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Active Fund Performance in the Swedish Equity Market

A comparison of actively managed funds and passively managed index funds

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AUTHOR: Johan Andersson & Simon Eliasson

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Authors: Andersson, Johan & Eliasson, Simon

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Abstract

In the seemingly perpetual discussion about the underperformance of actively managed funds on a reward-to-volatility basis we are looking to answer the question: does passive funds outperform active funds in the Swedish market? With a sample period of ten years from January 2010 to December 2019 and a total of 40 funds including a U.S. sample set for reference, we provide research for an underexplored market. The use of previous research in fund investment is included to gain an insight into the difficulties of tracking and evaluating fund performance. To test our three hypotheses all funds are regressed using both the CAPM and Fama-French 3-Factor model in combination with Sharpe Ratios and an unpaired sample test. Fund alphas were found to be in accordance with the efficient market hypothesis, but we do not reject a higher mean of Sharpe Ratios for passive funds in our sample when accounting for fees. Equality between the two markets in our sample can neither be rejected.

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1. Introduction

Actively managed mutual funds have long been known to underperform on a risk adjusted basis compared to indices (Gruber, 1996; Frino and Gallagher, 2001; Bhootra, Drezner, Schwarz and Stohs, 2015). With ever increasing competition, declining expenses, and the wide availability of information the question whether actively managed funds are a valid option for risk-averse investors is still debated.

Gittelsohn (2019) described the end of an era for actively managed funds as passive equity funds finally surpass active equity funds in market capitalization. While keeping both the value of the fund industry and previous empirical research in mind it is also important to consider the ethics regarding actively managed funds. Are ill informed investors simply coerced by brokers into investing in less profitable funds or are there other explanations for these investors seemingly irrational decisions?

The performance of active funds has been extensively researched and we will contribute to the research by applying theories in fund segmentation, agency conflict and recent discoveries in tracking errors to determine the competitiveness of actively managed mutual funds. The purpose of our investigation will be to determine whether the average investors in the Nordic markets should focus their capital on active or passive mutual funds. We will also include data from the U.S. equity market to provide comparative results on previous research to help determine the significance of our results as most prior studies have used the S&P 500 as a benchmark index.

The following chapter contains a literature review that aims to explain not only how fund performance can be measured on a risk adjusted basis but also theories of tracking errors for historic data. The chapter Data gives a brief overlook of our sample. Data is followed by a presentation of methods where our data is adjusted and introduced to appropriate models to answer the question: do passive funds outperform active funds in the Swedish market?

We then present our results. Both the Capital Asset Pricing Model (CAPM) and Fama-French 3-Factor model was applied but as most fund alphas where insignificant the test for mean alphas between our active and passive sample set was disregarded. We do however, not reject the test of mean Sharpe Ratio between our sample sets and can therefore say, with a confidence level of 95 percent, that the passive fund sample outperforms the active funds sample on a risk-to-volatility basis. In the last part of Results, we present a cross-country comparison between our two markets, Sweden, and the U.S. By testing the equality of Sharpe

Ratio means between the two markets we find no evidence of unequal means between the countries. Furthermore, the equality of means between active funds in each market is rejected while funds with a passive strategy display equal means. Finally, the paper ends with a discussion of our findings and suggestions for future research.

2. Theory

Funds can be divided into two major categories, passive funds, and active funds. While the strategy and goals of funds in each category vary greatly, there are distinct characteristics which helps us define a funds as either passive or active. A passive fund adopts a passive management strategy where the funds is trying to track and replicate an underlying benchmark index or portfolio (Sharpe, 1991). Most passive funds are so called index funds aiming to replicate an index and can offer good diversification while keeping fees low due to low turnover. Active funds instead, try to exceed market returns with active management and differing portfolio management strategy to make specific investments to meet a target return or outperform a benchmark index.

The first problem one faces when trying to measure the performance of any mutual fund is defining, or rather identifying an appropriate market for comparison. Market indices have been around for decades with equity indices such as the S&P 500 trying to represent the overall U.S. stock market. For investors seeking market returns without having to construct their own portfolio, passive index funds can provide a well-diversified portfolio while minimizing managerial costs. Index funds furthermore grants investors the ability to evaluate the performance of actively managed portfolios without some of the inherent tracking errors found when comparing directly to indices (Frino and Gallagher, 2001).

Index funds have traditionally had securities weighted based on their market capitalization, as done by more modern indices such as the S&P 500. This form of traditional index funds (TIFs) have often proved the efficient market hypothesis correct as TIFs have, in multiple different periods and studies, beaten 87 percent of their actively managed counterparts (Saporito 2014). Earlier research by Sharpe (1991) and Gruber (1996) also questions the performance of actively managed funds compared to their TIF counterpart. While the comparison of active and passive management is interesting on its own, there is a fierce ongoing debate over the superior form of index funds.

Based on the work of Chang, Krueger and Thomas (2015) who investigated the performance of fundamental index funds (FIFs) versus TIFs concluded that there were few significant

differences between the two index formation techniques. There is still validity to the claims that the fundamental weighting techniques could outperform more traditional methods. Hackel, Livnat and Rai (2000) found abnormal returns when basing their investment strategy on accruals and free cash flow, supporting the claims that the use of estimators for a firm's intrinsic value should lead to higher yields for FIFs with a similar methodology. In more recent times Amenc (2012) disputes the claims made by Arnott (2011) and Chow, Hsu, Kalesnik and Little (2011) who implies that the outperformance in alternative weighting techniques is largely due to the exposure to value and size factors. Amenc accused Arnott, Chow, Hsu, Kalesnik and Little of "Creating confusion by discussing pseudo issues" (Amenc, 2012, p.3). While the debate over alternative index construction methods is nowhere near being settled, Amenc (2012) stresses the importance of comparative analysis.

Returning to Chang, Krueger and Thomas (2015) FIFs were found to have higher returns especially during periods of strong market advancements. The Sharpe Ratios, however, were similar between FIFs and TIFs as the higher returns found in FIFs could be explained by higher risk. With strong supporters and opponents of a fundamental weighting methodology in index funds recent research does not find the advantages of FIFs statistically significant. For our research both FIFs and TIFs should be seen as justified measures of actively managed fund performance.

There are two types of passive index funds. Before looking at the historical performance of actively managed funds we also need to understand key characteristics of both active funds and the investors they attract. These different characteristics could be explained by heterogeneity in the mutual fund market which often is excluded in early research (see Carhart 1997, Frino and Gallagher 2001).

While trying to explain the puzzling growth of actively managed mutual funds in the 1990's, Gruber (1996) was one of the first to question the implicit homogeneity in the mutual fund market. In his article Gruber proposed the theory of two different types of investors:

1. The disadvantaged clientele – represented by investors facing restrictions in underperforming funds such as pension funds with little or, at worst, no understanding and interest in the assets they are holding. Also influenced by brokers and advertising which in turn directs their money.
2. The sophisticated clientele – a group of investors that can recognizer and capitalize on predictors of future performance.

The theory of two types of investors or clients help rationalize the investment into actively managed funds as large portion of investors and flow of money is attributed by disadvantaged investors. Guercio and Reuter (2014) provided more extensive research by segmenting actively managed funds. Actively managed funds can be categorised as either direct- or broker-sold where the first has a higher incentive to generate alpha to attract the previously mentioned sophisticated investors. As the segment of direct-sold funds in Guercio and Reuters's article displays no evidence of underperformance in active funds further research has been suggested. When investigating the performance of active funds, one should therefore be aware of a possible agency conflict between brokers and investors to select an appropriate and segmented sample of funds.

2.1 Models

The Sharpe Ratio has long been used to evaluate stocks, funds, and entire portfolios on a risk-to-reward basis (Sharpe, 1966). By dividing the return or expected return of an asset minus the risk-free rate with the volatility or expected volatility during the same period an asset's performance can be fairly judged by accounting for risk. Even though the Sharpe Ratio is rather simple it provides an insightful measurement which when combined with the two following models will contribute to determine the best performing fund type.

The first model we will use to analyze our data is the CAPM first introduced by Sharpe (1964) which measures expected return per unit of risk. The model's intercept, given by α_i is the difference between the actual return and the predicted return from CAPM. It can also be interpreted as the excess return on the market for fund i. In an efficient market, α is expected to be zero. The model is given by equation (1).

$$R_{it} - R_{ft} = \alpha_i + \beta_i\left(R_{Mt} - R_{ft}\right) + \varepsilon_{it} \quad (1)$$

The CAPM which uses only one variable, market risk premium, to describe the return of a financial asset was later added upon by Fama and French (1992) who introduced two additional factors, Small Minus Big (SMB) and High Minus Low (HML) to better explain the return. This model is given in equation (2). Fama and French (1993) noticed two classes of stock outperforming the market, small cap and value stock, that is stocks with a high book-to-market ratio. The additional factors reflect the exposure to these two classes which results in the Fama-French 3-Factor model explaining over 90 percent of the return compared to the average of 70 percent for the simpler CAPM (Fama and French, 1993).

$$R_{it} - R_{ft} = \alpha_i + \beta_i\left(R_{Mt} - r_{ft}\right) + \beta_{i,SMB}SMB_t + \beta_{i,HML}HML_t + \varepsilon_{it} \quad (2)$$

The β_i variable in both CAPM and the Fama-French 3-Factor model describes the systematic risk of fund i compared to the market. For CAPM an index fund that perfectly mirrors the underlying index $\beta = 1$ where β will reflect the additional (lesser) amount of return as systematic risk can be priced.

$$\beta_i = \frac{cov(r_i, r_m)}{var(r_m)} \quad (3)$$

2.2 Historical performance

By examining the Swedish fund market Dahlquist, Engström and Söderlind (2000) found multiple characteristics that did not differ from research made on other markets. Their results showed that larger equity funds create lower alphas than smaller equity funds. Equity funds performed the best during their selected time period, outperforming bond funds and money markets. The study also displayed that fees are negatively related to a fund's performance.

To distinguish the effect active funds have over passive funds, Glode (2011) wrote a paper on management's contribution to fund performance. Glode argues that one major reason for active fund underperformance is the fee charged by active funds. When looking at prior research, Glode notes the historic underperformance of actively managed funds and to further investigate this creates a model to rationalize the active strategy. Using the model he finds that one major contribution of the negative alpha is the fee charged by the active management to compensate for their skills.

Let R_0 represent the gross return on a risk-free investment. The return on a passive portfolio such as an index is represented by r^p. Let a be the active return, f the charged fee decided by management, and v the randomness in the model. Model (4) represent the return for an active managed fund.

$$R_0 + r^p + a - f + v. \quad (4)$$

In this model, $R_0 + r^p$ represent the return for a passive fund, and $a - f + v$ is the excess return of an active strategy over a passive strategy. This means that a manager that chooses an active strategy should be able to produce an active return greater than the fee to rationalize the strategy. Glode argues that in equilibrium the active contribution should equal zero. Hence,

$$E[m(a - f + v)] = 0. \quad (5)$$

Adding the new variable m, representing a stochastic discount factor or pricing kernel larger than zero (Back, 2017). If fees were to be too low and the active contribution larger than zero, management would be worse off. Since they are missing out on revenue due to a lower fee, and not maximizing their utility. A condition where management contribution is below zero would mean that investors are worse off compared to a passive strategy. Poor management contribution will therefore lead investors to stop investing in the active portfolio and the fund will have no capital to reinvest.

An important question for management contribution is whether it is possible to create value due to skills through superior stock picking or market timing, or if high alphas in active funds is due to pure luck. Bhootra, Drezner, Schwarz and Stohs (2015) investigated if performance is due to luck or skill. Mathematically it is possible that a fund outperforms their benchmark due to luck, however, the probability is small and would not hold over time. They use a binominal distribution with a sample of 981 funds to interpret the possibility to keep high returns with only luck. Testing the persistence in the top quarter over time only 20 percent were able to remain in the top quarter of the sample. After five years, only 0.5 percent were able to perform in the top. Therefore, they argue that it is unlikely to remain a winner based on luck. However, it was not determined what types of skill that were superior to create such value.

A discussion that has been well covered is the persistence of fund performance and whether it is possible to predict future returns. Carhart (1997) tested if there exist a relationship between future and past return using the Fama-French-Carhart 4-Factor model to determine the performance of the funds. Carhart discovered that there is some relationship between past and future returns on a one-year period. However, Carhart did not find any evidence suggesting that past returns can be used to predict future return.

Most traditional methods of calculating the performance of funds has been Sharpe's CAPM, the Fama-French 3-Factor model and the Fama-French-Carhart 4-Factor model. Elton, Gruber and Blake (1996) extended the Fama-French model to better evaluate performance. They considered the human factor added by an actively managed fund and their model is consistent with other more traditional models, displaying signs that persistence in performance exists on a one-year basis.

An interesting distinction that is found in their article is that it is possible to predict performance over a longer period of time. Elton, Gruber and Blake (1996) found a relationship that could predict performance in a three-year period for their sample data.

The human factor, however, is more complex as alpha is affected by both managerial skill and underlying fees. This is a management utility-maximization problem management faces when trying to maximize their own profit while balancing to keep the alpha above zero. Elton, Gruber and Blake find empirical evidence that managers increase the fees over time when performing in the top decile of the market.

Another puzzle in performance research has been how momentum is built. Whether short-term persistence is actively managed or just momentum built by the managers. Hendricks, Patel and Zeckhauser (1993) tested the phenomenon of "hot-hands" by funds. The test was made to check for autocorrelation in their regression, to see if positive residuals is followed by positive residuals. The results showed that there exists short-term persistence or momentum in funds where superior short-term persistence can explain the short-term future performance of a fund. In the counter position there also exists "icy hands". On the contrary, funds that perform bad previously is expected to perform bad in the future as well.

This far, we have mostly investigated the persistence for actively managed funds. The well covered aspect that managers can create portfolios that can perform according to their respective benchmark and affect the alpha. Crane and Crotty (2018) argue that managerial skill can affect the performance of passive funds as well. The argument is similar to the one made by Bhootra, Drezner, Schwarz and Stohs (2015), that in order for winners to exists, there must be losers that are unskilled or unlucky. Crane and Crotty found that passive funds also possess skill to perform in the top of the market. In fact, the results suggest that the distribution of unskilled active funds is similar to the unskilled passive strategies.

An overwhelming amount of previous research has been on the U.S. market. Cremers, Ferriera, Matos and Starks (2016) tested the performance of funds on a global level, including 32 countries in their sample set to determine the performance of funds globally. In addition to the prior discussed strategies, active management, and passive management, they added another category, named "closet indexing". Closet indexing refers to the practice of following a passive strategy but labeling the fund as an actively managed fund. They found that actively managed funds react positively in terms of higher alphas when facing competition from passive funds that charge lower fees. The existence of closet indexing funds however, has a negative effect on truly actively managed funds and their alphas.

2.3 Hypothesis Test

We are going to conduct three different tests to see how the performance between active and passive funds differ. The null hypothesizes are stated as H_1, H_2, and H_3, respectively.

2.3.1 Hypothesis 1

The first hypothesis is an analysis of the respective alphas for passive and actively managed funds. This is the risk- and fee-adjusted returns from the respective fund strategy. The null hypothesis is thus that passive funds should be able to perform higher risk- and fee-adjusted returns than the active funds.

$$H_1: \alpha^{Passive} > \alpha^{Active}$$

The returns for passive funds should replicate the return of a benchmark index and should thus be able to bear a lower risk in terms of volatility than that of active funds. Actively managed funds should not be considered as a reasonable investment when accounting for the additional fees charged according to Gruber (1996). We base our hypothesis on Grubers reasoning behind investments in actively managed funds.

2.3.2 Hypothesis 2

The second test we are going to conduct is based on Sharpe's Ratio where the risk-return relationship of passive and active funds is tested. Sharpe Ratio gives an indication of the risk-to-reward relationship of funds in our sample sets.

$$H_2: \mu^{Passive} > \mu^{Active}$$

The test is based on the mean for Sharpe Ratio, where the hypothesis states that the mean for passive funds should be higher than the mean for active funds. This is coinciding with hypothesis test one, where the alphas are tested. Our null hypothesis is that the reward for investing in passive funds is greater when accounting for the level of risk in each individual fund. This can be true both if the return for passive funds is greater than the return in active funds, or if the volatility of passive funds is lower than the level of volatility for active funds.

2.3.3 Hypothesis 3

The third hypothesis tested is a cross-country comparison. The Swedish market is compared to the U.S. market to investigate the level of risk-adjusted return for investors in each market. This test can also be used to compare our results of the U.S. market to prior research and match the results to the Swedish fund market for further comparison.

$$H_3: \mu^{Swe} = \mu^{USA}$$

3. Data

To measure and determine the performance of active and passive funds in the two markets, Sweden, and U.S., we began by collecting monthly returns. Beginning with the Swedish market records from the Swedish investment focused bank Avanza was used to gain insight on the Swedish fund market and investor preferences. We made three clear assumptions to select funds for our Swedish sample sets:

1. Swedish investors will pick amongst the most popular active and passive funds and funds with high popularity today are likely to have been popular at the beginning of our time period.
2. Swedish investors will add funds reflecting the European, U.S. and global stock market due to the lack of funds purely reflecting the Swedish stock market and to gain diversification benefits.
3. Swedish investors will compare their returns to a common index such as the Six Return Index (SIXRX) even though individual funds are better compared to European, U.S. or global indices.

With these assumptions in mind monthly return data for the period 2010-01 to 2019-12 was gathered from Handelsbanken's database of historical fund data for ten active and ten passive funds based on Avanza's record of number of owners. Monthly returns were used to accurately capture volatility while keeping the number of observations at a more manageable level.

With a larger market for funds in the U.S. we decided to pick the funds according to three different criteria. For the active funds, we first looked at the Morningstar rating, where it is to be four or above. Secondly, the turnover ratio should be above 85 percent to be categorized as an actively managed fund and to minimize the problem of closet indexing. Thirdly, the funds in our sample were picked across various industry focuses, fund families and sizes to represent the diversification efforts of an investor. Lastly, U.S. investors are assumed to use the S&P 500 as a benchmark index and the performance of the two U.S. sample sets will therefore be compared to the S&P 500.

An important note is that the use of current Morningstar ratings for fund selection can cause certain biasedness of historical winners. However, winners are expected to remain winners according to the theory of Hendricks, Patel and Zeckhauser (1993) and Bhootra, Drezner, Schwarz and Stohs (2015) and Morningstar ratings are awarded through historical

performance. Extra caution was taken when using benchmarks such as the current Morningstar rating as the whole market had been affected by high market volatility caused by the COVID-19 virus outbreak when we collected the data.

The passive funds selected for the U.S. market are made up of index funds set to replicate the return of the S&P 500 and mutual funds with a turnover ratio below 15 percent set to replicate other global indices. For passive funds, the annual report expense ratio for individual funds was compared to the category average to avoid discrepancies. After finding ten active and ten passive funds matching our criteria monthly return data was gathered from Yahoo Finance. For U.S. funds adjusted returns were used to account for dividend payout during the time period.

Having created our samples containing historical data for ten active and passive funds and appropriate benchmark indices for the two markets our first category of data is complete. Before continuing we would like to note that the chosen time period, 2010-01 to 2019-12, will make our results representative of a period of long-term economic growth. The decade following the financial crisis of 2007-08 came with strong market advances and during 2013 both OMXS30 and S&P 500 saw all time historical highs and continued to advance for the remainder of our period. With most previous research having time periods of five years, often including a financial crisis, our time period covers a long period of financial prosperity and the data from our sample can therefore differ greatly to previous research.

The second category consists of market data for both target markets. Market data will be used in calculations for risk-free and risk-adjusted returns, CAPM and the Fama-French 3-Factor model. Risk-free return (R_f) will be calculated based on the one-month U.S. T-bill rates as we assume an investment horizon of at least one month for fund investment and to match with the monthly fund returns. For the Swedish market one-month Swedish T-bill rates will be used to represent R_f with the same assumptions as for the U.S. market. As mentioned previously SIXRX will represent Swedish market returns (R_m) with the S&P 500 representing U.S. R_m. Data for the Fama-French 3-Factor model will be gathered for the variables SMB and HML. For the Swedish market, the three variables R_f, SMB and HML is gathered from the Swedish House of Finance Data Center. Kenneth R. French Research Returns Database from Dartmouth College was used to gather the corresponding variables for the U.S. market.

3.1 Correlation Matrix

In Table 1 trough Table 4 we present the correlation matrixes for our four sample sets consisting of Swedish passive, Swedish Active, U.S. passive and U.S active. Correlation is measured on a range of zero to one, with one representing perfect correlation.

Table 1 and 2 are the correlation matrixes for our two passive sample sets. We find a strong correlation close to one across multiple funds in both tables which is explained by the effort of passive funds to replicate the return of an underlying index. Furthermore, the correlation amongst U.S. funds are greater than those found amongst Swedish funds with funds such as VOO, SPY and IVV having almost perfect correlation between one another and with the S&P 500 index. We can observe that the passive funds found in our U.S. sample set display higher correlation to the chosen benchmark index compared to our Swedish sample set.

Table 1: Correlation matrix for Swedish passive funds. Correlation is measured between 0 to 1.

	SPT AF INV	SPP AF US	DNB I.G.I	AMF AF EU	DNB G.I	SPP AF GBL	SWED R US	SPP AF SW	SPP AF EU	SEB SF IND	SIXRX
SPT AF INV	1	0.566	0.693	0.787	0.570	0.708	0.569	0.901	0.764	0.914	0.925
SPP AF US	0.566	1	0.936	0.614	0.790	0.907	0.991	0.603	0.672	0.564	0.604
DNB INV GBL IND	0.693	0.936	1	0.750	0.796	0.963	0.930	0.720	0.812	0.692	0.728
AMF AF EU	0.787	0.614	0.750	1	0.586	0.818	0.612	0.786	0.909	0.811	0.805
DNB GBL IND	0.570	0.790	0.796	0.586	1	0.771	0.791	0.594	0.627	0.577	0.604
SPP AF GBL	0.708	0.907	0.963	0.818	0.771	1	0.895	0.762	0.872	0.740	0.764
SWED R US	0.569	0.991	0.930	0.612	0.791	0.895	1	0.579	0.650	0.552	0.593
SPP AF SW	0.901	0.603	0.720	0.786	0.594	0.762	0.579	1	0.829	0.963	0.977
SPP AF EU	0.764	0.672	0.812	0.909	0.627	0.872	0.650	0.829	1	0.792	0.809
SEB SF IND	0.914	0.564	0.692	0.811	0.577	0.740	0.552	0.963	0.792	1	0.973
SIXRX	0.925	0.604	0.728	0.805	0.604	0.764	0.593	0.977	0.809	0.973	1

Table 2: Correlation matrix for U.S. passive funds. Correlation is measured between 0 to 1.

	VOO	SPY	IVV	SWPPX	VGSLX	KBE	FNCMX	SWSSX	DIA	QQQ	S&P 500
VOO	1	0.999	1.000	0.971	0.596	0.770	0.936	0.802	0.955	0.913	0.986
SPY	0.999	1	0.999	0.976	0.632	0.760	0.945	0.822	0.960	0.925	0.987
IVV	1.000	0.999	1	0.975	0.637	0.762	0.946	0.823	0.961	0.925	0.987
SWPPX	0.971	0.976	0.975	1	0.619	0.742	0.947	0.884	0.930	0.906	0.963
VGSLX	0.596	0.632	0.637	0.619	1	0.358	0.578	0.593	0.561	0.550	0.593
KBE	0.770	0.760	0.762	0.742	0.358	1	0.711	0.758	0.754	0.622	0.795
FNCMX	0.936	0.945	0.946	0.947	0.578	0.711	1	0.862	0.877	0.972	0.946
SWSSX	0.802	0.822	0.823	0.884	0.593	0.758	0.862	1	0.764	0.746	0.842
DIA	0.955	0.960	0.961	0.930	0.561	0.754	0.877	0.764	1	0.849	0.963
QQQ	0.913	0.925	0.925	0.906	0.550	0.622	0.972	0.746	0.849	1	0.909
S&P 500	0.986	0.987	0.987	0.963	0.593	0.795	0.946	0.842	0.963	0.909	1

The correlation matrixes for both of our active sample sets can be found in Table 3 and 4. The correlation amongst active funds in both our market are considerably lower than the values found in Table 1 and 2. Furthermore, the correlation of funds to the chosen benchmark index in our active sample sets are also lower than the correlation for our passive sample sets.

Evaluating the correlation between our active funds and their respective benchmark indices should give us further insight in the success of our diversification efforts for funds in our active sample sets. As correlation also can be used as a benchmark for how well an index fund manages to capture the underlying index, we will further discuss the correlation matrixes in the chapter Discussion.

Table 3: Correlation matrix for Swedish active funds. Correlation is measured between 0 to 1.

	SWEDB NT A	LFK FF A	ÖHM GLOB HBA	SKG GLOB	D&G SB	LNB_SWE	HDB TTV	SWED R TECH	SPL AF STB	DNB TEK	SIXRX
SWEDB NT A	1	0.617	0.610	0.465	0.802	0.723	0.582	0.655	0.824	0.668	0.791
LFK FF A	0.617	1	0.401	0.374	0.697	0.629	0.463	0.394	0.657	0.517	0.665
ÖHMAN GLOB HB A	0.610	0.401	1	0.548	0.547	0.591	0.685	0.870	0.665	0.786	0.682
SKG GLOB	0.465	0.374	0.548	1	0.473	0.485	0.407	0.575	0.510	0.597	0.506
D&G SB	0.802	0.697	0.547	0.473	1	0.828	0.593	0.521	0.877	0.673	0.856
LNB_SWE	0.723	0.629	0.591	0.485	0.828	1	0.653	0.539	0.846	0.687	0.939
HDB TTV	0.582	0.463	0.685	0.407	0.593	0.653	1	0.598	0.609	0.629	0.676
SWED R TECH	0.655	0.394	0.870	0.575	0.521	0.539	0.598	1	0.631	0.820	0.630
SPL AF STB	0.824	0.657	0.665	0.510	0.877	0.846	0.609	0.631	1	0.707	0.921
DNB TEK	0.668	0.517	0.786	0.597	0.673	0.687	0.629	0.820	0.707	1	0.717
SIXRX	0.791	0.665	0.682	0.506	0.856	0.939	0.676	0.630	0.921	0.717	1

Table 4: Correlation matrix for U.S. active funds. Correlation is measured between 0 to 1.

	CPOAX	SAGAX	MSEIX	BALFX	FPURX	TRVLX	FIVFX	PAGSX	PAVLX	PRGTX	S&P 500
CPOAX	1	0.863	0.596	0.738	0.651	0.725	0.691	0.709	0.751	0.839	0.613
SAGAX	0.863	1	0.660	0.735	0.703	0.698	0.722	0.792	0.744	0.804	0.715
MSEIX	0.596	0.660	1	0.679	0.691	0.685	0.706	0.774	0.680	0.537	0.818
BALFX	0.738	0.735	0.679	1	0.742	0.922	0.876	0.859	0.935	0.842	0.855
FPURX	0.651	0.703	0.691	0.742	1	0.766	0.725	0.795	0.775	0.702	0.788
TRVLX	0.725	0.698	0.685	0.922	0.766	1	0.806	0.819	0.994	0.839	0.834
FIVFX	0.691	0.722	0.706	0.876	0.725	0.806	1	0.922	0.813	0.749	0.845
PAGSX	0.709	0.792	0.774	0.859	0.795	0.819	0.922	1	0.828	0.765	0.920
PAVLX	0.751	0.744	0.680	0.935	0.775	0.994	0.813	0.828	1	0.862	0.835
PRGTX	0.839	0.804	0.537	0.842	0.702	0.839	0.749	0.765	0.862	1	0.640
S&P 500	0.613	0.715	0.818	0.855	0.788	0.834	0.845	0.920	0.835	0.640	1

3.2 Descriptive Statistics

In Table 5 and Table 6 we have collected the descriptive statistics for the funds in our sample over the selected time period. The returns are adjusted for fees and risk-free rate. The total return is equal to the return for the whole period of January 1st, 2010 to December 31st, 2019. Mean, median and variance is computed monthly. Three funds in our sample has a shorter sample period than the total ten-year period but were still included due to their high popularity.

Two of the funds in the Swedish market found in Table 5, Swedbank Robur Ny Teknik A and LFR Fastighetsfond A, generated a superior total return of 517 and 457 percent, respectively. These two funds show no abnormality in variance compared to the sample set mean while still performing far beyond the benchmark index SIXRX which during the same period generated a total return of 205 percent. Three founds in the Swedish market were not able to generate a return of 100 percent while a total of nine funds in our Swedish sample outperformed the return of our benchmark index. From the top performer to the worst performer we find a 457-percentage point difference. While our first intent was to only include funds that covered at least our time period the two funds Spiltan AF Invest and DNB Glob Indx were still included due to their high popularity from Swedish Investors and start dates relatively close to the start of our sample period. Spiltan AF Invest began is measured from December 2011 and DNB Glob Indx from September 2011.

In the U.S. market from Table 6, we observe a smaller spread from the best to worst performer in terms of total return (282-percentage points). However, only four were able to produce a higher total return than the benchmark index S&P500. The highest return found in the U.S. sample set is PRGTX at 395 percent, and the lowest found for FIVFX at 113 percent. VOO is the only fund in our U.S. sample set that has a shorter time period and was measured from October 2010.

Table 5: Descriptive statistics for both passive and active funds for Swedish market. The expense ratio is given on an annual basis. The numbers are in percentage.

FUND	TOT RET.	MEAN	MEDIAN	VARIANCE	EXPENSE
SWEDBANK ROBUR NYTEK A	516.751	1.616	2.011	0.179	1.34
LFR FASTIGHETSFOND A	457.498	1.547	0.967	0.215	1.49
DNB TEKNOLOGI A	369.741	1.398	1.756	0.205	1.73
SPILTAN AF INVEST	299.952	1.520	2.083	0.163	0.00
SPP AF USA	284.567	1.190	1.002	0.123	0.22
SWEDB ROB ACC USA	284.477	1.188	1.089	0.120	0.32
DIDNER & GERGE SMÅBOLAG	247.245	1.133	1.134	0.180	1.51
DNB GLOB INDX A	215.932	1.077	1.327	0.089	0.51
SWEDBANK ROBUR TECH A	211.560	1.041	1.327	0.179	1.39
SPILTAN AKTIEFOND STABIL	190.931	0.950	1.223	0.113	1.62
ÖHMAN GLOBAL HÅLLBAR A	178.330	0.917	1.107	0.121	1.41
DNB INVEST GLOB INDX SA	171.451	0.888	0.944	0.104	0.22
LANNEBO SVERIGE PLUS	163.032	0.914	1.031	0.210	1.81
SKAGEN GLOBAL A	160.007	0.930	1.324	0.267	1.08
SPP AF SVE A	146.326	0.835	1.334	0.161	0.26
SEB SVE INDXF	140.082	0.815	1.093	0.165	0.23
SPP AF GLOB A	140.038	0.784	0.926	0.104	0.23
HDB TILLVÄXTMARKNAD TEMA A	62.484	0.482	1.097	0.152	1.70
SPP AF EUR	63.365	0.473	0.503	0.126	0.22
AMF AF EUR	60.298	0.476	0.843	0.162	0.59
SIXRX	205.289	1.009	1.438	0.149	-

Table 6: Descriptive statistics for both passive and active funds in U.S. market. The expense ratio is given on an annual basis. The numbers are in percentage.

FUND	TOT RET.	MEAN	MEDIAN	VARIANCE	EXPENSE
PRGTX	395.153	1.674	1.713	0.689	0.910
QQQ	380.686	1.412	1.899	0.191	0.200
FNCMX	285.404	1.226	1.425	0.191	0.300
CPOAX	273.918	1.363	1.927	0.541	1.150
SAGAX	237.530	1.239	1.375	0.451	1.260
SWPPX	233.879	1.080	1.301	0.140	0.020
SPY	234.456	1.078	1.408	0.134	0.030
IVV	235.250	1.080	1.439	0.133	0.040
VOO	224.532	1.125	1.430	0.117	0.030
DIA	224.172	1.046	1.070	0.122	0.016
VGSLX	190.348	0.994	1.038	0.206	0.120
SWSSX	180.331	1.028	1.464	0.331	0.040
TRVLX	174.121	0.952	1.087	0.216	0.780
PAGSX	161.303	0.916	1.381	0.225	1.120
PAVLX	162.124	0.914	1.159	0.214	1.040
MSEIX	146.577	0.900	1.500	0.283	1.120
KBE	140.910	0.921	1.528	0.370	0.350
BALFX	128.690	0.731	0.949	0.079	0.630
FPURX	130.408	0.756	0.693	0.115	0.530
FIVFX	113.188	0.737	1.031	0.208	1.010
S&P 500	238.734	1.091	1.325	0.139	-

The descriptive statistics for our sample sets is found in Table 7. The average total return for actively managed funds is the highest at 255.8 percent, which is in the line with Tables 5 and 6 where active funds in Sweden has observations with superior return. The average standard deviation for U.S. active funds stands in the top of 5.25 percent.

Neither the passive nor the active funds in U.S. had a higher average total return than the total return for the comparable index (S&P 500). Nor could the passive funds in Sweden perform higher total return than the benchmark index (SIXRX) on average. The mean for all four categories were arguably close to one, but differed from the median, so we would not expect any normal distribution.

Table 7: Summary of data for our four sample sets and the comparable indices for respective market.

	TOTAL RETURN	MEAN	MEDIAN	VARIANCE	ST. DEVIATION
AVERAGE PASSIVE SWE	182.89	0.93	1.14	0.13	3.63
AVERAGE PASSIVE U.S.	233.00	1.10	1.40	0.19	4.06
AVERAGE ACTIVE SWE	255.76	1.09	1.30	0.18	4.24
AVERAGE ACTIVE U.S.	192.30	1.02	1.28	0.30	5.25
SIXRX	205.29	1.01	1.44	0.15	3.87
S&P 500	238.73	1.09	1.33	0.14	3.73

To give an insight for the variables used to conduct CAPM and Fama-French 3-Factor model. R_f is the risk-free rate in our sample period for respective country. HML and SMB is used for Fama-French 3-Factor regression. The risk-free rate for Sweden and U.S. is both similar at a total return of about five percent. The biggest difference is for the SMB variable, where the variable for Sweden has had a positive change over the whole time period, but in U.S. it was negative for the whole period. However, the monthly mean for both SMB and HML is relatively similar between the two sample sets.

Table 8: Descriptive statistics for the variables used for the regressions.

	TOTAL	MEAN	MEDIAN	STD DEVIATION
***HML* SWE**	-0.378	-0.004	-0.003	0.028
***HML* U.S.**	-0.252	-0.002	-0.003	0.023
***SMB* SWE**	0.002	0.001	-0.006	0.037
***SMB* U.S.**	-0.068	0.000	0.002	0.023
R_f SWE	0.054	0.000	0.000	0.001
R_f U.S.	0.052	0.000	0.000	0.001

4. Method

With all data gathered we began by transforming the adjusted monthly closing prices to month to month percentage returns. These returns where then further adjusted to account for the different fee structures and give a fair comparison between the passive funds with low, or even no fees and the actively managed funds. Active funds had fees ranging from 0.44 to 2.11 percent with an average of 1.43 percent in the Swedish market and fees ranging from 0.53 to 1.26 percent with an average of 0.955 percent for the U.S. market. The following parts of the chapter will cover our three different hypothesis tests.

4.1 Hypothesis 1

The efficient market hypothesis states that consistent alpha generation is impossible (Fama, 1970) and by applying equation 1, CAPM and equation 2, Fama-French 3-Factor model to our data we can test if this theory holds. As prior research has shown clear evidence of underperformance in actively managed funds (Crane and Crotty, 2018), funds in our active sample set should consistently generate negative alphas.

To test our first hypothesis, differences in alphas for active and passive funds, two OLS regressions were performed for each individual fund. For CAPM the excess return of fund i is set as the dependent variable with market return given by SIXRX for the Swedish market and S&P 500 for the U.S. market as the independent variable. The two market specific variables SMB and HML were then added for the Fama-French 3-Factor model. A standard significance level of 0.05 was selected to see if alphas from the two models were equal to, or significantly different from zero.

4.2 Hypothesis 2

With the possibility of finding alphas that are not significantly different from zero we decided to add a second hypothesis. The additional hypothesis is based on Sharpe Ratios for each individual fund with means collected from different sample sets. By forming sample sets for active and passive funds for our two markets we can test whether the means of each sample set significantly differs from one another with an unpaired sample comparison that follows a t-distribution. The intent of this test is to find similarities or superiorly performing sample sets on a risk adjusted basis.

The second and third hypothesis is tested through an unpaired sample test. The second hypothesis test follows a t-distribution with the rejection area above the critical values, $T > t_{1-\alpha}$ from E-handbook of statistical methods (NIST/SEMATECH, 2012)[1]. The t-values are collected as a function of the average in the sample. Where in hypothesis test two, passive funds correspond to population one and active funds corresponds to population two.

$$T = \frac{\bar{Y}_1 - \bar{Y}_2}{\sqrt{\left(\frac{s_1^2}{N_1}\right) + \left(\frac{s_2^2}{N_2}\right)}} \tag{6}$$

Five different tests are conducted, active vs. passive within each market, passive vs. active between the two markets and one including all funds in our sample where passive vs. active funds from both markets are tested.

4.3 Hypothesis 3

As we have chosen to include two different markets, we will also conduct a third test. The third test is conducted like the second test, by collecting the ratios for all funds. This test, however, is made with Sweden and U.S. as the samples. Thus, this test is including 20 observation instead of ten found in in the previous tests. The reasoning behind including this test is to discover possible differences between the two markets by evaluating the performance of all sample sets between the Swedish and U.S. market. We intend to do three different tests for our third hypothesis, Swedish market vs. U.S. market, Swedish passive vs. U.S. passive and Swedish active vs. U.S. active.

In the third hypothesis test, Sweden is represented by population one in equation 6 and U.S. is represented by population two. Testing equality mean between two samples is a two-tailed test with rejection region $|T| > t_{\frac{1-\alpha}{2}, d.f.}$.

[1] Degrees of freedom for our tests is calculated as $d.f. = \frac{\left(\left(\frac{s_1^2}{N_1}\right)+\left(\frac{s_2^2}{N_2}\right)\right)^2}{\left(\frac{\left(\frac{s_1^2}{N_1}\right)^2}{N_1-1}\right)+\left(\frac{\left(\frac{s_2^2}{N_2}\right)^2}{N_2-1}\right)}$ (NIST/NEMATECH, 2012). Assuming unequal variances.

5. Results

In the following chapter we present the results from our three hypothesis tests. In Hypothesis 1 we display the two OLS regression results from CAPM and the Fama-French 3-Factor model. Hypothesis 2 shows the results of our unpaired sample test of Sharpe Ratio mean and Hypothesis 3 covers the test of equality of means between the Swedish and U.S. market.

5.1 Hypothesis 1

For our first test, a comparison between mean alphas for the passive and active sample sets separately for the Swedish and U.S. market is made, both the CAPM and Fama-French 3-Factor models were applied to each individual fund. Table 9 through 12 display the regression output for all funds in each of our four sample sets. For the results to be applicable for our first test a majority, if not all, fund alphas will have to be significantly different from zero.

In Table 9 we find the regression outputs for Swedish active funds. The alphas regressed through the CAPM with market risk premium as the solely independent variable are, on average, positive with a mean of 0.0028. Two out of the ten actively managed funds in the Swedish market produced negative alphas, but only two alphas that were significant. The betas are, on average, below one with only a single fund taking higher risk and requiring higher return than the market, captured by the SIXRX index. Regressing the fund returns using the Fama-French 3-Factor model and including the two variables SMB and HML, the R^2 values for all funds increase to various degrees.

Table 9: Regression outputs from the actively managed funds in Sweden. Asterisks represent a significant variable, and the bottom row is the mean value of each variable from the outputs.

FUND	CAPM			FAMA-FRENCH 3-FACTOR				
	Intercept (α)	Beta (β)	R^2	Intercept (α)	Beta (β)	SMB	HML	R^2
SWEDB NT A	0.0074*	0.8642*	0.6250	0.0067*	0.8796*	0.0299	-0.1507	0.6359
LFK FF A	0.0074*	0.7970*	0.4421	0.00760*	0.7791*	-0.1831*	-0.0242	0.4631
ÖHM GLOB HB A	0.0030	0.6138*	0.4648	0.0033	0.6062*	-0.0126	0.0778	0.4690
SKG GLOB	0.0025	0.6773*	0.2565	0.0022	0.6766*	-0.0728	-0.0896	0.2614
D&G SB	0.0018	0.9392*	0.7336	0.0019	0.9394*	0.0192	0.0241	0.7341
LNB SWE	-0.0021	1.1138*	0.8826	-0.0019	1.1056*	-0.0535	0.0292	0.8848
HDB TTV	-0.0021	0.6824*	0.4570	-0.0012	0.6605*	-0.0863	0.1560	0.4768
SWED R TECH	0.0034	0.6903*	0.3971	0.0033	0.6914*	-0.0263	-0.0487	0.3986
SPL AF STB	0.0014	0.8025*	0.8483	0.0010	0.8091*	-0.0047	-0.0877*	0.8536
DNB TEK	0.0055	0.8392*	0.5136	0.0055	0.8359*	-0.0382	-0.0105	0.5146
MEAN	0.0028	0.8020		0.0028	0.7983	-0.0351	-0.0155	

The Swedish passive funds found in Table 10 also generate a positive alpha, on average, but with a lower mean value of 0.0016 for the CAPM and a slightly higher mean value of 0.0017 for the Fama-French 3-Factor model. Although the mean of alphas for passive funds are lower than the active funds in Table 9, we now see four funds with significant alphas. Two of these funds, SPP AF US and DNB GBL IND generated positive alphas while SPP AF SW and SEB SF IND generated negative alphas. Including the SMB and HML variables once again results in increased R^2 values but only results in four significant alphas compared to five when using the CAPM. The mean of betas for Swedish passive funds for the CAPM (0.75) is somewhat lower than the mean of betas for the Swedish active funds (0.8) with two funds having betas above one.

Alphas for a total of six funds out of the 20 Swedish funds in our sample are significantly different from zero. As no actively managed funds generated significant negative alphas we can confirm that the efficient market hypothesis holds. Therefore, hypothesis 1 will not be conducted for the Swedish market as it would require at least a majority of significant alphas.

Table 10: Regression outputs from passive funds in Sweden. Asterisks represent a significant variable, and the bottom row is the mean value of each variable from the outputs.

FUND	CAPM			FAMA-FRENCH 3-FACTOR				
	Intercept (α)	Beta (β)	R^2	Intercept (α)	Beta (β)	SMB	HML	R^2
SPT AF INV	0.0030	1.0551*	0.8559	0.0032	1.0589*	-0.0804	-0.0158	0.8612
SPP AF US	0.0064*	0.5473*	0.3652	0.0068*	0.5391*	0.0023	0.1040	0.3722
DNB GBL IND	0.0027	0.6062*	0.5293	0.0030	0.6037*	0.0369	0.0807	0.5358
AMF AF EU	-0.0037	0.8378*	0.6487	-0.0036	0.8368*	0.0056	0.0193	0.6489
DNB GBL IND	0.0060*	0.4724*	0.3648	0.0057*	0.4792*	0.0270	-0.0601	0.3694
SPP AF GBL	0.0014	0.6360*	0.5830	0.0017	0.6315*	0.0126	0.0725	0.5872
SWEDB R US	0.0065*	0.5322*	0.3519	0.0069*	0.5254*	0.0123	0.1008	0.3586
SPP AF SW	-0.0019*	1.0152*	0.9548	-0.0018*	1.0126*	-0.0147	0.0122	0.9550
SPP AF EU	-0.0028	0.7431*	0.6551	-0.0023	0.7360*	0.0113	0.1034	0.6616
SEB SF IND	-0.0022*	1.0226*	0.9470	-0.0023*	1.0247*	-0.0166	-0.0485	0.9483
MEAN	0.0016	0.7468		0.0017	0.7448	-0.0004	0.0369	

In Table 11 only three out of the ten actively managed funds in the U.S. market generated positive, but insignificant, alphas using the CAPM. When introducing the variables SMB and HML none of the actively managed funds were able to generate a positive alpha. The introduction of the two variables does, however, increase R^2 values to a greater extent than it did for both Swedish sample sets. The number of funds with an alpha significantly different from zero is still low with only a single fund when using the CAPM and two for the Fama-French 3-Factor model.

Table 11: Regression outputs from the actively managed funds in U.S. Asterisks represent a significant variable, and the bottom row is the mean value of each variable from the outputs.

FUND	CAPM			FAMA-FRENCH 3-FACTOR				
	Intercept (α)	Beta (β)	R^2	Intercept (α)	Beta (β)	SMB	HML	R^2
CPOAX	0.0004	1.2089*	0.3756	-0.0029	1.2898*	0.0140	-1.1340*	0.4966
SAGAX	-0.0017	1.2879*	0.5113	-0.0034	1.2707*	0.3616	-0.9575*	0.6146
MSEIX	-0.0037	1.6745*	0.6691	-0.0026	1.0019*	0.8041*	-0.4179*	0.7813
BALFX	0.0003	0.6439*	0.7305	-0.0006	0.7040*	-0.2302*	-0.0516	0.7647
FPURX	-0.0003	0.7175*	0.6203	-0.0008	0.7100*	0.1176	-0.2858*	0.6568
TRVLX	-0.0018	1.0388*	0.6956	-0.0019	1.0552*	-0.0906	0.0761	0.6981
FIVFX	-0.0039	1.0349*	0.7143	-0.0057*	1.1055*	-0.1597	-0.4231*	0.7693
PAGSX	-0.0036*	1.1715*	0.8472	-0.0046*	1.1921*	0.0181	-0.3362*	0.8724
PAVLX	-0.0022	1.0353*	0.968	-0.0023	1.0553*	-0.0937	0.0391	0.6999
PRGTX	0.0012	1.4256*	0.4099	-0.0015	1.5190*	-0.1494	-0.7638*	0.4575
MEAN	-0.0015	1.1239		-0.0026	1.0887	0.0592	-0.4255	

In comparison to the results found in Table 11, eight out of the passively managed funds in Table 12 manages to produce positive alphas using the CAPM. When accounting for more market variables we see a decrease in number of funds with positive alphas to five. For all ten funds, no matter what model being applied, no alphas are significantly different from zero. We cannot make any conclusion whether the alphas for passive funds are higher than the alphas for active due to the low number of significant alphas. Like the Swedish market the results of our regressions will not be applicable to our intended test.

Table 12: Regression outputs from passive funds in U.S. Asterisks represent a significant variable, and the bottom row is the mean value of each variable from the outputs.

FUND	CAPM			FAMA-FRENCH 3-FACTOR				
	Intercept (α)	Beta (β)	R^2	Intercept (α)	Beta (β)	SMB	HML	R^2
VOO	0.0004	0.9668*	0.9729	-0.0003	1.0122*	-0.1881*	0.0007	0.9863
SPY	0.0002	0.9672*	0.9739	-0.0003	1.0122*	-0.1867*	0.0091	0.9853
IVV	0.0002	0.9666*	0.9749	-0.0003	1.0116*	-0.1865*	0.0080	0.9863
SWPPX	0.0002	0.9665*	0.9273	-0.00038	1.0076*	-0.1508*	-0.0580	0.9368
VGSLX	0.0021	0.7224*	0.352	0.0015	0.7351*	0.0031*	-0.1803	0.3600
KBE	-0.0049	1.2965*	0.6322	-0.0008	1.1082*	0.4961*	0.9006*	0.7952
FNCMX	0.0017	1.1078*	0.8953	-0.0008	1.1278*	0.0225	-0.3429*	0.9263
SWSSX	-0.0039	1.2996*	0.7088	-0.0019	1.1073*	0.8337*	-0.1556	0.7989
DIA	0.0006	0.9021*	0.9266	0.0004	0.9413*	-0.1925*	0.1059*	0.9418
QQQ	0.0025	1.0657*	0.8266	0.0006	1.1588*	-0.2672*	-0.3723*	0.8895
MEAN	-0.0001	1.0261		-0.0002	1.0222	0.0184	-0.0085	

Finally looking at the differences between the Swedish and U.S. market we can note than funds in the U.S. market, on average, have significant betas closer to one than the funds in the Swedish market. The funds in both U.S. sample sets also display, even if they are close to one, betas above one compared to the mean of betas for Swedish active funds at 0.8 and 0.75 for Swedish passive funds. Also note that the two market variables SMB and HML, which are market specific, appears to have larger effect on funds in the U.S. sample sets compared to the Swedish with the two variables being significant for far more U.S. funds.

Out of the 40 funds regressed with the Fama-French 3-Factor model only eight funds in our sample had alphas significantly different from zero. As the number of significant alphas is far too low, it is unreasonable to conduct at a test using sample set mean of alphas. We will therefore disregard hypothesis test one and further discuss our results in the following chapter.

5.2 Hypothesis 2

For hypothesis two, that is based on mean comparison of Sharpe Ratios. The results after conducting the individual Sharpe Ratios for each fund is found in Table 13. The hypothesis is that the Sharpe Ratio mean for passive funds is greater than the mean for active funds.

To gain additional insight in the returns of the funds in our Swedish sample we can use the Sharpe Ratio to determine risk-adjusted return characteristics. By dividing the return minus the risk-free rate of fund i with the variance of fund i we obtain a reward-to-volatility ratio (Sharpe, 1966). A high Sharpe Ratio can be attained by both high returns and low volatility. We can see that the two highest ratios for Swedish passive funds comes from Spiltan Aktiefond Investmentbolag (1.28) and DNB Global Indeks A (1.25). Swedish active funds have a higher spread in Sharpe Ratios with Öhman Global Hållbar A (1.54) finding a balance between moderate return and volatility as the highest Sharpe Ratio in the whole sample set. However, the lowest Sharpe Ratios for our sample is represented by Sweden as well. Where AMF Aktiefond Europa (0.410) sits at the bottom.

The U.S. market has VOO (1.140) as the highest Sharpe Ratio and KBE (0.525) as the lowest, both of which are passive funds. The actively managed funds in U.S. has lower spread with BALFX (0.902) generating the highest Sharpe Ratio and FIVFX (0.559) the lowest. The Swedish funds have a higher average (0.929) than the U.S. market (0.804).

Table 13: Sharpe Ratio for each individual fund over the time period of ten years.

FUND	SHARPE RATIO	FUND TYPE	COUNTRY
ÖHMAN GLOBAL HÅLLBAR A	1.538	Active	Sweden
SWEDBANK ROBUR NYTEK A	1.327	Active	Sweden
SPILTAN AF INVEST	1.280	Passive	Sweden
DNB GLOB INDX A	1.253	Passive	Sweden
SWEDB ROB ACC USA	1.188	Passive	Sweden
SPP AF USA	1.178	Passive	Sweden
LFR FASTIGHETSFOND A	1.159	Active	Sweden
VOO	1.140	Passive	U.S.
QQQ	1.119	Passive	U.S.
DNB TEKNOLOGI A	1.072	Active	Sweden
DIA	1.037	Passive	U.S.
IVV	1.025	Passive	U.S.
SPY	1.022	Passive	U.S.
SWPPX	1.000	Passive	U.S.
SPILTAN AKTIEFOND STABIL	0.979	Active	Sweden
FNCMX	0.973	Passive	U.S.
DNB INVEST GLOB INDX SA	0.956	Passive	Sweden
DIDNER & GERGE SMÅBOLAG	0.926	Active	Sweden
BALFX	0.902	Active	U.S.
SWEDBANK ROBUR TECH A	0.852	Active	Sweden
SPP AF GLOB A	0.845	Passive	Sweden
FPURX	0.771	Active	U.S.
VGSLX	0.759	Passive	U.S.
SPP AF SVE A	0.721	Passive	Sweden
TRVLX	0.711	Active	U.S.
PRGTX	0.699	Active	U.S.
SEB SVE INDXF	0.696	Passive	Sweden
LANNEBO SVERIGE PLUS	0.691	Active	Sweden
PAVLX	0.685	Active	U.S.
PAGSX	0.668	Active	U.S.
CPOAX	0.642	Active	U.S.
SAGAX	0.639	Active	U.S.
SKAGEN GLOBAL A	0.623	Active	Sweden
SWSSX	0.619	Passive	U.S.
MSEIX	0.587	Active	U.S.
FIVFX	0.559	Active	U.S.
KBE	0.525	Passive	U.S.
SPP AF EUR	0.462	Passive	Sweden
HDB TILLVÄXTMARKNAD TEMA A	0.428	Active	Sweden
AMF AF EUR	0.410	Passive	Sweden

The test whether the mean of Sharpe Ratios for passive funds is larger than the mean for actively managed funds is tested through an unpaired sample comparison. The sample size for the first four tests in Table 14 is 20 observations and 40 observations for the fifth test. We assume unequal variance throughout all five tests (NIST/NEMATECH, 2012). Hypothesis 2 is tested through an unpaired sample test, with a one-sided rejection region. Table 14 gives the t-values and means for the test. Passive funds are denoted as $\bar{Y}_1^i$ for country i, from equation 6.

Table 14: Output from equality of means test through Eviews, converted to a one-sided test. Asterisk means that the hypothesis is rejected with a significance level of 0.05.

	T VALUE	MEAN 1	MEAN 2	TOT MEAN	VAR 1	VAR 2
PASS SWE VS. ACT SWE	-0.412	0.899	0.959	0.929	0.105	0.111
PASS U.S VS. ACT U.S.	3.191*	0.922	0.686	0.804	0.045	0.009
PASS SWE VS. ACT U.S.	1.992*	0.899	0.686	0.793	0.105	0.009
PASS U.S VS. ACT SWE	-0.302	0.922	0.959	0.941	0.045	0.111
PASS TOT VS. ACT TOT	1.018	0.910	0.823	0.867	0.071	0.077

As shown, the test between passive and active funds in Sweden with a critical value of 1.740, is not rejected. Meaning that we find enough evidence with a 95 percent confidence level that the Sharpe Ratio mean for passive funds in Sweden is greater than the mean for active funds in Sweden. The test to see if the passive funds in U.S. has a greater mean than the active funds in Sweden is also found in Table 14. This test is not rejected with a 95 percent confidence level.

When testing whether the mean of passively managed funds in the U.S. is greater than the mean of actively managed funds in the same market, the hypothesis is rejected. The t-value from the test (3.191) is larger than the critical value from the t-distribution (1.771), we do not find enough evidence that the mean of passive is greater with 95 percent confidence. Testing if the mean for passive funds in Sweden is greater than the mean for active funds in U.S. is also rejected. The critical value (1.992) is larger than the t-value (1.796), not enough evidence is found that the mean for passive funds in Sweden is greater than the active funds in U.S. We find that we reject both test when testing the mean of active funds in U.S. Meaning that we find no evidence that the mean of Sharpe Ratios for passively managed funds in Sweden and U.S. is statistically greater than the mean for active funds in the U.S market. The low variance for U.S. active funds (0.009) could explain the rejection of the null hypothesis for the test where the active funds in U.S. is compared.

The last row in Table 14 shows the outcome for a test to see if all passive funds in our sample has a greater mean than all active funds. The t-value from the test (1.018) is smaller than the critical value (1.686), therefore we cannot reject the null hypothesis that the mean for passive funds is larger than the active funds. The hypothesis $(H_2: \mu^{Passive} > \mu^{Active})$, for three of the five tests conducted is not rejected.

5.3 Hypothesis 3

For our last hypothesis test, we test whether the mean in Sharpe Ratios for the two markets is equal.. We assume different variances in these tests as well, calculating degrees of freedom for each test. We test it against the t-distribution, but with a two-sided rejection area, with a confidence level of 0.95.

Table 15: Two-sided equality of mean test for our three categories. Asterisk means that the hypothesis is rejected with a significance level of 0.05.

	T-VALUE	MEAN 1	MEAN 2	TOT MEAN	VAR 1	VAR 2
SWEDEN VS. U.S.	1.478	0.929	0.804	0.867	0.103	0.040
PASS SWE VS. PASS U.S.	-0.187	0.899	0.922	0.910	0.105	0.045
ACT SWE VS. ACT U.S.	2.487*	0.960	0.686	0.823	0.111	0.009

We do not reject the test for equality of means in the sample set Sweden vs. U.S. market. The t-value (1.278) is between the critical values (±2.037), we do not find enough evidence to reject the null hypothesis of equality of means. A test between the two markets for passively managed funds is also conducted. Again, we find a t-value (-0.187) between the critical values (±2.120) from the t-distribution, therefore we cannot reject the null hypothesis. No evidence is found that the mean in Sharpe Ratios is unequal between the two countries.

However, the equality of means for actively managed funds is rejected, as the t-value (2.487) is outside of the critical values (±2.201). We find no evidence of equality for the means between the two markets for active funds. A note for this test is that the variance for the active funds in Sweden is twelve times larger than the variance for the U.S. active funds, which could explain the rejection.

Two of the three tests for equality of means are not rejected, Sweden vs. U.S. and passive funds in Sweden vs. passive funds in U.S. We can therefore say, with a 95 percent confidence level, that the means are equal for these two markets.

6. Discussion

When looking at the correlation matrixes found in the chapter Data it was clear that funds in both U.S. sample sets showed greater correlation to one another compared to the Swedish sample set. The correlation between passive funds in the U.S. market was particularly high and could be the result of several factors. On one hand most passive funds in the U.S. market used the S&P 500 as an underlying index. VOO, SPY and IVV had an almost perfect correlation with all three funds trying to track the performance of the same benchmark index, the

S&P 500. Furthermore, by looking at the correlation between the funds and the S&P 500 we can conclude that VOO, SPY and IVV all managed to generate results close to the benchmark index even when adjusting for fees. On the other hand, few Swedish passive funds shared the same benchmark index due to the lack of funds tracking Swedish indices. This differentiation between Swedish passive funds is likely to explain some of the differences between the Swedish and U.S. market.

As our reason for including the U.S. market was to better be able to compare our results to previous research, we can again find unexpected discrepancies between the Swedish and U.S. market. The betas found when regressing both passive and active funds in the U.S. market are in line with previous research from Cremers, Ferreira, Matos and Stark (2016) and Karceski (2002) who both use similar methods for fund selection.

The low betas for Swedish passive funds could be caused by Swedish funds having different benchmark indices than our selected market benchmark for Sweden, the SIXRX. Indicating that the SIXRX index could be less volatile than other European and global indices. As the Swedish active funds have low betas compared to their U.S. counterparts and are selected based on popularity, Swedish investors as a group could be more risk averse than other investors. Investment risk profile based on geographic has not been explored in our research but could account for the discrepancies between the Swedish and U.S. market. Furthermore, the larger impact the U.S. market has on global financial markets could explain the closer relationship of U.S. funds to their respective benchmark indices compared to Swedish funds.

From our first hypothesis we were not able to reject the efficient market hypothesis as few funds in all sample sets generated alphas significantly different from zero. As few alphas were significant, we dismissed our first test and can conclude that even when adjusting for the risk-free rate and fees both fund types can be assumed to be priced fairly in terms of fee structures. However, as ownership of actively managed funds have greatly declined in recent years there is still a possibility of finding active fund types with consistent negative alphas. The segmentation of investors and funds proposed by Gruber (1996), Guercio and Reuter (2014) could provide clarity as to why actively managed funds have become less popular. We would therefore recommend further research of funds that are broker-sold or promoted by financial intermediaries.

In our second hypothesis we found that the mean of Sharpe Ratios for our Swedish passive sample set was statistically greater than the active sample set in the same market. This proves that passively managed index funds can generate higher return per unit of risk compared to

actively managed funds in our sample. It should however be noted that variance has a large effect on the outcome of the unpaired sample test and the use of a larger sample is recommended. The hypothesis test comparing the U.S. sample sets is reject, as is the test between Swedish passive and U.S. active. Actively managed funds in the U.S. market accounted for the lowest variance (0.009), by far. This could be explained by the U.S. having a larger financial market which could increase competition and decrease variance between funds being offered in the U.S. market.

With our third hypothesis we found the mean of Sharpe Ratios between the two countries to be statistically equal. We can therefore conclude that even with a larger spread and higher variance found in the Swedish sample sets the two markets provide similar levels of reward per unit of risk for our sample. This discovery strengthens the results of our final test found in hypothesis two comparing all passive sample sets to all active sample sets as the two markets display statistical equality. This test fails to reject greater performance in passive funds compared to active funds, this time with larger sample sets and considerably less difference between sample set variance. As we cannot reject equality between the two markets earlier research by Crane and Crotty (2018), Hendricks, Patel and Zeckehauser (1993) and Chang, Kreuger and Thomas (2015), can be seen as applicable to the Swedish market.

The greatest difficulty when evaluating the performance of Swedish passive and active funds was the construction of an appropriate sample. In larger markets such as the U.S. it is possible to choose funds based on strenuous criteria and assumptions while still finding a plentiful amount of fitting funds. This problem certainly exists for other small financial markets and will always prove a difficulty for similar future research. With our results we can also conclude that a larger sample should be preferred over a longer sample period as is found in previous research from Crane and Crotty (2018). Lastly, we would recommend articles from Frino and Gallagher (2001) to avoid possible tracking errors when tracking the performance of index funds and the inherent seasonality caused by dividend pay-outs and quarterly earnings reports in fund markets.

As a final note, we would like to point out that the results found in our thesis indicates that findings in previous research, studying the U.S. market, is applicable to the Swedish equity market. This fact makes comparisons between the two markets viable for us and future research. Our findings also help both new and experienced investors make decisions regarding what funds to select for their portfolio and opens up for a discussing of differences in investment risk profiles depending on geographic location.

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