BI Norwegian Business School - campus Oslo

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## Master Thesis

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Does Fund Size Diminish Mutual Fund Performance?

A Study of the Norwegian Market

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# Abstract

The main goal of this thesis is to examine the relationship between Norwegian mutual fund size and performance. More precisely, we aim to examine whether there is any difference in the performance of small and large Norwegian mutual funds during the period 2008-2017. The research period is further divided into tree sub-periods for the purpose of including several aspects of both growth and recession periods. We will construct from our sample three groups based on size (small-, medium-, and large-cap) in order to evaluate whether size has an impact on performance.

We will use regression analysis in the form of the Fama and French 3-factor model, Carhart 4-factor model and Fama and French 5-factor model to evaluate excess returns. Further, we look at Jensen's Alpha and Sharpe Ratio for performance measures.

While the effect of scale on performance is an important question, it has received little research attention in Norway to date. We are mostly motivated by past research conducted in the US, and aim to contribute with a rare empirical standpoint for this research area by studying the Norwegian mutual fund market.

We reserve the right to make changes in the process of developing the Master Thesis.

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# 1.0 Introduction

## 1.1 Motivation

The capital market in Norway is continuously growing and evolving as time passes, consequentially affecting managers to actively adapt the innovation with the purpose of outperforming the market. The Norwegian population savings in mutual funds have become more common during the last few years, and by the end of 2017 NOK 231 billion was invested in Norwegian mutual funds. In total, explicitly for 2017, Norwegian personal customers have net subscribed mutual funds for NOK 18,4 billion, which corresponds to an increase of 20 percent from the beginning of the year (VFF, 2017). This is seen in context to the transition from the traditional pension benefit plans to defined contribution pension plans as well as a commercialization of the securities market. Developments in the financial market and changes in the state's public pension scheme results in each of us making more financial decisions than before. In addition, the fact that Norwegians are living longer will make it necessary to save more on their own to maintain purchasing power when retired. It is therefore important for the future that savings are well managed to ensure return. What kind of structure of mutual funds should Norwegians choose for their future savings?

Information technology has led consumers to gain access to more suppliers and a larger offer of products, thereby increasing the opportunities in the savings market. In 2016, the Norwegian government conducted a tax reform. In the reform, the government decided that yielded interest rates and stock shares should have different tax rates (Bergo 1, 2016 and amendment of the Tax Act § 10-20). A lower tax rate on interest rates has given those who are saving in fund accounts a tax advantage as the product previously was taxed as interest income. In addition, the Norwegian government released two new distinctly Norwegian products in 2017, namely “Aksjesparekonto” (share shavings account) and Individual Pension Savings (IPS). with tax benefit. Both products make it easier and more beneficial for individuals to save in share and mutual funds.

These are all explanatory factors for the growing popularity for saving in mutual funds in Norway. Several funds have increased significantly in size, and some stand out as more popular and reputable than other funds.

Mutual funds and performance measurement have become an important topic in finance. There exists a large number of research articles regarding performance measurement and many consider whether active management provides excess returns, and whether active asset management is preferable to passive management. There is, however, less research in the Norwegian fund market centered around how the size of the various mutual funds affects the fund's performance.

This thesis aims to identify the relationship between different fund sizes and returns in Norwegian mutual funds, namely whether performance depends on the size or asset base of the fund. Such study of possible scale effects will be useful for investors, but also for those who are in charge of the decision-making authority in Norwegian funds. This may be important for critical assessments regarding optimal fund size, further giving input to the discussion about management fees.

Further, this research aims to increase common understanding regarding the factors driving fund return, and to open the door for further research on an industry of increasing importance for Norwegian households. As this master thesis progresses, it would be interesting to investigate whether the issue of persistence of fund performance depends on the scale-ability of fund investments (Gruber, 1996; Berk, Green, 2002).

## 1.2 Research question

The main focus in this research is to reveal size effects among Norwegian mutual funds. The thesis aims to examine whether there are any differences in the performance of large and small Norwegian mutual funds during the period 2008-2017. The core research question is formulated as:

*"Is there a significant difference between the risk-adjusted returns of small and large Norwegian mutual funds?"*

> ***Ho**: There is non-significant difference between the risk-adjusted returns of small and large mutual funds in Norway.*
> ***H1**: There is a significant difference between the risk-adjusted returns of small and large mutual funds in Norway.*

# 2.0 Literature review

There exists limited research regarding whether fund size affects abnormal returns in Norwegian mutual funds. Thus, this study offers a rare empirical standpoint for the research area. However, there are more studies conducted in the US on this topic. Whether the size of a mutual fund has an impact on the funds return and risk has long been a topical issue in the portfolio theory. There are several reasons for this, but that the total assets of mutual funds have risen dramatically since the 1980`s to the present, changes in taxation of mutual funds, transitions in information technology and that mutual funds have delivered high excess return in periods, makes the research issue particularly relevant.

Regarding our thesis topic, most of the previous research investigates scaling effects and capital flows in mutual funds. Positive scale effects can be defined as average unit cost reduction at increased production volume (fixed labor costs, gathering information, research and administrative costs). Negative scale effects are working in the opposite way, namely increasing the cost level. The following section in the preliminary thesis contains previous research on the relationship between size and return.

Berk & Green (2004) developed a theoretical model for active management of funds, which claims that fund return decrease with fund size. They stated that because investors deposit funds in a good performing fund, this will lead to economies of scale such as increased transaction costs. In the same year as Berk & Green developed their model, a comprehensive study performed in the American fund market was conducted by Chen, Hong, Huang & Kubik (2004). Their findings were in line with Berk & Green`s model, showing that the scaling relationship between fund size and return is negative. Studies performed in the US mutual fund market almost exclusively found negative correlation between size and return, which makes potential investigation in Norway even more interesting.

Indro et al. (1999) used a database of 683 mutual funds and examined the effect of style consistency on risk and return in the period 1993-1995. It was shown that the size of the funds is related to their respective returns and that if the fund should achieve returns that can defend the costs, the fund must be of a certain size (not exceed optimal size).

Beckers and Vaughan (2001) argued that when a fund performs well, this will lead to new investors adding fresh money to the fund in hopes of profiting from the successful strategy the fund leads. The consequence of this is increased total assets. Managers lose their flexibility as it becomes harder to go in and out of positions, so maintaining a desired investment profile becomes difficult over time.

Pollet and Wilson (2008) examined whether actively managed funds experience declining returns in line with growth. The results showed that managers scaled up their existing positions when the fund becomes bigger instead of developing new investment strategies. Large funds and funds investing in low-value limited companies diversify the portfolio better as a response to growth and that this diversification, especially for small-cap funds, can be seen in conjunction with better performance.

More research with results that indicate a correlation between size and returns of mutual funds is the work of Ferreia, Keswani, Miguel & Ramos (2012), who investigated the size effects of funds from Europe and the United States. The results indicated that the negative size effects detected in the US market are not a universal truth.

As previously mentioned, there is limited research conducted for the Norwegian mutual fund market regarding correlation between size and return. Rodalseth et al. (2004) observed in their master's thesis the Norwegian fund market for the period 1999-2004. The thesis concludes that there are no significant differences in the returns between large and small funds.

# 3.0 Theory

## 3.1 Efficient market hypothesis

According to Fama (1970), a marked is considered efficient when prices reflect all available information. When new information about a security becomes public, we expect that the information will be incorporated in the stock price instantaneously, according to the efficient market hypothesis (EMH). There are three versions of the EMH: the weak, semi-strong, and strong-form. Weak-form efficiency indicates that stock prices reflect all information contained in market trading data such as trading volume and historical price series. Semi-strong-form efficiency states that stock prices reflect all public information about a firm's prospects such as annual reports and balance sheet composition. Strong-form efficiency states that stock prices reflect all information relevant to the firm, even information that is only available to corporate insiders(Bodie,Marcus,Kane 2014).

Fund managers try to choose stocks that will outperform the marked index by predicting how the marked will change and pick stocks that are undervalued based on available information. The idea is that, in a fully efficient marked, investors cannot earn excess returns by trading on information that is reflected in prices. It is most reasonable to use the semi-strong-form efficiency for examining the relationship between fund size and returns in the Norwegian market, as most mutual fund managers rely on publicly available information. If there exists a relationship, the semi-strong-form efficiency would be violated.

## 3.3 Capital Asset Pricing Model

The capital asset pricing model (CAPM) describes the relationship between systematic risk and expected return for assets. The model was first introduced by William Sharpe (1964), John Lintner (1965), and Jan Mossin (1966), and is a leap from Markowitz's portfolio selection model. While Markowitz's model is only able to calculate expected return on portfolios, the CAPM is able to price any asset. The idea behind the model is that investors must be compensated for the time value of money and risk. This is represented through a risk-free rate ($R_f$) and beta (β), respectively. CAPM can be expressed as followed:

$$E(R_i) = R_f + \beta_i\left[E(R_m) - R_f\right] + \varepsilon$$

where:

| | |
|---|---|
| $E(R_i)$ | the expected return on asset i |
| $R_f$ | the risk-free rate |
| $\beta_i$ | the beta (systematic risk) of asset i |
| $E(R_m)$ | the expected return on the marked |
| ε | the error term |

While the equation above is in an ex ante form, it can be transformed into an ex post form:

$$R_i - R_f = \alpha_i + \beta_i[R_m - R_f] + \varepsilon$$

where:

| | |
|---|---|
| $R_i - R_f$ | the excess return of the asset beyond the risk-free rate |
| $\alpha_i$ | the return beyond what is predicted by the model |
| $R_m - R_f$ | the risk premium, i.e., the difference between the return on the market portfolio and the risk-free rate |

The only difference between the classical CAPM and the model above is the $\alpha_i$, which represents the excess return of a portfolio that is not explained by the factor(s) in the model. A significant positive or negative $\alpha_i$ indicates either positive or negative excess return.

The CAPM is a simple model and provides a good benchmark for performance evaluation. However, the model has been criticized for not being practical in the real world. Roll (1977) criticized the model for the fact that one needs complete knowledge of the true market portfolio's composition, which would make the theory not testable unless all individual assets are included in the sample. Therefore, we will base our regression analysis on extensions of the CAPM, such as the Fama and French models.

# 4.0 Methodology

## 4.1 Regression analysis

Linear regression analysis is used to estimate coefficients, and to look for size effects. In order to evaluate whether size has an impact on performance, we will construct from our sample three groups based on size (small-, medium-, and large-cap), and analyze the three groups using the Fama and French 3-factor and 5-factor models, as well as the Carhart 4-factor model. We will evaluate performance based on the measured alpha and corresponding t-values.

### 4.1.1 Fama and French 3-factor model

The 3-factor model, first introduced by Fama and French in 1993, is an extension of the CAPM. This model is designed to capture the relation between average return and size, and the relation between average return and price ratios like book-to-market. If the factor exposures $\beta_{i,m}$, $\beta_{i,SMB}$, and $\beta_{i,HML}$ capture all variation in expected returns, the intercept $\alpha_i$ is zero for all securities and portfolios i (Fama and French, 2014). If there is excess return, i.e. the intercept $\alpha_i$ is positive, it could stem from either manager skills or luck.

$$R_i - R_f = \alpha_i + \beta_{i,m}\left[E\left(R_m - R_f\right)\right] + \beta_{i,SMB}SMB + \beta_{i,HML}HML$$

where:

| | |
|---|---|
| SMB | Small Minus Big, i.e., the return of a portfolio of small stocks in excess of the return on a portfolio of large stocks. |
| HML | High Minus Low, i.e., the return of a portfolio of stocks with a high book-to-market ratio in excess of the return on a portfolio of stocks with a low book-to-market ratio. |

### 4.1.2 Carhart 4-factor model

The Carhart 4-factor model is an extension of the Fama and French 3-factor model, and includes an additional momentum factor. Carhart (1997) finds that the 4-factor model substantially improves on the average pricing errors of the CAPM and the 3-factor model.

$$R_i - R_f = \alpha_i + \beta_{i,m}\left[E\left(R_m - R_f\right)\right] + \beta_{i,SMB}SMB + \beta_{i,HML}HML + \beta_{i,MOM}MOM$$

where:

MOM the one-year momentum in stock returns

### 4.1.3 Fama and French 5-factor model

Fama and French (2014) presents two new variables to the 3-factor model, namely profitability (RMW) and investment (CMA). They argue that a 5-factor model directed at capturing patterns in the average stock returns performs better than the 3-factor model. However, the model is imperfect as the GRS test rejects the 5-factor model, but Fama and French (2014) estimate that the model explains between 71% and 94% of the cross-section variance of expected returns from the size, book-to-market, profitability, and investment portfolios.

$$R_i - R_f = \alpha_i + \beta_{i,m}\left[E\left(R_m - R_f\right)\right] + \beta_{i,SMB}SMB + \beta_{i,HML}HML + \beta_{i,RMW}RMW + \beta_{i,CMA}CMA$$

where:

RMW the difference between the returns on diversified portfolios of stocks with robust and weak profitability

CMA the difference between the returns of diversified portfolios of the stocks of low and high investment firms

## 4.2 Evaluating the results

### 4.2.1 T-test

The t-test is used to test the hypothesis about the significance of a single slope coefficient from the regression analysis. The formula for a test of significance approach to hypothesis testing using a t-test is:

$$test\ stat = \frac{\hat{\beta}_i - \beta_i^*}{SE\left(\hat{\beta}_i\right)}$$

where:

| | |
|---|---|
| $\hat{\beta}_i$ | the estimated regression coefficient |
| $\beta_i^*$ | the border value implied by the null hypothesis |
| $SE(\hat{\beta}_i)$ | the estimated standard error of $\hat{\beta}_i$ |

The most common t-test is setting $\beta_i^*$=0. If the test is $H_0$: $\beta_i^* = 0$ vs. $H_A$: $\beta_i^* \neq 0$, i.e. a test that the coefficient is zero against a two-sided alternative, this is known as a t-ratio test. The test statistic measures how many standard deviations the β is from zero, based on the level of significance you have chosen. The most common significance levels are 1%, 5% and 10%. This means the β needs to be 2.58, 1.96 or 1.64 standard deviations from zero, respectively, in order to be significantly different from zero. In that case, you can reject the null hypothesis.

### 4.2.2 F-test

If we want to test multiple hypotheses, that is, more than one coefficient simultaneously, we use the F-test. The formula can be expressed in the following way:

$$test\ stat = \frac{RRSS - URSS}{URSS} * \frac{T-k}{m}$$

where:

| | |
|---|---|
| RRSS | the restricted regression, i.e. restrictions are imposed on some βs |
| URSS | the unrestricted regression, i.e. coefficients are freely determined by the data |
| T | the number of observation in the sample |
| k | the number of parameters in the unrestricted regression |
| m | the number of restrictions |

If we want to test if all the slope coefficients are zero, the $H_0$ would require $\beta_1 = \beta_2 = \ldots = \beta_T = 0$. Based on the significance level and the degrees of freedom, you find a critical value:

$$F(m, T-k)$$

If the test statistic is higher than the critical value, you can reject the null hypothesis.

### 4.2.3 Diagnostic Tests

Due to the fact that we primarily will be working with cross-sectional time series, we see the need for performing a linear regression validity test in order to avoid spurious regressions. Such a test will require all the following five classical OLS assumptions to hold:

i. $E(u_t) = 0$
ii. $Var(u_t) = \sigma^2 < \infty$
iii. $Cov(u_t, u_j) = 0$
iv. $Cov(u_t, x_t) = 0$
v. $u_t \sim N(0, \sigma^2)$

In this section of the thesis, we will apply White and Breusch-Godfrey in order to test for respectively heteroscedasticity and serial correlation. To test for normality, we will apply a Jarque-Bera-test. Finally, we will use Newey-West (1987) to produce heteroscedasticity and autocorrelation consistent (HAC) standard errors.

## 4.3 Performance measures

In general, when measuring the performance of the various funds it is advisable not to look at the absolute returns. There has to be a common comparison basis. Hence, risk-adjusted performance targets will be emphasized in the assessment of the individual fund and the return on the size portfolio. This section presents the chosen performance models which will be used in our investigation.

### 4.3.1 Jensen's Alpha

Jensen's Alpha (1968) is a measure of performance that aims to determine abnormal returns and is based on the CAPM. The model is based on historical data (ex-post) as opposed to CAPM which intends to explain expected return (ex-ante). Jensen`s Alpha can be expressed in the following way:

$$\alpha_p = R_p - \left[R_f + \beta_p\left(R_m - R_f\right)\right] + \varepsilon_p$$

According to the CAPM, the expected value of alpha is zero for all securities, as long as the stocks are fairly priced. An alpha larger than zero indicates superior performance, while an alpha smaller than zero indicates underperformance. If the alpha is positive and significant, it would imply that the fund is able to earn abnormal returns.

### 4.3.2 Sharpe ratio

Sharpe (1966) developed the risk-adjusted performance target (Reward-to-Variability Ratio), now known as the Sharpe Ratio. The ratio is calculated by measuring a fund`s average return earned in excess of the risk-free rate per unit of volatility or total risk. The ratio gives indication of how the investor is compensated given the portfolio`s overall risk.

$$S_p = \frac{R_p - R_f}{\sigma_p}$$

where:

| | |
|---|---|
| $S_p$ | The Sharpe ratio of the fund |
| $R_p$ | The return of the fund |
| $R_f$ | The return on a risk-free investment |
| $\sigma_p$ | The funds risk/volatility measured in standard deviation |

An investor would essentially like to achieve the highest possible Sharpe ratio by maximizing the excess return given the volatility.

# 5.0 Data

## 5.1 Data selection

This Master Thesis aims at studying the abnormal differences between returns of small and large mutual funds in Norway. For conducting our analysis, we need available data on the Norwegian mutual fund market. For gathering sufficient data regarding historical figures on total assets and customer relationships, we believe that the best platform is Verdipapirfondenes Forening (VFF), which is a service organization for companies that have a license to conduct fund management and/or active (individual) management. The association prepares continuous statistics and other information about the fund industry in Norway and internationally. In the empirical part of the assignment, we will use monthly data from beginning of January 2008 to the beginning of January 2018. For data collection (returns, flow, customer base, family size, age/history etc.) we will use the following data bases: VFF, Oslo Stock Exchange`s database, Thomson Reuters Datastream and NHH Børsprosjektet. In addition, we will need the risk-free rate in the chosen period, which can be obtained from Norges Banks' websites. Information regarding the turnover rate and age is also made available by Morningstar, as well as from the annual reports of the respective funds. We are in the process of establish contact with both of the last two mentioned.

We will use data sets which is free of survivorship bias. Survivorship bias is the tendency for mutual funds with poor performance to be dropped by mutual fund companies, generally because of poor results or low asset accumulation. This phenomenon, which is a well-known widespread in the fund industry, results in an overestimation of the past returns of mutual funds. In order to take this important issue into account when analyzing past performance, we include all Norwegian mutual funds traded during the period 2008 - 2017.

## 5.2 Selection of benchmark index

We need to carefully consider which reference index to use in the thesis. We will take into consideration what index the funds themselves is using as a benchmark. As previous mentioned, the research will focus on mutual funds in Norway, i.e. Norwegian funds with at least 80% of total assets invested in Norwegian shares. The natural choice of reference index and benchmark so far seems to be the Oslo

Børs Mutual Fund Index (OSEFX). This is also in line with Morningstar's performance analyzes of Norwegian funds.

OSEFX is a weighted version (capped version) of the main Oslo Børs Benchmark Index, or OSEBX. It is investable and contains a representative sample of all Norwegian shares on Oslo Stock Exchange. OSEFX is adjusted to meet particular diversification requirements and to comply with the EU directives set forth in UCITS, which regulate investments in mutual funds (Sørensen, 2009). By Norwegian law, we have that Norwegian mutual funds must invest/hold at least 16 different stock and that each stock position cannot exceed 10% of total asset in the fund (Sørensen 2009).

Regarding the process of data collection and above-mentioned factors (selection of index, data platforms etc.), we reserve the right to make possible future changes.

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