondloven, 2012). These regulations limit funds on how they can invest. There are restrictions on how much one single stock can be weighted in the fund, and the regulations function as diversification rules. One single stock cannot exceed 10% of the total value of the fund, and stocks with weights in the

fund between 5% and 10% can maximum sum up to 40% of total value of the fund (Morningstar, 2013). After UCITS was implemented in the security market it started to serve as quality recognition for investors. The investors will know that the portfolio managers in the fund are not able to take on extreme bets in one stock – UCITS ensures diversified funds. Funds that do not want, or are not allowed, to be a UCITS fund are called AIF´s (Alternative Investment Funds). These funds have more freedom when choosing their investments, but they are also associated with higher risk. Funds labelled as an AIF has to follow the AIFMD (Alternative Investment Funds Management Directive) (KPMG, 2014).

Based on the criteria I have set for my sample of funds, the results I get may be influenced by survivorship bias. The survivorship bias is present when mutual funds that have been closed or merged during the period of research are not included in the study. Mutual funds closing tend to do so due to lack of performance or merging into other funds to hide poor performance (Elton, Gruber, & Blake, 1996). When survivorship bias exists in a sample of mutual funds, the consequence is that the results of performance calculations may be overstated relative to the true performance. In my study, where I only include funds that have not been closed during the period, the average returns of the funds will not be representative for the whole fund universe. The results will only reflect the average returns for long-term survivors, and the performance of the portfolio manager may be better than if I had included all funds (Bodie et al., 2011). When comparing my fund universe, represented by the equally-weighted portfolio, against the benchmark index, it is important to keep in mind that survivorship bias may exist and that this portfolio does not reflect the whole fund universe existing of both open, closed and merged mutual funds.

### 5.3 Choice of Benchmark Index

Based on the information about the most relevant indices described in chapter 2.2, the most appropriate benchmarks would be either OSEBX or OSEFX. Since OSEFX is a weight-adjusted version of OSEBX, and all of my funds except one have this index as their benchmark index, OSEFX is the most appropriate benchmark to use in this research. In addition, OSEFX are required to follow the same regulations as UCITS funds. This makes OSEFX an even more accurate benchmark to compare the funds against.

## 5.4 Net Asset Value

The net asset value (NAV) is the value of a security when buying or selling, fees excluded (Morningstar, 2014b). The NAV is the value of each share, also called the per-share price. The number of shares outstanding in the fund changes all the time, depending on the period's net subscription. The net asset value are calculated every day, usually from the end-value, and can be calculated as (Bodie et al., 2011):

$$NAV = \frac{Market\ value\ of\ assets\ minus\ liabilities}{Shares\ outstanding} \tag{17}$$

NAV represents the net value of the fund divided by each share. NAV is used to calculate the funds return for each period, as I will describe in the next section. Because all of my calculations are based on net asset values, I will not consider the management fees when evaluating and ranking the funds.

## 5.5 Rate of Return

The rate of return of an investment in a mutual fund depends whether the funds pay dividends or not. The funds in my research do not pay dividends, and the rate of return for these funds are measured as the increase or decrease in the net asset value. When calculating the rate of return for funds that do not pay dividends, you simply measure the relationship between the net asset values for each period (Bodie et al., 2011):

$$r_{t,t-1} = \frac{NAV_t - NAV_{t-1}}{NAV_{t-1}} \tag{18}$$

- $r_{t,t-1}$ is the rate of return in the period
- $NAV_t$ is the per-share price at time t
- $NAV_{t-1}$is the per-share price at t-1

## 5.6 Risk-free Rate of Return

When measuring the performance of the funds we have to use a risk-free rate of return. This rate is supposed to reflect an investment in a risk-free security, even though you can never say something is completely risk free. In this context, the NIBOR rate is commonly used. NIBOR (Norwegian Interbank Offering Rate) is a term capturing different Norwegian money market

rates at different maturities. NIBOR exists with maturities from one week to a year. Oslo Stock Exchange is the calculation agent of this rate, and it is calculated as the average interest rate from chosen panel banks, such as DNB Bank ASA, Danske Bank and Swedbank (Finans Norge, 2015). The NIBOR rate is the rate the individual panel banks would charge when lending NOK to another active, leading Norwegian bank.

When comparing the fund returns and the return an investor would get from holding the money in a Norwegian bank, the most common NIBOR rate to use is the NIBOR 3-month rate. This is also the rate Morningstar uses in their models to calculate a funds return in excess of the risk-free rate (Morningstar, 2014c). Based on this, I choose the NIBOR 3-month rate of return as my risk-free rate in this research. To find a risk-free rate for the whole period to compare to the total return of the funds in this research, I calculated the average of 203 NIBOR 3-month observations. This average is used when I calculate the performance measures in chapter 5.10 and 5.11.

| | 1997-2013 |
|---|---|
| NIBOR 3-month | 4,21% |

Table 1 Risk-free rate of return

## 5.7 Other Studies on Mutual Fund Performance

There have been done several researches on mutual fund performance. In this chapter I will present some of these research papers and their results.

Lars Qvigstad Sørensen did a paper on the performance of all Norwegian equity mutual funds at the Oslo Stock Exchange. He found no significant alpha for the funds when creating an equally-weighted portfolio of all the mutual funds (Sørensen, 2009). This means he found no evidence of abnormal risk-adjusted return for the funds relative to a benchmark index. He used the OSEFX as benchmark index for as long as the index has existed, and prior to the establishment of this index he used OSEAX. His period of research was from 1982 to 2008, and he has included funds opening and closing in the period. In addition, he did not pick funds like I have done, and this suggests that his and my research should not necessarily yield the same results regarding the abnormal risk-adjusted returns.

The same has been concluded in another paper from the Journal of Banking and Finance, researching all Norwegian mutual funds in the period 2000-2010 (Gallefoss, Hansen, Haukaas, & Molnár, 2015). Their conclusion was that Norwegian mutual funds are both out- and underperforming the benchmark index, but aggregated they underperformed the benchmark index by approximately the management fees.

Fama and French (2010) wrote a paper on the same subject, but with U.S. equity mutual funds in the period 1984-2006. They found that the aggregate portfolio of the funds is close to the market portfolio, but the management fees lower the returns to the investors (Fama & French, 2010). Nevertheless, if they exclude the cost in fund expense ratio, they find evidence of both negative and positive alpha values.

## 5.8 Descriptive Statistics

In table 2 the mean monthly return and mean monthly standard deviation for each fund for the whole period is presented in descending order with respect to the mean monthly return. OSEFX is included to compare the funds against both each other and to the benchmark.

| | $\bar{r}_p$ | $\bar{\sigma}_p$ | Maximum value | Minimum value |
|---|---|---|---|---|
| Delphi Norge | 1.22% | 7.06% | 23.01% | -24.93% |
| Alfred Berg Gambak | 1.17% | 6.91% | 27.25% | -27.38% |
| Klp Aksje Norge | 1.12% | 5.91% | 17.59% | -29.77% |
| Atlas Norge | 1.11% | 7.46% | 36.85% | -25.25% |
| Carnegie Aksje Norge | 1.10% | 6.17% | 20.13% | -27.52% |
| Holberg Norge | 1.02% | 5.83% | 15.94% | -23.90% |
| Danske Invest Norge 2 | 0.98% | 6.08% | 14.91% | -29.49% |
| Pluss Aksje | 0.98% | 6.04% | 17.56% | -25.51% |
| Danske Invest Norge 1 | 0.92% | 6.08% | 14.85% | -27.17% |
| OSEFX | 0.91% | 6.11% | 16.52% | -27.17% |
| Alfred Berg Norge Classic | 0.90% | 5.98% | 17.10% | -27.01% |
| Odin Norge | 0.89% | 6.01% | 16.82% | -24.09% |
| Storebrand Norge | 0.87% | 6.11% | 15.51% | -28.83% |
| Omega Investment Fund A | 0.83% | 6.32% | 18.74% | -28.85% |
| Storebrand Optima Norge | 0.81% | 6.27% | 14.59% | -29.29% |
| Handelsbanken Norge | 0.79% | 6.16% | 17.75% | -28.82% |
| Nordea Avkastning | 0.79% | 5.97% | 16.64% | -26.18% |
| Dnb Norge | 0.78% | 5.94% | 15.81% | -24.12% |
| Nordea Vekst | 0.68% | 6.07% | 16.80% | -26.22% |

Table 2 Mean monthly returns and standard deviations

From the results in table 2 we see that both all funds and the index (OSEFX) had a positive average monthly return in the period 1997-2013. However, there are interesting differences. Some of the funds had a higher monthly return than the benchmark, and others had lower monthly return. The distribution of funds beating the benchmark and funds underperforming the benchmark is equally shared – 50% of the funds beat the benchmark with respect to mean monthly returns and 50% did not. However, this has to be seen relative to the funds volatility, represented by their mean monthly standard deviation. This is called risk-adjusted return.

Four of the nine funds beating OSEFX with respect to mean monthly return also had lower standard deviation than OSEFX. For these funds (Danske Invest Norge 1, Danske Invest Norge 2, Holberg Norge and KLP Aksje Norge) we can conclude that they outperformed OSEFX on a monthly basis at the same time as they had lower volatility than the index.

The fund with most variations in the monthly return is Atlas Norge with a standard deviation of 7,46%. To justify this we see that this fund had higher monthly return than OSEFX. The fund with the lowest volatility is Holberg Norge with a standard deviation of 5,83%. This fund had a higher monthly return than OSEFX, but lower risk.

The maximum and minimum values show how much the value of a fund can vary within a single month. KLP Aksje Norge had the biggest drop (-29,77%) during a one-month period. The highest gain for a one-month period was generated by Atlas Norge (36,85%). It is also interesting to see that the variations in maximum values were much bigger than the variations in minimum values. The biggest loss for each fund during one month lies between -24,12% and -29,77%, while the biggest gain for each fund during one month lies in the interval 14,59% to 36,85%.

### 5.8.1 Total Shareholder Return

Total Shareholder Return (TSR) describes the performance of the funds in a different way than average numbers do. As described in chapter 4.3.5, TSR reflects the value creation a fund has generated during a specific period. TSR can be calculated from day to day, but it gives a better picture of the growth (or decline) when calculated over a longer period of time. In table 3 the value growth from 1997 to 2013 is presented. I added an equally-weighted portfolio consisting of an equally share of all the funds.

| Fond (1997-2013) | Total Shareholder Return | Ranking |
|---|---|---|
| Delphi Norge | 464.23% | 1 |
| Carnegie Aksje Norge | 428.95% | 2 |
| Alfred Berg Gambak | 386.26% | 3 |
| Pluss Aksje | 330.09% | 4 |
| Klp Aksje Norge (1999-2013)* | 312.55% | 5 |
| Danske Invest Norge 2 | 300.98% | 6 |
| Alfred Berg Norge Classic | 286.81% | 7 |
| **OSEFX** | **271.92%** | **8** |
| Equally-weighted portfolio | 267.82% | 9 |
| Odin Norge | 250.06% | 10 |
| Danske Invest Norge 1 | 250.04% | 11 |
| Atlas Norge (1998-2013)* | 247.92% | 12 |
| OSEBX | 243.10% | 13 |
| Holberg Norge (2001-2013)* | 229.67% | 14 |
| Storebrand Norge | 225.24% | 15 |
| Nordea Avkastning | 212.07% | 16 |
| Handelsbanken Norge | 211.44% | 17 |
| Dnb Norge | 201.26% | 18 |
| Omega Investment Fund A | 198.27% | 19 |
| Nordea Vekst | 147.80% | 20 |
| Storebrand Optima Norge (2001-2013)* | 137.10% | 21 |
| Risk Free Investment | 100.24% | 22 |
| * Fund established after 1997 | | |

Table 3 Total Shareholder Return

TSR represents the aggregated return of a fund, an index or a single stock. The numeric value of TSR is equal to the percentage growth in the funds net asset value from the first observed NAV to the last observed NAV. In my research the first observed NAV for the funds is 31.01.1997. For the funds that were not established in 1997, marked with a star (*), TSR is calculated from their launch date. The last observed NAV for all of the funds are 31.12.2013.

Table 3 shows that Delphi Norge was the fund with the highest growth in NAV through the 17-year period. This funds NAV increased by 464,23%. In comparison, OSEFX´s NAV increased by 271,92%, and Delphi Norge had a greater value creation in this period than its benchmark index. Storebrand Optima Norge and the other funds marked with a star (*) are difficult to compare with respect to TSR as they are measured for a shorter time period than the other funds.

If your investment was risk-free, the value of the investment done in 1997 would have grown by 100,24% in 2013. This is supposed to reflect the value growth if the money was placed in a safe bank account instead of in a more risky fund. The best fund according to total shareholder return had a value in 2013 almost 5 times as big as its value in 1997. This shows that in the long-run the value of the funds increase more than they decrease, and there is reason to believe that saving in mutual funds will be more popular in the future. This is partly because of the decreased interest rates from investing your money in bank deposits. In comparison, a bank deposit in 1997 would have been doubled in value in 2013.

One of the best funds with respect to monthly average returns and standard deviation, Danske Invest Norge 1, had a lower TSR than the benchmark index. This can be explained by Danske Invest Norge 1´s higher Sharpe ratio than OSEFX (see table 5), and this funds combination of risk and return may be favourable relative to OSEFX.

The equally-weighted portfolio consisting of all the funds underperformed OSEFX based on TSR. The underperformance is only by 4,1 percentage points, but it shows that on average my fund universe did not beat the market when we only look at the absolute numbers.

OSEBX, together with OSEFX, are included to show the value growth in the overall Norwegian equity market between 1997 and 2013. We see that OSEBX had a lower total return than OSEFX, but OSEBX still outperformed eight of the funds with respect to total return. However, two of these funds were not established until 2001.

## 5.9 Results From the Regression Analysis

The regression analysis done in this research is based on the regression equation from the single-index model. From this model, the estimates necessary to analyse the sample of funds is derived and enables me to describe each funds combination of risk and return and compare it to their benchmark index. The regression is linear and is formally expressed as:

$$r_p = \alpha_p + (\beta_p \cdot r_m) + \varepsilon_{pt} \qquad (19)$$

In this regression, the return of the funds, $r_p$, is the dependent variable. This is the variable the regression analysis predicts. The return of the benchmark index, $r_m$, is the independent

variable used to predict the dependent variable. When conducting the regression, we find estimates of the variance of each fund, represented by the alpha and beta values. In addition, the residuals of the regression model, $\varepsilon_{pt}$, at time $t$ is estimated. The residuals reflect the random disturbance. This error term has an expected mean value of zero.

| | **Alpha *(p-value)*** | **Beta** | **$R^2$** |
|---|---|---|---|
| Alfred Berg Gambak | 0.003 *(0.32)* | 0.99 | 0.78 |
| Alfred Berg Norge Classic | 0.000 *(0.50)* | 0.99 | 0.98 |
| Atlas Norge | 0.003 *(0.19)* | 1.14 | 0.83 |
| Carnegie Aksje Norge | 0.002 *(0.29)* | 0.96 | 0.90 |
| Danske Invest Norge 1 | 0.000 *(0.99)* | 0.98 | 0.95 |
| Danske Invest Norge 2 | 0.001 *(0.55)* | 0.98 | 0.95 |
| Delphi Norge | 0.003 *(0.20)* | 1.08 | 0.84 |
| Dnb Norge | -0.001 *(0.29)* | 0.97 | 0.98 |
| Handelsbanken Norge | 0.000 *(0.67)* | 0.99 | 0.96 |
| Holberg Norge | 0.002 *(0.28)* | 0.89 | 0.88 |
| Klp Aksje Norge | 0.001 *(0.27)* | 0.94 | 0.95 |
| Nordea Avkastning | -0.001 *(0.33)* | 0.98 | 0.97 |
| Nordea Vekst | -0.002 *(0.08)** | 0.99 | 0.95 |
| Odin Norge | 0.001 *(0.75)* | 0.92 | 0.82 |
| Omega Investment Fund A | -0.001 *(0.49)* | 0.99 | 0.94 |
| Pluss Aksje | 0.001 *(0.31)* | 0.97 | 0.93 |
| Storebrand Norge | 0.000 *(0.63)* | 1.00 | 0.98 |
| Storebrand Optima Norge | 0.000 *(0.75)* | 0.96 | 0.93 |
| *Significant at a significance level of 10% | | | |

**Table 4 Results from regression analyses**

Table 4 presents the results from the estimates derived from the regression model. The first estimates, the funds alpha values, represent the unsystematic risk discussed in chapter 4.1. These values tells us whether the fund did or did not manage to generate risk-adjusted excess return during the period of research relative to the benchmark, OSEFX. The numbers in the brackets is the p-value of the alpha´s. These values help determining whether the alpha´s are statistically significant or not. To determine the significance I chose a significance level of 5% (one can also use a 10% significance level), meaning that the null hypothesis ($H_0$: $\alpha_p = 0$) will be rejected if the p-value is below 0,05. If the p-value is higher than 0,05 we fail to reject the null hypothesis, and I have no evidence to say that the fund generated excess risk-adjusted return relative to OSEFX. This is the case for all of my funds. Some of the funds had positive alpha values, which indicate positive excess risk-adjusted return, but because these excess returns are so small, we say that they are not statistically significant. The same applies for

those with a negative alpha – they had negative risk-adjusted excess return but it is not statistical significant. Based on this test, I do not have evidence to say that any of my funds generated significant positive or negative risk-adjusted excess return.

My result was somewhat expected, primarily because of two reasons. The first reason is that the other studies on the same subject have found the same result, as stated in chapter 5.7. The other reason is that information is easily available for all agents in the market. There are strict regulations preventing inside information and it demands either great skills or great luck for a manager to generate statistical significant risk-adjusted excess return over a longer period.

The estimated beta values of the funds tell us the proportion of systematic risk the fund is bearing relative to OSEFX. A beta value below 1 represents lower systematic risk than OSEFX and a beta higher than 1 represents more systematic risk than OSEFX. As we see from table 4, most of the funds had a beta close to 1. The two funds sticking out is Atlas Norge with a beta of 1,14, and Holberg Norge with a beta of 0,89. The beta of Atlas Norge is telling us that this fund had more risk than OSEFX. The natural way of justifying this risk is if Atlas Norge also generated higher return than OSEFX. Holberg Norge had a quite low beta, and lower risk means we could expect lower returns. The average beta for all of the funds for the whole period is 0,98. This shows that in the long run, the funds volatility relative to the volatility of their benchmark index does not differ much, and on average the funds were not exposed to higher systematic risk than the benchmark. However, this conclusion is only valid for my sample of funds and does not represent the whole fund universe.

In chapter 2.1.1 I described the criteria for a mutual fund to be classified into a group. The mutual funds in my research are geographically classified as Norwegian, and this means at least 80% of the funds capital has to be invested in Norwegian listed securities. The last 20% is the reason the funds have different betas and systematic risk than OSEFX. The opportunity the funds have to invest 20% elsewhere than in only Norwegian listed securities may give the fund lower or higher systematic risk, since OSEFX invest 100% in listed Norwegian securities and hence a beta of 1.

The $R^2$ for each fund tells us if the regression model is a good fit for the data sets and how the independent variable (OSEFX) influences the dependent variable (the fund). When discussing the funds $R^2$ a general range for this measure is useful (Morningstar, 2015b):

- 0,7 – 1 = high correlation between the fund and the index
- 0,4 – 0,7 = average correlation between the fund and the index
- 0,01 – 0,4 = low correlation between the fund and the index

We see that all of the funds are located in the range between 0,7 – 1 which represents high correlation between OSEFX and the fund. When $R^2$ is 1, the regression model manages to explain all the variations in the fund. This is not the case for any of my funds, but Storebrand Norge is the fund with the highest $R^2$. A $R^2$ of 0,98 means that 98% of the variations in Storebrand Norge can be explained by the variations in OSEFX. Only 2% of the variations in Storebrand Norge are variations that cannot be explained by the variations in OSEFX. This funds high $R^2$ ratio tells us that Storebrand Norge is a fund investing closely to its benchmark index.

The fund with the lowest $R^2$, Alfred Berg Gambak, is still in the range of high correlation, but here the regression model can explain only 78% of the variations in the fund. 22% of the variations in Alfred Berg Gambak are not explained by variations in OSEFX. $R^2$ can imply how close the funds investments is to the benchmark index, and it seems Alfred Berg Gambaks portfolio deviates more from OSEFX than Storebrand Norge does, and it might be a fund taking bigger bets.

## 5.10 Sharpe Ratio

As explained in chapter 4.3.1, the Sharpe ratio is a measure describing the funds and the index risk and return profile. The way to optimize the risk-return profile in an investment is to locate at the capital allocation line and find the best combination of assets to maximize the Sharpe ratio.

To calculate the Sharpe ratio I use the numbers presented in Appendix 4. The risk-free rate of return I get from table 1. The Sharpe Ratio for Alfred Berg Gambak is:

$$SR_{GA-GAMB} = \frac{(0{,}1497 - 0{,}0421)}{0{,}2392}$$

$$SR_{GA-GAMB} = 0{,}4496$$

In table 5 the Sharpe Ratio for each fund is presented. I have also ranked the funds after the value of the Sharpe Ratio.

| | Sharpe Ratio | Ranking |
|---|---|---|
| Klp Aksje Norge | 0.496 | 1 |
| Delphi Norge | 0.467 | 2 |
| Carnegie Aksje Norge | 0.461 | 3 |
| Alfred Berg Gambak | 0.450 | 4 |
| Holberg Norge | 0.434 | 5 |
| Danske Invest Norge 2 | 0.394 | 6 |
| Pluss Aksje | 0.391 | 7 |
| Atlas Norge | 0.386 | 8 |
| Danske Invest Norge 1 | 0.351 | 9 |
| Alfred Berg Norge Classic | 0.345 | 10 |
| OSEFX | 0.344 | 11 |
| Odin Norge | 0.336 | 12 |
| Storebrand Norge | 0.317 | 13 |
| Omega Investment Fund A | 0.282 | 14 |
| Storebrand Optima Norge | 0.276 | 15 |
| Nordea Avkastning | 0.275 | 16 |
| Handelsbanken Norge | 0.271 | 17 |
| Dnb Norge | 0.270 | 18 |
| Nordea Vekst | 0.201 | 19 |

Table 5 Results and ranking of the Sharpe Ratio

Assuming a rational investor with mean-variance preferences, the optimal investment decision would be to invest in the fund with the highest Sharpe ratio. In this fund the investor would get the highest return relative to the risk he has undertaken. From table 5 we see that the three best funds with respect to the risk-return profile in the period 1997-2013 were KLP Aksje Norge, Delphi Norge and Carnegie Aksje Norge. OSEFX had a Sharpe Ratio of 0,344. This means that the index have during the research period had a greater return relative to the risk than eight of the 18 funds.

## 5.11 $M^2$

In chapter 4.3.2 I described the $M^2$ measure and how it is related to the Sharpe Ratio. This relationship is what I will use to calculate the $M^2$ measure for the funds. To calculate the $M^2$ measure I use the Sharpe Ratio for each fund from table 5, and the annualized standard deviation for OSEFX from Appendix 4.

$$M^2_{GA-GAMB} = (0{,}4496 - 0{,}344) \times 0{,}2116$$

$$M^2_{GA-GAMB} = 0{,}0223$$

In table 6 the $M^2$ measure for each fund is presented along with the rankings of the funds.

| | $M^2$ | Ranking |
|---|---|---|
| Klp Aksje Norge | 0.032 | 1 |
| Delphi Norge | 0.026 | 2 |
| Carnegie Aksje Norge | 0.025 | 3 |
| Alfred Berg Gambak | 0.022 | 4 |
| Holberg Norge | 0.019 | 5 |
| Danske Invest Norge 2 | 0.010 | 6 |
| Pluss Aksje | 0.009 | 7 |
| Atlas Norge | 0.008 | 8 |
| Danske Invest Norge 1 | 0.001 | 9 |
| Alfred Berg Norge Classic | 0.000 | 10 |
| Odin Norge | -0.001 | 11 |
| Storebrand Norge | -0.006 | 12 |
| Omega Investment Fund A | -0.013 | 13 |
| Storebrand Optima Norge | -0.014 | 14 |
| Nordea Avkastning | -0.015 | 15 |
| Handelsbanken Norge | -0.016 | 16 |
| Dnb Norge | -0.016 | 17 |
| Nordea Vekst | -0.030 | 18 |

Table 6 Results and ranking of the $M^2$ measure

From table 6 we see that the rankings are the same as the rankings from the Sharpe Ratio in table 5; KLP Aksje Norge, Delphi Norge and Carnegie Aksje Norge are the funds with the highest $M^2$ during the period 1997-2013.

A postitive $M^2$ means that the fund outperforms the benchmark relative to its risk. The $M^2$ measure is therefore a risk-adjusted measure. A negative $M^2$ means that the fund has underperformed the benchmark. We see that 50% of my funds according to the $M^2$ measure underperformed OSEFX, which has a $M^2$ of zero.

## 5.12 Tracking Error and Information Ratio

The tracking error and the information ratio, as described in chapter 4.3.3, are measures concerning the excess return of the funds and its variations. To calculate the tracking error and the information ratio for the funds, I have used the values presented in Appendix 4. All of the funds in my study have a beta close to 1. As discussed in chapter 4.3.3, the beta estimates allows me to compute the information ratio using the funds excess returns.

$$TE_{GA-GAMB} = \sigma_{(r_p - r_m)} = 0{,}2173$$

$$IR_{GA-GAMB} = \frac{0{,}035}{0{,}2173}$$

$$IR_{GA-GAMB} = 0{,}1611$$

In table 7 I have presented the funds information ratio and their ranking with respect to the information ratio. The funds respective tracking error is presented as well.

| | Information ratio | Ranking | Tracking error |
|---|---|---|---|
| Klp Aksje Norge | 0.704 | 1 | 4.09% |
| Carnegie Aksje Norge | 0.403 | 2 | 6.37% |
| Delphi Norge | 0.379 | 3 | 10.91% |
| Alfred Berg Gambak | 0.161 | 4 | 21.73% |
| Danske Invest Norge 2 | 0.158 | 5 | 6.38% |
| Pluss Aksje | 0.113 | 6 | 7.95% |
| Holberg Norge | 0.098 | 7 | 15.17% |
| Atlas Norge | 0.092 | 8 | 29.43% |
| Danske Invest Norge 1 | 0.019 | 9 | 6.14% |
| Odin Norge | -0.019 | 10 | 14.96% |
| Alfred Berg Norge Classic | -0.020 | 11 | 5.12% |
| Omega Investment Fund A | -0.151 | 12 | 7.29% |
| Storebrand Optima Norge | -0.176 | 13 | 7.31% |
| Storebrand Norge | -0.201 | 14 | 2.81% |
| Handelsbanken Norge | -0.274 | 15 | 5.51% |
| Dnb Norge | -0.320 | 16 | 5.41% |
| Nordea Vekst | -0.598 | 17 | 5.12% |
| Nordea Avkastning | -0.600 | 18 | 2.66% |

Table 7 Information ratio and tracking error

From table 7 we see that 50% of the funds had a positive information ratio. A positive information ratio means that the fund has generated positive excess return relative to the benchmark, adjusted for the risk the fund has taken. Negative information ratio means negative excess return and that the fund has not been able to generate a positive return on the active risk it has taken. This distribution matches the distribution from chapter 5.8 where 50% of the funds had a greater mean monthly return. It also matches the distribution of the $M^2$ measure in chapter 5.11, where 50% of the funds outperformed OSEFX.

The three funds with the highest information ratio (KLP Aksje Norge, Carnegie Aksje Norge and Delphi Norge) are the funds with the greatest excess return relative to the unsystematic

risk, represented by the tracking error. The tracking error tells us how much variation there are in the funds excess return. To be able to generate stabilized excess return relative to the benchmark over a long period of time, the aim is to minimize the tracking error.

## 5.13 Hypothesis Testing

When performing a regression analysis there are certain elements necessary to examine. These elements are properties related to the data sets, and will give an indication if the results from the regression are reliable or not. When validating the reliability of my results I have performed tests of the residuals testing for heteroscedasticity, autocorrelation and non-normality. These test are done based on assumptions underlying the regression model I have used. My regression model follows the method known as the method of ordinary least squares (OLS). This is a method helping to fit a straight line to the data set. By finding the best fit to the straight line means taking the every vertical distance from the point of the observation line, square it and then minimize the total sum of squares (Brooks, 2008). OLS is a method where you find estimates to minimize the total sum of squares, and these estimators are the alpha and beta values. When the assumptions underlying the model I regress are fulfilled, I know that the estimators are the best, linear, unbiased estimators (BLUE).

### 5.13.1 Spearman Rank Correlation Test

Heteroscedasticity is present if the variance of the residuals is not constant. This is not preferable, we want the residuals to be homoscedastic, i.e. have a constant variance. Heteroscedasticity can therefore be expressed as:

$$V(\varepsilon_p) \neq \sigma^2 \qquad (20)$$

The tests null hypothesis is that the residuals are homoscedastic. The alternative hypothesis will then be that the residuals are heteroscedastic. This test depends on the p-values of the test statistics ($\rho_s$), and is used to determine whether the residuals of each fund are heteroscedastic or not. In table 8 the results from the test are presented.

| | $\rho_s$ | P-value |
|---|---|---|
| Alfred Berg Gambak | 0.874 | 0.00 |
| Alfred Berg Norge Classic | 0.985 | 0.00 |
| Atlas Norge | 0.947 | 0.00 |
| Carnegie Aksje Norge | 0.951 | 0.00 |
| Danske Invest Norge 1 | 0.973 | 0.00 |
| Danske Invest Norge 2 | 0.975 | 0.00 |
| Delphi Norge | 0.917 | 0.00 |
| DNB Norge | 0.986 | 0.00 |
| Handelsbanken Norge | 0.968 | 0.00 |
| Holberg Norge | 0.929 | 0.00 |
| KLP Aksje Norge | 0.970 | 0.00 |
| Nordea Avkastning | 0.989 | 0.00 |
| Nordea Vekst | 0.972 | 0.00 |
| Odin Norge | 0.889 | 0.00 |
| Omega Investment Fund A | 0.958 | 0.00 |
| Pluss Aksje | 0.970 | 0.00 |
| Storebrand Norge | 0.989 | 0.00 |
| Storebrand Optima Norge | 0.956 | 0.00 |

**Table 8 Spearman Rank Correlation test results**

The decision rule is that if the p-value is lower than 0,05, we reject the null hypothesis ($H_0: \rho_s = 0$), and keep the alternative hypothesis. From the table we see that the null hypothesis is rejected for all of the funds, since the p-value is zero for all funds, and I do not have evidence to say that the residuals of the funds are homoscedastic. I have to keep the alternative hypothesis and conclude that the residuals do not have constant variance, i.e. heteroscedasticity exist.

This means I have not fulfilled the assumption underlying the model stating constant variance of the residuals. But the OLS estimators still remain unbiased, consistent and asymptotically normal (Stock & Watson, 2012). The consequence of this violation is that OLS is no longer the most efficient estimator, but it is still unbiased.

### 5.13.2 Durbin-Watson Autocorrelation Test

When using the method of OLS, the residuals have to be independent. This means no correlation between the residual at time *t* and the residual at time *t+1*. If the residuals are dependent and correlated, we say that there exists autocorrelation between the residuals. To be certain that the residuals are independent and not correlated, I have performed a test called

Durbin-Watson. In addition, I have made plots showing the residuals versus the lagged residuals. The plot for Alfred Berg Gambak is presented in Appendix 4.1. The test statistics are presented in table 9.

| | **Durbin-Watson ($d$)** |
|---|---|
| Alfred Berg Gambak | 1.474* |
| Alfred Berg Norge Classic | 1.773 |
| Atlas Norge | 1.522* |
| Carnegie Aksje Norge | 1.910 |
| Danske Invest Norge 1 | 1.982 |
| Danske Invest Norge 2 | 1.982 |
| Delphi Norge | 2.029 |
| DNB Norge | 1.898 |
| Handelsbanken Norge | 1.887 |
| Holberg Norge | 1.675** |
| KLP Aksje Norge | 2.039 |
| Nordea Avkastning | 2.169 |
| Nordea Vekst | 1.969 |
| Odin Norge | 1.758 |
| Omega Investment Fund A | 1.730 |
| Pluss Aksje | 2.333 |
| Storebrand Norge | 2.133 |
| Storebrand Optima Norge | 2.181 |
| * Lower than $d_l$<br>** $d_l < d < d_u$ | |

**Table 9 Results of Durbin-Watson test**

To determine whether autocorrelation exists in my data sets or not I use the critical values matching the significance level of 0,05. The lower boundary is $d_l = 1{,}65$ and the upper boundary is $d_u = 1{,}69$ (Mendenhall & Sincich, 2012). The decision rule for this test is to reject the null hypothesis ($H_0$: No residual correlation) if the test statistics $d$ is lower than 1,65. If $d$ is greater than 1,69 we fail to reject the null hypothesis, and a $d$-value between 1,65 and 1,69 is in the uncertainty region where we need more information to draw a correct conclusion.

From table 9 we see that most of the funds have a $d$-value greater than 1,69, and I fail to reject the null hypothesis for these funds. This means that I have no evidence to state that there exists positive autocorrelation between the residuals for these funds.

The only two funds with a $d$-value smaller than 1,69 are Alfred Berg Gambak and Atlas Norge. These funds $d$-values are located in the rejection region and I reject the null hypothesis and keep the alternative hypothesis. This means, according to this test statistic, that there exists positive autocorrelation between these two funds residuals. Holberg Norge is the only fund with a $d$-value located in the inconclusive region. For this fund I do not have enough information to conclude whether positive autocorrelation between the residuals exist or not. The consequences that the residuals of Alfred Berg Gambak and Atlas Norge are autocorrelated are much the same for when the residuals are heteroscedastic. The OLS estimators are still unbiased and linear, but they are no longer the most efficient estimators meaning they do not have minimum variance compared to those with no autocorrelation (Gujarati & Porter, 2012).

### 5.13.3 Testing for Normality

Underlying the model that I regress, there are assumptions about the distribution of the residuals. When using a regression method following the method of OLS, the residuals have to be normally distributed and this can be tested both graphically and statistically. When statistically testing for normality, there are multiple appropriate tests to use. I have chosen to use the values of the skewness and excess kurtosis to determine whether the residuals follow a normal distribution or not. The values of skewness and excess kurtosis are presented in table 10. A perfectly normal distributed data set has zero skewness and zero excess kurtosis. However, some level of skewness and excess kurtosis is acceptable, and the results have to be compared to graphical normal probability plots to be able to draw a conclusion. The skewness and excess kurtosis gives us an idea of the distribution of the residuals, but I have also looked at graphical probability plots for each fund. The probability plot for Alfred Berg Gambak is presented in Appendix 3. In general skewness greater than 0,5 gives indications that the distribution is asymmetrical and may not be normally distributed. When excess kurtosis exceeds zero, the distribution of the residuals have a higher and sharper peak than the normal distribution.

| | Skewness | Excess Kurtosis |
|---|---|---|
| Alfred Berg Gambak | 0.00 | 0.00 |
| Alfred Berg Norge Classic | 0.26* | 0.95* |
| Atlas Norge | 0.00 | 0.00 |
| Carnegie Aksje Norge | 0.00 | 0.00 |
| Danske Invest Norge 1 | 0.00 | 0.00 |
| Danske Invest Norge 2 | 0.00 | 0.00 |
| Delphi Norge | 0.01 | 0.00 |
| DNB Norge | 0.00 | 0.00 |
| Handelsbanken Norge | 0.77* | 0.00 |
| Holberg Norge | 0.24* | 0.32* |
| KLP Aksje Norge | 0.00 | 0.00 |
| Nordea Avkastning | 0.00 | 0.00 |
| Nordea Vekst | 0.00 | 0.00 |
| Odin Norge | 0.12* | 0.94* |
| Omega Investment Fund A | 0.52* | 0.15* |
| Pluss Aksje | 0.00 | 0.00 |
| Storebrand Norge | 0.05 | 0.00 |
| Storebrand Optima Norge | 0.00 | 0.00 |
| *Indications of non-normality | | |

Table 10 Skewness and excess kurtosis

From table 10 we see that five of the funds have values of skewness and excess kurtosis indicating a non-normal distribution. For the rest of the funds, skewness and excess kurtosis indicate a normal distribution. Even if the residuals are non-normally distributed, the regression is robust (Mendenhall & Sincich, 2012). The inferences derived from the regression analysis tend to be valid even though there is evidence of non-normality, and the assumption of normality is not completely satisfied. This depends on the level of non-normality, and a strictly non-normal distribution of the residuals may lead to invalid inferences. None of my funds shows signs to be highly skewed or have a high excess kurtosis, so in this case a slight deviation from a normal distribution will still make the OLS estimators good estimators because the time series contains many observations.

## 5.14 Performance in Bull and Bear Markets

In chapter 3.2 I defined and described the main periods of bull and bear markets between 1997 and 2013. The purpose behind this was to analyse whether there exists a relationship between the fund managers relative performance to the different stock market conditions.

To evaluate this I make a hypothesis to either be confirmed or rejected by my results. Do active managers on average outperform the benchmark by more in bullish markets than they do in bearish markets? I want to check if my results can give any indication that it is easier for the managers to generate higher excess returns when the stock market is in an upswing than when the market is falling. The reason behind this is that I believe it is easier for a portfolio manager to add on risk in bull markets, than to reduce portfolio risk in a bear market.

Table 11 presents each funds annual excess return relative to OSEFX. I have also created an equally-weighted portfolio consisting of all the funds existing in the period with equal weights. The excess return of this portfolio is calculated as the arithmetic mean of all the funds excess returns. The annualized returns in each period for each fund is presented in Appendix 5, and a ranking of each period is presented in Appendix 6.

| | **Bear market 2000-2003** | **Bull market 2003-2007** | **Bear market 2007-2009** | **Bull market 2009-2013** |
|---|---|---|---|---|
| Alfred Berg Gambak | 4.8% | 6.7% | 5.5% | 0.1% |
| Alfred Berg Norge Classic | 0.7% | 1.1% | 3.8% | 0.5% |
| Atlas Norge | -5.3% | 15.0% | 3.9% | -0.9% |
| Carnegie Aksje Norge | 3.0% | 2.1% | 3.2% | -1.2% |
| Danske Invest Norge 1 | 2.2% | -3.4% | 5.0% | 2.3% |
| Danske Invest Norge 2 | 3.5% | -0.1% | 5.7% | 3.3% |
| Delphi Norge | 4.9% | 7.1% | 4.3% | 2.1% |
| DNB Norge | -2.3% | -2.3% | 3.8% | -1.9% |
| Handelsbanken Norge | -4.0% | -1.6% | 5.1% | -0.1% |
| Holberg Norge | - | 13.4% | 2.2% | -5.5% |
| KLP Aksje Norge | 0.9% | 2.6% | 3.8% | -0.1% |
| Nordea Avkastning | -2.4% | -2.5% | 0.4% | -0.1% |
| Nordea Vekst | -3.9% | -2.8% | -4.8% | -0.2% |
| Odin Norge | 4.7% | 11.5% | -1.4% | -10.9% |
| Omega Investment Fund A | 3.3% | -6.4% | 2.8% | 1.6% |
| Pluss Aksje | 3.2% | -8.2% | 5.0% | -0.7% |
| Storebrand Norge | -2.5% | 0.5% | 2.0% | 0.5% |
| Storebrand Optima Norge | - | -2.9% | 0.3% | -2.1% |
| **Equally-weighted portfolio** | 0.7% | 1.7% | 2.8% | -0.7% |

**Table 11 Annual excess return in bull and bear markets**

For the first bear market period in the Norwegian stock market (January 2000 – December 2002), 10 of the 16 funds generated annual excess return. We also see that an equally weighed

portfolio consisting of 16 funds would have outperformed OSEFX with an annual excess return of 0,7%.

In the second period, the bull market from January 2003 to December 2006, nine of the 18 funds were able to generate annual excess return. The best fund with respect to excess return this period was Atlas Norge, which outperformed OSEFX by 15%. An equally-weighted portfolio would have outperformed OSEFX by 1,7%.

In the second bear market period, from January 2007 to December 2008, 16 of the 18 funds were able to generate annual excess return. This period does not support my hypothesis that actively managed funds generate higher excess return in bullish markets, since the equally-weighted portfolio outperforms OSEFX by 2,8% in a time where the Norwegian stock market was falling. In addition, this period does not imply that it is easier for the active managers to generate excess return in bullish markets. This bearish market period is the period where most of the funds were able to outperform OSEFX.

In the last bull market period, from January 2009 to December 2013, 7 of the 18 funds generated annual excess return. This result does not support my hypothesis either. The equally-weighted portfolio underperformed OSEFX. A reason for this may be that the financial crisis, that affected markets globally, made the portfolio managers nervous somehow, and they maybe searched for low risk stocks for their funds. Norwegian mutual funds have the freedom to invest 20% of the fund outside Norwegian listed stocks, and this gives the fund the opportunity to either take on big bets, or invest in safe, low-beta stocks to reduce the risk. OSEFX does not have this opportunity, and from Appendix 5 we see that all funds seen as one, the annual returns stabilized just below the annual return OSEFX generated.

If I assemble the periods of bull market and the periods of bear market, 75,7% of my funds generated annual excess returns in the periods of bear market. In the bull markets upswings in the Norwegian stock market, only 44% of the funds generated annual excess return. This is not in accordance with my hypothesis that active managed funds outperform the benchmark more in bullish markets.

From table 11 we see that there are only three funds that managed to generate annual excess return relative to OSEFX for all four periods; Alfred Berg Gambak, Alfred Berg Norge Classic and Delphi Norge. The rest of the funds have at least one period with negative annual excess return. The only fund generating negative excess return for all periods is Nordea Vekst. We see from Appendix 4 as well, that Nordea Vekst is the fund with the lowest mean annual excess return for the whole period.

The results from table 11 depend only on the funds return, and do not take either systematic or unsystematic risk into account. To be able to say something about the funds risk and return profiles during the periods of bull and bear, I have performed regression analyses computing alpha and beta values. The alpha values, representing the unsystematic risk, will show whether the funds generated risk-adjusted excess return relative to OSEFX in a certain period, and if the alpha´s are statistically significant or not. The beta values, representing the systematic risk, show the funds volatility relative to the volatility of OSEFX. For all periods of bull and bear OSEFX has alpha values of 0 and beta values of 1.

| | **Bear market 2000-2003** | | | **Bull market 2003-2007** | | |
|---|---|---|---|---|---|---|
| | **Alpha *(p-value)*** | **Beta** | **$R^2$** | **Alpha *(p-value)*** | **Beta** | **$R^2$** |
| Alfred Berg Gambak | 0.005 *(0.62)* | 1.19 | 0.69 | 0.002 *(0.78)* | 1.05 | 0.73 |
| Alfred Berg Norge Classic | 0.001 *(0.71)* | 0.97 | 0.97 | 0.000 *(0.94)* | 1.02 | 0.97 |
| Atlas Norge | -0.005 *(0.53)* | 1.04 | 0.69 | 0.004 *(0.43)* | 1.15 | 0.82 |
| Carnegie Aksje Norge | -0.003 *(0.68)* | 0.85 | 0.69 | -0.002 *(0.53)* | 1.04 | 0.94 |
| Danske Invest Norge 1 | 0.001 *(0.59)* | 0.93 | 0.97 | -0.002 *(0.20)* | 0.99 | 0.98 |
| Danske Invest Norge 2 | 0.002 *(0.25)* | 0.92 | 0.97 | -0.001 *(0.38)* | 0.99 | 0.98 |
| Delphi Norge | 0.007 *(0.36)* | 1.38 | 0.83 | 0.002 *(0.60)* | 1.05 | 0.83 |
| Dnb Norge | -0.002 *(0.18)* | 0.99 | 0.98 | -0.002 *(0.12)* | 1.03 | 0.98 |
| Handelsbanken Norge | -0.002 *(0.63)* | 0.97 | 0.93 | -0.003 *(0.12)* | 1.06 | 0.97 |
| Holberg Norge | | | | 0.008 (0.05)* | 0.98 | 0.84 |
| Klp Aksje Norge | 0.000 *(0.88)* | 0.96 | 0.96 | 0.001 *(0.76)* | 1.03 | 0.97 |
| Nordea Avkastning | -0.003 *(0.33)* | 1.02 | 0.94 | -0.001 *(0.17)* | 0.99 | 0.99 |
| Nordea Vekst | -0.004 *(0.25)* | 1.02 | 0.91 | -0.002 *(0.29)* | 1.01 | 0.96 |
| Odin Norge | 0.004 *(0.50)* | 1.04 | 0.83 | 0.008 *(0.06)*** | 0.95 | 0.82 |
| Omega Investment Fund A | 0.003 *(0.36)* | 1.04 | 0.94 | -0.006 *(0.03)** | 1.08 | 0.92 |
| Pluss Aksje | 0.003 *(0.36)* | 1.01 | 0.95 | -0.005 *(0.00)** | 1.00 | 0.97 |
| Storebrand Norge | -0.002 *(0.29)* | 1.05 | 0.98 | 0.000 *(0.73)* | 1.03 | 0.98 |
| Storebrand Optima Norge | | | | -0.002 *(0.55)* | 1.00 | 0.89 |
| * Significant at a 5% significance level<br>** Significant at a 10% significance level | | | | | | |

**Table 12 Regression results for 2000-2003 and 2003-2007**

From the regression analyses shown in table 12, we see that none of the funds in the first period of bear market had statistically significant alpha values. This means that I have no evidence to say that any of the funds generated statistically significant risk-adjusted excess return in the period 2000-2003. Most of the beta values in the same period are close to 1, but one of the funds deviates more than the other funds. Delphi Norge has a beta of 1,38, meaning this fund had more systematic risk than OSEFX in the period and hence more volatile than its benchmark index. This should lead to higher returns, and we see, although it is not statistically significant, that the alpha value of the fund is the highest for the period. In the first period of bear market, Holberg Norge and Storebrand Optima Norge are excluded. This is because these funds were not established until 2001, and hence the returns for these funds do not go back to 2000.

For the second period, the bull period from 2003-2007, three of the funds (Holberg Norge, Omega Investment Fund A and Pluss Aksje) have statistically significant alphas with a significance level of 5%. For Holberg Norge this means I have evidence to say that the fund outperformed OSEFX with respect to the risk-adjusted excess return by 0,8%. For Omega Investment Fund A and Pluss Aksje, their significant alpha is negative, and I can conclude that these two funds underperformed OSEFX with respect to risk-adjusted excess return. Odin Norge has a statistically significant alpha when the significance level is at 10%.

| | Bear market 2007-2009 | | | Bull market 2009-2013 | | |
|---|---|---|---|---|---|---|
| | **Alpha *(p-value)*** | **Beta** | **$R^2$** | **Alpha *(p-value)*** | **Beta** | **$R^2$** |
| Alfred Berg Gambak | 0.002 *(0.73)* | 0.96 | 0.94 | 0.002 *(0.45)* | 0.88 | 0.90 |
| Alfred Berg Norge Classic | 0.002 *(0.30)* | 0.96 | 0.99 | 0.001 *(0.44)* | 0.96 | 0.98 |
| Atlas Norge | 0.002 *(0.53)* | 0.92 | 0.98 | -0.001 *(0.29)* | 1.03 | 0.97 |
| Carnegie Aksje Norge | 0.002 *(0.38)* | 0.95 | 0.99 | 0.001 *(0.79)* | 1.01 | 0.93 |
| Danske Invest Norge 1 | 0.003 *(0.37)* | 0.87 | 0.96 | 0.000 *(0.80)* | 0.99 | 0.97 |
| Danske Invest Norge 2 | 0.004 *(0.37)* | 0.86 | 0.96 | 0.001 *(0.44)* | 0.99 | 0.97 |
| Delphi Norge | 0.000 *(0.97)* | 0.85 | 0.96 | 0.002 *(0.40)* | 0.95 | 0.91 |
| Dnb Norge | 0.002 *(0.31)* | 0.91 | 0.99 | 0.001 *(0.73)* | 0.91 | 0.96 |
| Handelsbanken Norge | 0.004 *(0.11)* | 1.02 | 0.99 | 0.000 *(0.83)* | 1.00 | 0.93 |
| Holberg Norge | -0.003 *(0.47)* | 0.69 | 0.92 | -0.005 *(0.05)** | 0.94 | 0.91 |
| Klp Aksje Norge | -0.001 *(0.86)* | 0.86 | 0.92 | -0.001 *(0.66)* | 1.02 | 0.97 |
| Nordea Avkastning | -0.001 *(0.52)* | 0.94 | 0.99 | 0.000 *(0.68)* | 0.99 | 0.99 |
| Nordea Vekst | -0.006 *(0.06)*** | 0.90 | 0.97 | 0.000 (0.79) | 0.99 | 0.98 |
| Odin Norge | -0.008 *(0.19)* | 0.67 | 0.87 | -0.005 *(0.12)* | 0.85 | 0.82 |
| Omega Investment Fund A | 0.002 *(0.56)* | 0.95 | 0.97 | 0.001 *(0.73)* | 1.02 | 0.94 |
| Pluss Aksje | 0.003 *(0.33)* | 0.81 | 0.97 | 0.001 *(0.29)* | 0.92 | 0.98 |
| Storebrand Norge | 0.001 *(0.77)* | 0.95 | 0.99 | 0.000 *(0.53)* | 0.99 | 0.99 |
| Storebrand Optima Norge | -0.001 *(0.80)* | 0.92 | 0.96 | 0.000 *(0.92)* | 0.93 | 0.90 |
| * Significant at a 5% significance level<br>** Significant at a 10% significance level | | | | | | |

**Table 13 Regression results for 2007-2009 and 2009-2013**

When looking at the results from the regression analysis for the bear market period from 2007-2009 in table 13, none of the funds have a statistically significant alpha when using a significance level of 5%. However, with a significance level of 10%, Nordea Vekst has a negative significant alpha. This means Nordea Vekst underperformed OSEFX with respect to risk-adjusted excess return by 0,6%. The beta values in this period is a bit more spread than the first two periods, but we see that the fund with the lowest beta (the lowest systematic risk), Odin Norge, also produced the lowest alpha (lowest risk-adjusted excess return). On the other hand, the fund with the highest beta, Handelsbanken Norge, produced the highest alpha. This is in accordance with the portfolio theory described in chapter 4.

In the last period of bull market, from 2009-2013, only one of the funds produced a statistically significant alpha. Holberg Norge had an alpha of -0,005 meaning I have evidence to say that the fund underperformed OSEFX by 0,5% with respect to risk-adjusted excess return. The rest of the funds did not generate significant alphas.

The low number of funds with significant alpha values shows that I am not able to discover patterns with respect to risk-adjusted excess return for the periods of bull and bear market.

However, I am able to say something about the funds systematic risk relative to the benchmark.

| | Average beta |
|---|---|
| 1997-2013 | 0.98 |
| Bear market 2000-2003 | 1.02 |
| Bull market 2003-2007 | 1.03 |
| Bear market 2007-2009 | 0.89 |
| Bull market 2009-2013 | 0.96 |

Table 14 Average beta

Table 14 shows the average beta for all of the funds, both for the whole period and for the periods of bull and bear market. For the first two periods of bear market and bull market, we see that the funds on average had a little higher systematic risk than OSEFX. In the two last periods, the funds volatility was lower than the volatility of OSEFX. However, the average beta for the funds in the period 2007-2009 was relatively low and shows that during the financial crisis the funds did not take on extreme bets with high risk.

## 5.15 Total Ranking

In this chapter I will use the results from the previous chapters to discuss the total ranking of the funds, based on the performance measures and total shareholder return. In table 15 I have ranked the funds based on the three performance measures from chapter 4.3.1, 4.3.2 and 4.3.3. The Sharpe ratio and the $M^2$ measure gives the same ranking, but combined with the information ratio the rankings differs a little. To do this total ranking based on the performance measures, I added up the three rankings for each fund and divided it by three.

| | Total Ranking |
|---|---|
| Delphi Norge | 1 |
| KLP Aksje Norge | 2 |
| Carnegie Aksje Norge | 3 |
| Alfred Berg Gambak | 4 |
| Holberg Norge | 5 |
| Danske Invest Norge 2 | 6 |
| Atlas Norge | 7 |
| Pluss Aksje | 8 |
| Danske Invest Norge 1 | 9 |
| Alfred Berg Norge Classic | 10 |
| Odin Norge | 11 |
| Storebrand Norge | 12 |
| Omega Investment Fund A | 13 |
| Storebrand Optima Norge | 14 |
| Nordea Avkastning | 15 |
| Handelsbanken Norge | 16 |
| Dnb Norge | 17 |
| Nordea Vekst | 18 |

Table 15 Total Ranking

This ranking shows that a rational investor in 1997 should have invested in Delphi Norge, KLP Aksje Norge, Carnegie Aksje Norge or one of the other highly ranked funds assumed a perfect foresight. The funds with the lower rankings would, according to the three performance measures, not yield as good risk-adjusted return as the highest ranked funds in the 17-year period.

To be sure that these performance measures give a correct picture of the reality, I simulate investments in each fund. The investment was 1000 NOK in each fund in 1997, and for the funds not established in 1997, I invested 1000 NOK from their launch date. This simulation results in which funds you would have got the highest capital gain, and is purely return based. The calculations of the investments are based on the total shareholder return (TSR), discussed in chapter 4.3.5. The value of the 1000 NOK investment in Alfred Berg Gambak in 1997 would in 2013 been worth:

$$Final\ value_{GA-GAMB} = 1000 * (1 + TSR_{GA-GAMB})$$
$$Final\ value_{GA-GAMB} = 1000 * (1 + 386{,}26\%) = 4863\ NOK$$

In table 16 the simulated investments are presented and ranked from highest capital gain to the lowest. I simulated an investment in OSEFX as well to compare the funds to the benchmark. The risk-free rate of return calculated in chapter 5.5 is also included, representing a risk-free deposit in the bank of 1000 NOK in 1997.

| | December 2013 |
|---|---|
| Delphi Norge | 5642 |
| Carnegie Aksje Norge | 5290 |
| Alfred Berg Gambak | 4863 |
| Pluss Aksje | 4301 |
| Klp Aksje Norge (1999-2013) | 4126 |
| Danske Invest Norge 2 | 4010 |
| Alfred Berg Norge Classic | 3868 |
| **OSEFX** | **3719** |
| Equally-weighted portfolio | 3678 |
| Odin Norge | 3501 |
| Danske Invest Norge 1 | 3500 |
| Atlas Norge (1998-2013) | 3479 |
| Holberg Norge (2001-2013) | 3297 |
| Storebrand Norge | 3252 |
| Nordea Avkastning | 3121 |
| Handelsbanken Norge | 3114 |
| Dnb Norge | 3013 |
| Omega Investment Fund A | 2983 |
| Nordea Vekst | 2478 |
| Storebrand Optima Norge (2001-2013) | 2371 |
| Risk-Free Investment | 2002 |

Table 16 Value Growth 1997-2013

From table 16 we see that there are quite large differences between the funds. While an investment in Delphi Norge would give a final value of 5642 NOK in 2013, the investment in Nordea Vekst would only have grown to 2478 NOK. In other words, if you invested in Nordea Vekst in 1997 rather than Delphi Norge, you would in 2013 had 56% less capital gain. Storebrand Optima Norge is the lowest ranked fund, but it was launched in 2001, and comparing it to funds started in 1997 is unfair. The highest ranked funds in table 15 are also the funds with the largest actual capital gains. This shows that high risk-adjusted performance coincides with high total return.

Figure 4 shows the value growth of the fund with the highest capital gain (Delphi Norge), the fund with the lowest capital gain (Storebrand Optima Norge), OSEFX and the risk-free

investment. In addition, an equally-weighted portfolio (FUNDS) of all the funds are included in the figure, showing the average return of all funds.

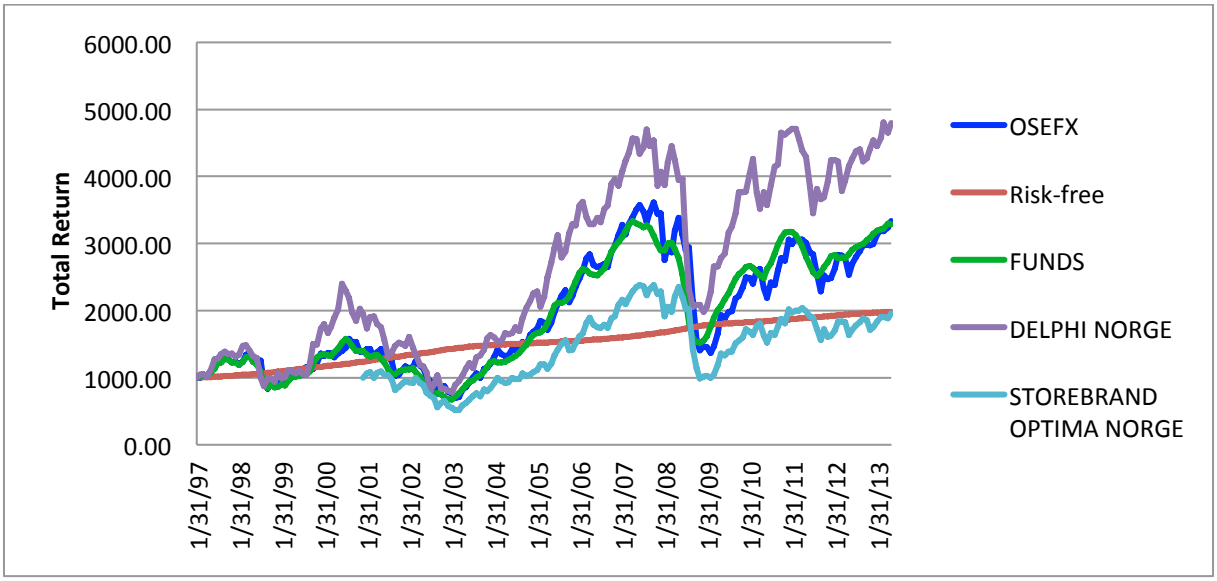


**Figure 4 Total Returns**

If you invested 1000 NOK in OSEFX in 1997, the value in 2013 would be 3719 NOK. Compared to the funds, this investment is among the best half. In comparison, a strictly risk averse investor with a 1000 NOK deposit in the bank in 1997 would have 2002 NOK in his account in 2013. This is 65% less than if he invested in Delphi Norge.

When evaluating the performance of the funds in different states of the stock market, I based the evaluation on return and excess return. To see which funds managed to deliver the highest capital gain (or lowest capital loss) I have done the same simulation as I did for the whole period, in the periods of bear market and bull market. The results for the three best funds, the three worst funds (below the red line) and OSEFX are presented in table 17 and 18. The simulated investment starts at the beginning of the period and the final value is the value at the end of the period. I simulated an investment for the first period of 1000 NOK in January 2000 and calculated the final value at the end of the bear market period in December 2002. The same follows for the other periods.

| 2000-2003 | Bear market | 2003-2007 | Bull market |
|---|---|---|---|
| Danske Invest Norge 2 | 671 | Holberg Norge | 5457 |
| Carnegie Aksje Norge | 664 | Odin Norge | 5229 |
| Danske Invest Norge 1 | 642 | Delphi Norge | 4639 |
| **OSEFX** | **596** | Equally-weighted portfolio | 4162 |
| Equally-weighted portfolio | 584 | **OSEFX** | **4142** |
| Nordea Vekst | 526 | Storebrand Optima Norge | 3763 |
| Alfred Berg Gambak | 508 | Omega Investment Fund A | 3515 |
| Atlas Norge | 417 | Pluss Aksje | 3283 |

Table 17 Value growth 2000-2003 and 2003-2007

In the first period of bear market we see from table 17 that all of the funds had a capital loss. But there are still differences between the funds. If you invested in Atlas Norge in 2000 rather than Danske Invest Norge 2, the capital loss would be 583 NOK rather than 329 NOK. As we see from Appendix 5, Atlas Norge has a higher standard deviation than Danske Invest Norge 2, and this risk may be some of the reason for the funds capital loss. For this period, Atlas Norge also has a higher beta value, indicating higher systematic risk. In general, higher risk should be rewarded by higher return, hence higher risk may lead to greater losses.

In the period of bear market from 2003 to 2007, an investment of 1000 NOK in January 2003 would yield a relatively high capital gain even when investing in the lowest ranked fund, Pluss Aksje. If you invested 1000 NOK in the highest ranked fund in this period, Holberg Norge, you would during only 4 years have increased the value by impressing 445%. Holberg Norge´s standard deviation in this period was not especially high during this period either (see Appendix 5), and the total ranking of the fund in table 15 shows that the fund is ranked number 5 for the whole period. Holberg Norge´s beta for the period is 0,98 indicating that this fund was able to generate high return without bearing a high risk in this period.

| 2007-2013 | Bear market | 2009-2013 | Bull market |
|---|---|---|---|
| Pluss Aksje | 568 | Danske Invest Norge 2 | 2865 |
| Danske Invest Norge 2 | 562 | Danske Invest Norge 1 | 2760 |
| Danske Invest Norge 1 | 550 | Delphi Norge | 2701 |
| Equally-weighted portfolio | 502 | **OSEFX** | **2561** |
| Storebrand Optima Norge | 469 | Equally-weighted portfolio | 2461 |
| Nordea Avkastning | 465 | Storebrand Optima Norge | 2304 |
| **OSEFX** | **448** | Holberg Norge | 1906 |
| Nordea Vekst | 427 | Odin Norge | 1659 |

Table 18 Value growth 2007-2009 and 2009-2013

The simulated investment of 1000 NOK in 2007 would as expected not yield any capital gain, but the funds managed to get through this period relatively well compared to the index. OSEFX had the second highest capital loss this period, and only Nordea Vekst was outperformed by the benchmark with respect to total return. The rest of the funds had lower capital loss than OSEFX, and this implies that the portfolio managers in these funds were clever in their stock picking and portfolio management in a bearish stock market.

In the last period, the bull market from 2009-2013, the funds did not perform as well compared to OSEFX as they did in the period 2007-2009. They did generate return and the simulated investment had significant capital gains, but in the bull market from 2003-2007, the capital gains were much higher and the bull market stronger.

Danske Invest 1 and Danske Invest 2 are among the top three funds in three of the periods. This shows that these two funds have either had great luck in their investments, or they are skilled when it comes to picking the optimal investments in different cycles in the stock market. Table 17 and 18 also show that an equally-weighted portfolio of all the funds beat OSEFX in the first period of bull market and the last period of bear market. The portfolio underperforms OSEFX in the first period of bear market and the last period of bull market. However, it is important to keep in mind the risk of survivorship bias when looking at the equally-weighted portfolio. It only includes funds that existed the whole bear/bull period, and funds closing during the periods are excluded. This may lead to survivorship bias and based on this portfolio I cannot draw conclusions for the whole fund universe, only for the funds included in this study.

# 6 Conclusion

In this thesis I have done an analysis of 18 different Norwegian mutual equity funds in the period 1997-2013. During this period the equity market in Norway, represented by the Oslo Stock Exchange Benchmark Index have increased by 243%. In the same period, the best performing fund, with respect to total shareholder return, have increased its value by 464%, while the worst performing fund increased only by 137%.

An equity fund is always expected to beat risk-free interest rate through a business cycle, but the goal of active portfolio management is also to beat the market, or more precisely the benchmark index they compare themselves against. This has been the main research topic throughout the thesis; to see whether the portfolio managers of the active managed funds actually have been able to generate excess return relative to their benchmark. I have analysed this both for the whole period of 1997-2013, but also through four distinct periods representing bullish and bearish periods in the stock market. Did the portfolio managers perform better in bull markets than in bear markets?

To be able to conclude on these questions, I applied different performance measures; both risk-adjusted and absolute return-based measures. These measures are made to make it easier to compare funds, evaluate fund managers and they are helpful tools to the investors when seeking an active manager which hopefully provide excess return for his fund in the future.

Another way to evaluate a funds performance is to apply series of historical data into a regression analysis. This analysis shows the relationship between the fund and its benchmark. The regression produces alpha-values, an important term in this field of study. These values tell you whether the fund managed to generate risk-adjusted excess return relative to the benchmark – the main goal for the active portfolio managers. Other studies (Sørensen, 2009) tends to conclude that the alpha values are not significant, meaning no significant under- or outperformance by the funds. None of the alphas during the 17-year period for my funds were significant either. This does not mean the funds did not generate excess return, but the excess returns they generated adjusted for risk were not statistically significant.

The other output from the regression analysis is the funds beta values and $R^2$. The beta values represent the funds risk relative to the benchmark. The funds beta values, both for the whole

period and for the periods of bull and bear market, were close to one. However, I observed beta values indicating that the funds had either higher or lower systematic risk than their benchmark index. All of the funds $R^2$ were high and this shows that the movements in the benchmark index are highly correlated with the movements in the funds.

The performance measures I used other than the output from the regression analysis was the Sharpe ratio, the $M^2$ measure and the information ratio. These measures reflect which investment decision would have been the optimal for a rational investor. Based on these measures I ranked the funds and found out which funds would be the best investment for a rational investor. The top ranked funds were usually found at the highest rankings in all of the performance measures. Not surprisingly, they also topped the rankings when measuring total shareholder return.

When evaluating the different periods, the results were more differentiated. It does not seem to be a clear pattern with respect to the funds excess return in different stock market states, but a larger number of the funds managed to outperform the benchmark during bear markets than in the periods of bull market with respect to excess return. The regression analyses conducted for the periods of bull and bear market gave much the same results as for the whole period, but some of the funds had significant alphas during the periods. However, the few significant alphas generated were both positive and negative and I was not able to discover a distinct trend based on this. The beta values of the funds during the different periods were more spread than when analysing the whole period. This shows that the fund manager either choose to adjust their portfolio by taking on higher risk due to a growing stock market, or reducing the risk to minimize losses in a declining stock market.

To evaluate the funds against their benchmark, I created an equally weighted portfolio consisting on equal shares of every fund. This portfolio is supposed to represent all of the funds seen as one, and check if this portfolio would manage to beat the benchmark. For the whole period, the portfolio did not manage to beat the benchmark with respect to total shareholder return. An investment in an index fund in this period would yield a higher capital gain than investing in the equally-weighted portfolio. However, the equally weighted portfolio has a lower beta than the benchmark index, and the expected return will therefore be lower as well. When looking at this portfolio for the shorter periods, the portfolio would beat the benchmark in the first three periods with respect to total shareholder return.

To sum up, the active managed funds I have investigated through different stock market cycles both did and did not beat their benchmark. In my sample of funds, the distribution of funds outperforming versus the ones underperforming the benchmark is close to 50-50. And on average, over the whole period, and as a group they actually underperformed versus their benchmark. While the alpha values were not significant, we still see that the capital gains from investing in the highest ranked funds were much higher than the capital gain of the benchmark. The performance measures also indicate outperformance of the benchmark of some funds and underperformance by others. However, all these measures are based on historical data, and they are not necessarily reliable indicators for future performance. Picking an active manager seems to be difficult despite statistical methods and advanced quantitative measurements. Perhaps there is a need for an even deeper analysis of the strategy and investment philosophy behind each active managed fund before making a qualified decision. If this looks to complex, time consuming and risky, you should probably just go for the index.

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# Appendix

## 1 Presentation of the Funds

| Fund | Ticker | Launch date | Benchmark index | Minimum investment | Management fee |
|---|---|---|---|---|---|
| Alfred Berg Gambak | GA-GAMB | 01/11/90 | OSEFX | kr 25 000 | 1.80% |
| Alfred Berg Norge Classic | AI-NORG | 31/12/94 | OSEFX | kr 25 000 | 1.20% |
| Atlas Norge | NR-NORGE | 24/02/98 | OSEFX | Kr 50 000 | 0.75% |
| Carnegie Aksje Norge | CA-AKSJE | 07/07/95 | OSEFX | kr 1 000 | 1.20% |
| Danske Invest Norge 1 | FF-NORGE | 03/01/94 | OSEFX | kr 1 000 | 2.00% |
| Danske Invest Norge 2 | FF-NORII | 02/01/94 | OSEFX | kr 50 000 | 1.25% |
| Delphi Norge | DF-NORGE | 03/06/94 | OSEFX | kr 300 | 2.00% |
| DNB Norge | DK-PBNOR | 27/07/95 | OSEFX | kr 100 | 1.80% |
| Handelsbanken Norge | HF-NORGE | 06/03/95 | OSEFX | kr 1 000 | 2.00% |
| Holberg Norge | HO-NORGE | 28/12/00 | OSEFX | kr 1 000 | 1.50% |
| KLP Aksje Norge | KL-AKSNO | 18/09/98 | OSEFX | kr 3 000 | 0.75% |
| Nordea Avkastning | KF-AVKAS | 01/02/81 | OSEFX | kr 100 | 1.50% |
| Nordea Vekst | KF-VEKST | 02/01/81 | OSEFX | kr 100 | 2.00% |
| Odin Norge | OD-NORGE | 26/06/92 | OSEFX | kr 3 000 | 2.00% |
| Pareto Omega Investment Fund A | OR-INVF | 03/01/85 | OSEFX | kr 2 000 | 1.80% |
| Pluss Aksje | FO-AKSJE | 27/12/96 | OSEFX | kr 50 000 | 1.20% |
| Storebrand Norge | SP-NORGE | 16/08/83 | OSEFX | kr 100 | 1.50% |
| Storebrand Optima Norge | SP-OPTIM | 28/12/00 | OSEBX | kr 100 000 | 1.00% |

## 2 Regression Analysis From STATA of Alfred Berg Gambak (1997-2013)

Regression analysis: GA-GAMB (regressand) versus OSEFX (regressor)

Regression equation:

$$GAGAMB = 0.0025886 + 0.9940892 \times OSEFX$$

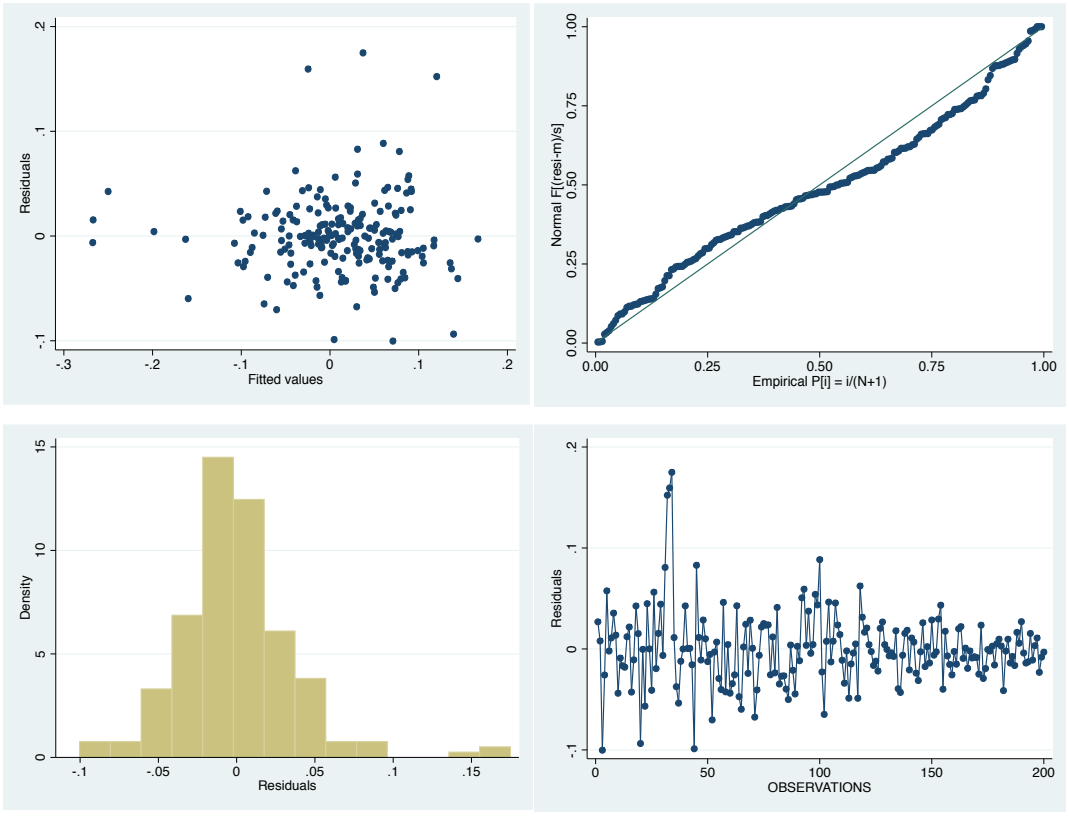
```
. regress GAGAMB OSEFX
```

| Source | SS | df | MS |
|---|---|---|---|
| Model | .940526071 | 1 | .940526071 |
| Residual | .268879574 | 198 | .001357978 |
| Total | 1.20940565 | 199 | .006077415 |

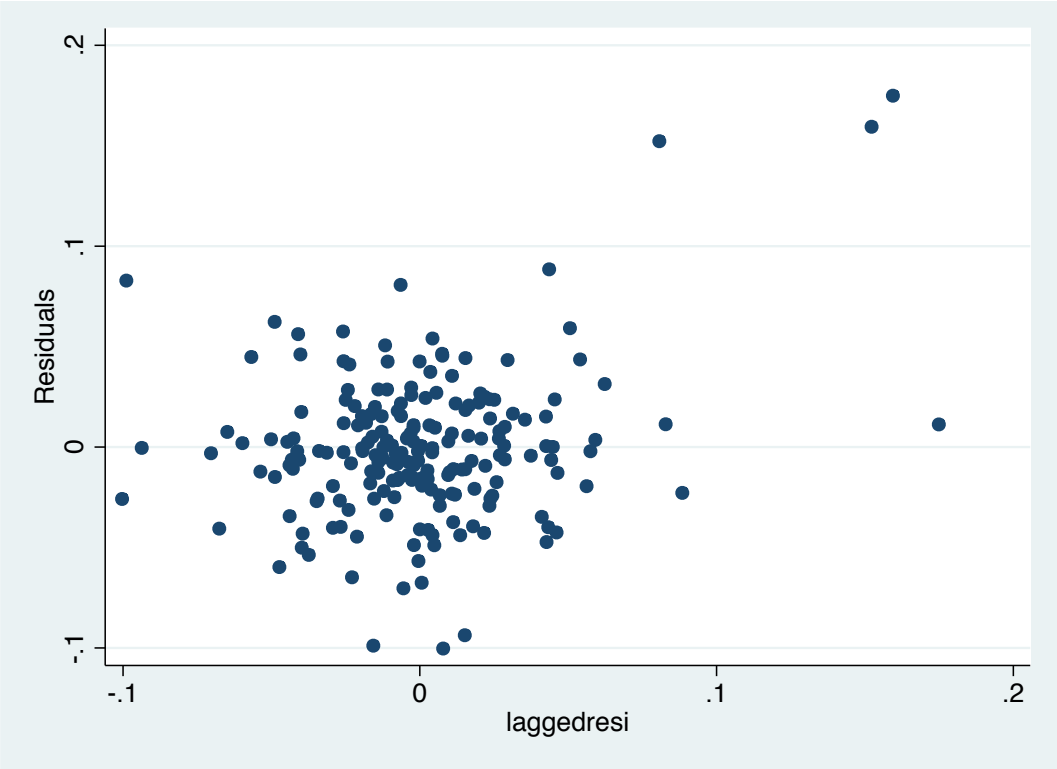
| | |
|---|---|
| Number of obs | 200 |
| F( 1, 198) | 692.59 |
| Prob > F | 0.0000 |
| R-squared | 0.7777 |
| Adj R-squared | 0.7766 |
| Root MSE | .03685 |

| GAGAMB | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| OSEFX | .9940892 | .0377734 | 26.32 | 0.000 | .9195993 | 1.068579 |
| _cons | .0025886 | .0026255 | 0.99 | 0.325 | -.0025889 | .0077661 |

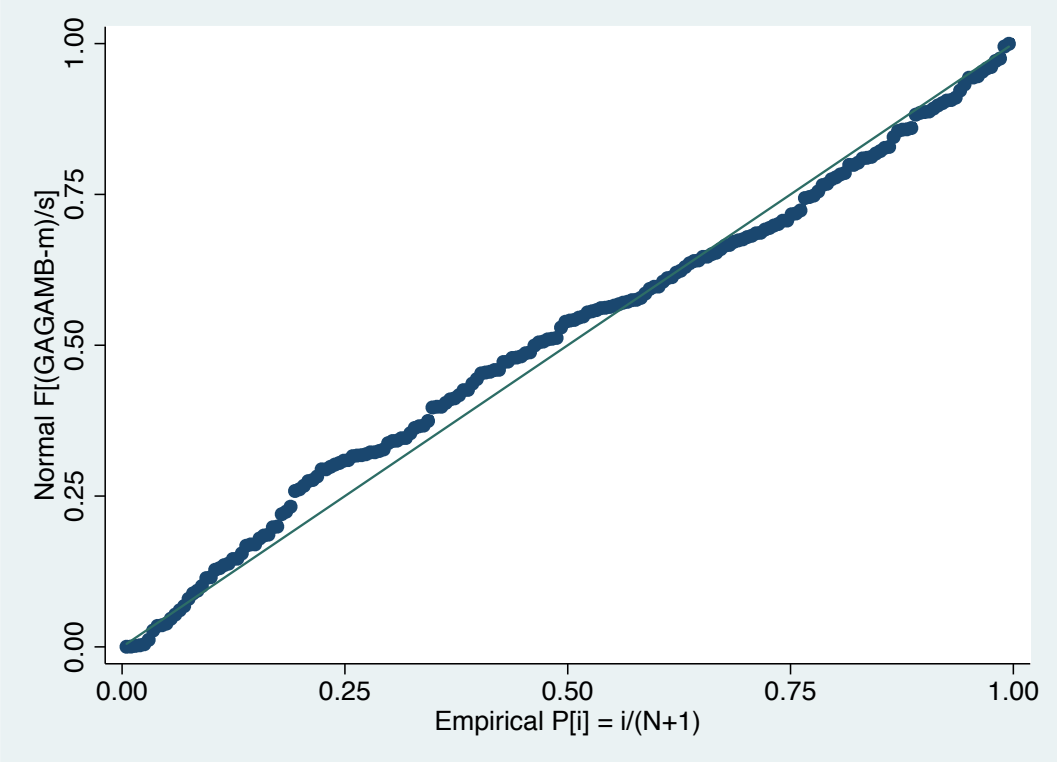
Durbin-Watson statistics = 1.473633
Mean residuals = 4.11e-12



## 4.1 Result From Testing for Autocorrelation of Alfred Berg Gambak




## 4.2 Result From Testing for Normality for Alfred Berg Gambak



## 4 Annualized Mean Returns, Annualized Mean Excess Returns and Annualized Mean Standard Deviations for the Period 1997-2013

| | $\bar{r}_p$ | $(\bar{r}_p - \bar{r}_M)$ | $\bar{\sigma}_p$ |
|---|---|---|---|
| Risk-free | 4.21% | | |
| OSEFX | 11.47% | | 21.16% |
| Alfred Berg Gambak | 14.97% | 3.50% | 23.92% |
| Alfred Berg Norge Classic | 11.37% | -0.10% | 20.72% |
| Atlas Norge | 14.18% | 2.71% | 25.84% |
| Carnegie Aksje Norge | 14.03% | 2.56% | 21.37% |
| Danske Invest Norge 1 | 11.58% | 0.12% | 21.07% |
| Danske Invest Norge 2 | 12.48% | 1.01% | 21.08% |
| Delphi Norge | 15.60% | 4.13% | 24.46% |
| DNB Norge | 9.73% | -1.73% | 20.59% |
| Handelsbanken Norge | 9.96% | -1.51% | 21.34% |
| Holberg Norge | 12.95% | 1.49% | 20.19% |
| KLP Aksje Norge | 14.34% | 2.88% | 20.48% |
| Nordea Avkastning | 9.87% | -1.59% | 20.66% |
| Nordea Vekst | 8.41% | -3.06% | 21.02% |
| Odin Norge | 11.19% | -0.28% | 20.83% |
| Omega Investment Fund A | 10.36% | -1.10% | 21.89% |
| Pluss Aksje | 12.36% | 0.90% | 20.93% |
| Storebrand Norge | 10.90% | -0.57% | 21.18% |
| Storebrand Optima Norge | 10.18% | -1.28% | 21.70% |

# 5 Annualized Returns and Standard Deviations in Periods of Bull Market and Bear Market

| | Bear market 2000-2003 | | Bull market 2003-2007 | | Bear market 2007-2009 | | Bull market 2009-2013 | |
|---|---|---|---|---|---|---|---|---|
| | $\bar{r}_p$ | $\bar{\sigma}_p$ | $\bar{r}_p$ | $\bar{\sigma}_p$ | $\bar{r}_p$ | $\bar{\sigma}_p$ | $\bar{r}_p$ | $\bar{\sigma}_p$ |
| OSEFX | -13.3% | 22.7% | 43.7% | 18.7% | -20.6% | 29.6% | 25.8% | 18.5% |
| Alfred Berg Gambak | -8.5% | 32.7% | 50.4% | 22.8% | -15.1% | 28.6% | 25.9% | 16.5% |
| Alfred Berg Norge Classic | -13.7% | 23.1% | 44.9% | 19.6% | -16.7% | 28.2% | 26.3% | 17.7% |
| Atlas Norge | -20.5% | 28.5% | 51.6% | 23.4% | -16.6% | 28.2% | 25.6% | 19.1% |
| Carnegie Aksje Norge | -10.3% | 21.9% | 45.8% | 20.1% | -17.3% | 28.2% | 24.8% | 19.5% |
| Danske Invest Norge 1 | -11.1% | 21.0% | 40.3% | 18.7% | -15.5% | 26.3% | 28.4% | 18.7% |
| Danske Invest Norge 2 | -9.8% | 21.0% | 41.4% | 18.8% | -14.9% | 26.0% | 29.3% | 18.7% |
| Delphi Norge | -8.5% | 34.1% | 50.8% | 21.4% | -16.3% | 25.5% | 28.2% | 18.1% |
| DNB Norge | -15.6% | 23.0% | 2.9% | 19.6% | -2.1% | 27.5% | 24.2% | 17.4% |
| Handelsbanken Norge | -17.3% | 23.1% | 42.1% | 20.2% | -15.5% | 30.0% | 26.0% | 19.0% |
| Holberg Norge | - | - | 57.2% | 19.5% | -18.3% | 21.9% | 20.6% | 17.8% |
| KLP Aksje Norge | -12.5% | 22.0% | 46.3% | 20.1% | -16.8% | 25.3% | 25.9% | 18.9% |
| Nordea Avkastning | -15.7% | 23.9% | 41.2% | 18.8% | -20.2% | 27.4% | 26.0% | 18.8% |
| Nordea Vekst | -17.2% | 24.3% | 40.9% | 19.5% | -25.3% | 27.3% | 25.9% | 18.8% |
| Odin Norge | -8.7% | 25.9% | 55.2% | 19.4% | -21.9% | 22.0% | 15.2% | 17.0% |
| Omega Investment Fund A | -10.0% | 23.9% | 37.3% | 20.7% | -17.8% | 28.6% | 27.7% | 19.5% |
| Pluss Aksje | -10.1% | 22.7% | 35.5% | 19.2% | -15.5% | 24.7% | 25.4% | 17.3% |
| Storebrand Norge | -15.8% | 24.1% | 44.3% | 19.6% | -18.6% | 27.9% | 26.6% | 18.4% |
| Storebrand Optima Norge | - | - | 3.1% | 20.0% | -20.2% | 28.1% | 24.0% | 18.2% |

# 6 Excess Return Ranked for the Periods of Bull Market and Bear Market

| Bear market 2000-2002 | | Bull market 2003-2006 | | Bear market 2007-2009 | | Bull market 2009-2013 | |
|---|---|---|---|---|---|---|---|
| Delphi Norge | 4.9% | Atlas Norge | 15.0% | Danske Invest Norge 2 | 5.7% | Danske Invest Norge 2 | 3.3% |
| Alfred Berg GAMBAK | 4.8% | Holberg Norge | 13.4% | Alfred Berg Gambak | 5.5% | Danske Invest Norge 1 | 2.3% |
| Odin Norge | 4.7% | Odin Norge | 11.5% | Handelsbanken Norge | 5.1% | Delphi Norge | 2.1% |
| Danske Invest Norge 2 | 3.5% | Delphi Norge | 7.1% | Danske Invest Norge 1 | 5.0% | Omega Investment Fund A | 1.6% |
| Omega Investment Fund A | 3.3% | Alfred Berg Gambak | 6.7% | Pluss Aksje | 5.0% | Alfred Berg Norge Classic | 0.5% |
| Pluss Aksje | 3.2% | KLP Aksje Norge | 2.6% | Delphi Norge | 4.3% | Storebrand Norge | 0.5% |
| Carnegie Aksje Norge | 3.0% | Carnegie Aksje Norge | 2.1% | Atlas Norge | 3.9% | Alfred Berg Gambak | 0.1% |
| Danske Invest Norge 1 | 2.2% | Alfred Berg Norge Classic | 1.1% | Alfred Berg Norge Classic | 3.8% | Handelsbanken Norge | -0.1% |
| KLP Aksje Norge | 0.9% | Storebrand Norge | 0.5% | DNB Norge | 3.8% | Nordea Avkastning | -0.1% |
| Alfred Berg Norge Classic | 0.7% | Danske Invest Norge 2 | -0.1% | KLP Aksje Norge | 3.8% | KLP Aksje Norge | -0.1% |
| DNB Norge | -2.3% | Handelsbanken Norge | -1.6% | Carnegie Aksje Norge | 3.2% | Nordea Vekst | -0.2% |
| Nordea Avkastning | -2.4% | DNB Norge | -2.3% | Omega Investment Fund A | 2.8% | Pluss Aksje | -0.7% |
| Storebrand Norge | -2.5% | Nordea Avkastning | -2.5% | Holberg Norge | 2.2% | Atlas Norge | -0.9% |
| Nordea Vekst | -3.9% | Nordea Vekst | -2.8% | Storebrand Norge | 2.0% | Carnegie Aksje Norge | -1.2% |
| Handelsbanken Norge | -4.0% | Storebrand Optima Norge | -2.9% | Nordea Avkastning | 0.4% | DNB Norge | -1.9% |
| Atlas Norge | -5.3% | Danske Invest Norge 1 | -3.4% | Storebrand Optima Norge | 0.3% | Storebrand Optima Norge | -2.1% |
| | | Omega Investment Fund A | -6.4% | Odin Norge | -1.4% | Holberg Norge | -5.5% |
| | | Pluss Aksje | -8.2% | Nordea Vekst | -4.8% | Odin Norge | -10.9% |