STOCKHOLM SCHOOL OF ECONOMICS

Active Management in Swedish National Pension Funds

An Analysis of Performance in the AP-funds

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Abstract:
This paper investigates the active management in the Swedish National Pension Funds. Monthly returns have been collected from two out of six funds for the time period 1 January 2003 to 31 December 2007. Three different models; Jensen's alpha, the Treynor & Mazuy Market-timing model and Fama and French Three Factor Model, have been applied to empirically test if active management contributes with excess returns to the Swedish pensioners. Furthermore, performance is compared to three different benchmarks; two external equity indices and one internal index provided by the funds. The results are ambivalent depending on what benchmark that is used. When comparing the funds' performance to the internal index, no significant excess return can be identified. For the external indices the results support a value creation by active management. These excess returns are a product of funds' selective ability and not a market-timing ability.

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EXHIBITS, EQUATIONS AND TABLES

1 Introduction

In the Introduction we present the topic at hand and give the reader our view of why it is an area of interest. We determine what we hope to achieve with this report in terms of research contribution. Finally, we give the reader a brief outline of the report.

By the end of 2007 the six Swedish National Pension Funds ("AP-funds") had a total of 850 billion SEK of assets under management ("AuM"), which makes them among the largest shareholders on the Swedish stock market. Almost 20 percent of every Swedish citizen's monthly salary goes directly into a general pension system. The Swedish Parliament has assigned the mission of managing a part of this capital to the AP-funds consisting of the First, Second, Third, Fourth, Sixth and Seventh AP-fund. The primary goal of these funds is to maximize the long-term return whilst maintaining a low level of risk in order to secure the pensions for the Swedish senior citizens of today and of the future (SFS 2000:192). We find it interesting to evaluate the performance of the AP-funds as they have been trusted to manage the pension capital of most Swedish citizens.

The respective board for each of the six AP-funds have concluded that the primary goal will best be achieved by managing the fund actively. Active management refers to an investment strategy where the purpose is to outperform a benchmark index by increasing the risk in the portfolio if the market is predicted to go up, alternatively reducing the loss when the market is declining. However, research papers[1] that evaluate active management strategies tend to show little or no support for the creation of excess returns through active portfolio management. Rather, portfolio managers often destroy value for investors over time. This is especially true after taking the costs related to active management into account. Consequently, the fact that the funds apply an active management strategy seems to us controversial since the efficiency and effectiveness of this strategy has been questioned.

1.1 Objectives, Purpose and Contribution

In this paper we aim to investigate whether the active management of the Swedish AP-funds has contributed to successfully grow the AuM, or if a passive strategy[2] would be more beneficial to the Swedish pensioners. By using three different and complementary models, we will investigate whether the funds create excess returns and thereby answer the question:

Does Active Management Create Value for the Swedish National Pension Funds?

We have two purposes with this study. First, we intend to evaluate whether the active management of the Swedish Pension funds creates value for the Swedish pensioners or not. The individual pensioner has no ability to influence where or how their pension capital is invested, however, individuals will be affected by the outcome of the chosen investment strategy. Hence, this report is of interest to all Swedish citizens entitled to a future pension and adds to the limited academic

[1] For example, Jensen (1969). More articles will be covered in *Section 4* Prior Research.

[2] Passive strategy is to buy the benchmark index.

research currently available on the topic. A second purpose is to evaluate the selected models' appropriateness to analyze portfolio performance. By comparing and contrasting the results from the different models and by using different benchmarks in the analysis we hope to add to the empirical research on the subject.

1.2 Delimitations

This study is limited to include two of the six Swedish National Pension Funds. We hope that our results are representative for the four of the AP-funds. We do not aim to draw any conclusion regarding any other type of funds.

We have chosen to include three different models in the quantitative analysis, which includes different variables that may have an explanatory effect on portfolio returns. In the section *Previous Research*, we address alternative models of portfolio performance which include additional explanatory variables. However, we only address the variables included in the selected models.

1.3 Outline

The disposition of this report is as follows:

2 Method

In this section we outline the choice of method including a brief description of how we have collected and processed our data, how we have selected the models used for the quantitative analysis of the data and what statistical methods we apply to secure the robustness of our results.

3 Background

In this section we present a more thorough description of how the Swedish Pension System is constructed. We give a description of the AP-funds role in the Pension System and their regulatory environment. In addition, we will briefly present the investment strategies of the funds.

4 Prior Research

In this section a theoretical framework is presented as well as a summary of the most relevant research on portfolio performance theory. First, we describe the chronological development of portfolio performance theory. Second, we outline the arguments put forward by several researchers regarding benchmark efficiency.

5 Models for Quantitative Analysis

In this section we present the three models selected for the performance evaluation of Fund A and Fund B: Jensen's alpha, Treynor and Mazuy's Market-timing Model and Fama and French's Three Factor Model.

6 Research Question

In this section we will state four subordinated research questions which will guide us in forming hypotheses for data analysis and thereby help us to better answer our main question. The research questions have been derived from the information gathered in Sections 4 and Section 5.

7 Data

The data has been collected directly from Fund A and Fund B. In this section we describe the attributes of our data. Further, we present the assumptions regarding the risk-free rate, discuss the selected time period, present the cost of operations and explain the choice of benchmarks. In addition, the additional data required for the Fama and French model is presented.

8 Results

To best illustrate our findings the results is presented in two sections. First, we present the result by model, starting with Jensen's alpha, continuing with Treynor and Mazuy's Market-timing model and last Fama and French's Three Factor Model. Second, we will present the result per benchmark, starting with the strategic portfolio, continuing with the MSCI World Index and thereafter the OMXS30 Index. The analysis of the output is embedded in the presentation of the results.

9 Conclusion

In the conclusion, we start by answering the four subordinate research questions based on the output from the statistical tests. Thereafter, we address the main question of this paper.

10 Discussion, Critique and further Research

The discussion will present a more nuanced interpretation of our results, including the investment alternatives for the fund and their regulative environment. We aim to discuss how our results should affect the AP-funds' organization and investment strategies. Critique against the report will be presented as well as proposals for further research.

2 Method

In this section we outline the choice of method including a brief description of how we have collected and processed our data, how we have selected the models used for the quantitative analysis of the data and what statistical methods we apply to secure the robustness of our results.

We have collected data from two of the six AP-funds, which will be referred to as Fund A and Fund B. The names have been randomly selected. It is our judgment that these two funds are representative for the first four Swedish pension funds (AP1-AP4) since they aim to fulfil the same mission in the Swedish Pension System. The time period that will be analyzed is ranging from the 1st January 2003 to the 31st December 2007. The data contain monthly observations of the return on the actual portfolio, as well as a strategic portfolio which is the funds' targeted portfolio in a mid-term perspective. Hence, the analysis is based on 60 observations for each of the two funds.

Based on an initial study of relevant literature on portfolio performance, we have decided to apply three different models in order to evaluate the funds' active management. First, we use Jensen's alpha to analyze performance and calculate the excess return. We want to determine if the funds are able to generate returns that are above what is predicted by the Capital Asset Pricing Model ("CAPM"), that is, if they perform better than a given benchmark.

Jensen's alpha does not explain whether returns are related to an ability to accurately time the market (timing) or the ability to pick the right stocks (selectivity). In the presence of a timing ability, Jensen's model will suffer from a statistical bias[3]. Consequently, we also use the quadratic regression of Treynor and Mazuy, which differentiates between timing and selectivity. In the absence of timing, the alpha in Jensen's model should be equivalent to the alpha in Treynor and Mazuy's Market-timing Model.

We will complement our analysis with Fama and French's Three Factor Model. Fama and French add two additional explanatory factors, size and book-to-market ratio, to the standard CAPM when evaluating portfolio returns. The additional factors included may provide additional explanatory value to total portfolio returns, in addition to the market risk factor.

Roll discussed the sensitivity of portfolio performance evaluation to the choice of benchmark[4] in his article from 1978. Therefore, the performance of Fund A and Fund B will be evaluated against three different benchmarks for each of the selected models. First, the return of the portfolio will be evaluated against the funds' strategic portfolios. The strategic portfolio is used internally to calculate the active return and the portfolio the funds would hold if they did not apply active management in

[3] The statistical bias is described in detail in *Section 4.*

[4] We will further outline this reasoning in *Section 4.*

a short perspective.[5] The results generated with this benchmark will be contrasted against two external indices: the MSCI World Global Standard Index ("MSCI World") and the OMXS30.

The performance of the funds will be analyzed both before and after taking the funds' costs into account to see whether the AP-funds cover their costs of operations or not. The costs have been collected from each fund's annual reports for the relevant time period.

We will perform a number of robustness tests to be able to draw reliable conclusions from our data. The statistical significance of our variables will be tested with a two-tailed t-test. We will also test one model's ability to explain the funds' returns by performing an F-test. All of the robustness tests are performed on a 5 percent significance level.

[5] Based on the mid-term and long-term analysis of the funds which is in accordance with rules and regulations set out by the Swedish government, see *Section 3*.

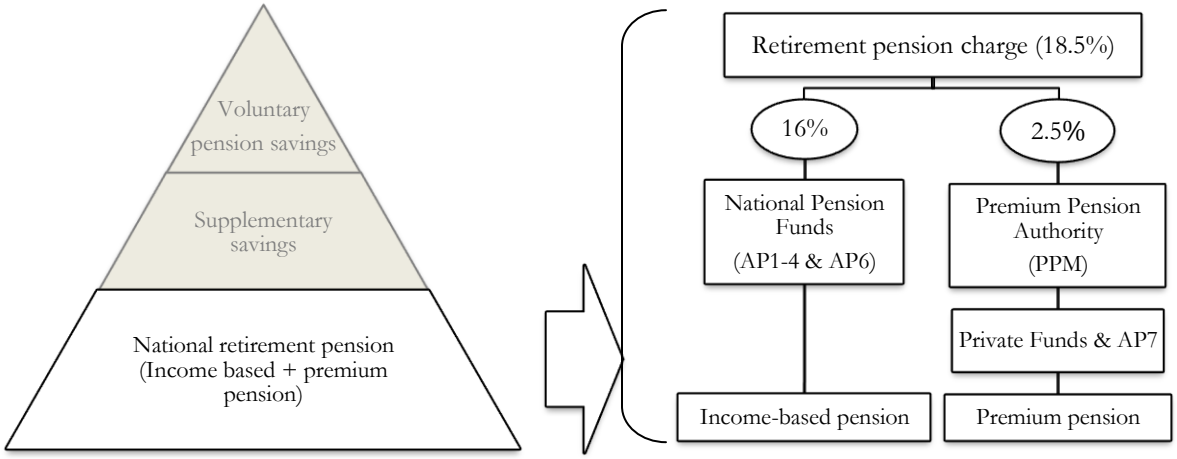
3 Background

In this section we present a more thorough description of how the Swedish Pension System is constructed. We give a description of the AP-funds role in the Pension System and their regulatory environment. In addition, we will briefly present the investment strategies of the funds.

3.1 The Swedish Pension System

In 2001, a new pension system[6] was implemented which can be resembled to a pyramid (*Exhibit 1*). The base in this pyramid is the national retirement pension, which can be divided into earnings related pension and premium pension ("PPM"). The payments to the earning related pensions correspond to 16 percent of the salary before tax, whilst 2.5 percent of the salary goes into the PPM.

Exhibit 1: The Swedish Pension System



Source: AP2 Website (2008)

The earnings related pension is managed by five funds: the First, Second, Third, Fourth and Sixth AP-fund. The pension system is a pay-as-you-go system, that is, the pension fees are used to pay current pensions for people who have already retired. The AP-funds function under the same regulations; although, they operate individually on a competitive market and differ somewhat regarding investment strategies.

The First to Fourth AP-funds are so called buffer funds; they exist to even out momentary fluctuations in incoming and outgoing payments (AP1 Website, 2008). At the time of the reform, each of the funds was given assets worth SEK 138 billion (AP1 Annual report, 2001). Every individual's pension right equals the total amount paid and is indexed each year for changes in the income index[7]. If the Swedish Social Insurance Agency[8] does not have the assets available to transfer

[6] Demographic and economic changes during the second half of the 20th century significantly increased the pressure on the former Swedish pension system, referred to as *Folkpension* and *ATP*. The government realized that the pension system needed a reformation to secure pensions for future generations and the new system was implemented.

[7] The income index shows the change in the average income in Sweden.

[8] Swedish Social Insurance Agency pays out the pension right and receives the pension charge.

the value of the pension rights, the First to Fourth AP-funds finance the temporary imbalance between the contributions and disbursements. If there is deficit in the pension system, each fund will contribute with one fourth of total amount (SFS 2000:192). If the funds are unable to finance the transfer there will be an automatic rebalancing and the pension rights are indexed by a lower amount than the income index (AP1 Website, 2008). When the balance ratio is lower than one[9] the index is adjusted until the balance is restored with an amount dependent on the balance ratio.

The Sixth AP-fund is a closed AP-fund, which means that its returns are reinvested and no payments to balance the cash flow of the national pension system are made. The fund has the same goal when it comes to maximize long-term returns with a low corresponding level of risk, but differs when it comes to investment directives (AP6 Website, 2008). The premium pension is managed by either the Seventh AP-fund or by private fund managers. An individual has the freedom of choosing who will manage the 2.5 percent of the pension that goes into the premium pension. If the individual does not take an active decision, this part of the salary automatically goes into the Seventh AP-fund. The Sixth and Seventh AP-funds will not be further addressed in this paper.

3.2 The Swedish Pension Funds' Strategy

The fourth chapter of the Swedish National Pension Funds Act (SFS 2000:192) regulates the investment directives for the First to Fourth (and Seventh AP-fund). The investment rules in *Exhibit 2* limit the organizations in their operational work and provide general investment directions common for all the funds.

Exhibit 2: Investment Directives

- Investments may be made in all types of listed and negotiable instruments on the capital market
- At least 30 percent invested in fixed income securities with low credit and liquidity risk
- Maximum of 40 percent exposure to currency risk
- Maximum of 5 percent invested in unlisted securities and only indirectly via mutual funds or venture capital companies
- Maximum of 10 percent of the voting rights invested in single listed company. For unlisted venture capital companies, a maximum of 30 percent
- Shares listed in Swedish companies: maximum of 2 percent of the total value of Swedish shares on an authorized Swedish stock exchange or marketplace
- At least 10 percent managed by external managers
- No commodities

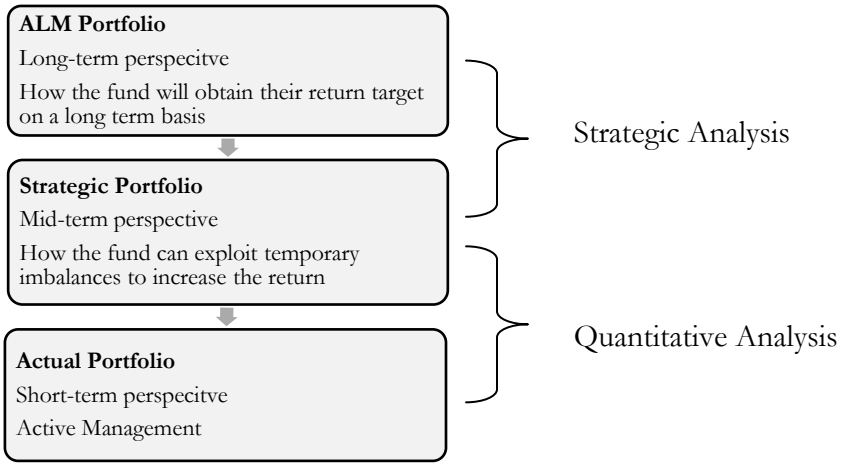
Source: AP1 Website (2008)

The goal of the Swedish pension funds is designed to be attained through a two dimensional analysis, illustrated in *Exhibit 3*. The Asset Liability Management ("ALM") portfolio and the strategic

[9] The liabilities exceed the assets.

portfolio are determined by a strategic analysis. The strategic analysis generates the optimal portfolio given a pre-determined risk level. In a first step, an ALM analysis is performed, which determines the proportion of different assets in order to achieve the target return. Based on a belief that in a mid-term perspective the market may deviate from the scenario that has been determined in the ALM analysis, the boards of the pension funds can decide upon variations from the ALM portfolio in the strategic portfolio.

Exhibit 3: Investment Analysis of the AP-funds



Source: Interview (2008)

In addition, excess return is to be earned through active management in the actual portfolio, which is determined by a quantitative analysis. In the active management of the fund there are two goals. One is to uphold the strategic portfolio and the other is to further increase the return of the fund.[10] Consequently, the strategic portfolio is also a reference portfolio and a neutral position in the active fund management. If a passive management is applied, the risk of the actual portfolio is not deviated from the strategic portfolio by more than 0.5 percent in active risk (or tracking error[11]).

[10] The AP-funds benchmark their performance against the strategic portfolio to determine the excess return; the strategic portfolio is used to approximate the market portfolio.

[11] The tracking error is a risk measurement and defined as the standard deviation of the excess return.

4 Prior Research

In this section a theoretical framework is presented as well as a summary of the most relevant research on portfolio performance theory. First, we describe the chronological development of portfolio performance theory. Second, we outline the arguments put forward by several researchers regarding benchmark efficiency.

4.1 Performance Measurement of Portfolio Managers

In 1952 Markowitz stated his mean variance theory, which laid the foundation of modern portfolio theory. His reasoning originates in the hypothesis that all investors aim to maximize returns whilst minimizing risk. Hence, in theory the optimum portfolio is determined by two variables: the expected return and the variance. Markowitz argues that the portfolio with the maximum expected return does not necessarily offer the lowest variance. Rather, there is a trade off between risk and return and an investor can increase return by increasing variance or reduce variance by decreasing return. The rational investor will select a portfolio that maximizes returns while minimizing variance, or vice versa. Consequently, the investor will not simply maximize the expected return and minimize the variance; rather, she will maximize return for a given level of variance.

The CAPM, put forward by Sharpe (1964), Lintner (1965) and Mossin (1966), states that the expected return of any traded security is directly related to a single risk factor: the return on the market portfolio. The return in excess of the risk-free rate is proportional to the asset's contribution to the market risk in relation to the excess return on the market portfolio. Today, the CAPM is the most commonly used model for calculating portfolio return.

The performance evaluation of mutual funds made progress during the 1960s. In 1965 Treynor published "How to Rate Management of Investment Funds" and introduced a new method for performance evaluation. The measure had its basis in modern portfolio theory and develops a portfolio-possibility line which related the expected return to the portfolio manager's risk preference. Hence, Treynor introduced the first risk adjusted measure for performance evaluation.

In 1966, Sharpe extends the research on the subject in "Mutual Fund Performance" by stating that the performance of an efficient portfolio is depends on the expected return and the predicted variability of risk. The predicted variability of risk is measured as the standard deviation of the return. Sharpe introduces a ratio, today commonly referred to as the Sharpe ratio, to use in the performance evaluation. The ratio is measured as the excess return (over the risk-free interest rate) divided by the return's standard deviation. Altogether, 34 mutual funds were evaluated between 1954 and 1963, disclosing positive ratios. The results of the study can be interpreted as the return of the portfolio compensates for the additional risk taken.

Two years later, in 1969, Jensen published the article "The performance of mutual funds in the Period 1945-1964". Jensen argues that if a portfolio manager has an ability to predict future market fluctuations, she can create returns higher than the return predicted by the CAPM. The excess return can be measured by adding the alpha coefficient to the CAPM. Jensen tried his hypothesis on 115 mutual funds in the period from 1955 to 1964 and found a negative average value of alpha. This

conclusion holds both gross and net of management expenses; consequently, portfolio managers on average do not generate returns high enough to cover the costs of active management (Jensen, 1968). Jensen's alpha has become one of the most widely used models to evaluate portfolio managers' performance; however, it has been criticized due to an inherent statistical bias, benchmark inefficiency and the assumption of a constant beta. As a response, new articles have been published and new models have been developed on the topic in order to increase the efficiency of performance evaluation.

Because of the statistical bias in Jensen's model, which will be addressed in the next section, the alpha is underestimated if the portfolio manager has a timing ability. Treynor and Mazuy (1966) developed a commonly used model, referred to as the Market-timing Model, by using a quadratic regression to differentiate the timing ability of the portfolio manager from the ability to select undervalued securities.[12] Treynor and Mazuy statistically tested the performance of 57 actively managed mutual funds between 1953 and 1962 with an F-test[13] in order to assess the portfolio manager's timing ability. A high F-value would indicate that the quadratic regression's curvature is real and not a product of random chance. Out of the 57 studied funds, only one showed a curved line with an acceptable F-value. The result of Treynor and Mazuy's study indicates that investors do not have a timing ability.[14]

In 1996, Ferson and Schadt empirically evaluate Treynor and Mazuy's model and find that the model has a limited capacity to accurately explain portfolio managers' performance. As a response, the authors develops a conditional performance evaluation model that that allows for time varying expected returns and risk by using a predetermined information variable. The authors claim that abnormal returns, calculated from traditional models, can be assigned lagged information variables that are publicly available rather than timing and selectivity. This return should, however, not be confused for superior performance. Possible information variables include interest rates, yield spreads and dividend yields to mention a few. Unconditional models, on the other hand, consider superior information to be *any* information correlated with future market returns. By allowing a time-varying beta (a conditional beta) Ferson and Schadt (1996) concluded that the inferior performance suggested by traditional measures is to a large extent explained by a negative covariance between betas and the conditional expected market returns.

Fama and French questioned the ability of the CAPM to accurately predict portfolio returns. The authors reconstructed portfolios containing shares from the NYSE for the time period between 1928 and 1993 to assess how well a portfolio's beta could predict future returns (Fama and French, (2000). The results showed that the market beta in most cases fails to accurately predict portfolio returns. Especially poor is the correlation regarding small cap companies and companies with high book-to-market ratio (Brealey et al, 2006). Fama and French (2000) claim in their report that returns

[12] For further reading Grinblatt and Titman (1989a) developed an alternative measure of performance: The Positive Weighting Measure. By constructing a hypothetical portfolio using observed quarterly weights and multiplying them with the monthly excess returns, Grinblatt and Titman found a way to overcome the statistical bias (Engström, 2004).

[13] An F-test tests the model's explanatory ability on the independent variable.

[14] A portfolio manager can still provide the investors with an excess rate of return, this return is however a product of her ability to select undervalued securities or simply by chance rather than an ability to predict the future general movements in the market.

are not only dependent on the strategic risk as the CAPM predicts but rather on several different factors, such as firm size and the book-to-market ratio. As a response to their findings, the authors developed an alternative model to evaluate portfolio performance, commonly referred to as the Fama and French Three Factor Model.

We have chosen to work with three different models in the analysis of Fund A and Fund B: Jensen's alpha, Treynor and Mazuy's Market-timing Model and the Fama and French Three Factor Model. Given the reasoning in this section, we believe that these models will be complementary to each other when evaluating the funds' performance. *Exhibit 4* summarizes the models and their rational.

Exhibit 4: Summary of Chosen Models

MODEL	RATIONAL
Jensen's Alpha	Determination of excess returns
Treynor and Mazuy's Market-timing Model	Differentiates between timing and selective ability
Fama and French Three Factor Model	Additional explanatory factors: size and book-to-market

4.2 Benchmark Selection in Performance Evaluation

Evaluating portfolio performance with models that originate from the CAPM requires a benchmark. As stated in *Section 2*, we use both the funds' strategic portfolios and two external indices as benchmarks in this study. However, the choice of benchmark is a matter of discussion. Next, we will outline the most important contributions to this discussion.

The most common critic against the choice of benchmark was stated by Roll (1978) in his article "Ambiguity when performance is measured by the security market line". Roll points out the difficulty of distinguishing between an inefficient benchmark and the performance of a fund. Further, Roll states that performance can be sensitive to the specification of an inefficient benchmark and directs his criticism towards the securities market line ("SML"), which is often used as a benchmark to assess portfolio performance. The SML describes a relationship between mean returns on portfolios and the risk of these portfolios, which is calculated against a market index. Portfolio managers are often considered to be successful in their investment strategy if the return produced is higher than the return anticipated by the SML and unsuccessful if the opposite is true. Roll opposed the SML as a robust assessment criterion and the beta as an unambiguous measure of risk.

Roll tests the performance of several portfolio managers against three different indices; an index composed of equal weights, an index composed of weights proportional to the aggregate market values of individual assets, as well as an index with the same mean return (in the sense of Markowitz 1959). The results show that which portfolio manager that is defined as successful differs substantially depending on benchmark. For example, the rank correlation using the two first indices stated above is close to zero. Roll's findings can be explained by the fact that every single portfolio's risk level differs depending on the index against which the portfolio is benchmarked. It is a major mistake to believe that a beta is a generic attribute of an individual portfolio as any performance of a portfolio manager can be created by a conscious choice of benchmark.

Theoretically, to find an efficient benchmark one would have to include every single possible available asset. Hence, Roll (1978) concludes that it will be virtually impossible to choose an efficient benchmark as it is impossible to observe *all* investment opportunities and their respective returns in reality. From this reasoning it can be conclude that all benchmarks are possibly inefficient and therefore the performance of portfolio managers will be incorrectly measured and comparisons between portfolio managers impossible.

In 1994 Grinblatt and Titman empirically tested the sensitivity of Jensen's alpha and Treynor and Mazuy's Market-timing Model to the choice of benchmark. The investigation was based on a sample of 109 passive portfolios and 279 mutual funds in the years between 1974 and 1984. They used four different benchmarks; two equally weighted indices, one factor-based benchmark and one characteristic-based benchmark.[15]

If a benchmark is efficient, analyzing the passive portfolios should not indicate any performance at all, given a properly designed model. Grinblatt and Titman (1994) find, in accordance with Roll (1978), that the choice of benchmark does have a considerable affect on the outcome of the performance evaluation. For example, the study shows that one of the equally weighted indices generates a 10 percent abnormal return on a passive portfolio, which indicates that the equally weighted index is inefficient as a benchmark. Furthermore, the mutual funds show a negative performance when benchmarked against the two equally weighted indices as well as the factor-based benchmark but zero performance when using the characteristic-based benchmark. Grinblatt and Titman argue that the difference with regards to performance is due to a size related bias that they believe exists for the three first indices. For the studied time period, large cap stocks demonstrate a poor performance relative these benchmarks. Consequently, the mutual funds which included large cap stocks also show a poor performance when compared to these benchmarks. Grinblatt and Titman find that there is no pair of benchmarks included in the investigation that shows upon a correlation close to one.

Grinblatt and Titman concludes that the benchmark does not only affect the performance level but they also affect the performance of funds relative each other. However, they point out that their findings do *not* indicate that it is impossible to analyze fund performance but rather that it is important to avoid using an inefficient benchmark.

[15] The fourth benchmark, called the P8 benchmark, was developed by Grinblatt and Titman in 1988. According to Grinblatt and Titman the P8 is not subject to size related bias, dividend yield bias or beta related bias. The basic idea behind the P8 benchmark is that different company characteristics correlate to the stocks' factor features (for example dividend, size and beta). Consequently, a portfolio that is characteristic-based can be used as a proxy for those factors.

5 Models for Quantitative Analysis

In this section we present the three models selected for the performance evaluation of Fund A and Fund B: Jensen's alpha, Treynor and Mazuy's Market-timing Model and Fama and French's Three Factor Model.

5.1 Jensen's Alpha

Jensen defines portfolio performance as a concept with twofold dimensions. First, it concerns a portfolio manager's ability to successfully predict the price of a security in the future, and second, the ability of reducing the insurable risk of the portfolio (Jensen, 1968). Consequently, the performance is defined in terms of risk and return.

Jensen derives his theory from the CAPM straight-line equation. According to the CAPM, securities earn an expected return exactly proportional to its systematic risk. However, Jensen concludes that if a portfolio manager has a predictive ability she can earn returns in excess of what is predicted by the CAPM. That is, she will systematically invest in securities with a positive random error term above zero. Consequently, Jensen's model allows for the regression not to pass through the origin and the efficient market hypothesis is thereby abandoned. *Equation 1* measures the realized returns and not the expected returns (Jensen, 1968).

Equation 1: Jensen's Alpha

$$\widetilde{\boldsymbol{R}}_{\boldsymbol{j,t}} - \boldsymbol{R}_{\boldsymbol{f,t}} = \boldsymbol{a}_{\boldsymbol{j}} + \boldsymbol{\beta}_{\boldsymbol{j}}\left(\widetilde{\boldsymbol{R}}_{\boldsymbol{M,t}} - \boldsymbol{R}_{\boldsymbol{F,t}}\right) + \widetilde{\boldsymbol{u}}_{\boldsymbol{j,t}}$$

Where:
$\tilde{R}_{j,t} - R_{f,t} = the\ risk\ premium$
$a_j = Jensen's\ alpha$
$\beta_j = the\ measure\ of\ risk\ or\ the\ systematic\ risk$
$\left(\tilde{R}_{M,t} - R_{F,t}\right) = the\ market\ risk\ premium$
$\tilde{u}_{j,t} = the\ error\ term$

Jensen describes an inherent statistical bias in his model which may cause a successful manager's performance not to be reflected in a positive intercept (alpha). A portfolio manager's ability to forecast the market can be divided into the ability to forecast price movements of individual securities (selectivity) and the ability to forecast the general behaviour of the market (timing). The risk in the total portfolio will equal a targeted beta assumed constant for all periods and the random variable that will vary depending on the manager's expectations (*Equation 2)*. If the portfolio manager expects the market factor to rise (fall) in the next period, she will increase (decrease) the risk in the portfolio by increasing (decreasing) the exposure to the random variable.[16]

[16] The risk in the portfolio is adjusted through a change in the holdings between securities, bonds and cash or simply by changing to more or less risky securities in the portfolio.

Equation 2: Total Portfolio Risk in Jensen's Alpha

$$\tilde{\beta}_{j,t} = \beta_j + \tilde{\varepsilon}_{j,t}$$

Where:
$\tilde{\beta}_{j,t} = the\ risk\ in\ the\ portfolio$
$\beta_j = the\ target\ risk\ level\ the\ portfolio\ manager\ wishes\ to\ maintain\ on\ average\ through\ time$
$\tilde{\varepsilon}_{j,t} = the\ random\ variable$

If the portfolio manager is able to forecast the market, there will be a positive relationship between the market factor and the random variable (*Equation 3)*. If the portfolio manager expects the market factor to be positive, she will raise the random variable. If the portfolio manager, on the other hand, expects the market factor to be negative, she will decrease the random variable.

Equation 3: Random Variable in Jensen's Alpha

$$\tilde{\varepsilon}_{j,t} = a_j\tilde{\pi}_{j,t} + \tilde{\omega}_{j,t}$$

Where:
$\tilde{\varepsilon}_{j,t} = the\ random\ variable$
$a_j = the\ portfolio\ manager's\ forecasting\ ability$
$\tilde{\pi}_{j,t} = the\ market\ factor$
$\tilde{\omega}_{j,t} = the\ error\ term$

The error term is assumed to be normally distributed and have an expected value of zero. The forecasting ability is reflected as the alpha, which will be positive if the portfolio manager can forecast the market factor, otherwise it will be zero. Given a conscious investment strategy, a negative alpha would be irrational. The size of the *positive* alpha will show how much the portfolio manager is willing to bet on her forecast of a positive *or negative* market factor. If the manager cannot forecast the market factor, the alpha will be zero since there is nothing to bet on and the error term is zero.

Jensen derives a more general model for describing a systematic measurement bias in the expected beta. The following relationship was derived using *Equation 2* and *Equation 3* and explains the expected value of the least square estimator.[17]

Equation 4: The Measurement Bias in Jensen's Alpha

$$E(\tilde{\beta}_j) = \beta_j - a_j E(R_m)$$

Where:
$E(\tilde{\beta}_j) = the\ expected\ beta\ or\ the\ least\ square\ estimator\ beta$
$\beta_j = target\ risk\ level\ the\ portfolio\ manager\ wishes\ to\ maintain\ on\ average\ over\ time$
$a_j = the\ portfolio\ manager's\ forecasting\ ability$
$E(R_m) = the\ expected\ return\ on\ the\ market\ portfolio$

[17] Assuming zero correlation between the market factor and the error term.

To conclude the reasoning behind the statistical bias in Jensen's alpha, a positive alpha can be a consequence of the manager's ability to forecast either an individual securities performance (selectivity) or the general behaviour of the market (timing). However, if the portfolio manager has a timing ability, there will be a downward bias in the estimated risk parameter as shown in *Equation 4*. As a result, there will be an upward bias in the targeted beta in *Equation 1*; the beta is overstated. In case of a timing ability, the alpha in *Equation 1* will therefore be underestimated. An unbiased measurement is only possible to obtain in the absence of a timing ability.

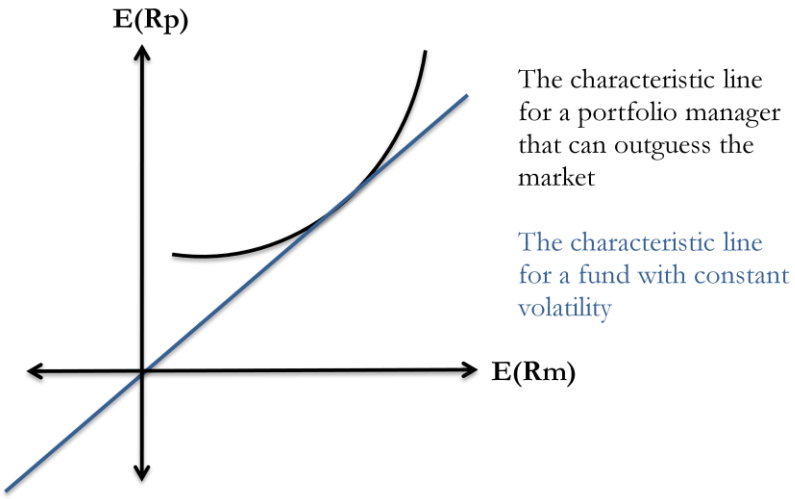
Besides the statistical bias and benchmark inefficiency (the latter was addressed in *Section 4* above), Jensen's alpha also implicitly inherits the weaknesses of the assumptions that the CAPM relies on (*Appendix 1, Assumption of CAPM*). It is important to note that in reality these assumptions are unrealistic and consequently the model may not give a proper reflection of reality. Further, Grinblatt and Titman (1994) points out the fact that when testing large samples of data for a positive alpha even a few percentages positive return may be considered insignificant in the statistical testing. This is due to the fact that in large samples, the level of statistical significance is adjusted to account for extreme performance as a result of chance. However, in absolute numbers a few percent may very well create considerable value for the investors.

5.2 Treynor and Mazuy Market-timing Model

In order to evaluate the reliability of our results derived in Jensen's model, we need to determine whether a statistical bias exists or not. The timing ability can be calculated with Treynor and Mazuy's quadratic model. An underlying assumption in the model is that the portfolio manager adjusts the portfolio beta depending on her prediction of the future market fluctuations. If a portfolio manager has a predictive ability, she will increase the portfolio beta to earn higher returns when a market rise is anticipated. If, on the other hand, a market downturn is predicted, the portfolio beta is decreased and volatile securities are replaced by less volatile securities and/or bonds and cash (Treynor and Mazuy, 1966).

The Treynor and Mazuy (1966) model is based on a characteristic line. The characteristic line is determined by plotting a managed fund's returns against the return of a suitable index. If the slope is the same in a bear market as in a bull market, the line is constant (the black line in *Exhibit 5*). Hence, the tangent of the line describes the sensitivity of the fund in relation to market fluctuations. If a fund manager has the ability to continuously outguess the market, she will alternate between two characteristic lines. Every time the market has rise, the manager will choose a high volatility line and every time the market goes down, a low volatility line. This ability will produce a kinked characteristic line.

Exhibit 5: Illustration of the Characteristic Line, Treynor and Mazuy



Source: Treynor and Mazuy (1966)

Given a predictive ability of the portfolio managers, Treynor and Mazuy (1966) argue that portfolio managers' ability to anticipate market changes correlates to how strong these changes are. For example, if the market experience a strong upswing, a portfolio manager is more likely to predict this than if the market is just slightly shifting up. Consequently, it is to be expected that the fund managers change the fund volatility correspondingly. The outcome of this reasoning is that fund volatility will gradually be transitioned from a flat slope when the market is doing extremely badly to a steep slope when the market is doing very well. The slope in between these two market extreme is varying continuously which produce a concave characteristic line (the blue line in *Exhibit 5)*. If a portfolio manager has a timing ability, she will be able to adjust fund volatility in accordance to the concave line.

Equation 5: Treynor and Mazuy's Market-timing Model

$$\tilde{R}_P = \alpha_p + \beta_{1p}\tilde{R}_I + \beta_{2p}\tilde{R}_I^2 + \tilde{\varepsilon}_p$$

Where:
$\tilde{R}_p = the\ risk\ premium$
$\alpha_p = alpha$
$\beta_{1p} = the\ risk\ in\ the\ portfolio$
$\tilde{R}_I = the\ excess\ return\ of\ the\ benchmark\ portfolio$
$\beta_{2p} = beta\ in\ the\ quadratic\ term$
$\tilde{R}_I^2 = the\ squared\ excess\ retrun\ of\ the\ benchmark\ portfolio$
$\tilde{\varepsilon}_p = the\ error\ term$

The quadratic regression is similar to Jensen's alpha besides the fact that it allows for two explanatory variables. The regression's intercept is an estimate of the portfolio manager's selective ability and the quadratic term is an estimate of the timing ability. Together, the alpha and the quadratic term is referred to as the Treynor and Mazuy Measure of Total Performance (Grinblatt and Titman, 1994) and defined as:

Equation 6: The Treynor and Mazuy Measure of Total Performance

$$TM = \alpha_p + \beta_{2p} Var(\tilde{R}_I)$$

Where:
$\alpha_p = alpha$
$\beta_{2p} = beta\ in\ the\ quadratic\ term$
$Var(\tilde{R}_I) = variance\ in\ portfolio\ i$

The Measure of Total Performance is explicitly made to note beta variations that are linearly correlated to the index return (Treynor and Mazuy, 1966). If a portfolio manager lack timing ability, Treynor and Mazuy's model and Jensen's alpha should produce approximately the alpha (Grinblatt and Titman, 1994).

The Treynor and Mazuy model has also been object to criticism. Ferson and Schadt evaluated so called buy-and-hold strategies with Treynor and Mazuy's model in 1996.[18] By definition, these strategies do not have any intention to speculate in different securities or market movements and should therefore not show upon any timing or selective ability. However, Ferson and Schadt found that the portfolio managers showed a negative timing ability and significant positive stock-picking ability. These findings imply that the Treynor and Mazuy model does not have the capability to accurately explain timing and selectivity.

5.3 Fama and French Three Factor Model

In the CAPM model there is only one explanatory factor to a portfolio's performance, the relative risk as measured by the market beta, and all risk is aggregated into this variable. As already addressed, Fama and French (1992), point out the weaknesses of beta to accurately predict the return of a portfolio. When stocks generally performed better than the market, Fama and French observe two types of anomalies. First, they point out that stocks with small market capitalization ("market cap") tend to earn higher returns than stocks with a large market cap. Second, stocks with high book-to-market ratio (value stocks) tend to earn higher returns than stocks with a low book-to-market ratio (growth stocks).[19] As a result, Fama and French added two explanatory variables to the CAPM and developed the model known as the Fama and French Three Factor Model.

[18] Important to notice is that the critique that originates from the CAPM assumption and the discussion regarding benchmark efficiency is relevant for the evaluation of the results from Treynor and Mazuy's Market-timing Model.

[19] The positive relationship between the book-to-market and average return is called the value premium. Fama and French argue against the sample-specific explanation, compensation for increased risk, overreaction due to firm performance or the behavioral explanation brought forward by Daniel and Titman (1997).

Equation 7: The Fama and French Three Factor Model

$$E(R_{it}) - R_{ft} = \beta_{iM}\left[E(R_{iM}) - R_{ft}\right] + \beta_{is}E(SMB_t) + \beta_{ih}E(HML_t)$$

Where:

$E(R_{it}) = expected\ return\ of\ the\ portfolio$
$R_{ft} = risk - free\ interest\ rate$
$\beta_{iM} = market\ risk\ factor$
$E(R_{iM}) = expected\ return\ of\ the\ whole\ stock\ market$
$\beta_{is} = size\ risk\ factor$
$E(SMB) = expected\ return\ of\ small\ cap\ \ minus\ big\ cap\ returns$
$\beta_{ih} = book - to - market\ risk\ factor$
$E(HML) = expected\ return\ of\ the\ high\ minus\ low\ book - to - market\ returns$

Fama and French develop benchmark factors derived from six constructed benchmark portfolios consisting of American securities to be used in the model. The risk premium is a value-weighted return based on all stocks at the NYSE, the AMEX and the NASDAQ minus the interest rate of a one-month Treasury bill. The SMB variable is an average return of three small portfolios less the average return of three large portfolios, which corresponds to the premium received if investing in small cap stocks. The HML variable is derived by taking the average return on two constructed value portfolios minus the average return on two growth portfolios and consequently corresponds to the premium return received for investing in shares with high book-to-market ratios.[20]

The main criticism against the Three Factor Model is its empirical motivations. Even if returns may vary with size and book-to-market ratios, these returns do not stem from forecasts of variables that generally are of concerns to investors. Malkiel (2003) questions the reliability of the size factor and by looking at the return of small cap firms, between the mid 1980s to the end of the 1990s; he concludes that there has been no gain from holding small cap stocks. Rather, Malkiel acknowledge that large cap companies have delivered better returns for the investigated time period. Malkiel suggests that his findings might be a function of portfolio managers' increasing interest in investing in high liquidity firms as a result of the increasing institutionalization of the stock market.

[20] The Fama and French model is used to test whether these two anomalies have explanatory power over our result; however, an alpha is added in *Equation 7* in our calculations to test the portfolio performance.

6 Research Questions

In this section we will state four subordinated research questions which will guide us in forming hypotheses for data analysis and thereby help us to better answer our main question. The research questions have been derived from the information gathered in Sections 4 and Section 5.

As we stated in the introduction, in this report, we aim to answer the main question:

Does Active Management Create Value for the Swedish National Pension Funds?

Given the choice of three complementary models in this study, we hope to perform a nuanced and robust analysis of Fund A and Fund B's performance. In order to structure this analysis to answer the main question we have formulated four subordinated research questions based on the information presented in *Section 4* and *Section 5*:

1) *Is Jensen's alpha positive for Fund A and Fund B?*

2) *Does the portfolio returns for Fund A and Fund B indicate a selective and/or timing ability?*

3) *Can the additional variables size and book-to-market ratio add any explanatory value to portfolio returns of Fund A and Fund B and thereby reduce the size of alpha?*

4) *How does the choice of benchmark affect the performance evaluation of Fund A and Fund B?*

By answering question (1) through (3) we can compare and contrast the different models and thereby also fulfil the second purpose of this study as they represent the three different models of choice.

7 Data

The data has been collected directly from Fund A and Fund B. In this section we describe the attributes of our data. Further, we present the assumptions regarding the risk-free rate, discuss the selected time period, present the cost of operations and explain the choice of benchmarks. In addition, the additional data required for the Fama and French model is presented.

7.1 Monthly Returns Fund A and Fund B

The data incorporates monthly returns of the actual portfolio and the strategic portfolio and was provided to us directly from Fund A and Fund B. The data series is calculated including reinvested dividends, adjusted for splits and mergers and net of fees charged to the investor[21]. The total return has been rounded off to two decimals by the funds.

Exhibit 6 and *Exhibit 7* below give a review of the attributes of our data. Later the result of our regressions will be tested with a t-test. A t-test compares the differences between two normally distributed samples. Therefore, we look at the skewness and the kurtosis of our two samples to ensure that the output from the t-tests is reasonable (which can be found in *Appendix 5)*. To begin, we can point out that *Exhibit 6* and *Exhibit 7* can be seen as rough estimates of a normal distribution.

In a normal distributed sample the skewness coefficient is zero and the kurtosis coefficient is three. The data series of Fund A has a negative skewness[22] of -0.28, which indicate a skew to the left of the sample's mean, that is, the left tail is longer relatively the right tail (*Exhibit 6)*. Furthermore, the kurtosis is positive 3.27, which mean that the sample peak relatively near the mean and is characterised by heavy tails. Fund B has a negative skewness of -0.12 and a positive kurtosis of 3.59 (*Exhibit 7*).

We have performed a JB Test of Normality[23] on our data samples testing the null hypothesis of the sample having a normal distribution. If the data samples are normally distributed, the JB coefficient is expected to be zero. Fund A has a JB coefficient of 0.95. When comparing to the chi-square table for 2 degrees of freedom[24], there is a 63 percentage that the null-hypothesis is true; consequently, we cannot reject that the sample has a normal distribution. For Fund B, the JB coefficient is 1.04 and there is a 61 percent chance that the null-hypothesis is true.

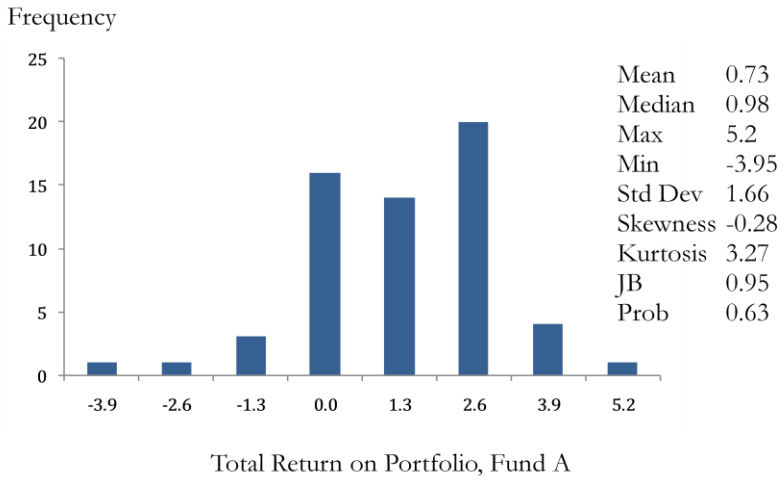
[21] Regarding net of fees charged to the investor we acknowledge the possibility of small amounts of fees being netted against the income directly.

[22] In a normally distributed sample the skewness coefficient is zero and the kurtosis coefficient is three.

[23] Formula for the JB test in *Appendix 6*.

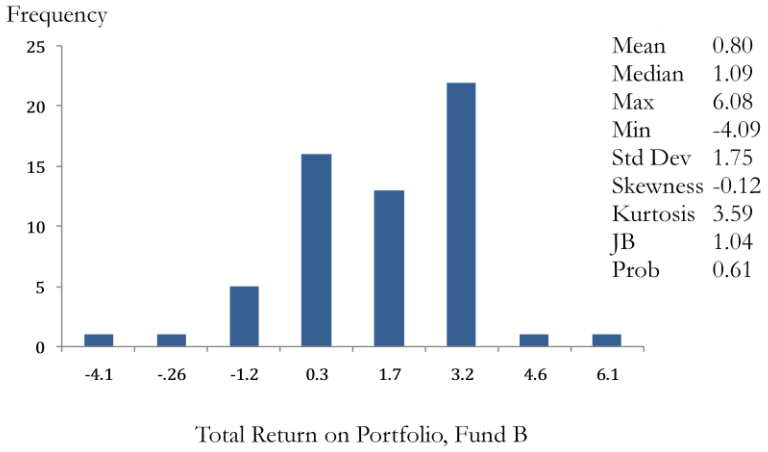
[24] Jarque and Bera (1987) showed that for large samples the JB coefficient follows a chi-square distribution with 2 degrees of freedom.

Exhibit 6: Data Description of Fund A



Source: Data from Fund A

Exhibit 7: Data Description of Fund B



Source: Data from Fund B

According the Central Limit Theorem ("CLT"), a sample distribution can be said to be approximately normally distributed if the sample size is large. A sample with more than 30 observations is typically considered as large (Gurjarati, 2003). Our sample containing 60 data points can therefore be approximated as a normal distribution according to the CLT.

To conclude, we believe that it is reasonable to assume a normal distribution in the samples of Fund A and Fund B considering the results of the JB test of Normality and the CLT. Consequently, we have not found any reason not to believe in the t-tests of our regressions.

7.2 The Risk-free Interest Rate

In order to calculate the excess return of the portfolios in accordance with the models described in *Section 5*, we need to use a risk-free interest rate. Following common practice the interest rate for a

Swedish government bond maturing in one month is used as an approximation for the risk-free interest rate in the subsequent analysis of the regressions. The yearly rate has been transformed into monthly rates and was collected from the webpage of the Swedish National Debt Office (2008).

7.3 Selected Time Period

The time period chosen for the investigation is the five year period between January 2003 and December 2007, due to availability of data. As mentioned earlier, the monthly returns during this period generate 60 points serving as a base for our analysis and enable us to theoretically get significant values of the performance variables.

7.4 Costs of Operations

We aim to apply the selected models both on total returns net and gross of costs. The information in *Exhibit 8* was generated from the two funds' annual reports from 2003 to 2007. The cost included in the calculations for the two funds are commission costs, personnel costs including variable salary and other administrative expenses. We have assumed the costs to be constant over the year and transformed the figures from the annual reports to monthly costs. When including the funds' costs in our subsequent calculations, the cost ratio has been deducted from the total return.

Exhibit 8: Average Annual Costs and Fees (% of AuM)

	2003	2004	2005	2006	2007
Fund A	0.15	0.16	0.17	0.16	0.16
Fund B	0.18	0.24	0.21	0.16	0.17

Source: Annual Reports, Fund A and Fund B, 2003-2007

The cost and fees associated with Fund A and Fund B seem to be stable around 0.16 percent of AuM. For Fund A the costs has been stable for the whole period. For Fund B one can observe a slight decrease in the average annual cost from higher levels during 2003 to 2005.

7.5 Choice of Benchmarks

As follows from the reasoning in *Section 4.2*, the analysis may be sensitive to the choice of benchmark. We have therefore decided to include three different benchmarks to approximate the market return.

First, the performance of the two funds will be compared against an internal benchmark; the strategic portfolio. The strategic portfolio's monthly returns have been provided from Fund A and Fund B and are calculated on a daily basis. The benchmarks' returns are derived by aggregating the index chosen for a specific market times the weight of this specific market in relation to the total portfolio.[25] The strategic portfolio is calculated as the total return including reinvested dividends.[26] The index is also adjusted for splits and mergers and net of fees charged to the investor.

[25] The index is also adjusted for an exchange rate risk.

[26] The tax rate is deducted from the dividend before reinvestment.

Second, the strategic portfolio will be contrasted against two external indices; the MSCI World which is a global index and the Swedish OMXS30. We find this interesting since we then can determine if the funds would have grown their AuM more successfully by following the market indices' weights in their portfolio.[27] The MSCI World describes the equity market performance of more than 20 developed markets and includes both large and mid cap stocks (*Appendix 3, Countries in the MSCI World Index*). The index is calculated with net dividends reinvested (MSCI Barra Website, 2008). The data series was collected from the MSCI Barra Website (2008) and transformed from USD to SEK using the monthly average USD/SEK exchange rate extracted from Datastream[28].

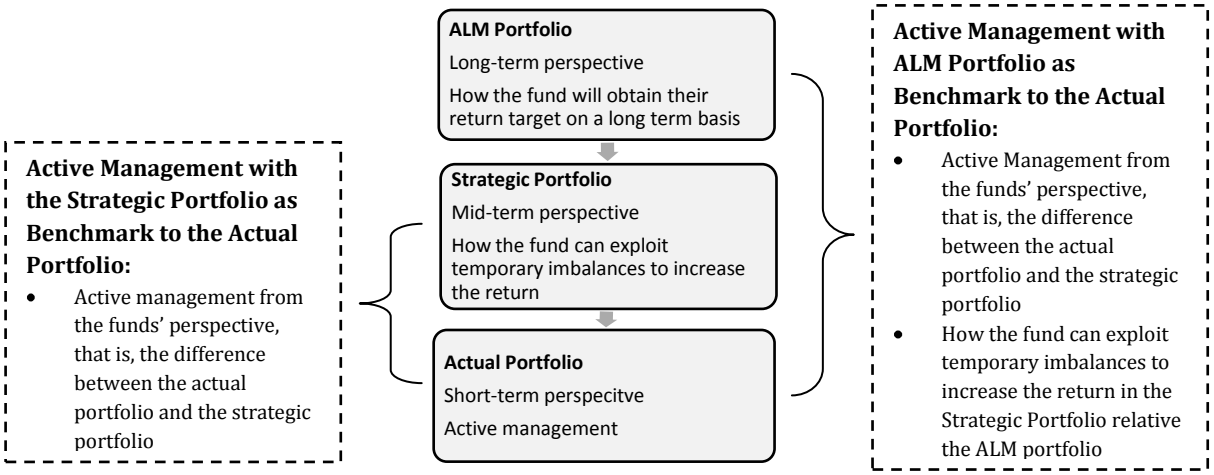
The OMXS30 is a Swedish equity index comprised of the 30 stocks with the largest market cap on the Stockholm Stock Exchange (*Appendix 4, Companies in the OMXS30 Index)*. The index is continuously adjusted to not be affected corporate actions and each stock's weight is determined by the actual market cap of each company (OMX Nordic Exchange Website, 2008). We extracted the data series from Datastream.

The reason why we do not benchmark the actual portfolio against the ALM portfolio is because the ALM portfolios' returns have not been available for us. However, we would like to point out that such a comparison would have been of interest. In order to determine if active management creates value for the funds, we want to contrast it to a passive investment strategy. If a passive strategy was applied on a long-term basis, the funds' actual portfolios would most likely resemble the ALM portfolio which optimizes the portfolio in their mission to create value for the Swedish pensioners on a long-term basis whilst comply with the restrictions set out by the government in the Swedish National Pension Funds Act. If we benchmarked the funds' actual portfolio returns against the ALM portfolio we would also capture how the fund exploits temporary imbalances on a mid-term perspective in addition to the short-term perspective, which is illustrated in *Exhibit 9*. This is important to understand before using the strategic portfolio as a benchmark.

[27] Either, one can buy an index fund or, internally by having someone rebalance the portfolio weights once in a while when the index weights change. The latter investment style would require less costs of management than having the current active management of the fund.

[28] Thomson Datastream is a statistical database.

Exhibit 9: ALM Portfolio as Benchmark



Note: Exhibit 2 adjusted to illustrate the active management of the funds
Source: Interview (2008)

7.6 Factors in Fama and French's model: HML and SMB

In order to perform regressions using the Three Factor Model, we needed data for the size factor and the book-to-market factor. The data has been collected from Kenneth French's website for the relevant time period. The values of the SMB and HML factors are derived from calculations based on American securities.

8 Results

To best illustrate our findings the results is presented in two sections. First, we present the result by model, starting with Jensen's alpha, continuing with Treynor and Mazuy's Market-timing model and last Fama and French's Three Factor Model. Second, we will present the result per benchmark, starting with the strategic portfolio, continuing with the MSCI World Index and thereafter the OMXS30 Index. The analysis of the output is embedded in the presentation of the results.

8.1 Results Displayed per Model

8.1.1 Jensen's Alpha

1) Is Jensen's alpha positive for Fund A and Fund B?

The result in *Table 1* was extracted after performing linear regressions of the total fund performance of Fund A and Fund B against the three benchmarks. We aim to evaluate the alpha, which is the interception of the linear regression analysis.

Table 1: Output Linear Regressions before and after Costs

		EXCLUDING COSTS			INCLUDING COSTS		
		α	β	R^2	α	β	R^2
Fund A	Strategic Portfolio	0.016	1.026	0.995	0.003	1.026	0.995
	MSCI World	0.442	0.450	0.665	0.428	0.450	0.665
	OMXS30	0.305	0.360	0.763	0.291	0.360	0.763
Fund B	Strategic Portfolio	-0.018	1.001	0.993	-0.034	1.001	0.993
	MSCI World	0.517	0.446	0.589	0.501	0.446	0.589
	OMXS30	0.337	0.395	0.823	0.321	0.395	0.823

To determine the significance of the result, we will perform statistical tests. We perform a two-tailed t-test on a 5 percent significance level, which corresponds to a t-value[29] of 2.00 for 58 degrees of freedom. For the test, we form the null hypothesis that Jensen's alpha is not different from zero against the alternative hypothesis that Jensen's alpha is different form zero. If the null hypothesis is accepted, there is no relationship between the active management of the funds (alpha) and the return. The same test is performed for the market beta.

$H_0: \alpha = 0$ $H_1: \alpha \neq 0$

$H_0: \beta = 0$ $H_1: \beta \neq 0$

[29] The t-value is measure how much the independent variable explain the dependent variable. The higher the t-value is, the more probable it is that the independent variable has explanatory power.

Table 2: T-test and P-values for Linear Regressions before Costs

EXCLUDING COSTS		α	t	5% sign.	p	β	t	5% sign.	p
	Strategic Portfolio	0.016	1.010	*Accepted*	0.316	1.026	109.911	Rejected	0.000
Fund A	MSCI World	0.442	3.452	Rejected	0.001	0.450	10.739	Rejected	0.000
	OMXS30	0.305	2.774	Rejected	0.007	0.360	13.656	Rejected	0.000
	Strategic Portfolio	-0.018	-0.855	*Accepted*	0.396	1.001	90.387	Rejected	0.000
Fund B	MSCI World	0.517	3.458	Rejected	0.001	0.446	9.115	Rejected	0.000
	OMXS30	0.337	3.370	Rejected	0.001	0.395	16.425	Rejected	0.000

From *Table 1* and T*able 2*, we can derive the following:

When benchmarked against the strategic portfolios, neither Fund A nor Fund B creates a positive value of alpha that is significantly different from zero. However, the market beta is above one, which means that the risk has been increased relative the strategic portfolios. The value of R^2 is high as most of the portfolio return is correlated to the return of the strategic portfolio and not the active management of the funds (*Table 1*).

When instead benchmarking the funds' performance against the two external indices we get different results. Both Fund A and Fund B creates a significant value of alpha with a correspondingly low risk as the value of the market beta is below 0.5 for both funds (*Table 1*). Thus, as opposed to the strategic portfolio, the portfolio managers of the funds show successful performance when compared to both MSCI World and OMXS30.

Taking the operational costs of the two funds into account does not affect the results considerably as can be seen in *Table 1* above. The absolute size of alpha decrease somewhat but the nature of the findings above is not altered. Further, the results from the hypothesis testing are approximately the same as in *Table 2* above (*Appendix 5*). Hence, even after costs the portfolio managers of the two funds create a significant value for their investors when benchmarked against MSCI World and OMXS30 but cannot be said to do so in relation to the strategic portfolio.

8.1.2 The Treynor and Mazuy Market-timing Model

2) Does the portfolio returns for Fund A and Fund B indicate a selective and/or timing ability?

The results in *Table 3* and *Table 4* below were extracted after performing quadratic regressions of the total fund performance of Fund A and Fund B against three benchmarks. The beta in the quadratic term (β_2) is evaluated to determine if the portfolio managers have a timing ability. The alpha measure is evaluated as a measure of selectivity and compared to Jensen's alpha from the previous section.

The Treynor and Mazuy model is tested with an F-test.[30] We form the null-hypothesis that the variables included in the model does not have any explanatory power on total returns, against the alternative hypothesis that at least one variable has explanatory power on portfolio total returns. The hypothesis is tested on a 5 percent significant level, which corresponds to an F-value of 1.53 for 57 degrees of freedom.

[30] The F-test is performed to assess how well the model corresponds to reality and is used mainly for multiple regressions.

H_0: F = No variables affect total return H_1: F = At least one variable affect total return

Table 3: Output Quadratic Regressions before Costs

EXCLUDING COSTS		α	β_1	β_2	F	5% sign.	p	R^2
	Strategic Portfolio	0.028	1.031	-0.005	6132.006	Rejected	0.000	0.995
Fund A	MSCI World	0.480	0.453	-0.004	56.907	Rejected	0.000	0.666
	OMXS30	0.405	0.389	-0.008	98.490	Rejected	0.000	0.776
	Strategic Portfolio	-0.026	0.997	0.003	4055.965	Rejected	0.000	0.993
Fund B	MSCI World	0.578	0.452	-0.007	41.195	Rejected	0.000	0.591
	OMXS30	0.400	0.413	-0.005	136.721	Rejected	0.000	0.828

Table 4: Output Quadratic Regression after Costs

INCLUDING COSTS		α	β_1	β_2	F	5% sign.	p	R^2
	Strategic Portfolio	0.015	1.031	-0.005	6146.668	Rejected	0.000	0.995
Fund A	MSCI World	0.466	0.453	-0.004	56.885	Rejected	0.000	0.666
	OMXS30	0.392	0.389	-0.008	98.491	Rejected	0.000	0.776
	Strategic Portfolio	-0.042	0.997	0.003	4050.162	Rejected	0.000	0.993
Fund B	MSCI World	0.562	0.452	-0.007	41.175	Rejected	0.000	0.591
	OMXS30	0.383	0.413	-0.005	136.672	Rejected	0.000	0.827

The null hypothesis is rejected in all scenarios (*Table 3* and *Table 4)*, which means that the model includes at least one variable that has explanatory power of the total returns. In order to understand the explanatory ability of each variable we follow up the robustness test by performing t-tests[31], in a similar manner as in *Section 8.1.1*. The following hypotheses are formed:

H_0: $\alpha = 0$ H_1: $\alpha \neq 0$

H_0: $\beta_1 = \beta_2 = 0$ H_1: β_1 and/or $\beta_2 \neq 0$

Table 5: T-test and P-values for the Quadratic Regressions before Costs: Alpha and Market Beta

EXCLUDING COSTS		α	t	5% sign	p	β_1	t	5% sign	p
	Strategic Portfolio	0.028	1.543	*Accepted*	0.128	1.031	102.673	Rejected	0.000
Fund A	MSCI World	0.480	2.999	Rejected	0.004	0.453	10.523	Rejected	0.000
	OMXS30	0.405	3.339	Rejected	0.001	0.389	12.804	Rejected	0.000
	Strategic Portfolio	-0.026	-1.097	*Accepted*	0.277	0.997	81.039	Rejected	0.000
Fund B	MSCI World	0.578	3.096	Rejected	0.003	0.452	8.985	Rejected	0.000
	OMXS30	0.400	3.563	Rejected	0.001	0.413	14.688	Rejected	0.000

Table 6: T-test and P-values for the Quadratic Regressions before Costs: the Beta in the Quadratic Term

EXCLUDING COSTS		β_2	t	5% sign	p
	Strategic Portfolio	-0.005	-1.368	*Accepted*	0.177
Fund A	MSCI World	-0.004	-0.402	*Accepted*	0.689
	OMXS30	-0.008	-1.803	*Accepted*	0.077
	Strategic Portfolio	0.003	0.765	*Accepted*	0.448
Fund B	MSCI World	-0.007	-0.553	*Accepted*	0.583
	OMXS30	-0.005	-1.213	*Accepted*	0.230

[31] Hypothesis testing after costs for the Treynor and Mazuy model are found in *Appendix 5*.

The results from our analysis of Treynor and Mazuy's quadratic regressions (*Table 3* to *Table 6*) provide us with results similar to Jensen's alpha both before and after cost. First, the portfolio managers for Fund A and Fund B cannot be said to have any selective ability as the null hypothesis cannot be rejected because the alpha is not significantly different from zero. Second, in comparison to the external benchmarks, the portfolio managers do appear to have an ability to create value for their investors since alpha has a significant positive value.

The additional explanatory variable in Treynor and Mazuy's model, the quadratic term as measured by β_2, is not significantly different from zero for any benchmark or fund. Hence, in accordance with Treynor and Mazuy's findings from 1966, we can completely rule out a timing ability of the funds. Moreover, by this finding we can also rule out the existence of a statistical bias in Jensen's alpha. The high p-values that correspond to the t-test of the timing beta do, however, lowers somewhat the reliability of these findings.

8.1.3 Fama and French Three Factor Model

3) Can the additional variables size and book-to-market ratio add any explanatory value to portfolio returns of Fund A and Fund B and thereby reduce the size of alpha?

The result in *Table 7* and *Table 8* was extracted after performing multiple regressions of the total fund performance of Fund A and Fund B against the three benchmarks. The Fama and French model aims to disclose if the portfolio performance is driven by the market beta only, or if size and book-to-market ratios can add additional explanatory power to the total return.

The result of the model is tested with the F-test[32]. We form the null-hypothesis that the variables included in the model do not have any explanatory power on total returns, against the alternative hypothesis that at least one variable has explanatory power on portfolio total returns:

H_0: F = No variables affect total return H_1: F = At least one variable affect total return

Table 7: Output Multi-factor Regressions before Costs

EXCLUDING COSTS		**α**	**β_1**	**β_2**	**β_3**	**F**	**5% sign.**	**p**	**R^2**
	Strategic Portfolio	0.016	1.036	-0.011	-0.010	4099.608	Rejected	0.000	0.995
Fund A	MSCI World	0.396	0.399	0.169	0.104	48.530	Rejected	0.000	0.722
	OMXS30	0.287	0.328	0.132	0.059	71.046	Rejected	0.000	0.792
	Strategic Portfolio	-0.022	1.009	-0.017	0.013	2878.529	Rejected	0.000	0.994
Fund B	MSCI World	0.463	0.394	0.166	0.146	34.859	Rejected	0.000	0.651
	OMXS30	0.317	0.368	0.097	0.090	101.151	Rejected	0.000	0.844

Table 8: Output Multi-factor Regressions after Costs

INCLUDING COSTS		**α**	**β_1**	**β_2**	**β_3**	**F**	**5% sign.**	**p**	**R^2**
	Strategic Portfolio	0.002	1.036	-0.011	-0.010	4107.796	Rejected	0.000	0.995
Fund A	MSCI World	0.383	0.399	0.169	0.104	48.526	Rejected	0.000	0.722
	OMXS30	0.274	0.328	0.132	0.059	71.073	Rejected	0.000	0.792

[32] The hypothesis is tested on a 5 percentage significant level, which corresponds to a t-value of 1.53 for 56 degrees of freedom.

	Strategic Portfolio	-0.038	1.009	-0.017	0.012	2869.330	Rejected	0.000	0.994
Fund B	MSCI World	0.447	0.394	0.166	0.146	34.382	Rejected	0.000	0.651
	OMXS30	0.301	0.368	0.097	0.090	101.102	Rejected	0.000	0.844

As can be seen in *Table 7* and *Table 8,* the null hypothesis is rejected in all scenarios, which means that the model includes at least one variable that has explanatory power over the total returns; hence, it is relevant perform t-tests. The following hypotheses are tested on a 5 percent significance level:

H_0: $\alpha = 0$ H_1: $\alpha \neq 0$

H_0: $\beta_1 = \beta_2 = \beta_3 = 0$ H_1: β_1 and/or β_2 and/or $\beta_2 \neq 0$

Table 9: T-test and P-values for Alpha and Market Beta in the Multi-factor Regressions before Costs

EXCLUDING COSTS		**α**	**t**	**5% sign.**	**p**	**β_1**	**t**	**5% sign.**	**p**
	Strategic Portfolio	0.016	0.957	*Accepted*	0.343	1.036	94.492	Rejected	0.000
Fund A	MSCI World	0.396	3.312	Rejected	0.002	0.399	9.518	Rejected	0.000
	OMXS30	0.287	2.735	Rejected	0.008	0.328	11.820	Rejected	0.000
	Strategic Portfolio	-0.022	-1.053	*Accepted*	0.297	1.009	79.995	Rejected	0.000
Fund B	MSCI World	0.463	3.279	Rejected	0.002	0.394	7.954	Rejected	0.000
	OMXS30	0.317	3.308	Rejected	0.002	0.368	14.525	Rejected	0.000

Table 10: T-test and P-values for SMB and HML Betas in the Multi-factor Regressions before Costs

EXCLUDING COSTS		**β_2**	**t**	**5% sign.**	**p**	**β_3**	**t**	**5% sign.**	**p**
	Strategic Portfolio	-0.011	-1.352	Accepted	0.182	-0.010	-1.232	Accepted	0.223
Fund A	MSCI World	0.169	2.961	Rejected	0.004	0.104	1.710	Accepted	0.093
	OMXS30	0.132	2.622	Rejected	0.011	0.059	1.120	Accepted	0.267
	Strategic Portfolio	-0.017	-1.770	Accepted	0.082	0.013	1.269	Accepted	0.210
Fund B	MSCI World	0.166	2.461	Rejected	0.017	0.146	2.047	Rejected	0.045
	OMXS30	0.097	2.124	Rejected	0.038	0.090	1.868	Accepted	0.067

The multi-factor regression generates similar results regarding the alpha of Fund A and Fund B as the two previous models analyzed. The alphas are insignificant in comparison to the strategic portfolio with a corresponding market beta above one, but significantly positive when compared to the external market indices with a corresponding low market beta.

As can be derived from *Table 9* and *Table 10* above, neither the size factor (SMB variable β_2) nor book-to-market facor (HML variable β_3) has any explanatory value over total portfolio returns when benchmarked against the strategic portfolio. However, for the size factor, our findings are the opposite when looking at the external indicies MSCI World and OMXS30. Both funds earn returns that correlates significantly to investments in small cap stocks. Investing in shares with a high book-to-market factor on the other hand, does not render extra return as the hypothesis is accepted in most cases with only one exception for Fund B when benchmarked against MSCI World.

Analouge to our previous reasoning, taking operational costs into account does not change the nature of our findings.[33]

[33] Hypothesis testing after costs for the Fama and French model are found in *Appendix 5*.

8.2 Result Displayed per Benchmark

4) How does the choice of benchmark affect the performance evaluation of Fund A and Fund B?

8.2.1 Strategic Portfolio

In an attempt to summarize and illustrate the impact the choice of benchmark has on performance we rearrange our results in order to more easily compare the output.

Table 11: Results Strategic Portfolio before Costs

EXLUDING COSTS		Fund A				Fund B			
		α/β	t	5% sign.	p	α/β	t	5% sign.	p
Jensen	Alpha	0.016	1.010	Accepted	0.316	-0.018	-0.855	Accepted	0.396
Treynor and Mazuy	Selectivity	0.028	1.543	Accepted	0.128	-0.026	-1.097	Accepted	0.277
	Timing	-0.005	-1.368	Accepted	0.177	0.003	0.765	Accepted	0.448
Fama and French	Alpha	0.016	0.957	Accepted	0.343	-0.022	-1.053	Accepted	0.297
	SMB	-0.011	-1.352	Accepted	0.182	-0.017	-1.770	Accepted	0.082
	HML	-0.010	-1.232	Accepted	0.223	0.013	1.269	Accepted	0.210

As can be derived from *Table 11* above, when benchmarking the actual portfolio's performance against the strategic portfolio, the only variable that actually has explanatory power is the market beta. Hence, no excess returns (alpha) are produced by the portfolio managers and thereby the portfolio managers are not successful in their active management for any of the funds. Consequently, they cannot be said to have either selective or timing ability. Investing in small cap firms or value shares cannot be said to correlate with portfolio return.

Given the restrictive risk profile of the AP-funds, the strategic portfolio is not deviated from in terms of risk enough to give any room for excess returns or losses. None of the values in *Table 11* are significantly different from zero. For the funds internally, the strategic portfolio may be a useful benchmark. However, in order to evaluate how the funds perform relative the general market, the strategic portfolio is a poor choice of benchmark.

8.2.2 MSCI World

In *Table 12* below, we summarize the values each model's most important variables when benchmarked against MSCI World.

Table 12: Results MSCI World before Costs

EXLUDING COSTS		Fund A				Fund B			
		α/β	t	5% sign.	p	α/β	t	5% sign.	p
Jensen	Alpha	0.442	3.452	Rejected	0.001	0.517	3.458	Rejected	0.001
Treynor and Mazuy	Selectivity	0.480	2.999	Rejected	0.004	0.578	3.096	Rejected	0.003
	Timing	-0.004	-0.402	*Accepted*	0.689	-0.007	-0.553	*Accepted*	0.583
Fama and French	Alpha	0.396	3.312	Rejected	0.002	0.463	3.279	Rejected	0.002
	SMB	0.169	2.961	Rejected	0.004	0.166	2.461	Rejected	0.017
	HML	0.104	1.710	*Accepted*	0.093	0.146	2.047	Rejected	0.045

From MSCI World we derive very different results regarding the success of the funds' active management. The value of alpha, when benchmarked against MSCI World, becomes significantly

different from zero for all three models. This leads us to the conclusion that the portfolio managers of the funds are successful in their investment strategies. However, the actual portfolio held by the portfolio manager is to a large extent a consequence of the composition of the strategic portfolio. We therefore consider the alpha of the portfolio managers as the deviation from the strategic portfolio (0.016 for Fund A and -0.018 for Fund B) and hence the alpha of the investment decision of the management team to hold the strategic portfolio as the difference between 0.016 and 0.442 for Fund A and the difference between -0.018 and 0.517 for Fund B.

In addition, when benchmarking against MSCI World as opposed to the strategic portfolio, we find that there are other factors that affect total return. For example, investing in small cap stock gives a significantly positive effect on portfolio return (*Table 12).*

8.2.3 OMXS30

Finally, we look at the result produced by the regressions performed against OMXS30 in *Table 13*.

Table 13: Results OMXS30 before Costs

EXLUDING COSTS		**Fund A**				**Fund B**			
		α/β	**t**	**5% sign.**	**p**	**α/β**	**t**	**5% sign.**	**p**
Jensen	Alpha	0.305	2.774	Rejected	0.007	0.337	3.370	Rejected	0.001
Treynor and Mazuy	Selectivity	0.405	3.339	Rejected	0.001	0.400	3.563	Rejected	0.001
	Timing	-0.008	-1.803	Accepted	0.077	-0.005	-1.213	Accepted	0.230
Fama and French	Alpha	0.287	2.735	Rejected	0.008	0.317	3.308	Rejected	0.002
	SMB	0.132	2.622	Rejected	0.011	0.097	2.124	Rejected	0.038
	HML	0.059	1.120	Accepted	0.267	0.090	1.868	Accepted	0.067

The nature of our results, when benchmarking against the OMXS30, are to a great extend analogue with the result produced when benchmarking against MSCI World. Hence, the active management can be concluded to add value to the funds, whilst this excess returns only is a product of a selective ability. Further, it can be derived that the size factor does have an explanatory power over total portfolio returns. These similarities in findings between the benchmarks are reasonable considering the fact that the largest companies on the OMX Stockholm are also international companies.

By using three different indices we understand how sensitive our results are to the choice of benchmark. In accordance with Roll's findings (1978), we question the efficiency of our different benchmarks as the absolute size of the alpha differs for every one of them. Further, we see that the ranking the funds, according to their performance, is also sensitive to what benchmark that is used. We will continue this discussion in *Section 10*.

9 Conclusion

In the conclusion, we start by answering the four subordinate research questions based on the output from the statistical tests. Thereafter, we address the main question of this paper.

In this paper we aimed to evaluate the performance of two of the Swedish National Pension Funds. We have performed regressions on data collected from the two funds for the time period 2003 – 2007 in order to answer our research question.

1) *Is Jensen's alpha positive for Fund A and Fund B?*

When benchmarking against the strategic portfolio the funds do not create abnormal returns. The value of alpha for Fund A and Fund B is not significantly different from zero. The restrictions put on the funds in the National Pension Funds Act (SFS2000:192) and the risk levels determined by the funds' boards in their respective strategic analysis hinders each portfolio manager to deviate too much from the strategic portfolio. Thus, the opportunity for the funds to create excess return is limited. Clearly, the deviations from the funds' own selected benchmark is not large enough for us to observe significant alphas. It is therefore questionable if Fund A and Fund B should engage in active management.

In most scenarios the value of alpha is positive both net and gross of costs, which means that the active management of the funds in these scenarios at least do not destroy value. Further, even an insignificant positive value of alpha, given the size of the funds, may in absolute terms generate value for investors. The same can be said for the negative insignificant alpha observed in Fund B, which would indicate that Fund B is destroying value before and after costs of operations through its deviations from the strategic portfolio.

When benchmarking against MSCI World and OMXS30, our calculations show significant values of alpha with corresponding low beta value. These results can be interpreted as both Fund A and Fund B are performing well since they earn an abnormal return whilst having a low risk in comparison to the market.

2) *Does the portfolio returns for Fund A and Fund B indicate a selective and/or timing ability?*

After performing the regression analysis we have not identified any timing ability in Fund A or in Fund B that is statistically significant for any of the benchmarks. We conclude that the Swedish National Pension Funds do not have any timing ability.

As already mentioned, the selective ability in Treynor and Mazuy's Market-timing model should be approximately the same as Jensen's alpha in the absence of a timing ability. In our results, the quadratic factor deviates somewhat from zero, which in turn has affected the market beta and the alpha in Treynor and Mazuy's model. However, these effects are rather small and the market beta and the alpha in the quadratic regression is approximately the same as in the linear regression.

Consequently, the funds can be said to have selective ability. We can thereby rule out that the existence of a statistical bias has affected our results calculating Jensen's alpha.

3) *Can the additional variables size and the book-to-market ratio add any explanatory value to portfolio returns of Fund A and Fund B and thereby reduce the size of alpha?*

We have applied Fama and French's Three Factor Model to our data in order to determine if the portfolio performance is driven by the market beta and the funds ability to generate excess returns only, or if a size and book-to-market factor can have additional explanatory power over the total return.

The result varies with benchmark and fund. For the strategic portfolio, market cap and book-to-market ratio do not have explanatory power over the returns. When benchmarking with the external indices, the size factor has an explanatory power over returns for both the funds while the book-to-market ratio has only explanatory power over the returns in one scenario, when Fund B is benchmarked against the MSCI World.

Our findings regarding Fama and French's two additional variables leave our conclusion regarding portfolio managers' performance unchanged since the explanatory power is not large enough to decrease the abnormal returns observed in the previous models to zero. We do conclude that size and book-to-market factors cannot fully explain the alpha generated for the two external indices.

4) Does the choice of benchmark affect the performance evaluation of Fund A and Fund B?

Finding the perfect market portfolio to benchmark returns against has not been the focus of this paper. Therefore, we will not draw any conclusions about which one of the selected indices that are best suited to benchmark the funds' performance against. However, to answer our main question with confidence we need to determine the robustness of our results.

We conclude that the performance evaluation is affected by the choice of benchmark. We have observed that the benchmark used by the funds, the strategic portfolio, generate results quite different from the results derived using the external indices. Further, the performance of Fund A and Fund B relative each other also differ depending on the choice of benchmarks.

Does active management create value for the Swedish National Pension Funds?

To summarize the findings above, active management in a short-term perspective does not create significant value for the AP-funds when compared to the mid-term perspective of the strategic portfolio. However, the funds create significant excess value if compared to investing in a portfolio with the same composition as the MSCI World or OMXS30. Unfortunately, we cannot say whether the active management creates excess return in comparison to the long-term perspective of the funds since we did not get access to the ALM portfolio.

The funds' performance is explained by a selective ability and not a timing ability, which increases the robustness of Jensen's alpha. The additional factors in Fama and French's Three Factor Model,

size and book-to-market, have somewhat ambivalent explanatory power over the total return of the funds; however, including them does not eliminate the abnormal returns observed calculating Jensen's alpha when benchmarking against the external indices.

10 Discussion, Critique and Further Research

In this section we will present a more nuanced interpretation of our results, analysis and conclusions. We will address our assumptions, the validity and reliability of the report. Furthermore, we will discuss alternative investment strategies and organizational structures for the AP-funds. Critique against the report will be presented as well as proposals for further research.

10.1 Discussion

Our calculations are based upon several assumptions that may affect its accuracy. We will therefore look at how our assumptions have overstated/understated our results and thereby affected our conclusions. In the light of our conclusions, we will also consider alternative strategies for the funds.

10.1.1 Assumptions

In the data section, we explained our assumptions regarding the monthly returns, selected time period, risk-free interest rate, cost of operations, choice of benchmarks and the input factors in Fama and French's model. The monthly returns and the cost of operations are fixed data provided to us by the fund and through information in the annual reports respectively. We trust that the returns given to us from Fund A and Fund B are accurate.

The risk-free interest rate in our calculations is approximated by the Swedish government bond maturing in one month. We believe that this is the most accurate rate to use since we are evaluating Swedish funds.

The assumptions regarding the benchmarks have already been thoroughly discussed and we have concluded that our results are sensitive to the choice of benchmark. We would like to point out again though, that the strategic portfolio is an internal index and therefore not an objective benchmark to evaluate funds' performance against. However, we believe that including it adds value to this study since the funds have investment restrictions and since the strategic portfolio is used to benchmark performance internally.

MSCI World and OMXS30 are equity indices, with a high diversification level. These indices do not fulfil the investment directives set out by the government for the funds or follow the risk level determined by the boards. They do, however, give an indication of the opportunity cost of capital of investing the Swedish pension capital in the AP-funds. To summarize, we can with confidence say that including other benchmarks in this study would produce different results. Nevertheless, by critically evaluating the selected benchmark, we believe that we have provided a robust analysis of Fund A and Fund B's performance.

In the light of the financial crisis observed in 2008, the selected time period becomes relevant to discuss. We have evaluated the performance of Fund A and Fund B for a period of time when the market has more or less continuously been going up. The funds may have dared to increase the risk of their portfolios to a greater extent than if the market had been more volatile. Including the recent

economic downturn or the recession in the early 2000's may have produced different results. However, this reasoning contradicts the fact that we concluded in this study that the funds lack a timing ability.

In the Fama and French Three Factor Model, we have approximated the size and book-to-market factors by data based on observations of American securities. We cannot rule out that if these observations were more internationally diversified, or based on Swedish securities, our results would have been different. However, we are investigating the economic effect of these factors on portfolio returns and believe that these effects are not country specific. Moreover, as financial markets have become increasingly integrated we believe that the American market is representative also for the areas outside of the U.S. in which Fund A and Fund B have invested.

10.1.2 Passive Management

Active management is applied by the AP-funds as a consequence of the belief that they can create abnormal returns in excess of the ALM portfolio on a long-term basis by mid-term deviations in the strategic portfolio and short-term deviations in the actual portfolio.

Our study shows that benchmarking against the strategic portfolio does not create significant excess returns for the funds. We therefore question the choice of Fund A and Fund B of having active portfolio management since this is a costly strategy compared to passive management.

If the strategic portfolio is used as benchmark, a passive management strategy would be not to deviate from this in the actual portfolio. Such a passive strategy would require some costs associated with the rebalancing of portfolio weights to uphold the strategic portfolio; however, they would be considerable lower than the current costs.

Previously in this paper we stated that the ALM portfolio also can be seen as an alternative passive strategy of the AP-funds. As the ALM portfolio is unavailable to us we cannot say whether active management of the funds creates an excess return or not in relation to it. However, if the funds did not deviate in the strategic portfolio from the ALM portfolio, an even larger part of the costs of management could be cut as the ALM portfolio is not rebalanced in the mid-term perspective.

Yet another investment strategy available to the funds is to abandon their strategic analysis (i.e. the ALM portfolio) and instead invest in an index such as the MSCI World and OMXS30, alternatively an index fund. However, given that the results we have derived are accurate, the funds actual portfolios do create excess returns in comparison to these indices why this strategy cannot be advised. Further, investing in an index fund is costly and is not an option for the funds today, as it would satisfy the regulations set out in the Swedish National Pension Funds Act (SFS2000:192).

Finally, we will address the option of investing the funds' capital in fixed-income securities on a long-term basis. As the pension funds' primary goal is to maximize the long-term return while maintaining a low level of risk, investing in a risk-free asset such as a government security, do offer favorable conditions. However, historically on a long-term basis, the equity market has always

outperformed the returns of bonds. Therefore, we find it discussable that the AP-funds are limited to hold a large portion of their respective portfolios in fixed-income securities with low risk.

Given that the AP-funds would be managed passively (for any strategy outlined above), we see no real reason for the existence of four different funds. The correlation between Fund A and Fund B's total performance is more than 98 percent, indicating that there is little or no risk diversification between them. Since the mission of the funds is the same and they all perform an ALM-analysis with the same goal at hand, we have a reason to believe that this correlation is representative for all of the four funds (AP1-AP4). Hence, an alternative to today's pension system would be to merge the four AP-funds into one, which in theory at least is feasible since they operate under the same regulations. Given a merger, considerable cost synergies could be realized which would add value to Swedish pensioners. However, merging the AP-funds into one would create a powerful investor in the Swedish financial market. Hence, the AP-fund would probably be able to influence areas in which it lacks the right competences.

10.2 Validity and Reliability

In this study, we aimed to evaluate the performance of the Swedish National Pension Funds.

According to us, our study can be considered valid if our selected models produce results that are relevant to the question we aimed to answer. Further, the study can be considered to be reliable, if our calculations have been performed consistently for every model and if replicating the study, the same results would be derived.

In order to provide our main research question with a robust answer, we chose not only to analyze the funds' performance with one performance model, but with three. Jensen's alpha is one of the most commonly used models for portfolio performance evaluation and by comparing and contrasting it to the Treynor and Mazuy Market-timing model and the Fama French Three Factor Model we believe that we increased the validity of our conclusions. However, the choice of benchmark is yet again a problem. We have outlined the difficulties of selecting an efficient benchmark and cannot say whether we succeeded to do so in this study or not. This, of course, limits the validity of our results. Further, a longer time period with more than 60 observations would increase the validity of our results as would the analysis of data from additional AP-funds.

In terms of producing reliable results, performing a quantitative analysis is helpful. Under the assumption that we have performed our calculations in a correct manner, which to our best of knowledge we have, the results produced should be reliable.

The data we have collected as input to our model is highly relevant when discussing the validity and reliability. In previous sections, we have thoroughly discussed our assumptions behind the data collection. As we have based our choice of input on a thorough analysis of the available options we hope to have achieved both a high level of validity and a high level of reliability in this study.

10.3 Critique against the Report

Given the scope of this report, we limited our analysis to include only two additional explanatory variables on portfolio return, namely size and book-to-market ratio. Nevertheless, other factors might have explanatory power which would decrease the size of the alpha in our results.

As already discussed, 60 observations is a somewhat short period of observations and a longer period of time would definitely increase the reliability of our findings. However, we do not believe that daily returns would have altered our conclusions. Further, the fact that only two of the six AP-funds were included in the study decrease the validity of our conclusions.

In addition, we have not tested our two samples for homoscedastic or autocorrelation before performing our linear and multiple regressions.

10.4 Proposals for Further Research

We have identified some potential areas for further research that we feel is of particular interest:

1) *Investigate the performance of all six AP-funds*

Our aim with this report was first to include all of the funds in the analysis. However, limited willingness of co-operation made this impossible. Nevertheless, it remains interesting and of high value to Swedish future pensioners to pursue such a study.

2) *Investigate portfolio performance divided by each type of security and/or geographical market*

In order to establish if active management of different types of securities have added more (or less) to the total return of the portfolio, it would be highly relevant to make an analysis of performance divided per type of security included in the portfolio and/or per investments in geographical markets.

3) *Compare the performance of the AP-funds with equivalent funds outside Sweden*

The long-term perspective of the funds and the special regulations that they comply with limits the number of comparable funds within Sweden. Therefore, to evaluate the performance relative other funds, an international investigation would be of interest.

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Appendix 1 Definitions

Active management	An investment strategy where the goal is to outperform a benchmark index by increasing the risk in the portfolio if the market is predicted to go up, alternatively reducing the loss when the market is declining.
ALM portfolio	The ALM portfolio is set by the boards of the AP-funds through a strategic analysis. The portfolio determines how the fund will obtain their target return on a long-term basis.
AP-funds	Swedish National Pension Funds.
CAPM	Capital Asset Pricing Model.
CLM	Central Limit Theorem is a theorem that states that the distribution of sample means from large populations is approaching a normal distribution.
Earnings related pension	The individual receives a pension right through payments of 16 percent of the salary before tax. The earning related pension is a part of the Swedish Pension System.
HML	The book-to-market factor in Fama French's Three Factor Model.
Kurtosis	Asymmetry of a probability distribution. Positive kurtosis; a peaked distribution. Negative kurtosis: a flat distribution.
Market Beta	The assets correlation with the market. Market beta of zero indicates that the asset is independent. Market beta of 1.0 indicates that the asset's return follows the market return.
Passive management	An investment strategy where the goal is to perform as a benchmark index and not deviate from the risk in that portfolio.
Pension Fund	Buffer funds in the Swedish Pension System.
PPM	The Premium Pension Authority.
SMB	The size factor in Fama French's Three Factor Model.
Security Market Line	The intercept in the SML is the risk free rate and the slope of the line displays the market risk premium.
Selective ability	Jensen (1964): The portfolio manager's ability to forecast an individual securities performance.
Skewness	Asymmetry of a probability distribution. Negative skew: left tail is longer than the right tail. Positive skew: right tail is longer than the left tail.
Strategic portfolio	Set by the boards of the AP-funds through a strategic analysis and determines how the fund can exploit temporary imbalances to increase the return by deviating from the ALM portfolio. Also, benchmark for the active management internally.
Timing ability	Jensen (1964): The portfolio manager's ability to the general behaviour of the market.

Appendix 2 Assumptions

Assumptions CAPM:

The CAPM relationship is based on the following assumptions (Brealey et al., 2006).

- Investors aim to maximize return for every given risk level (i.e. they invest in mean-variance efficient portfolios)
- Investors borrow and lend at the risk-free interest rate without incurring taxes or transaction costs
- Investors have homogeneous expectations concerning volatilities, correlations and expected returns of available securities
- Investors can buy and sell all securities at competitive market prices and no asymmetric information exists

Appendix 3 Countries in the MSCI World Index

The Morgan Stanley Compounded World Index Standard Core (MSCI World)

The following countries included:

Countries in the MSCI World Index

Australia	Japan
Austria	Netherlands
Belgium	New Zealand
Canada	Norway
Denmark	Portugal
Finland	Singapore
France	Spain
Germany	Sweden
Greece	Switzerland
Hong Kong	United Kingdom
Ireland	USA
Italy	

Appendix 4 Companies in the OMXS30 Index

The OMX Stockholm 30 Index (OMXS30)

The following companies are included:

Share	ISIN	Share	ISIN
ABB	CH0012221716	**SAND**	SE0000667891
ALFA	SE0000695876	**SCA B**	SE0000112724
ASSA B	SE0000255648	**SCV B**	SE0000308280
ATCO A	SE0000101032	**SEB A**	SE0000148884
ATCO B	SE0000122467	**SECU B**	SE0000163594
AZN	GB0009895292	**SHB A**	SE0000193120
BOL	SE0000869646	**SKA B**	SE0000113250
ELUX B	SE0000103814	**SKF B**	SE0000108227
ENRO	SE0000718017	**SSAB A**	SE0000171100
ERIC B	SE0000108656	**SWED A**	SE0000242455
HM B	SE0000106270	**SWMA**	SE0000310336
INVE B	SE0000107419	**TEL2 B**	SE0000314312
LUPE	SE0000825820	**TLSN**	SE0000667925
NDA SEK	SE0000427361	**VGAS SDB**	SE0000367823
NOKI SEK	FI0009000681	**VOLV B**	SE0000115446

Appendix 5 Statistical Tests after Costs

Jensen's Alpha

(A)Table 14: T-test and P-values for the Linear Regressions after Costs

INCLUDING COSTS		α	t	5% sign.	p	β	t	5% sign.	p
	Strategic Portfolio	0.003	0.194	*Accepted*	0.847	1.026	110.059	Rejected	0.000
Fund A	MSCI World	0.428	3.348	Rejected	0.001	0.450	10.737	Rejected	0.000
	OMXS30	0.291	2.653	Rejected	0.010	0.360	13.657	Rejected	0.000
	Strategic Portfolio	-0.034	-1.606	*Accepted*	0.114	1.001	90.305	Rejected	0.000
Fund B	MSCI World	0.501	3.351	Rejected	0.001	0.446	9.113	Rejected	0.000
	OMXS30	0.321	3.210	Rejected	0.002	0.395	16.424	Rejected	0.000

Treynor and Mazuy Market-timing Model

(A)Table 15: T-test and P-values for the Quadratic Regressions after Costs

INCLUDING COSTS		**α**	**t**	**5% sign**	**p**	**β_1**	**t**	**5% sign**	**p**
	Strategic Portfolio	0.015	0.815	*Accepted*	0.419	1.031	102.793	Rejected	0.000
Fund A	MSCI World	0.466	2.914	Rejected	0.005	0.453	10.520	Rejected	0.000
	OMXS30	0.392	3.229	Rejected	0.002	0.389	12.804	Rejected	0.000
	Strategic Portfolio	-0.042	-1.780	*Accepted*	0.080	0.997	80.974	Rejected	0.000
Fund B	MSCI World	0.562	3.009	Rejected	0.004	0.452	8.983	Rejected	0.000
	OMXS30	0.383	3.417	Rejected	0.001	0.413	14.683	Rejected	0.000

(A)Table 16: T-test and P-values for the Quadratic Regressions after Costs: the quadratic term

INCLUDING COSTS		**β_2**	**t**	**5% sign**	**p**
	Strategic Portfolio	-0.005	-1.362	*Accepted*	0.179
Fund A	MSCI World	-0.004	-0.401	*Accepted*	0.690
	OMXS30	-0.008	-1.801	*Accepted*	0.077
	Strategic Portfolio	0.003	0.779	*Accepted*	0.439
Fund B	MSCI World	-0.007	-0.551	*Accepted*	0.584
	OMXS30	-0.005	-1.208	*Accepted*	0.232

Fama and French Three Factor Model

(A)Table 17: T-test and P-values for Alpha and Market Beta in the Multi-factor Regressions after Costs

INCLUDING COSTS		α	t	5% sign.	p	β_1	t	5% sign.	p
	Strategic Portfolio	0.002	0.137	*Accepted*	0.892	1.036	94.579	Rejected	0.000
Fund A	MSCI World	0.383	3.200	Rejected	0.002	0.399	9.517	Rejected	0.000
	OMXS30	0.274	2.609	Rejected	0.012	0.328	11.822	Rejected	0.000
	Strategic Portfolio	-0.038	-1.820	*Accepted*	0.074	1.009	79.873	Rejected	0.000
Fund B	MSCI World	0.447	3.166	Rejected	0.003	0.394	7.951	Rejected	0.000
	OMXS30	0.301	3.141	Rejected	0.003	0.368	14.522	Rejected	0.000

Appendix 6 Additional Equations

(A)Equation 8: Skewness

$$Skewness = \frac{\sum_{i=0}^{N}(\mathrm{Y_i} - \overline{\mathrm{Y}})^3}{(N-1)s^3}$$

Where:
$Y = sample\ mean$
$S = standard\ deviaion$
$N = number\ of\ data\ points$

(A)Equation 9: Kurtosis

$$Kurtosis = \frac{\sum_{i=0}^{N}(\mathrm{Y_i} - \overline{\mathrm{Y}})^4}{(N-1)s^4}$$

Where:
$Y = sample\ mean$
$S = standard\ deviaion$
$N = number\ of\ data\ points$

(A)Equation 10: Jarque-Bera

$$JB = \frac{n}{6}\left(S^2 + \frac{(K-3)^2}{4}\right)$$

Where:

$n = degrees\ of\ freedom$
$S = sample\ skewness$
$K = sample\ kurtosis$