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Bachelor Thesis

Active fund management or passive index cruising?

An empirical analysis of the performance of Swedish equity funds

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Abstract

How should an investor pick funds to invest in? What is the best strategy, picking active or passive funds? It's hard to navigate the fund landscape when there is ambiguous evidence and advice coming from different directions. Do fund managers outperform the market and passive funds? Do they bring something extra of value to the table in regards to their high management fees? The question seems almost age-old at this point, from dart throwing monkeys outperforming high profile fund managers to famous investors proclaiming that active fund management is dead, it's hard to know what is really true about active versus passive fund management. Over the last 20 years the popularity of equity funds has exploded, mutual equity fund savings in Sweden has tripled in just 10 years, going from 1000 billion SEK to over 3000 billion SEK [1]. 76% Of the Swedish population purposely invest in funds and 70% of this is invested in equity funds [2]. In this interesting and rapidly growing market we want to investigate whether active fund management is superior or if passive cruising in index funds should be your go-to investment strategy. This is intriguing and important since nobody seems to reach a conclusive answer, time periods researched are old and we find few studies that use Swedish market fund data. Hence we study the performance of passive and active mutual equity funds on the Swedish market from 2010 to 2020. We use some basic methods, like the *Capital Asset Pricing Model* based *Single-Index Model*, *Sharpe Ratio*, *Treynor Ratio* but also some more complicated models like the *Fama French Three-Factor Model* and the *Carhart Four-Factor Model*.

[1] https://www.fondbolagen.se/fakta_index/Fondsparande-efter-kategori/

[2] https://www.fondbolagen.se/globalassets/faktaindex/studier-o-undersokningar/det-svenska-fondsparandet-ur-ett-internationellt-perspektiv-2018.pdf

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1

Introduction

In this opening section we introduce the subject which our thesis means to investigate. We provide some background, our purpose and research questions together with our delimitations.

1.1 Motivation

Several studies have investigated if there exists any significant difference in performance between active and passive mutual funds however, the majority of studies, for example Jensen (1968), Ippolito (1989) and Elton et al. (1993), have been conducted using US equity fund data. Everyone except Ippolito (1989) reached the conclusion that active funds do not outperform index funds. We find only a handful of studies that use Swedish equity fund data, Dahlquist et al. (2000) and Engström (2004). The evidence from the Swedish funds indicate a pattern that contradicts the general conclusion that active fund management do not generate any excess return over index funds. The most recent Swedish study we found covered the time period of 1993 - 2013. We do not find a lot of comprehensive studies that cover the performance of Swedish mutual funds during the past decade, which motivated us to dedicate our bachelor thesis to conduct this study and fill this research gap.

The vast majority of prior studies have arrived at different conclusions on if active mutual funds outperform the market. Jensen (1968) concluded that active mutual funds do not outperform the market, Ippolito (1989) found evidence that active mutual funds utilize the fact that information is costly and thus earn excess returns compared to passive index funds due to asymmetric information. Elton et al. (1993) emphasized that Ippolito (1989)s evidence can be derived from him not using a suitable benchmark, which consequently lead him to overestimate the performance of active management funds. There have been studies investigating if there exists any correlation between funds performance and management fees, Malkiel (1995) found no evidence indicating this. The overall consensus is that there exists no significant evidence that active funds tend to outperform passive funds. However, some of the prior studies conducted on the Swedish market found evidence that some fund managers actually do outperform the market. Dahlquist et al. (2000) finds evidence that Swedish active mutual funds outperform passive funds. This was later also observed by Engström (2004) however, Flam & Vestman (2017) conclusion was not in line with the previously two and they rejected the idea that some managers possess actual 'skills´ that would help them generate excess return compared to the benchmark. The research conducted on the Swedish market do not conclusively agree that active funds actually succeeds to outperform passive funds but their combined results to some extent contradict the general picture. With our study we seek to find a better understanding in the differences between active and passive mutual funds during the past decade. Our intention is to investigate and further elaborate if there exist a significant difference in performance between the risk-adjusted performance of active and passive mutual funds. By that we will further look at two specific factors, fund age and total asset value, to try determine what causes this potential difference.

1.2 Purpose

The core purpose of this thesis is to provide an empirical analysis of the risk-adjusted performance of active and passive mutual funds. The purpose is to analyse if there exists a risk-adjusted performance difference between active and passive mutual funds and to investigate if performance vary depending on size or age.

1.3 Research questions

The core of our study is to empirically analyse fund data to determine if active or passive mutual equity funds perform better in terms of risk-adjusted returns. First research questions reads as follows,

- Is there a difference in risk-adjusted performance between active and passive Swedish mutual equity funds?

We also divide our sample into different size groups, small, medium and large, to determine if performance vary depending on size, as shown by Chen et al. (2004), Yan (2008), Indro et al. (2019) and Dahlquist et al. (2000), increasing fund size erodes performance. Second research questions reads as follows,

- Does risk-adjusted mutual fund performance vary depending on fund age?

Lastly we will investigate if mutual fund performance vary depending on total asset value. There is a possibility that mutual fund performance may differ depending on how old the fund is, Karoui & Meier (2010) finds that newly started funds experience higher returns than their older counterparts. To study this we divide our sample into two groups, young and old, to determine if performance vary depending on age. Third and final research questions reads as follows,

- Does risk-adjusted mutual fund performance vary depending on fund size?

1.4 Delimitations

This study will investigate only equity funds which exist on the Swedish market, is accessible to Swedish investors and invests primarily in Swedish stocks (over 50%). We wish to sample a homogeneous group of funds who share the same characteristics to be able to better understand and trust our results. The time period will be limited to between 2010 - 2020. We have chosen funds who focus on a blend of small, mid and large cap funds. All of our funds re-invest the dividends back into the fund and so does not pay out dividends.

1.5 Contributions

This study contributes to the research by analysing mutual fund performance during a recent time period, 2010 - 2020. Furthermore it investigates only Swedish mutual funds which only have been performed by a few researchers before. We use different established models, such as the Fama French Three-Factor Model and Carhart Four-Factor Model, to gain a broad perspective on our results. These methods are regular used when analyzing fund data and have been used in previously studies conducted on the Swedish market. By analysing a new time period and focus on solely Swedish equity funds our thesis contribute to extend the knowledge about risk-adjusted fund performance. We also divide our sample of funds into different groups depending on age and total fund assets to determine if performance vary depending on size and age. We find few studies that have done this in the past and believe our thesis may help broaden the knowledge on what affect fund performance.

2

Literature review

In this section we look at the previous literature and studies, what it says about our subject, and how we might move forward, draw conclusions and hypothesize from that.

One of the first studies to investigate performance between active and passive mutual funds was done by Jensen (1968), where he investigates 115 funds over the time period 1945-1964. He develops the performance measure known as Jensen's Alpha, which is a risk-adjusted performance measure. His hypothesis in the study is that the alpha is equal to zero, and that there is no significant difference between the performance of active and passively managed mutual funds. He arrives at the conclusion that you cannot say that actively managed funds perform better than an index based asset ("buy-the-market-and-hold") and finds significance for negative alphas for active funds. This means that the active funds did not outperform the passive asset on a risk-adjusted basis.

Fama (1970) concludes that there exists considerable support for the efficinet market hypothesis. He argues that fund managers cannot beat the market on a risk adjusted basis since market prices already reflect all the available information. However, Ippolito (1989) makes the argument that information is costly to collect, thus claiming that active mutual fund managers may and should charge a fee to compensate them for that expense. In an efficient market, the supposedly excess return, compared to the overall market, generated by this information accumulation should be eliminated due to management fees and other expenses. By investigating the performance of 143 different active mutual funds compared to S&P500 over a 20-year time frame Ippolito (1989) finds evidence, in contradiction to Jensen (1968), that active mutual funds slightly outperform passive index funds. By observing the alpha values for all funds Ippolito (1989) saw that there was a tendency towards positive alphas and he therefore concludes that active mutual funds actually perform better than passive index funds. However, he also finds evidence that the risk-adjusted return, not including management fees, is comparable to passive mutual funds. He concludes that the market is efficient, and management fees are uncorrelated to fund performance, and does not yield any excess return compared to the benchmark index, indicating that active mutual funds do not outperform passive assets.

Elton et al. (1993) emphasises in their article the importance of benchmark indexes used in earlier research and suggest that Ippolito (1989)s conclusion, that active mutual funds outperform comparable index funds, can be explained by the usage of an inadequate benchmark index. By using the same data set as Ippolito (1989), Elton et al. (1993) proves that the positive alphas observed by Ippolito (1989) originates from non-S&P500 assets, thus the usage of S&P500 as a benchmark index was not suitable. By adjusting for outside S&P500 investments Elton et al. (1993) proves that Ippolito (1989)s result would have been in line with former studies such as with Jensen (1968).

Furthermore, Malkiel (1995) finds a correlation between low management fees and high returns, where actively managed funds do not outperform the market even though they charge more. He also emphasises that survivorship bias is much more substantial than previously thought and that earlier studies have excluded terminated mutual funds, thus overestimating their performance. He also challenged the fact that good performing funds tend to perform well in the short term as well. They did observe abnormal excess return when analysing fund performance during the 1970s, however this was not present when analysing fund performance during the 1980s.

The notion that actively managed funds did not outperform index funds was further elaborated on by Gruber (1996). He questions why investor still buy actively managed mutual funds, even though the majority of all available research speaks against it. He performs empirical research where he compares active and index funds that follow the S&P500. His results are consistent with those of Jensen (1968), Elton et al. (1993) and Malkiel (1995), index funds had, in general, higher alpha values. His conclusion was that index funds generated a higher risk-adjusted return and investors would be better off only buying passive mutual funds.

Henriksson (1984) looks at 116 open-end active mutual fund in the US to determine if active management could outperform the market. His result indicates that although the actively managed funds did have lower systematic risk than the market, they still underperform the market. He also concludes that fund managers were not able to successfully forecast fluctuations in the market, be it large or small fluctuations. One interesting outcome from his research is that he finds a negative correlation between the alpha values and the beta values which led him to question the use of the Capital Asset Pricing Model to evaluate portfolio performance.

Another aspect regarding mutual funds performance is how fund size affects fund performance. McGuiga (2006) investigates this and looks at American mutual funds during the period 1983 - 2003. He divides his sample into "large-cap domestics stock funds" and "mid-cap domestic stock funds" and seeks to understand if there exists any difference in performance that depend on fund focus. He arrives at several interesting conclusions, for large cap funds, the longer the investment horizon, the harder it was to outperform the market. However, he observes that 10.59 % of the large funds did outperform the market on a 20-year horizon. The chance to pick a fund that actually did outperform the market was between 10.59 - 24.71, however choosing a loosing fund was associated with a high cost, in the form of missed returns. Another important implication is also that he neglects all the funds that cease to exist during his period, thus survivorship bias affect the results, performance may in fact be lower than reported. When analysing the mid cap funds he uses an almost identical approach as with the large cap funds, he just changes the benchmark index to S&P400 mid cap instead. The result from this survey was in line from that of the large cap funds, however the proportion of the funds that had outperformed the index was 2.63 % in comparison with 10.59 % for large cap. This consequently also lead to an even smaller chance of 2.63 - 13.16 % that an investor would buy a outperforming fund. He lands in the conclusion that active mutual funds, both large cap and small cap, are not preferable alternatives to index funds since passive index fund did outperform the active funds in more than 50 % of the cases (72.19 - 84.71 % for large and 68.42 - 94.74 % for small).

Cuthbertson et al. (2010) performs a comprehensive meta-study where they evaluate prior studies performed on US and UK active mutual funds and index funds between 1975 to 2002. He concludes that investors had a tendency to not avoid high cost index funds, meaning that several index funds charged a high, unreasonable, management fee. Regarding active mutual funds they find that active mutual funds actually did earn a positive risk-adjusted return during recessions compared to the benchmark. They conclude that roughly 5% of active mutual funds in the US and UK had had net positive alphas. The top performing mutual funds seems to have an aggressive and growth focused investment philosophy. They find little to no evidence that fund managers could time the market and thus earn abnormal profits and that picking ‘winner´funds is virtually impossible. Their final conclusion is that investor should focus on low fee cost index funds and avoid past ‘loser´active mutual funds.

The amount of studies performed on the Swedish mutual fund market is not as comprehensive compared to the US market. There has only been published a few different studies on the Swedish equity fund market, Dahlquist et al. (2000) covers 126 different Swedish funds between 1993 and 1997. Their main focus was to investigate if certain fund attributes affects fund performance. By looking at the alpha values they arrives at the conclusion that larger equity funds performed less well compared to smaller equity funds. They also observes a negative relationship between management fees and performance. However, they also find evidence that active mutual funds somewhat outperformed passive mutual funds.

Engström (2004) evaluates 112 different Swedish active mutual funds between 1996 - 2000. By observing alpha values his result is in line with what Dahlquist et al. (2000) concludes, active management actually does outperform the benchmark index, thus contradicting the most common conclusion. His result indicates that the average Swedish mutual fund and the average small cap fund outperforms the selected benchmark. He presents evidence that small cap managers succeeds to make tactical and strategic decisions, thus explaining the good performance. He claims that small cap managers exploits short term information asymmetries and thus earning abnormal profits. He could also prove that a buy-and-hold strategy that replicates the average Swedish mutual fund generated the same return, excess fees and other expenses.

Finally Flam & Vestman (2017) performs a study on 115 different Swedish active mutual funds and 15 passive mutual funds between 1993 - 2013. They observes a positive alpha of 0.9 % on a yearly basis for the active funds, however that was before management fees and other expenses and, adjusted for that they gained a negative alpha of -0.5%. When performing an average equal-weighted portfolio over 36 months they observed a negative alpha, however, they note that individual funds had a substantial variation in their performance, ranging from -15.3 % and 13.6 %. They also highlights that over 50 % of the funds actually have a positive alpha and the greatest fund have a yearly gross alpha of 15.2 %. Their evidence indicate that several fund managers seems to posses true 'skills´ with their investment decisions. As earlier studies have concluded that poor managers that have had a persistence negative alpha continuous to perform poorly. Regarding the index funds, they are able to conclude that passive funds generate a smaller gross profit which can be derived from the fact that they face a higher market risk. Their data indicates that when funds was ranked by their prior performance their returns seems to converge toward the mean return after approximately two years. This fact lead them to contradict their prior conclusion that some fund managers seemed to posses true 'skills´ when picking stocks. They cannot see any persistent management skill that generated abnormal returns. They performs another test to elaborate if the performance of active mutual funds could be derived from good or bad luck. Interestingly good and bad luck could explain most of the persistence in the funds performance. When adjusting for luck only a small fraction of the top percentile seems to posses superior skills. When they adjusted for different life time and different cost the evidence do not support the fact that even these fund managers posse any superior 'skills'.
Their recommendation is, as it often seems to be, to invest in passive funds.

3

Theoretical overview

This section defines and explains the core theoretical concepts which provide the necessary basic knowledge on which the thesis lays its foundation on.

3.1 Modern Portfolio Theory

The fundamental rules of modern portfolio theory (MPT) implies that investors consider future returns as desirable and variance, which is equivalent to risk, as undesirable. The optimal portfolio choice is to maximize the discounted value of future return for a given risk level. The theory implies that an investor should diversify his funds among all securities who provides the highest expected return. Through diversification an investor can benefit from the law of numbers and decrease variance and thus increase the probability that the actual yield will equal the expected yield. According to the theorem there should exist an efficient portfolio per risk level. However, the portfolio with the lowest variance does need to generate the highest expected return. As securities are too intercorrelated it is impossible to eliminate all variance. An investor should therefore try to maximize the expected return a given level of variance. There are circumstances were a investor can increase the expected return by a increase in variance or by a decrease in variance (Markowitz, 1952).

To maximize expected return an investor may implement the E-V rule (expected return - variance of return) as decision rule. This rule ensures an investor to chose a portfolio with the highest expected return at a given risk level. An investor should invest in the portfolio that yields the highest expected risk-adjusted return. The rule also implies that a well diversified portfolio do not need to be superior compared to a less diversified portfolio. A security with a high expected return but with a high variance in return does not need to be the most lucrative investment. A security with a slightly lower expected return but a significant lower variance in return can thus yield a higher return (Markowitz, 1952).

An important implication of the MPT is that there should exist an efficient portfolio per level of variance. However, Markowitz (1952) is vague when it comes to defining the efficient portfolio and although he proves its existence theoretically, its existence in reality is questionable. Nevertheless, Markowitz (1952) notion regarding an efficient portfolio have encourage many investors to try to replicate it in an effort to maximize their profits. A common technique is to use a market index as a complement for the efficient portfolio and thus compare their portfolio against the market index. If, however, a market index would have been a equivalent alternative to an efficient portfolio then index funds tracking the market portfolio would be the most preferable alternative. This intuition question the existence of active mutual funds. Markowitz (1952) does not elaborate on what further implication the MPT has on attitude towards active fund management but according to his rather straight forward investment decision rule, active fund management seems redundant. However, an important remainder is that variance of return does not need to be persistence, in fact it is highly unlikely, given that the variance of return is variable. This variability in variance can be neglected by an index fund and are perhaps easier incorporated by an active fund manager.

3.2 Efficient Market Hypothesis

In his 1970s article, published in The Journal of Finance, Fama defines an efficient market as a market in which prices always fully reflect all the available information. The ideal market is one in which the price of a security always takes into account and includes all the available information. Self-interested market participants will constantly trade the security to fully reflect the available information and eliminate arbitrage opportunities, much like the law of one price. However, the market might not function completely efficiently, which Fama (1970) acknowledges and then specifies three different forms in which the market may be in; weak, semi-strong and strong. In the weak market form the price of a security only reflects historical data of trading volume and price changes, at this form we cannot make arbitrage profits using a technical analysis of past price and volume. In the semi-strong form the price also reflects all of the publicly available information, e.g., company issued news, press releases, announcements, company estimates. Strong-form suggests the price does not only contain all of the publicly available information, but also information which is not public, insider information and "all information" (Fama, 1970).

An implication of Fama's theory of efficient markets is that you cannot, consistently, outperform the market on a risk-adjusted basis since market prices already reflect all the available information, traders contribute to more and more efficient market prices and thus prices can only react to new information, and by definition new information is information that we do not currently have, making it impossible to predict. This theory suggests that active mutual funds do not perform better than passive mutual funds. There is a theory which considers this and states that the stock market prices evolve according to a "random-walk", price changes are random and cannot be predicted, which is consistent with Fama's efficient market hypothesis (Fama, 1970).

3.3 Hypotheses

Ambiguous theoretical evidence leads us to be unable to draw any definitive conclusions, is the market really efficient, and can one really beat it? Markowitz (1952) MPT implies that there exists an efficient market portfolio that maximizes the risk-adjusted return per level of variance. The most commonly used portfolio used to replicate an efficient portfolio is index portfolios, also used as a benchmark portfolio in several aforementioned studies in the literature review. Several earlier studies such as Jensen (1968) and Malkiel (1995) and others find evidence that active funds do not outperform passive index funds, with some exceptions such as presented by Ippolito (1989) and Dahlquist et al. (2000) and Engström (2004) who finds contradicting evidence.

Based upon the available theories and the literature we hypothesize that there is no statistical significant performance difference between active and passive mutual funds. To further investigate this we look at two specific factors, age and size. We look at fund age to see if there exists any difference in fund performance between young and old mutual funds. Karoui & Meier (2010) finds that newly started funds may experience a rising-star period, where young funds see greater returns than old funds in the beginning of their life-cycle. We find little research on this particular subject, and none that use Swedish equity fund data, which is why we hypothesize that there is no statistical significant performance difference between active and passive mutual funds that depend on age. We investigate if there exists a difference in performance depending on the size (total asset value) of different funds. We find some research on this topic, Indro et al. (2019), Chen et al. (2004) and Yan (2008) suggests that increasing fund size erodes performance. We find no studies using Swedish market equity data, which is why we hypothesize that there is no statistical significant performance difference that depend on total asset value.

4

Method

In this section we explain the method that we use to study the performance of our mutual funds. We introduce the Capital Asset Pricing Model, Multi-Factor Models based on CAPM and the performance measures Jensen's alpha, Sharpe Ratio and Treynor Ratio.

4.1 Choice of method and study

To perform a systematic comparison between passive and active fund performance this study has applied a quantitative method followed by comparative elements. The research follows a deductive approach since the hypothesis is based on already tested and established theories. A quantitative approach is suitable when analysing large sample of continuous data (Bryman & Bell, 2013). The regressions were performed in either Excel or in STATA.

4.2 Capital Asset Pricing Model

The Capital Asset Pricing Model (or simply CAPM) was introduced by Sharpe (1964), Lintner (1965), and Mossin (1966) independently. It's a model used for pricing individual portfolios or assets where it takes into account the asset's sensitivity to systematic risk, also known as market risk (β), which is non-diversable. CAPM builds on Markowitz (1952) Modern Portfolio Theory where he establishes a trade-off between expected return and risk. CAPM is essentially a continuation of that concept and the model can be applied to estimate the expected return of a fund in an efficient market. The model implies that the expected return of a market portfolio will be equivalent to a risk premium denominated as expected return excess the risk free rate. The formula for CAPM looks as follows,

$$E[R_i] = r_i = r_f + \beta_i(E[R_M] - r_f) \tag{4.1}$$

where,

$E[R_i]$ =Expected Return of a Security

r_f =Risk free interest rate

β_i =Measure of sensitivity to systematic risk

$E[R_M]$ =Market portfolio expected return

The implication of CAPM is that the expected return of an asset is proportionate to the risk premium on the market. The beta (β) in the model illustrates the assets sensitivity towards the systematic risk, also known as the market risk (Berk & DeMarzo, 2016).

For CAPM to hold it operates under three assumptions (Berk & DeMarzo, 2016):

1. Investors buy and sell securities at competitive market prices.
2. Investors seek to maximize their expected return for a given amount of volatility.
3. Investors hold homogeneous expectations about volatilities, correlations, and expected returns of securities.

The rationale of the CAPM implies that an investor should consider two types of costs when investing. The first is the cost of time, where the risk free rate serves as a compensation for the time value of money in the model. The second cost is the cost of risk where Sharpe (1964) concluded together with Markowitz (1952) that an investor can eliminate risk in an asset through diversification but will inevitably still face systemic market risk (Sharpe, 1964). The expression $\beta(E[R_M]$-$r_f)$ illustrates the risk premium for a portfolio and is equivalent to the demanded return given the level of systematic risk (Sharpe, 1964).

4.2.1 Single-Index Model

We use the Single-Index Model (SIM), which is a CAPM based model, it measures the risk and return of a stock or portfolio (Sharpe, 1964). Each stock performance is in relation to the performance of a market benchmark and the model assumes that only a single macroeconomic factor causes the systematic risk, hence the name Single-Index Model (Sharpe, 1964). It is expressed as follows,

$$r_{p,t} - r_{f,t} = \alpha_p + \beta_p(r_{m,t} - r_{f,t}) + \epsilon_{p,t} \tag{4.2}$$

where,

$r_{p,t}$ =Return on portfolio p at the time t

$r_{f,t}$ =Return on risk-free rate at the time t

β_p =Measure of sensitivity to systematic risk

α_p =Intercept, which is given by Jensen's alpha

$r_{m,t}$ =Return on the benchmark index at the time t

$\epsilon_{p,t}$ =Error term during the period t

In an efficient market, as described by Fama (1970), the expected value of the alpha coefficient is 0, which is why it is a good risk-adjusted performance measurement, it indicates how well the equity has performed after accounting for the risk it has taken.

4.3 Multi-Factor Models

There is critique against CAPM and the Single-Index Model (SIM), recognizing it's limitations specifically that it is too simple, and does not give sufficient explanation of fund behavior, emphasized by both Roll (1977) and Fama & French (1996). To account for this we also use the Multi-Factor Models.

4.3.1 Three-Factor Model

The Fama and French Three-Factor Model (Fama & French, 1993) expands on the SIM by adding size and value factors. The size factor, denominated as Small Minus Big is included so the model captures the fact that larger size, market capitalization, is usually equivalent to a higher profitability. The second factor tries to explain fund performance with regard to the book-to-market equity value. The argument is that firms with low book-to-market value tend to have persistently low profitability and low earning on assets (Fama & French, 1993). The Three-Factor Model is expressed as follows,

$$r_{p,t} - r_{f,t} = \alpha_p + \beta_p(r_{m,t} - r_{f,t}) + \beta_{p,s} SMB_t + \beta_{p,v} HML_t + \epsilon_{p,t} \tag{4.3}$$

where,
$r_{p,t}$ =Return on portfolio p at the time t
$r_{f,t}$ =Return on risk-free rate at the time t
β_p =Measure of sensitivity to systematic risk
α_p =Intercept, which is given by Jensen's alpha
$r_{m,t}$ =Return on the benchmark index at the time t
SMB_t =Difference in return between Small cap portfolio and Large cap portfolio at the time t
$\beta_{p,s}$ =Measure of sensitivity to size factors
HML_t =Difference in return between a portfolio containing value stocks and one consisting of growth stocks at the time t
$\beta_{p,v}$ =Measure of sensitivity to value factors
$\epsilon_{p,t}$ =Error term during the period t

If the $\beta_{p,s}$ coefficient is negative this indicates a heavier weight towards large cap assets, a positive

$\beta_{p,s}$ shows a heavier weight towards small cap assets. If the $\beta_{p,v}$ coefficient is negative this indicates a heavier focus on growth stocks, and if it is positive this means a heavier focus towards value stocks.

4.3.2 Four-Factor Model

The Carhart Four-Factor Model is an extension of the three-factor model which adds a cross-sectional factor to enhance the explanatory interpretation ability from the Three-Factor model. The CAPM was expanded with two new variables to better explain fund performance, some critique arose towards the Fama and French Three-Factor Model and how it neglected the momentum of stock prices. The foundation behind this is that the empirical evidence indicates that stocks which have outperformed past loser past three to twelve months will do so on a continuous basis thus creating a momentum in stock prices(Carhart, 1997). The hypotheses is that investors tend to buy 'winners' and sell 'losers' (Chan et al., 1996). To account for this momentum factor a new variable is added, denominated as the UMD factor which is "up-minus-down", where up indicates a 'winner' and down indicates a 'loser'. The Four-Factor Model is expressed as follows,

$$r_{p,t} - r_{f,t} = \alpha_p + \beta_p(r_{m,t} - r_{f,t}) + \beta_{p,s} SMB_t + \beta_{p,v} HML_t + \beta_{p,umd} UMD_p + \epsilon_{p,t} \quad (4.4)$$

where,
$r_{p,t}$ =Return on portfolio p at the time t
$r_{f,t}$ =Return on risk-free rate at the time t
β_p =Measure of sensitivity to systematic risk
α_p =Intercept, which is given by Jensen's alpha
$r_{m,t}$ =Return on the benchmark index at the time t
$\epsilon_{p,t}$ =Error term during the period t
$\beta_{p,s}$ =Measure of sensitivity to size factors
SMB_t =Difference in return between Small cap portfolio and Large cap portfolio at the time t
HML_t =Difference in return between a portfolio containing value stocks and one consisting of growth stocks at the time t
$\beta_{p,v}$ =Measure of sensitivity to value factors
UMD_p =Momentum factor at time t
β_{pumd} =Measure of sensitivity to momentum factors
$\epsilon_{p,t}$ =Error term during the period t

The β_{pumd} coefficient measures the portfolio's sensitivity to momentum, if it is positive the portfolio has a higher focus on stocks which have performed well in the past 12 months, sometimes referred to as "winners".

4.4 Performance measures

4.4.1 Jensen's alpha

Jensen's alpha (α) was first introduced in 1968 by Micheal C. Jensen in his article *The Performance of Mutual Funds in the Period 1945-1964*. It seeks to illustrate if an asset has under or overperformed the chosen benchmark. A positive alpha indicates that an asset or portfolio has overperformed compared to the benchmark while a negative alpha indicates the opposite (Jensen, 1968). This performance measure is an important parameter for the comparative section of the analysis in this study as Jensen's alpha will be used to compare active and passive portfolio in relation to the benchmark. Jensen's alpha measures the excess return predicted by the CAPM given the aforementioned variables in the CAPM expression (Bodie, 2018). The formula for Jensen's Alpha looks as follows,

$$Jensen's\ alpha = \alpha_p = \bar{r_p} - [\bar{r_f} + \beta_p(\bar{r_M} - \bar{r_f})] \tag{4.5}$$

were,
r_M = The average return from the market
r_p = The average return from a portfolio
r_f = The average risk free rate
β_p = Measure of sensitivity to systematic risk

4.4.2 Treynor Ratio

The Treynor ratio puts the risk-adjusted return in relation to systematic risk. It seeks to illustrate how well the security has performed given the level of systematic risk taken, a high Treynor ratio indicates good performance (Treynor, 1966). It is expressed as follows,

$$T_p = \frac{E(r_p) - E(r_f)}{\beta_p} \tag{4.6}$$

where,
$E(r_p)$ = Return of the portfolio
$E(r_f)$ = Risk-free rate of return
β_p = Measure of sensitivity to systematic risk

4.4.3 Sharpe Ratio

Introduced by William F. Sharpe in 1966, the Sharpe ratio defines the excess return of an investment compared to the total risk it is taking. The Sharpe ratio is an extension of the Treynor ratio and is quite similar. The Sharpe ratio tries to capture the amount of return received per level of risk, here denominated as volatility, hence the standard deviation (σ) in the denominator (Bodie, 2018). It is expressed as follows,

$$S_p = \frac{E(r_p) - E(r_f)}{\sigma_p} \tag{4.7}$$

where,
$E(r_p)$ = Return of the portfolio
$E(r_f)$ = Risk-free rate of return
σ_p = Standard deviation of the portfolio return

The Sharpe ratio measures the excess portfolio return and puts it in relation to the amount of total risk taken. A rational investor would desire a high risk premium and a low risk level, consequentially a higher Sharpe ratio is more desirable as it indicates that the portfolio yields a high return in relation to its risk level (Treynor, 1966). The Sharpe ratio is a suitable performance measure due to its simplicity and ease in comparability between funds.

4.4.4 Returns

We calculate the return of each fund using the price change of the Net Asset Value.

$$r_t = \frac{P_t - P_t{-1}}{P_t{-1}} \tag{4.8}$$

where,
r_t =Return of fund at the time t
P_t =Price of fund at the time t
$P_t{-1}$ =Price of fund at the time t-1

5

Data

This section describes the data collection process and where the data originates from as well as potential problems that may arise.

5.1 Data collection and selection

Collection of data was done in the Bloomberg Terminal. Using the Fund Screening tool < FSRC > in Bloomberg it is possible to enter different selection criteria to select the funds you are interested in. This study examines only mutual equity funds that are available on the Swedish market and have an investment focus on Swedish stocks, at least 50%. Using the < HFA > tool (Historical Fund Analysis) in Bloomberg it is possible to extract historical data for each selected fund. To determine the returns of each fund the Net Asset Value (NAV), also known as the fund price, was collected for each month from 2010-01-01 to 2020-01-01, this is an adjusted price which includes reinvested dividends. We also collected the Total Fund Assets, Fund Manager Stated Fee, and the Self-Chosen Benchmark. Factor loading data was retrieved from AQR [1], to be used in the Multi-Factor Models.

5.1.1 Survivorship bias

According to Ross (1992), survivorship bias may cause a problem if we only include funds that are currently active, the results may be skewed since funds who did not perform well were shut down or acquired (Ross et al., 1992). In the data collection step we collect funds which are both active and inactive, to try to minimize the problem of survivorship bias. Inactive funds are funds who during our time period were acquired by other funds or liquidated. However, looking at the descriptive summary table 6.1 we can see that when inactive funds are excluded, the arithmetic mean of the monthly returns increases, indicating that there may still be some survivorship bias affecting the results. Doing this we have attempted to minimize the problem of survivorship bias but must still recognize the possbility of it affecting the outcome of the study.

[1] https://www.aqr.com/Insights/Datasets/Betting-Against-Beta-Equity-Factors-Monthly

5.2 Selection of market benchmark

Since our data includes reinvested dividends (the mutual funds we select do not pay out dividends but instead reinvests them back into the fund) it is vital to choose an appropriate benchmark which also reflects this to be able to measure their performance. The SIX Return Index (SIXRX) reflects all of the stocks present on the Stockholm Stock Exchange and takes into account the dividends which stockholders receive. We obtain monthly data of the SIXRX return for the selected time period from Fondbolagen [2].

5.3 Selection of risk-free interest rate

As a proxy for the risk-free interest rate we chose to use the Swedish one-month Treasury bill (SE 1M). Treasury bills are used to finance the government's short-term borrowing requirement and are often considered to be non-defaultable, it is common practice to view them as risk-free (Bodie, 2018). The monthly data was obtained from Sveriges Riksbank [3].

[2] https://www.fondbolagen.se/fakta$_{i}ndex/marknadsindex/six-index/sixrx/$

[3] https://www.riksbank.se/en-gb/statistics/search-interest–exchange-rates/

6

Empirical Results

In this section we analyse the descriptive statistics, specifications tests are presented and explained. Eventually we present the results from the introduced Single-Index Model and Multi-Factor Models. We also perform cross-sectional analysis on the age of our mutual funds and total asset value.

6.1 Descriptive statistics

In table 6.1, Descriptive Statistics, we give an overview of our data. Mainly we want to use this overview to help us understand if there exists any underlying problems in our dataset such as, for example, outliers or survivorship bias.

Table 6.1: Descriptive Statistics of Active and Passive Mutual Fund Portfolios

	Active Portfolio	Passive Portfolio	Difference
Average Return (Mean)	0,871%	0,851%	0,0199%
Average Return (exclude inactive)	0,894%	0,869%	0,0249%
Median Return	0,01103	0,01213	0,00111
Max	0,1012	0,1029	0,0016
Min	-0,1040	-0,1030	0,0010
Standard Deviation	0,0429	0,0406	0,00229
Number of funds	52	14	38
No of inactive funds	20	4	16
Per of inactive funds	0,38	0,29	0,10
Total Assets Small funds (mean)	456	293	163
Total Assets Med funds (mean)	1999	1411	588
Total Assets Large funds (mean)	12477	6128	6349
Average age (years)	7,67	7,31	0,36
Average Management fee	1,20	0,32	0,88

This table reports the Descriptive Statistics results from our data, which gives an overview of any potential problems which may exist in our underlying data.

As seen in table 6.1 the average return is slightly higher for the active funds but the difference is relatively small. Interestingly, when excluding the inactive funds the average return for both active and passive funds increase. This indicates that our sample may suffer from survivorship bias, as underperforming funds most likely have been acquired or liquidated. However, looking at the total number of inactive funds, roughly one third of funds were inactive, 38 percent for active and 29 percent for passive. This indicates that survivorship bias may affect both the active and passive portfolio in the same proportion, thus not invalidating our comparative analyse.

In table 6.1 we also illustrate the mean for each size category. The funds have been divided in three different groups by splitting the sample per each 33th percentile. The average fund age is very similar to each other with just a small difference of 0,36 years. Lastly the average fund management fee was calculated, the active portfolio had a considerable higher management fee, which was to be expected since passive funds generally do not charge as much as active funds.

6.2 Outliers

Barnett & Lewis (1984) describes an outlier as "one that appears to deviate markedly from other members of the sample in which it occurs". Outliers may pose a problem, and may influence or skew our results, which is something that is undesirable. Trying to detect outliers, a two sample t-test was performed on the raw portfolio return data. This test shows, in table 6.2, no significant difference between the means of the raw active and passive portfolio returns. Looking at our Descriptive table 6.1 there seems to be no noticeable difference in median, max or min values. Additionally there seems to be no significant difference between the standard deviations of the two portfolios.

Table 6.2: Results from two sample t-test on raw portfolio returns

	PP raw	*AP raw*
Mean	*0,0085*	*0,0087*
Variance	0,0016	0,0016
Observations	119	119
Hypothesized Mean Difference	0	
df	236	
t Stat	-0,0384	
P(T<=t) one-tail	0,4847	
t Critical one-tail	1,6513	
P(T<=t) two-tail	0,9694	
t Critical two-tail	1,9701	
Ha: diff <0	Pr(T <t) = 0.4847	
Ha: diff != 0	Pr(|T| >|t|) = 0.9694	
Ha: diff >0	Pr(T >t) = 0.5153	
Ha: diff >0	Pr(T >t) = 0.5153	

This table shows the results from the t-test on the raw portfolio returns.

6.3 Specifications tests

6.3.1 Heteroscedasticity

When running our regressions we assume constant error variance, homoscedasticity. If homoscedasticity is absent then error variances are not constant and our error terms are heteroscedastic. This will invalidate the statistical tests of significance, the estimated standard errors cannot be used (Stock & Watson, 2014). Detecting heteroscedasticity is done using the White test (White, 1980) and Breusch-Pagan test (Breusch, 1979) in Stata. A high p-value ($p \geq \alpha = 0{,}05$) is not statistically significant and indicates weak evidence against the null hypothesis, in this case that we have constant error variance (homoscedasticity), ergo we do not reject the null hypothesis. We still cannot for certain say that there is no heteroscedasticity, even if we don't reject the null hypothesis. As shown in table 6.3 the White's tests indicates that there may be heteroscedasticity in the Multi-Factor Models (Three and Four-Factor) for the active portfolios, but no signs of heteroscedasticity in the remaining models.

Table 6.3: White's test for Ho: homoscedasticity against Ha: unrestricted heteroscedasticity

	Prob >chi2	
	Active Portfolio	Passive Portfolio
Single-Index Model	0.5593	0.8390
Three-Factor Model	0.0392	0.5859
Four-Factor Model	0.0276	0.6894

This test shows the results from the White's test for heteroscedasticity for both portfolios.

As shown in table 6.4 the Breusch-Pagan tests indicates that there are no signs of heteroscedasticity in any of the models.

Table 6.4: Breusch-Pagan / Cook-Weisberg test for heteroscedasticity
Ho: Constant variance
against Ha: Heteroscedastic variance

	Prob >chi2	
	Active Portfolio	Passive Portfolio
Single-Index Model	0.2042	0.8578
Three-Factor Model	0.0953	0.6339
Four-Factor Model	0.0940	0.6848

This test shows the results from the Breusch-Pagan and Cook-Weisberg test for heteroscedasticity for both portfolios.

6.3.2 Autocorrelation

An important aspect to account for in analysis of time series data is the potential problem of autocorrelation, as values over time tend to be correlated with values from previous time periods. Autocorrelation means that the error (ϵ) terms from a forecast are correlated thus violating the OLS assumption that the error terms should be independent. A consequence of autocorrelation can be that the estimated coefficient may be inefficient because they no longer have minimum variance property and the estimated standard errors may me underestimated (Cortinhas & Black, 2012). To determine if the data suffers from autocorrelation a Breusch-Godfrey test was performed in Stata where the null hypothesis is that there exists no autocorrelation.

A high p-value ($\geq$ alpha = 0,05) is not statistically significant and indicates weak evidence against the null hypothesis, in this case that we have no autocorrelation, ergo we do not reject the null hypothesis of no autocorrelation. As shown in table 6.5 the Breusch-Godfrey test indicates autocorrelation across all of our passive portfolio models.

Table 6.5: Breusch-Godfrey test for Ho: no autocorrelation against Ha: autocorrelation

	Prob >chi2	
	Active Portfolio	Passive Portfolio
Single-Index Model	0.1757	0.0156
Three-Factor Model	0.1155	0.0291
Four-Factor Model	0.1136	0.0362

This test shows the results from the Breusch-Godfrey test for autocorrelation for both portfolios.

To overcome the autocorrelation problem we can use the Newey-West, Heteroscedasticity and Autocorrelation Corrected (HAC), standard errors which is a covariance-variance estimator that accounts for both heteroscedasticity and autocorrelation (Newey & West, 1987). To perform these regressions one simply replaces the command regress with newey, which generates a regression result which is compensated for autocorrelation and heteroscedasticity. Since we find signs of autocorrelation, we use the Newey-West (HAC) standard errors for all of our models.

6.3.3 Multicolliniearity

Aonther problem that can arise when performing regression is the case with multicolliniearity, when two independent variables are highly correlated with each other (Cortinhas & Black, 2012). A scenario with multicolliniearity is mainly a interpretation problem and to test for multicolliniearity one may test the correlation between each independent variable. This was done for each factor for every model and for both the active and passive portfolio. Some degree of correlation between each variable is expected, however, there are only when variables are highly correlated that this may cause problem (Cortinhas & Black, 2012). As a rule of thumb we determined ($\geq$ r = 0,8) as a critical value and all coefficient equal or exceeding that was determined to suffer from mutlicolliniearity. As shown in table 6.6 and 6.7 there are no signs of multicolliniearity except between the benchmark and respective portfolio which was expected.

Table 6.6: Results for test for multicollinearity, active portfolio

r ≥ 0,8					
	erap	ersixrx	smb	hml	umd
erap	1				
ersixrx	0.9871	1			
smb	-0.1927	-0.1647	1		
hml	0.1390	0.1471	-0.0634	1	
umd	-0.1092	-0.1074	-0.0634	-0.1454	1

This table shows the results from the test for multicollinearity between the variables in the active portfolio.

Table 6.7: Results for test for multicollinearity, passive portfolio

r ≥ 0,8					
	erap	ersixrx	smb	hml	umd
erpp	1				
ersixrx	-0.1647	1			
smb	0.1471	-0.0634	1		
hml	-0.1074	0.0990	-0.1454	1	
umd	0.9927	-0.1734	0.1337	-0.1154	1

This table shows the results from the test for multicollinearity between the variables in the passive portfolio.

6.4 Regression results

6.4.1 Single-Index Model

The Single-Index Model in table 6.8 show that we find no significant difference in alphas between the active and passive portfolios. We also find significance for negative alphas for both types of mutual funds, both active and passive funds seems to underperform the benchmarket. This supports our first hypothesis and Jensen (1968) study where he hypothesize that there is no significant difference between the alphas and that they are close to zero. We observe that the passive portfolio have a higher market beta, thus they are more volatile towards the market and have a higher systematic risk. The difference is however only significant at 10 percent but nevertheless should not be rejected. This result is mostly inline with previous research such as Henriksson (1984) who also observed a higher systematic risk for passive funds. This result perhaps may seems preferable for active funds but as there was no significant difference in risk-adjusted performance no further conclusions can be made.

Table 6.8: Results from Single-Index Model

	Active Portfolio	Passive Portfolio	Difference Portfolio
α	-0,20%***	-0,23%***	0,25%
	(,0006)	(,0004)	(0,0016)
β	1,020***	1,025***	0,062*
	(,0154)	(,0121)	(0,028)
N	119	119	119
R	0,974	0,985	0,051

This table shows the results from the Single-Index Model, equation 4.2.
**** Significant at the 1%-level. ** Significant at the 5%-level.*
** Significant at the 10%-level.*

As we can see in table 6.9 there is a significant difference in the Treynor Ratios, equation 4.6, between the active and passive portfolios in the Single-Index Model, the passive funds perform better in relation to the amount of systematic risk they are taking. Considering the result from the single index model it is interesting that passive funds seems to outperform active despite that they had a higher systematic risk. Combining the result from the single index model and the Treynor ratio the result implies that passive funds outperform active funds per level of systematic risk taken.

Table 6.9: Single-Index Model - Treynor Ratios

	Treynor Active	*Treynor Passive*
Mean	0,004932965	0,006527036
Variance	2,2657E-05	2,38413E-06
Observations	52	14
Hypothesized Mean Difference	0	
df	62	
t Stat	-2,047712027	
P(T<=t) one-tail	0,02241521	
t Critical one-tail	1,669804163	
P(T<=t) two-tail	0,044830419	
t Critical two-tail	1,998971517	

This table shows a test of significance between the Treynor ratios, equation 4.6, for the active and passive portfolios in the Single-Index Model

6.4.2 Three-Factor Model

Table 6.10: Results from Fama-French Three factor model

	Active Portfolio	Passive Portfolio	Difference Portfolio
α	-0,21%***	-0,23%***	0,26%**
	(,0005)	(,0004)	(,0011)
β	1,016***	1,025***	0,034
	(,0174)	(,0133)	(,0205)
β-smb	-0,047**	-0,016	-0,237***
	(,0195)	(,0143)	(,0488)
β-hml	-0,014	-0,024	0,011
	(,0322)	(,0235)	(,036)
N	119	119	119
R	0,975	0,986	0,452

*This table shows the results from the Fama French Three-Factor Model, equation 4.3. *** Significant at the 1%-level. ** Significant at the 5%-level. * Significant at the 10%-level.*

For the Fama French Three-Factor Model the size coefficient (β-smb) is significant for our active portfolio, this means that the active portfolio weights itself toward large cap stocks, and there is a statistically significant difference between active and passive portfolio. This is an interesting result, our funds use a blend of small, mid and large cap and this shows that the active funds tend to weight itself favorably to large cap stocks. We do not however find significance for the passive portfolio and cannot say how it weights itself. In this model we also find significance for difference in alphas between the portfolios, where active funds tend to perform better than passive funds. As we could not draw any conclusion about the difference in risk-adjusted performance from the single index model we here find a significant difference at 5 percent in favor of active funds. Both fund forms seems to still underperform the benchmarket, but active less so. This result is in line with what previous research conducted on the Swedish market have observed. Both Engström (2004) and Dahlquist et al. (2000) observed that active funds outperformed passive counterparts. Contrary to what we observed in the single index model the difference in systematic risk is not significant. However, seen separately the passive funds seems to have a higher systematic risk than active funds. Both coefficient are highly significant at 1 percent, however the difference is not significant. No significance for the value coefficients (β-hml), ergo we cannot say anything about them.

Table 6.11: Three-Factor Model - Treynor Ratios

	Treynor Active	*Treynor Passive*
Mean	0,004928538	0,006520455
Variance	2,30768E-05	2,38228E-06
Observations	52	14
Hypothesized Mean Difference	0	
df	62	
t Stat	-2,031676744	
P(T<=t) one-tail	0,023238886	
t Critical one-tail	1,669804163	
P(T<=t) two-tail	0,046477771	
t Critical two-tail	1,998971517	

This table shows a test of significance between the Treynor ratios, equation 4.6, for the active and passive portfolios in the Three-Factor Model

As we can see in table 6.11 there is a significant difference in the Treynor Ratios, equation 4.6, between the active and passive portfolios in the Three-Factor Model, the passive funds perform better in relation to the amount of systematic risk they are taking. This result is very similar to that generated by the single index model. The result from the Three-factor model is thus ambiguous where the regression speaks in favor of active funds and the Treynor ratio speaks in favor for passive funds.

6.4.3 Four-Factor Model

Table 6.12: Results from Carhart Four-Factor Model

	Active Portfolio	Passive Portfolio	Difference Portfolio
α	-0,20%***	-0,21%***	0,19%*
	(,0008)	(,0005)	(,0011)
β	1,016***	1,024***	0,036*
	(,0169)	(,0133)	(,0195)
β-smb	-0,046**	-0,015	-0,241***
	(,0198)	(,0145)	(,0473)
β-hml	-0,014	-0,026	0,019
	(,035)	(,023)	(,0352)
β-umd	-0,002	-0,015	0,045**
	(,0339)	(,0171)	(,018)
N	199	199	199
R	0,974	0,985	0,462

*This table shows the results from the Carhart Four-Factor Model, equation 4.4. *** Significant at the 1%-level. ** Significant at the 5%-level. * Significant at the 10%-level.*

In the Carhart Four-Factor Model we see the same results as the Three-Factor Model regarding the

size coefficient (β-smb), the active portfolio weights itself toward large cap stocks, no significance for the passive portfolio and there is a significant difference between active and passive portfolio.
There is no significance for the value (β-hml) or momentum (β-umd) coefficients, however the difference between the momentum coefficient between active and passive is significant which means that there is a significant difference in how sensitive the portfolios are to momentum factors. As the difference seems to be positive this implies that active funds tend to buy 'winners' and sell 'losers' in a larger extent. This seems reasonable as they are managed actively and can respond more readily to momentum factors.

Looking at the alpha values both are negative and highly significant. Most notable is that we observe a significant and positive difference which implies that active funds outperform passive funds. The difference is only significant at 10 percent but nevertheless significant. We also observe a similar pattern as seen in the Single-Index Model and in the Three-Factor Model where passive funds seem to possess a higher systematic risk with a significant difference at 10 percent.

Table 6.13: Four-Factor Model - Treynor Ratios

	Treynor Active	*Treynor Passive*
Mean	0,00490387	0,006565694
Variance	2,3238E-05	2,45905E-06
Observations	52	14
Hypothesized Mean Difference	0	
df	62	
t Stat	-2,106222551	
P(T⩽t) one-tail	0,019620098	
t Critical one-tail	1,669804163	
P(T⩽t) two-tail	0,039240196	
t Critical two-tail	1,998971517	

This table shows a test of significance between the Treynor ratios, equation 4.6, for the active and passive portfolios in the Four-Factor Model

As we can see in table 6.13 there is a significant difference in the Treynor Ratios, equation 4.6, between the active and passive portfolios in the Four-Factor Model, the passive funds perform better in relation to the amount of systematic risk they are taking. We observed a higher systematic risk for passive funds in the Carhart four-factor model but nevertheless the passive funds are still able to outperform the active funds in respect their respective systematic risk. This once again illustrate the how ambiguous the result may be.

6.4.4 Individual Jensen's Alpha

Table 6.14: Jensen's Alpha for Individual Mutual Funds

	Positive	Significance Level 1%	5%	10%	Negative	Significance Level 1%	5%	10%
Panel A: Single-Index Model								
Active Portfolio	7	0	1	1	45	11	10	7
Passive Portfolio	1	0	0	0	13	5	5	2
Panel B: Fama-French Three-Factor Model								
Active Portfolio	10	0	2	0	42	9	4	3
Passive Portfolio	1	0	0	0	13	5	4	1
Panel C: Carhart Four-Factor Model								
Active Portfolio	10	0	0	1	42	5	11	1
Passive Portfolio	2	0	0	0	12	2	4	2

This table shows the individual Jensen's Alpha for the active and passive portfolios.

When performing the Single-Index Model only two active funds turned our significantly positive while 28 funds turned out negative. 28 of active funds were negative which was expected because we observed a significant alpha value in the regression model. Notable is that 22 alpha values were insignificant which represent roughly 42 percent of all the active funds. Regarding the passive funds none were significant positive and a total of 12 funds were significant negative. Contrary to the active funds 12 of 14 passive funds turned out significant, 85 percent, which is considerable higher than for the active funds. The fact that such a large proportion of the active funds turned out insignificant may invalidate the comparative capability.

As for the Three-Factor Model only 2 active funds turned out positive. Here only 13 funds turned out to be significant negative. This is a even smaller proportion of funds being significant than in the single index model. In fact 65 percent of all the funds were insignificant, creating additional suspicion that interpretation capability may be invalidated. What is notable is that only 10 of 14 (71 percent) passive funds turned out to be significant compared to 85 percent in the Single-Index Model.

A similar pattern is observed when performing individual alphas with the Carhart Four-Factor Model. Here only 1 active fund was positive active and 17 were negative and significant. Again 65 percent of the funds turned out insignificant. Interestingly, no passive funds were positive and active and only 8 of 14 (57 percent) of the passive funds were significant.

In general, when looking at the comprehensive picture, no individual index fund had a positive and significant alpha value while at least one active significant fund was positive. The results from the individual Jensen's alpha implies that there is a higher probability to pick a active fund with a positive alpha. However, if this stems from a bias in our data or from a actuality is hard to determine. The fact that a so large proportion of the individual alphas were insignificant, both for active and passive funds, may invalidate the interpretation capability.

6.4.5 Sharpe Ratio

Table 6.15: Significance Tests for Sharpe Ratios

	Sharpe Active	*Sharpe Passive*
Mean	0,1214	0,1550
SD	0,1031	0,0589
Variance	0,0106	0,0035
Observations	53	14
Pooled Variance	0,009192934	
df	65	
t Stat	-1,1657	
P(T<=t) one-tail	0,1240	
t Critical one-tail	1,6686	
P(T<=t) two-tail	0,2480	
t Critical two-tail	1,9971	

This table shows the significance test for Sharpe Ratios between the active and passive portfolios.

Looking at the table 6.15 we find no significant difference in Sharpe Ratio between the passive and active portfolios.

6.5 Cross-Sectional Analysis

To diversify our study and get a different perspective on our funds, the funds are divided into certain groups. We divide them into three groups depending on their Total Assets; Small, Medium and Large. An analysis of the difference between old and young funds is also performed.

6.5.1 Total Assets Portfolio Analysis

For this analysis the tables are available in the Appenix A section.

Table A.1 reports the results for the SIM Model for small sized portfolios. We find no significance for the alpha of the small active portfolio, but find significance for negative alpha for the passive small portfolio. We find significance for difference between the two small portfolios. Table A.2 reports the results for the SIM Model for medium sized portfolios. We find significance for negative alphas for both portfolios, where passive portfolio performs better than the active one. Table A.3 reports the results for the SIM Model for large sized portfolios, we find significance for negative alphas, and for difference between the portfolios, where the active portfolio performs better than the passive portfolio.

Table A.4 reports the results for the Three-Factor Model for small sized portfolios, we find significance for negative passive portfolios alphas and for difference between the two portfolios. We also find significance for negative β-smb coefficient, which indicates weight towards large cap stocks. Table A.5 reports the results for the Three-Factor Model for medium sized portfolios, we find significance for negative alphas and difference between the portfolios, where the passive portfolio performs better. Only weak significance for negative β-smb coefficient. Table A.9 reports the results for the Three-Factor Model for large sized portfolios, we find significance for negative alphas for both portfolios and difference between the portfolio alphas, where the active performs better than the passive.

Table A.7 reports the results for the Four-Factor Model for small sized portfolios, we find significance for negative passive portfolio alpha and difference between the alphas. Table A.8 reports the results for the Four-Factor Model for medium sized portfolios, we find significance for negative alphas and difference between them, where passive performs better. Table A.6 reports the results for the Four-Factor Model for large sized portfolios, we find significance for negative alphas and difference between them, where active performs better.

Across the board, looking at the active portfolio for all different models, we find that big active portfolios perform better than medium active portfolios. Large active portfolios also tend to outperform the large passive portfolios. However we find no significance for the alphas of small portfolios, for any of the models, which makes us unable to draw any conclusions about them. For passive funds however, we find the opposite to be true, small passive portfolios perform better than medium and large passive portfolios throughout all of our models.

Total asset value have seemingly a significant affect on fund performance both active and passive equity funds. Intuitively it seems reasonably that bigger funds tend to outperform smaller funds since good performance attracts capital. Logically, funds that have a performed well in the past have attracted and build up a larger proportion of capital. This is interestingly contradicting what Dahlquist et al. (2000) previously observed on the Swedish equity fund market.

6.5.2 Age-Based Analysis, Old and Young Portfolios

Table 6.16: Single-Index Model Results for Age-Based Portfolio Analysis

	Young Active	Young Passive	Young Diff	Old Active	Old Passive	Old Diff
α	-0,23%***	-0,22%***	0,96%***	-0,18%***	-0,23%***	0,28%*
	(,0008)	(,0006)	(,0015)	(,0006)	(,0004)	(,0015)
β	0,95***	1,227***	0,054*	1,034***	1,022***	0,049*
	(,0185)	(,0176)	(,031)	(,0159)	(,014)	(,0249)
N	119	119	119	119	119	119
R	0,950	0,981	0,025	0,974	0,980	0,031

*This table shows the results from the Single-Index Model, equation 4.2, for the age-based cross-sectional analysis. *** Significant at the 1%-level. ** Significant at the 5%-level. * Significant at the 10%-level.*

As we can see in table 6.16, there is a significant difference in the alphas between the young portfolios, which differs from our result from the Single-Index Model on the aggregate level (when comparing all funds in a portfolio). This shows that young active funds tend to do worse compared to young passive funds. We only find significance at the 10% level for difference between the old portfolios, but this result shows that the old active portfolio tends does better than the passive portfolio, possibly indicating some survivorship bias.

Table 6.17: Three-Factor Model Results for Age-Based Portfolio Analysis

	Young Active	Young Passive	Young Diff	Old Active	Old Passive	Old Diff
α	-0,23%***	-0,22%***	0,95%***	-0,19%***	-0,24%***	0,28%***
	(,0007)	(,0006)	(,0013)	(,0006)	(,0004)	(,001)
β	0,938***	1,233***	0,046	1,033***	1,023***	0,021
	(,018)	(,0203)	(,0331)	(,0174)	(,0148)	(,0185)
β-smb	-0,109***	0,044**	-0,117*	-0,028	-0,027*	-0,228***
	(,0233)	(,0207)	(,0647)	(,0214)	(,0161)	(,0469)
β-hml	-0,008	-0,013	-0,069	-0,026	-0,042	0,017
	(,0407)	(,0364)	(,0568)	(,0315)	(,0259)	(,0357)
N	119	119	119	119	119	119
R	0,955	0,981	0,098	0,974	0,981	0,433

*This table shows the results from the Fama French Three-Factor Model, equation 4.3, for the age-based cross-sectional analysis. *** Significant at the 1%-level. ** Significant at the 5%-level. * Significant at the 10%-level.*

We find significant difference between both the young and old alphas. The difference between the size coefficient (β-smb) is significant for the old portfolios, and only weakly significant for the young portfolios.

Table 6.18: Four-Factor Model Results for Age-Based Portfolio Analysis

	Young Active	Young Passive	Young Diff	Old Active	Old Passive	Old Diff
α	-0,23%**	-0,18%***	0,81%***	-0,18%**	-0,22%***	0,23%*
	(,001)	(,0007)	(,0013)	(,0008)	(,0006)	(,001)
β	0,938***	1,232***	0,051	1,033***	1,022***	0,023
	(,0175)	(,0206)	(,0313)	(,0171)	(,0149)	(,0179)
β-smb	-0,109***	0,047**	-0,125**	-0,028	-0,026	-0,231***
	(,0239)	(,0202)	(,0604)	(,0215)	(,0164)	(,0456)
β-hml	-0,008	-0,017	-0,054	-0,027	-0,043*	0,022
	(,0448)	(,0359)	(,0534)	(,0338)	(,0256)	(,0346)
β-umd	-0,001	-0,026	0,095**	-0,005	-0,011	0,036*
	(,0448)	(,0225)	(,0379)	(,0311)	(,0195)	(,0193)
N	199	199	199	199	199	199
R	0,955	0,981	0,139	0,974	0,981	0,438

*This table shows the results from the Carhart Four-Factor Model, equation 4.4, for the age-based cross-sectional analysis. *** Significant at the 1%-level. ** Significant at the 5%-level. * Significant at the 10%-level.*

We find significant difference between the young and only weakly significant difference for the old alphas. There is significant difference in the size coefficient (β-smb) for both the young and old portfolios. There is also significant difference for the value coefficient (β-hml), semi-strong for young portfolios and weak for old portfolios.

7

Conclusion

We started out our research by wanting to gain a deeper understanding of the performance difference between actively and passively managed equity funds. The research already conducted on the area, although plentiful, is ambiguous and most often use US equity fund data. To compare the two groups we use both simple models, the Single-Index Model but also more complex models like the Multi Factor Models. We also look at performance measures like the Treynor Ratio and the Sharpe Ratio.

We find significance for higher alphas for the old active portfolio, one intuitive reason for this may be the previously mentioned potential survivorship bias, where active funds who do not perform well are liquidated or acquired, due to this older active funds are more likely to see better performance.

When looking at the individual Jensen's alphas, there's a higher probability that a passive fund has a negative alpha compared to the active funds. However, the result from this may not be significant due to the high percentage of insignificant alphas.

We find that large active portfolios perform better than large passive portfolios as well as medium active portfolios. This is in line with what McGuiga (2006) observed on the US market as he also saw that larger funds outperformed smaller funds. Conclusively, for active portfolios, bigger is actually better and we find no evidence of fund size eroding performance. A result that contradicts what Indro et al. (2019), Chen et al. (2004) and Yan (2008) observed. Interesting to point out is that we find significance for difference in how active and passive mutual equity funds weight themselves towards the market. Illustrated by the SMB factor in the Three-factor model and in Carhart Four-factor model. In our case active funds tend to weight themselves toward large cap funds.

Interesting enough we find no significance for that the active or passive mutual funds focus more or less on value stocks, one could hypothesize that active funds focus more on growth stocks, while passive funds are more neutral, but we find no significance for this or for difference between them. Also interesting is that we find no significance that the active or passive mutual funds invest more or less in winners or losers, intuitively passive funds should be neutral and active funds potentially pick winners or losers. We cannot say how the active and passive specifically place themselves, only that there is significance for difference between them. Conclusively we find significance for negative alphas for both active and passive mutual equity funds, meaning that they do not outperform the benchmark. The results vary depending on which model used to determine the risk-adjusted return and the results are fairly ambiguous. In general we observe that passive mutual equity funds possess higher systematic risk. In both the Three-factor model and in Carhart Four-Factor Model we observe a significant difference between the alphas and can determine that active funds have a higher risk-adjusted return. This is most interesting because it is in line with what both Engström (2004) and Dahlquist et al. (2000) also observed when analysing Swedish mutual funds. Passive funds do however seem to generate better return for the level of systematic risk taken, as shown by the higher Treynor Ratios. Conclusively we find different results depending on the model and performance measure used, and we cannot for certain say that active is better than passive or vice versa.

8

Future research

Our funds invest in a blend of small, mid and large cap funds. What might be interesting is looking at only, for example, funds who invest primarily in a certain cap, to determine if this has any affect on the difference between passive and active mutual fund performance. Small cap assets generally perform better over a long investment period. One can hypothesize that active funds who invest in small cap assets perform better than passive mutual funds, providing the investment period is long-term.

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A

Appendix

Table A.1: Total Fund Assets Portfolio Results, SIM Small

	Small Active Portfolio	Small Passive Portfolio	Small Difference
α	-0,03%	-0,16%***	0,70%***
	(,0009)	(,0004)	(,0018)
β	0,985***	1,004***	0,065**
	(,0212)	(,0104)	(,0315)
N	119	119	119
R	0,934	0,986	0,035

*This table shows the results from the Single-Index Model, equation 4.2, for the total fund assets analysis for the Small Portfolios. *** Significant at the 1%-level. ** Significant at the 5%-level. * Significant at the 10%-level.*

Table A.2: Total Fund Assets Portfolio Results, SIM Medium

	Med Active Portfolio	Med Passive Portfolio	Med Difference
α	-0,30%***	-0,24%***	0,35%**
	(,0006)	(,0004)	(,0014)
β	1,032***	1,020***	0,045*
	(,0193)	(,0115)	(,0246)
N	119	119	119
R	0,972	0,982	0,029

*This table shows the results from the Single-Index Model, equation 4.2, for the total fund assets analysis for the Medium Portfolios. *** Significant at the 1%-level. ** Significant at the 5%-level. * Significant at the 10%-level.*

Table A.3: Total Fund Assets Portfolio Results, SIM Large

	Large Active Portfolio	Large Passive Portfolio	Difference Portfolio
α	-0,19%***	-0,23%***	0,24%*
	(,00057)	(,0005)	(,0015)
β	1,032***	1,037***	0,056**
	(,017)	(,0172)	(,025)
N	119	119	119
R	0,972	0,978	0,046

This table shows the results from the Single-Index Model, equation 4.2, for the total fund assets analysis for the Large Portfolios.
*** Significant at the 1%-level. ** Significant at the 5%-level.*
** Significant at the 10%-level.*

Table A.4: Total Fund Assets Portfolio Results, TFM Small

	Small Active Portfolio	Small Passive Portfolio	Difference Portfolio
α	-0,03%	-0,15%***	0,69%***
	(,0008)	(,0004)	(,0012)
β	0,975***	1,002***	0,031
	(,0218)	(,0106)	(,0262)
β-smb	-0,092***	-0,008	-0,307***
	(,0302)	(,0154)	(,0532)
β-hml	-0,008	0,014	0,019
	(,0423)	(,0196)	(,0451)
N	119	119	119
R	0,936	0,986	0,444

This table shows the results from the Fama French Three-Factor Model, equation 4.3, for the total fund assets analysis for the Small Portfolios.
*** Significant at the 1%-level. ** Significant at the 5%-level.*
** Significant at the 10%-level.*

Table A.5: Total Fund Assets Portfolio Results, TFM Medium

	Med Active Portfolio	Med Passive Portfolio	Difference Portfolio
α	-0,30%***	-0,25%***	0,35%***
	(,0006)	(,0004)	(,001)
β	1,027***	1,020***	0,022
	(,0215)	(,0125)	(,0184)
β-smb	-0,047*	-0,021	-0,206***
	(,0241)	(,0166)	(,0454)
β-hml	-0,009	-0,023	0,000
	(,0346)	(,0242)	(,0367)
N	119	119	119
R	0,972	0,982	0,385

This table shows the results from the Fama French Three-Factor Model, equation 4.3, for the total fund assets analysis for the Medium Portfolios.
*** Significant at the 1%-level. ** Significant at the 5%-level.*
** Significant at the 10%-level.*

Table A.6: Total Fund Assets Portfolio Results, TFM Large

	Large Active Portfolio	Large Passive Portfolio	Difference Portfolio
α	-0,19%***	-0,23%***	0,25%**
	(,0006)	(,0005)	(,001)
β	1,033***	1,039***	0,030
	(,0185)	(,01882)	(,0187)
β-smb	-0,016	-0,009	-0,215***
	(,0204)	(,0157)	(,0499)
β-hml	-0,031	-0,034	0,017
	(,031)	(,0294)	(,0335)
N	119	119	119
R	0,972	0,978	0,412

This table shows the results from the Fama French Three-Factor Model, equation 4.3, for the total fund assets analysis for the Large Portfolios.
*** Significant at the 1%-level. ** Significant at the 5%-level.*
** Significant at the 10%-level.*

Table A.7: Total Fund Assets Portfolio Results, FFM Small

	Small Active Portfolio	Small Passive Portfolio	Small Difference
α	-0,11%	-0,11%***	0,58%***
	(,0011)	(,0004)	(,0011)
β	0,978***	1,0***	0,035
	(,0204)	(,0101)	(,0245)
β-smb	-0,096***	-0,006	-0,312***
	(,0198)	(,0152)	(,0502)
β-hml	0,000	0,009	0,030
	(,0474)	(,0199)	(,0443)
β-umd	0,054	-0,029*	0,076***
	(,0486)	(,0161)	(,0272)
N	199	199	199
R	0,937	0,987	0,467

This table shows the results from the Carhart Four-Factor Model, equation 4.4, for the total fund assets analysis for the Small Portfolios.
*** Significant at the 1%-level. ** Significant at the 5%-level.*
** Significant at the 10%-level.*

Table A.8: Total Fund Assets Portfolio Results, FFM Medium

	Med Active Portfolio	Med Passive Portfolio	Difference Portfolio
α	-0,27%***	-0,23%***	0,31%***
	(,0008)	(,0005)	(,001)
β	1,026***	1,019***	0,036
	(,0216)	(,0125)	(,0195)
β-smb	-0,046*	-0,020	-0,208***
	(,02422)	(,017)	(,0444)
β-hml	-0,013	-0,025	0,005
	(,0360)	(,0236)	(,0364)
β-umd	-0,024	-0,014	0,030
	(,0343)	(,0182)	(,0186)
N	199	199	199
R	0,972	0,982	0,388

This table shows the results from the Carhart Four-Factor Model, equation 4.4, for the total fund assets analysis for the Medium Portfolios.
*** Significant at the 1%-level. ** Significant at the 5%-level.*
** Significant at the 10%-level.*

Table A.9: Total Fund Assets Portfolio Results, FFM Large

	Large Active Portfolio	Large Passive Portfolio	Difference Portfolio
α	-0,18%**	-0,22%***	0,21%**
	(,0008)	(,0006)	(,001)
β	1,032***	1,038***	0,032*
	(,0179)	(,0187)	(,0183)
β-smb	-0,016	-0,008	-0,218***
	(,0205)	(,016)	(,0492)
β-hml	-0,033	-0,035	0,022
	(,033)	(,0297)	(,0323)
β-umd	-0,011	-0,010	0,028
	(,0287)	(,0221)	(,0243)
N	199	199	199
R	0,972	0,977	0,413

This table shows the results from the Carhart Four-Factor Model, equation 4.4, for the total fund assets analysis for the Large Portfolios.
*** Significant at the 1%-level. ** Significant at the 5%-level.*
** Significant at the 10%-level.*