

FIN11 – Trading and Market Microstructure

COMPARING RETURNS BETWEEN NORWEGIAN ACTIVLY AND PASSIVELY MANAGED MUTUAL FUNDS

Candidate Numbers

- 23
- 55
- 60

Abstract

In this paper, we will analyse difference in expected return between active and passive management in Norwegian mutual funds. The basis for the analysis is to compare 18 actively managed mutual funds to three passively managed mutual funds, using the Oslo Stock Exchange Index (OSEBX) as a benchmark.

The objective of the analysis is to determine whether there is any statistically significant difference in expected returns between the two types of investment management strategies, letting us dismiss the null hypothesis of equal expected returns. We will examine data from a ten-year period, from January 2007 to January 2017, to see if we can determine if the common Norwegian investor is better off investing his savings in an actively managed mutual fund.

The results of the tests show that we cannot reject the null hypothesis claiming that the expected returns are equal for actively and passively managed mutual funds.

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Introduction

In this paper we will analyse if actively managed mutual funds outperform passively managed mutual funds, i.e. index funds. Active fund managers typically receive sizeable fees for managing their clients' investments, with no guarantee that they can beat the market. We deem this as a very contemporary topic as it is a challenging time for actively manged funds with a massive move towards index funds, as a result of continuous market upturn since the crash in 2008 (Schanke, 2017). With several studies conducted in different foreign markets, we have restricted our analysis to Norwegian mutual funds. Further, we are in a period of time where interest rates are lower than the present inflation rate in Norway. The low borrowing rates have increased the banks focus on expanding their income sources, where selling mutual funds as an alternative to the standard savings account has become a priority. We are curious to see if the common Norwegian investor is better off investing his long-term savings in an actively managed mutual fund versus a passively managed fund, especially since the Norwegian banks might have a bias towards recommending an actively managed fund in regards of fees.

The basis for the analysis is to compare 18 actively managed mutual funds to three passively managed mutual funds, using the Oslo Stock Exchange Index (OSEBX) as a benchmark. By analysing the different mutual funds' performance over a 10-year period, from January 2007 to January 2017, we try to analyse if there is a statistically significant difference in returns to see if we can dismiss the null hypothesis of equal expected returns.

First, we will address the aspects of active and passive management and the impact investment fees has on the investors net returns. Further we will introduce the different performances measures used to analyse the funds' performance before we present our analysis and findings.

Theory

Active and Passive Management

The term active and passive refers to the two main investment strategies used to generate return. The strategies differ in how the investment under management is utilized over time. Based on Sharpe's journal on *The Arithmetic of Active Management* (1991), the investors practicing the different strategies are classified as following:

- *A passive investor always holds every security from the market, with each represented in the same manner as in the market. Thus, if security X represents 3 per cent of the value of the securities in the market, a passive investor's portfolio will have 3 per cent of its value invested in X. Equivalently, a passive manager will hold the same percentage of the total outstanding amount of each security in the market.*
- *An active investor is one who is not passive. His or her portfolio will differ from that of the passive managers at some or all times. Because active managers usually act on perceptions of mispricing, and because such perceptions change relatively frequently, such managers tend to trade fairly frequently – hence the term "active".*

In accordance with the classification, the passive investor will obtain a weighted average of the returns on the securities within the market, i.e. the market return. The market return will equal a weighted average of the returns on the active and passive parts of the market, and thus the average active investor will also obtain the market return. Assuming that the cost of active management exceeds the costs of passively managing a given amount of money, Sharpe (1991) has proven two essential assertions; (1) *before costs, the return on the average actively managed dollar will equal the return on the average passively managed dollar and (2) after costs, the return on the average actively managed dollar will be less than the return on the average passively managed dollar*. If these simple relations were the undeniable truth, a rational investor would assumingly not even consider active management. This raises the question about the presence of sensible professionals claiming to beat the market.

In *Sharpening the Arithmetic of Active Management* (2017), Lasse Pedersen presents a revised and more realistic version of Sharpe's arithmetic. Sharpe's assertions are based on the implicit assumption that the market portfolio never changes, where the gains and losses aggregates to zero for all the active investors. As new stocks are issued, and indexes are reconstituted, i.e. changed to mirror the current market, this does not hold in the real world. As a consequence, changes in the market portfolio require passive investors to trade on a regular basis. Pedersen argues that the changes may be large enough for active investors in aggregate to add returns relative to passive investors. In addition, whenever passive investors trade to market-weight their portfolios, they may trade at less favourable prices, breaking Sharpe's equality (2017).

This directly contradicts with the *efficient market hypothesis*, the theory that it's impossible to beat the market. The reasoning is that the stock market efficiency causes existing share prices to always incorporate and reflect all relevant information. It states that stocks always trade at their fair value, which makes it impossible to outperform the market through stock selection and timing.

Nonetheless, *Sharpening the Arithmetic of Active Management* shows how active management can add value. To determine if the active investment strategy in fact does beat the passive strategy, the investment fees must be considered.

Investment Fees

An important differentiator when choosing a fund is the investment fees. Having professional managers allocating a funds' investments has its associated costs. The managers and their associated company compensate their efforts by deducting fees from their clients' investment. The mutual fund fees can be broken down into two broad categories:

I. *Ongoing Annual Fees*

II. *Shareholder Fees*

The ongoing annual fees refers to the aggregate of the funds operating costs, and are deducted as an annual percentage of the investments under management. These fees illustrate the total costs for operating the fund and are referred to as management fees. While the largest share goes to the fund's managers, it also covers the cost of accounting, auditing, legal expenses, recordkeeping and so forth.

The shareholder fees refer to the costs of buying or selling the funds. These comes in form of redemption fees and commissions, paid directly to the broker. The shareholder fees can be effectuated on the front-end or the back-end, meaning when you buy or sell the fund, also known as loads. The loads are usually a percentage of the investment. As a result, the front-end load reduces the size of the original investment and the future returns, while the back-end load reduces the size of the net investment when selling the fund.

For the purpose of the analysis, this paper will be focusing on the management fees and the front-end load when assessing the funds' performance, excluding the impact the back-end load has on the net investment. Although the back-end load is a clear factor when assessing the investments net value, it is not a factor in the analyses of the funds performances while the investment is under management. The back-end load first applies if the investor chooses to sell his position in the fund at the end of the period, and thus we have chosen to exclude it from our analysis.

Similar for the management fee and the front-end load is that they create a headwind for the funds net performance. By reducing the initial size of the investment with the front-end load and annually deducting management fees, the managers will have to not only beat the market to make excess returns,

but beat it with *more* than the equivalent of the deducted fees before it makes outperforming returns for their clients.

Illustrating with an example can help emphasize the effect fees have on net performance. Imagine we have two different mutual funds making an annual 10% return; Fund A and Fund B. Fund A has a front-end load of 5% and an annual management fee of 2%. Fund B has a 0.40% annual management fee and zero front-end load. With an initial investment of NOK 100,000, the starting point and base for future returns is reduced to NOK 95,000 for investors in Fund A. This is obviously unfortunate from the investors point of view, as a 10% return on NOK 95,000 is not the same as a 10% return on NOK 100,000. In comparison, if Fund B were to make a 10% return, Fund A would have to achieve a 15,8% return to match $110,000 as the net value of the investment in Fund B, i.e. more than the front-end load. By including the annual management fees in the equation, the difference becomes even greater. A 10% growth will result in a 9.56%[1] net return on investment in Fund B and a 2.41%[2] return in Fund A.

In this example, Fund A has the shareholder and management fees typically associated with an actively manged mutual fund, while Fund B can be thought of as a passively managed mutual fund, i.e. an index fund. While a 10% annual return is excessive compared to what one would expect from a fund trying to match the market, it was chosen for the easy comparison between the two.

In addition to the difference the fees can make in a single year, it is equally interesting looking at the impact on returns over a long term. To illustrate, we continue using Fund A and Fund B with an annual 10% return, and hold the initial investment of NOK 100,000 over a ten-year period, without any further investments in either funds. The development and value growth are illustrated in *figure 1* below. As a comparison, the blue graph represents the gross value of the initial investment, where fees are not included.

From the figure we can tell the gross value of the investment has reached a value of NOK 259,730, while fund A and B resulted in a net value of NOK 201,330 and NOK 249,180 respectively. With a 0.40% management fee, Fund B only differs NOK 10,550 or 4.06% from the gross value, while Fund A differs a remarkable NOK 58,400 or 22.48%. This example illustrates the magnitude of the impact the compounded fees have on net returns on investment, and implicate how an active managed fund is dependent on beating the market substantially to be able to make excess returns for their clients.

[1] $Return\ on\ Investment\ Fund\ B = \frac{NOK\ 100{,}000*(1+0.1)*(1-0.004)}{NOK\ 100{,}000} - 1 = 9.56\%$

[2] $Return\ on\ Investment\ Fund\ A = \frac{NOK\ 100{,}000*(1-0.05)*(1+0.1)*(1-0.02)}{NOK\ 100{,}000} - 1 = 2.41\%$

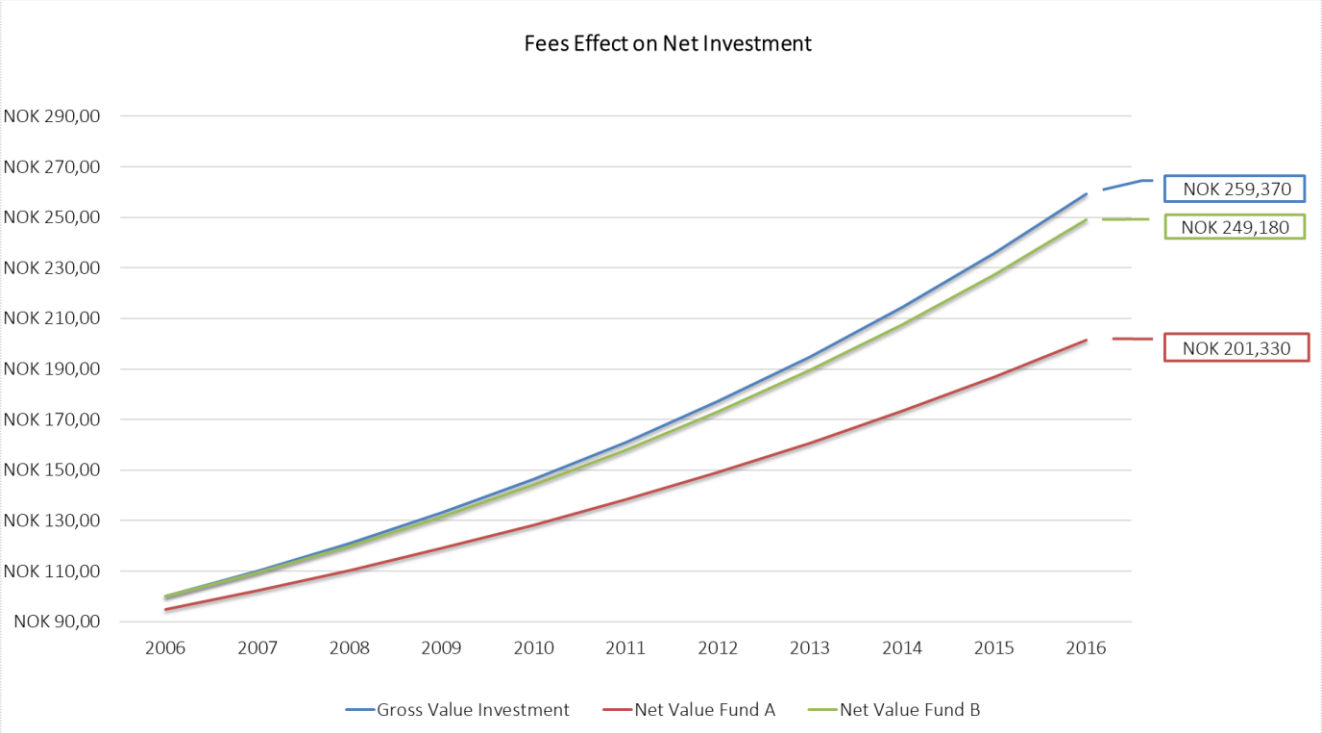


Figure 1 - Fees Long Term Effect on Net Investment. An initial investment of NOK 100,000 with a 10% annual return over a ten-year period from 2006 to 2016.

Performance measures

While fees have an impact on the net value of the investment, the performance of mutual funds are measured through various parameters. When looking at financial publications regarding funds, it is likely that we come across companies claiming that their fund is superior relative to their historical performance and high rankings amongst their peer group and benchmark. A "seal of approval" by a well-known investment research companies like Morningstar that rate mutual funds often follows this. It is important to have in mind that these performance results only represent one side of the equation regarding risk. To fully understand the risks associated with achieving the funds returns, it is necessary to look at more meaningful risk measures (Forbes, 2011). To statistically analyse the performance of our chosen funds with a more weighted focus on risk we found it feasible to include the following performance metrics:

The Sharpe Ratio

The Sharp Ratio is a measure of risk. The value is calculated with the standard deviation and return that exceeds the risk-free rate. If a fund has a high Sharp Ratio it indicates that the funds risk-adjusted development is good and vice versa. The ratio is used to compare how much risk a fund must take to achieve a return that is higher than the risk-free rate.

$$S = \left(\frac{\bar{R}_p - R_f}{\sigma_p}\right)$$

Where:

$\bar{R}p$ is the expected rate of return

Rf is the risk free rate

σp is the portfolio standard deviation

Figure 2 - The Sharpe Ratio Formula

Tracking Error

The tracking error (TE) measures the divergence between the fund and a benchmark (Harris, 2003). It shows how closely a fund follows its reference index or when comparing two funds. The measure is often used as a metric gauge on how well an investment is performing. Similarly, to all historically calculated numbers, TE does not necessarily need to be translated into future TE. In certain periods both the market/benchmark and the fund can move in the same direction and show a relatively low TE even if the physical risk exposure is different.

$$TE = \sqrt{\frac{\sum_{i=1}^{n} (R_p - R_\beta)^2}{N - 1}}$$

Where:

R_p is the return of manager or fund

R_β is the return of benchmark

N is the number of return periods

Figure 3 - The Tracking Error Formula

Information ratio

Information ratio (IR) is a risk-adjusted measure of performance that shows how much return a portfolio manager has achieved measured against the active risk that was taken (Morningstar, u.d.). A positive information Ratio (above zero) implies that the manager has achieved a positive return, and the higher the value, the more return has been achieved. If the IR is negative, it implies that the manager has achieved a negative return.

$$IR = \frac{R_p - R_i}{S_{p-i}}$$

Where:

R_p is the return of the portfolio

R_i is the return of the benchmark index

R_i is the Tracking Error

Figure 4 - The Information Ratio Formula

Beta

The beta is a measure of how sensitive the fund is to movements in the market in regard to volatility or systematic risk (Morningstar, u.d.). Beta is calculated using regression analysis where we can observe the investment's return response to swings in the market. A beta less than 1 means that the portfolio is less volatile than the market, while a beta greater than 1 indicates that the portfolio is more volatile than the market. A negative beta indicates that the portfolio fluctuates in the opposite direction than the market fluctuation.

$$\beta = \frac{Covariance(r_a, r_b)}{Var(r_b)}$$

Where:

Covariance is the property of a function of retaining its form when the variables are linearly transformed

Variance is a measure of the spread between numbers in a data set

r_a is the return of the asset

r_b is the return of the benchmark

Figure 5 – Formula for Beta

Alpha

Alpha is the excess return of a security relative to a market index benchmark (Morningstar, u.d.). It is dependent on that the beta is the only necessary risk measure and that the strength of the linear relationship between the fund and the benchmark index has been measured by R-squared. In this assignment we use alpha to directly measure the value added or subtracted by the fund manager. A positive alpha indicates that the fund has performed better than what its beta predicts, while a negative alpha indicates that the fund has performed worse.

$$\alpha = R_p - (R_f + (R_m - R_f)\beta)$$

Where:

R_p is the realized return of portfolio

R_f is the risk-free rate

R_m is the market return

Figure 6 - Formula for Alpha

The Fama and French Three-Factor Model

The Three-Factor Model is used as a method of explaining the risk and return of a stock or portfolio created by Eugene Fama and Kenneth French. It is an asset-pricing model that expands on the capital asset pricing model (CAPM) in order to make a better tool for evaluating managing performance (Blanco, 2012). CAPM is a model that describes the relationship between systematic risk and expected return and is used for pricing risky securities. The Fama-French Three-Factor model adds size and value to the market risk factor in CAPM. Its intent is to improve the model by considering that value and small-cap stocks regularly outperform the market and adjusts for this outperformance tenancy. Simply put, the model is attempts to explain excess return made by a fund. The first factor is market risk (beta) as in the CAPM model. The other two factors are *small minus big* and *high minus low*.

Small Minus Big

Small Minus Big (SMB) takes the spread in returns between large-sized and small-sized companies into account based on the companies' market capitalization. The factor is referred to as the "small firm effect" because smaller companies tend to outperform large companies. By incorporating the SMB-factor, we can see if the management of a fund was relying on the small firm effect to earn abnormal returns, meaning that they invested in stocks with low market capitalization.

High Minus Low

High Minus Low (HML) is referred to as a value premium and accounts for the spread in returns between value and growth stocks. The factor argues that companies with a high book-to-market ratio (value stocks) outperform companies with a lower book-to-market value (growth stocks). The book-to-market ratio is used to find the value of a company by comparing the book value of a company to its market value. HML gives an indication of the anticipated performance of the portfolio in the future. The formula for HML is used to calculate the associated range.

SMB and HML are calculated by combinations of portfolios composed by ranked stocks and available historical market data that can be found of Kenneth French's web page. The two factors are added to the CAPM which gives us the following formula:

$$r = R_f + \beta_3(K_m - R_f) + b_{SMB} * SMB + b_{HML} * HML + \alpha$$

Where:

r is the portfolio's expected return

β_3 is a "three factor" beta that is analogous to the normal beta,

but not equal to it, because there are now two additional factors

R_f is the risk-free rate of return

K_m is the return of the market portfolio

b_{SMB} and b_{HHL} are corresponding coefficients to SMB and HML once they are defined.

They are determined by linear regressions and can have positive or negative values

Up minus down big stocks (UMB)

In our initial analysis, in addition to the Fama and French three-factor model, we also include a fourth factor from Carhart four-factor model (Carhart, 1997). This is another extension to the CAPM and Fama and French three-factor model called up minus down big stocks (UMD). This factor measures the historical excess returns of the "winners" that went up minus the "losers" that lost value. This extension to the formula ads:

$$+ b_{UMD} * UMD$$

Where: b_{UMD} is the corresponding coefficient to UMB

Data and methodology

For the analysis in this paper, we have used monthly fund price data for 18 actively managed Norwegian funds over a ten-year period between January 2007 and January 2017. This time period includes the 2008 financial crisis, which heavily influenced the world's stock markets, including the Norwegian. The financial crisis and the aftermath will therefore heavily influence our dataset. The Norwegian fund market were chosen partly because studies in the past focused on the US market and partly because of the researchers are based in Norway. The 18 funds were chosen from the Norwegian website of Morningstar based on certain criteria. The criteria for a fund to be included in the analysis were the following:

I. The fund must have an active investment strategy.
II. The fund must be a Norwegian registered fund.
III. The fund must focus on the Norwegian equity market.
IV. The fund must have a minimum of 90% of its capital invested in stocks.
V. The fund must have been active within the time window mentioned.

This resulted in the final fund sample of 18 Norwegian actively managed funds. In addition to the 18 active managed funds, we chose three Norwegian index funds matching the same criteria as the active funds with exception of criteria I. as they have a passive investment strategy. Descriptive statistics of the selected funds are included in *table 1*. All price data for the selected funds and OSEBX for 120 months was collected from the Bloomberg Terminal, where the closing prices of the last trading day of each month was retrieved. All prices are adjusted for dividends and stock splits/reverse splits, as calculated by Bloomberg.

Due to criteria V. in selecting funds, survivorship bias may occur in our dataset. Survivorship bias is the tendency for mutual funds with poor performance to be shut down or merged into other funds. This phenomenon is widespread and may lead to overestimation of the average performance of mutual funds.

Studies show that chances for a fund's survival grows dramatically as you move to cheaper funds such as index funds. These funds are more than three times likely to survive than high-cost funds (Kinnel, 2016). In our dataset we have only included funds that have been active during the entire period as we could not find any survivorship-bias free data for the Norwegian market. Exclusion of funds that have been shut down may give a biased picture compared to reality and affect the results as the selection of funds in our dataset consists of funds that have been successful in the past.

	Returns			Fee structure		
	Average monthly return	**Average annual return**	**Std. Deviation**	**Front-end load**	**Management fee**	**Benchmark**
Alfred Berg Aktiv	0.55%	6.73%	0.3360	0.00%	1.50%	OSEBX
Atlas Norge	0.34%	4.02%	0.3284	0.10%	0.75%	OSEBX
Danske Invest II	0.59%	7.23%	0.3158	1.50%	1.25%	OSEBX
Delphi Norge	0.61%	7.31%	0.3483	0.20%	2.00%	OSEBX
DNB Norge III	0.39%	4.73%	0.3095	0.00%	1.00%	OSEBX
DNB Norge Selektiv II	0.44%	5.39%	0.3050	0.00%	1.00%	OSEBX
Eika Norge	0.30%	3.33%	0.3638	2.00%	2.00%	OSEBX
Fondsfinans Norge	0.68%	8.00%	0.3319	3.00%	1.00%	OSEBX
Pareto Aksje Norge I	0.35%	4.03%	0.3356	1.00%	1.00%	OSEBX
Pluss Aksje	0.54%	6.60%	0.3000	0.50%	1.20%	OSEBX
Storebrand Aksje Innland	0.26%	3.04%	0.2963	0.30%	0.60%	OSEBX
Storebrand Norge	0.43%	5.12%	0.3335	0.20%	1.50%	OSEBX
Storebrand vekst	0.81%	9.62%	0.4214	0.20%	2.00%	OSEBX
Nordea Norge Verdi	0.51%	5.91%	0.3124	0.50%	1.50%	OSEBX
Holberg Norge	0.22%	2.28%	0.3230	0.00%	1.50%	OSEBX
KLP AksjeNorge	0.43%	5.11%	0.3363	0.20%	0.75%	OSEBX
Nordea Kapital	0.48%	5.60%	0.3307	0.50%	1.00%	OSEBX
Handelsbanken Norge	0.58%	7.24%	0.3234	0.00%	2.00%	OSEBX
Average	0.47%	5.63%	0.3306	0.57%	1.31%	
Alfred Berg indeks	0.34%	3.99%	0.2942	0.00%	0.08%	OSEBX
KLP INDEKS I	0.34%	4.06%	0.2961	0.05%	0.10%	OSEBX
Pluss indeks	0.36%	4.30%	0.3021	0.50%	0.70%	OSEBX
Average	0.35%	4.12%	0.2974	0.18%	0.29%	

Table 1: Descriptive statistics for Norwegian mutual funds

Data for every fund's fee structure were found using the Norwegian Morningstar website. The standard deviation for every funds return were calculated on an annual basis. To calculate the average monthly and annual return, we used the geometric mean.

$$r_{i,average} = \left(\frac{p_{i,n}}{p_{i,1}}\right)^{\frac{1}{n}} - 1$$

Where:

$r_{i,average}$ is the average return over the period 1 to n.

$p_{i,n}$ is the price for fund i in period n.

$p_{i,1}$ is the price for fund i in the first period.

n is the number of periods,

for monthly average n was 120 and 10 for annual average.

Figure 7 - Formula of Geometric Mean

Risk free rate

The liquidity of Norwegian government bonds is considered weak compared to other western countries (Evjen, Grønvold, & Gundersen, 2017). Therefore, we found that Norwegian government bonds alone are not suitable as a measure of the risk-free rate in the market. Because of this we have used monthly forward-looking risk-free rates estimated from government securities and NIBOR (Ødegaard, 2017). NIBOR is the Norwegian interbank offered rate and is intended to reflect the interest rate level a bank require for unsecured money market lending in NOK to another bank. NIBOR is mainly used as it is more liquid, government bonds are used during the period before NIBOR (Ødegaard, 2017).

In our analysis later in this paper, we will use risk free rate to calculate the risk premium for every fund. In accordance with CAPM, by deducting the risk-free rate from the return of a fund we will obtain the risk premium.

$$R_i = r_i - rf$$

Where:

R_i is the risk premium for fund i.

r_i is the return for fund i.

rf is the risk free rate.

Figure 8 – Risk Premium

Benchmark index

We chose Oslo Stock Exchange Benchmark Index (OSEBX) as the benchmark for the funds (active and index). OSEBX is an investible index which comprises the most traded shares listed on Oslo Stock Exchange (Oslo Børs, 2017). We believe OSEBX was the most appropriate benchmark as OSEBX represent characteristics of all parts of the Norwegian market. The overall objective of this paper is to compare active managed portfolios returns to passive managed portfolios. Passive managed portfolios, such as index funds, are constructed to track a market index like OSEBX. In the analysis in this paper we have used price data for OSEBX to calculate tracking error and information ratio for every mutual fund.

Analysis

All the calculations of returns, standard deviation, Sharpe ratio, tracking error and information ratio and the production of graphs have been done by using Microsoft Excel. Stata was used to perform regressions in order to calculate alpha, beta and R^2 for each fund.

Performance

To compare the performance of each active fund, including OSEBX and index fund we graphed the growth of a hypothetical initial investment of NOK 100 over the time period from January 2007 to January 2017. In this analysis we show the impact of fees by comparing results, net and gross of fees.

Gross return

First, we present the gross return, meaning the performance before deduction of fees. The investment growth of the initial NOK 100 in the different funds are graphed in *figure 9* below.

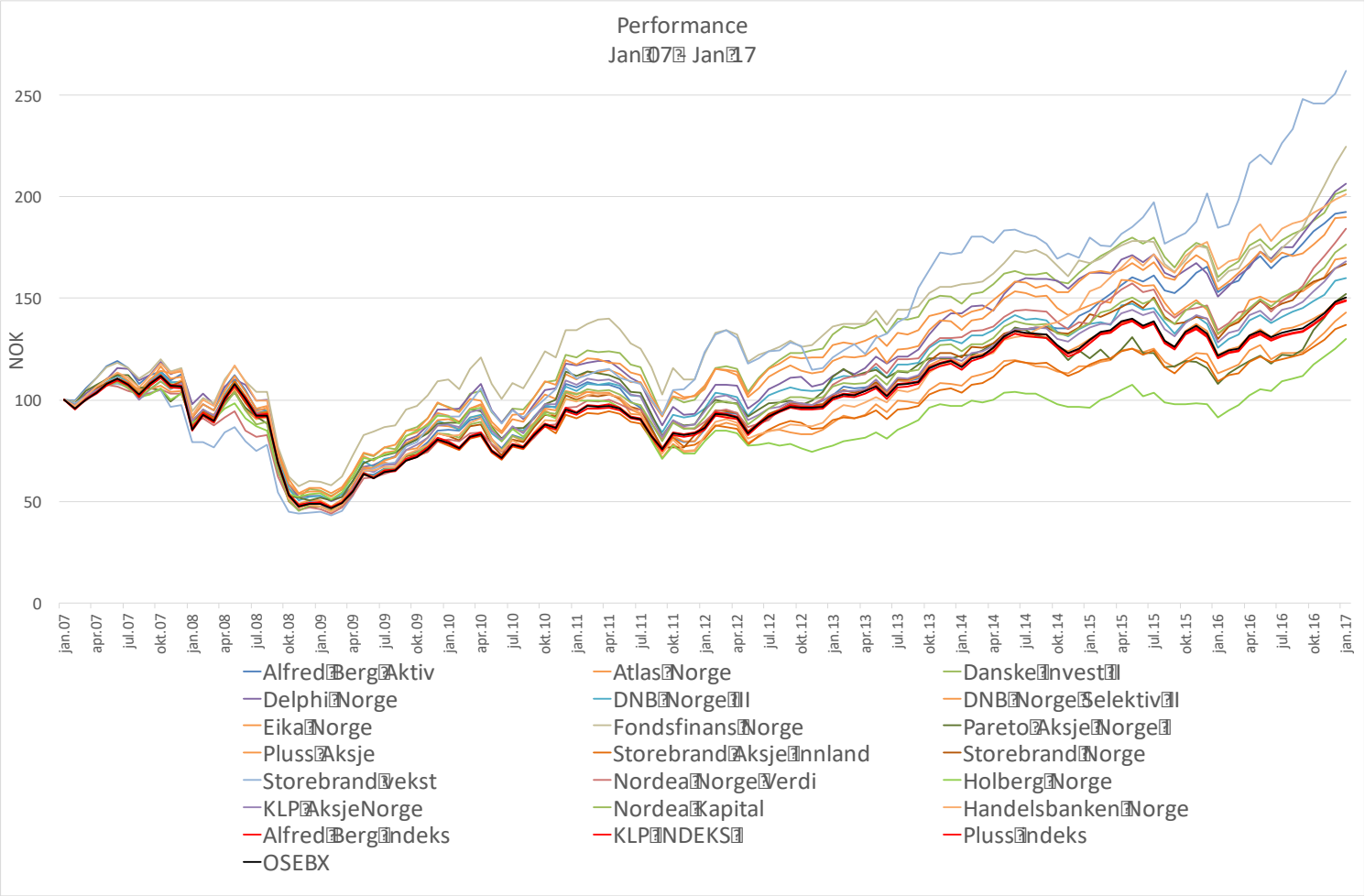


Figure 9: Performance Jan 07 - Jan 17, gross returns

The top performing fund of the 21 selected funds (active, index and OSEBX) over the ten-year period was *Storebrand Vekst*, in this fund the initial investment of NOK 100 grew to NOK 262.21. The worst performing fund was *Holberg Norge*, the NOK 100 grew to NOK 129.96 in this fund. Their benchmark index, OSEBX (highlighted in black), grew to NOK 150.43. The three passive managed index funds (highlighted in red), which are constructed to track OSEBX, followed the OSEBX closely and grew to respectively 149.83 (Alfred Berg Indeks), 150.83 (KLP Indeks I) and 153.63 (Pluss Indeks), averaging NOK 151.43. The average of the active managed funds was NOK 178.81.

Net return

Now we will present the results net fees by deducting the fees the different funds are charging. The net results enable us to determine whether any performance in picking stocks that outperform benchmarks is transferred over to investors after deducting the fees.

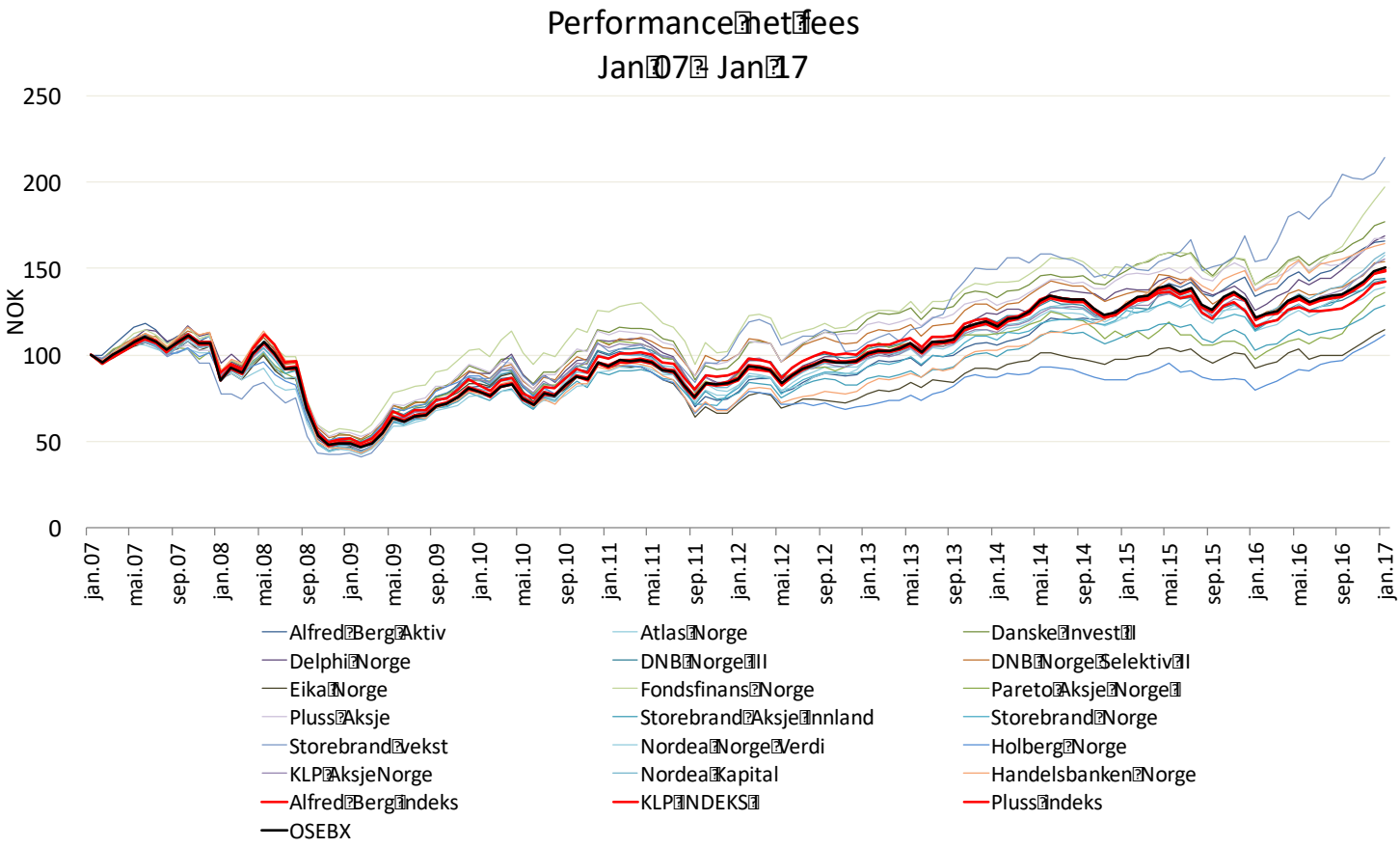


Figure 10: Performance Jan 07 - Jan 17, Net Returns

The top and worst performer after fees deducted was still *Storebrand Vekst* and *Holberg Norge*. They grew respectively to NOK 214.45 and NOK 111.86 from the initial investment of NOK 100. The average of the active managed funds has now fallen to NOK 155.62, which is barely above OSEBX that ended on NOK 150.43. The three index funds, which have substantially lower fees than the active managed funds, grew to respectively 148.64 (Alfred Berg Indeks), 149.25 (KLP Indeks I) and 142.54 (Pluss Indeks). *Pluss Indeks* has abnormal high fees considering it is an index fund. It has a management fee of 0.70% and a front-load fee of 0.50% compared to 0.00% front-load fee and 0.10% or lower management fee in the two other index funds. One of the active managed funds even has lower fees than *Pluss Indeks*, therefore we choose to exclude this index fund from this comparison. The average of the two cheapest index funds is NOK 148.94, which is close to the result of OSEBX.

Regression

We want to focus on the performance results gross fees. Evaluating these results allow us to identify if any of the selected active funds have skills in picking stocks that outperform relevant benchmarks. Therefore, we perform a linear regression on the monthly growth data for each fund compared to OSEBX. Results from linear regression will help us determine if the excess return relative to the OSEBX

benchmark is caused by something other than random chance or luck, as for example skills in stock picking.

Linear regression is a static method used to find correlations between to variables from a set of observations. A simple linear regression model can be noted by the following equation:

$$Y = \alpha + \beta X + \varepsilon$$

Where:

Y is the dependent variable, in this case the return of a fund.

X is the explanatory variable, in this case the return of the benchmark index.

α is the excess return of a fund relative to the benchmark index.

β is the correlation between the fund returns and the benchmark index.

ε is the random error component.

We have performed a such regression analysis in the data analysis and statistical software Stata to observe the correlation between the returns to a fund and the benchmark index (OSEBX). An output from a simple linear regression in Stata is shown in *table 2*. In this example, we tested the correlation between the return of the fund *Alfred Berg Aktiv* (vf1) and OSEBX (vose). The coefficient to vose represent the β of the fund. The constant coefficient (_cons) represent the fund's excess return i.e. alpha. The P-value ($P > |t|$) shows the statistical significance of the results. We have set the significance level at 0.05. The last important key number to observe from this output is R-squared (R^2), which is the percentage of the fund's movement that can be explained by OSEBX (vose).

Source	SS	df	MS	Number of obs	=	120
				F(1, 118)	=	1684.78
Model	.431434871	1	.431434871	Prob > F	=	0.0000
Residual	.03021711	118	.000256077	R-squared	=	0.9345
				Adj R-squared	=	0.9340
Total	.461651981	119	.003879428	Root MSE	=	.016

vf1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
vose	.9943362	.0242249	41.05	0.000	.9463644	1.042308
_cons	.0022194	.0014665	1.51	0.133	-.0006847	.0051235

Table 2: Output from Stata, simple linear regression.

Further, we performed the same regression again but now with the Fama-French factors SMB, SML and including the momentum factor UMD as additional variables, to see if they could explain more of the fund's movement. Monthly data for the Fama-French pricing factors were gathered by Professor Bernt Arne Ødegaard at the University of Stavanger using Norwegian data (Ødegaard, 2017) .

Generally, the R^2 did see a slight increase in the regressions with the Fama-French factors, but not a significant increase. *Table 3* show an output from the same regression as above, but with Fama-French factors as additional variables. The coefficient of SMB, SML and UMD show how much the factor contribute to the fund's return.

Source	SS	df	MS	Number of obs	=	119
				F(4, 114)	=	462.35
Model	.434833577	4	.108708394	Prob > F	=	0.0000
Residual	.02680364	114	.00023512	R-squared	=	0.9419
				Adj R-squared	=	0.9399
Total	.461637218	118	.00391218	Root MSE	=	.01533

vf1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
vose	1.073919	.0341159	31.48	0.000	1.006335	1.141502
SMB	.1573265	.0485643	3.24	0.002	.0611209	.2535321
HML	-.0457278	.0388682	-1.18	0.242	-.1227255	.0312699
UMD	.0442051	.0294578	1.50	0.136	-.0141507	.1025608
_cons	.0007846	.0014865	0.53	0.599	-.0021601	.0037293

Table 3 - Output from Stata, Simple Linear Regression - With Fama-French Factors

The results from all linear regressions are found in *table 3*, with and without the Fama-French factors. It can be noted that all the beta-values for each fund was statistical significant with P-values approximately equal to zero. Other factors that are statistical significant with a significance level of 0.05 are highlighted in red.

Results from the simple regressions with only one variable, OSEBX, show that none of the 18 actively managed funds have significant alpha-values, meaning their excess returns above OSEBX are statistical non-significant. These results show that we cannot reject a null hypothesis of equal expected returns for the fund and OSEBX. R^2 support this as it ranges from 73.56% to 98.39% among the actively managed funds.

From the regressions with the additional Fama-French factors, two actively managed funds have significant alpha-values. But not without misgivings. The alpha P-value for *Danske Invest II* are very close to the significance level of 0.05. With a such small data sample of only 18 actively managed funds, chances for a type I error increase. Type I error in statistics is the process of incorrectly rejecting the

null hypothesis in favour of the alternative. Therefore, we have to be careful to reject the null hypothesis based on P-values close to the significance level with such a small data sample. *Pluss Aksje* has alpha P-value comfortable below the significance level of 0.05, but none of the additional variables in the model are significant. This means that we are reluctant in rejecting the null hypothesis as the alpha value is non-significant in the simple model.

Many of the funds get significant results for the SMB factor, which accounts for the difference in returns between small and large companies. Only two funds showed significant results for HML factor, which accounts for the difference in returns between value and growth stocks. But none of these significant SMB/HML results in a significant alpha for the funds. In a guest lecture at NHH, Øyvind Schanke, CEO of Skagen funds, claimed that the momentum factor did not work for portfolios, only for single stocks (2017). Hence this statement we ignore the results regarding the momentum factor (UMD).

				With Fama/French factors:					
	Alpha	**Beta**	**R-squared**	**Alpha**	**Beta**	**R-squared**	**SMB**	**HML**	**UMD**
Alfred Berg Aktiv	0,2219%	0,9943	0,9340	0,0785%	1,0739	0,9399	**0,1573**	-0,0457	0,0442
Atlas Norge	0,0052%	1,0085	0,9584	-0,0214%	1,0498	0,9595	**0,0961**	-0,0045	-0,0257
Danske Invest II	0,2707%	0,9521	0,9368	**0,2937%**	0,9810	0,9386	0,0802	0,0050	**-0,0565**
Delphi Norge	0,2946%	0,9277	0,8942	0,1620%	1,0266	0,9031	**0,1865**	0,0395	0,0213
DNB Norge III	0,0558%	0,9746	0,9839	0,0729%	0,9748	0,9845	0,0140	-0,0260	-0,0199
DNB Norge Selektiv II	0,1100%	0,9743	0,9663	0,1505%	0,9772	0,9675	0,0199	0,0007	-0,0376
Eika Norge	-0,0161%	0,9660	0,8987	-0,0887%	1,0650	0,9127	**0,2164**	0,0415	-0,0543
Fondsfinans Norge	0,3609%	0,9611	0,8919	0,2764%	1,0528	0,9005	**0,2038**	0,0159	-0,0450
Pareto Aksje Norge I	0,0680%	0,8426	0,8095	-0,0426%	0,9753	0,8388	**0,3050**	-0,0154	-0,0703
Pluss Aksje	0,2197%	0,8873	0,9450	**0,2843%**	0,8669	0,9467	-0,0229	-0,0215	-0,0373
Storebrand Aksje Innland	-0,0714%	0,9850	0,9813	-0,0938%	1,0056	0,9819	0,0364	0,0252	0,0011
Storebrand Norge	0,1096%	0,9835	0,9179	0,0676%	0,9963	0,9187	0,0281	-0,0361	0,0171
Storebrand Vekst	0,5351%	0,9227	0,7356	0,4915%	0,9529	0,7552	0,1400	**-0,1949**	-0,0791
Nordea Norge Verdi	0,2202%	0,8238	0,8649	0,1967%	0,9089	0,8862	**0,1801**	**0,1041**	**-0,0726**
Holberg Norge	-0,0695%	0,8320	0,8400	-0,1948%	0,9526	0,8621	**0,2568**	0,0317	-0,0373
KLP AksjeNorge	0,1062%	0,9939	0,9429	0,1048%	1,0242	0,9459	0,0829	-0,0089	-0,0463
Nordea Kapital	0,1387%	1,0095	0,9729	0,1282%	1,0282	0,9743	0,0540	-0,0190	-0,0270
Handelsbanken Norge	0,2618%	1,0374	0,9154	0,1103%	1,1145	0,9230	**0,1615**	-0,0756	0,0392
Alfred Berg Indeks	-0,0019%	0,9904	0,9996	-0,0050%	0,9916	0,9996	0,0012	0,0012	0,0024
KLP INDEKS I	0,0032%	0,9965	0,9974	0,0037%	0,9908	0,9974	-0,0131	-0,0039	0,0057
Pluss Indeks	0,0198%	0,9915	0,9880	0,1042%	0,9636	0,9898	-0,0379	-0,0039	**-0,0490**

Table 4 - Stata results of linear regression.

Based on the regression in our data set, we assume that random chance or luck is the cause of returns differing from one another. The differing results are not explained by any tangible statistical significance. Subsequently, we can imply that these results are correlated to luck and according to the theory presented by Harris, this is a feasible assumption.

Risk adjusted return

	Average annual return	Std. Deviation	Sharpe ratio	Tracking error	Information ratio
Alfred Berg Aktiv	6,73%	0,3360	0,3195	0,0159	3,1103
Atlas Norge	4,02%	0,3284	0,2282	0,0127	1,3487
Danske Invest II	7,23%	0,3158	0,3161	0,0152	2,7576
Delphi Norge	7,31%	0,3483	0,3224	0,0198	2,7513
DNB Norge III	4,73%	0,3095	0,2419	0,0077	2,2148
DNB Norge Selektiv II	5,39%	0,3050	0,2645	0,0111	2,0574
Eika Norge	3,33%	0,3638	0,2094	0,0197	0,9318
Fondsfinans Norge	8,00%	0,3319	0,3324	0,0204	2,5754
Pareto Aksje Norge I	4,03%	0,3356	0,2203	0,0265	0,6094
Pluss Aksje	6,60%	0,3000	0,3354	0,0146	2,0491
Storebrand Aksje Innland	3,04%	0,2963	0,2374	0,0083	-0,0306
Storebrand Norge	5,12%	0,3335	0,3035	0,0178	1,7166
Storebrand Vekst	9,62%	0,4214	0,3848	0,0338	2,7067
Nordea Norge Verdi	5,91%	0,3124	0,3293	0,0224	1,4386
Holberg Norge	2,28%	0,3230	0,1987	0,0242	-0,2651
KLP AksjeNorge	5,11%	0,3363	0,2970	0,0148	1,9771
Nordea Kapital	5,60%	0,3307	0,3160	0,0102	3,3189
Handelsbanken Norge	7,24%	0,3234	0,3162	0,0192	2,3124
Average	5,63%	0,3306	0,2874	0,0175	1,8656
Alfred Berg Indeks	3,99%	0,2942	0,2245	0,0013	6,1924
KLP INDEKS I	4,06%	0,2961	0,2269	0,0031	3,0197
Pluss Indeks	4,30%	0,3021	0,2281	0,0066	1,6719
Average	4,12%	0,2974	0,2265	0,0037	3,6280

Table 5: Risk-return performance measures.

From *table 5* we see the results of the risk adjusted returns. With a standard deviation of 42,14% *Storebrand Vekst* stands out above the mean of 33,06%. The good performance of Storebrand Vekst can thus be explained by the higher risk relatively to the other funds.

Storebrand Vekst aslo has the highest Sharpe ratio, meaning the fund achieved the highest risk adjusted returns. It is also notable that the mean for actively managed mutual funds is higher than the index funds.

As expected, the tracking error for index funds is lower than the active funds. This is obvious as index funds are constructed to mirror the market and the benchmark index they try to replicate, as well as being diversified. On the other hand, the active funds per definition are poorly diversified.

Storebrand Aksje Innland and *Holberg Norge* are the only funds with a negative information ratio. This implies that they did not manage to generate excess returns relative to the OSBEX, or that they were inconsistent in doing so.

Weaknesses of the analysis

The analysis is based on a rather small dataset, with only 18 actively managed funds and three index funds. Such a small dataset makes it difficult to prove anything about active portfolio management compared to passive. Our dataset may also be subject to survivorship bias as we have chosen to only research funds that have been successful in the past. The chosen time period is relatively small to prove anything regarding this subject. Ten years may seem like a long period, but in this case, we need more data to be sure in our conclusion.

Conclusion

The overall objective of this paper was to compare passively managed mutual funds with actively managed mutual funds to see if Norwegian investors are better of investing their savings in the latter. There are many contradicting theories and hypothesis regarding the performance of passively versus actively managed funds. Sharpe's famous arithmetic of active management as well as the efficient market hypothesis debunks our research question. Contradictorily, Lasse Pedersen's revised and more realistic take on the arithmetic shows how it in fact is possible for active management to add value relative to passive management.

Although Pedersen's arithmetic claims it is possible for actively managed mutual funds to add value, we have seen how the fees play a key role when comparing passive and active funds. With high front-end loads and annual fees, expensive mutual funds are dependent on beating the market quite substantially to make excess returns for their investors.

The basis for the analysis was to compare 18 actively managed Norwegian mutual funds to three passively managed Norwegian mutual funds, using the Oslo Stock Exchange Benchmark Index (OSEBX) as a benchmark. As one of the criteria's, all the funds had to have a minimum of 90% of its capital invested in stocks. By implementing our chosen performance measures, we could not find any statistically significant difference in the mutual funds returns. Thus, we cannot reject the null hypothesis of equal expected returns for active and passive management.

As our dataset consists of only a small sample of the huge population of different mutual funds, the inference is not valid. Thus, any characteristics observed from our dataset is not necessarily representable for the entire population of mutual funds.

As a result, we cannot conclude whether the common Norwegian investor is better of investing his money in an actively managed fund compared to a passively managed fund on the basis of this analysis. As stated by Pedersen, active funds might be able to add value relatively to passive funds, but the costs must be evaluated versus the benefits.

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