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Ethical Funds' Performance

-A performance evaluation of eight ethical funds versus each other and the market

Bachelor Thesis 15 hp
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1 Abstract

This thesis provides an explanation of how well ethical funds perform in relation to a suitable market index and it also evaluates which bank in Sweden has the best performing Swedish ethical fund as well as the best performing Global ethical fund, between 2008 and 2011. Furthermore, it investigates if the funds are significantly different from the market index or not, by a reliable statistical method.

The investigation ultimately concludes that all observed funds are outperformed by their prospective suitable market index, with a significance level of five per cent. Nordea manages the best performing Swedish fund and Swedbank manages the best performing Global fund.

Keywords: Ethical fund, Mutual fund, Significance level, Sharpe ratio, Treynor ratio, CAPM, Single Index Model

2 Introduction

This chapter includes a description of background, research problem, purpose and method providing the reader with an introduction to the study.

2.1 Background

The frequency of ethical investments i.e. socially responsible investments (SRI) has increased during the last decade (Karlsson 2006 p. 229). The first ethical fund was initiated in the U.S. in 1928 by the temperance movement. This fund excluded investments in companies operating in the alcohol- and the tobacco industries. In the 1960s, large funds were established which rejected investments in companies selling weapons to the U.S. army during the Vietnam War. Further on, in the 1970s, funds boycotting the South African apartheid policy became essential. Since then, many new ethic and environmental funds have been created. Today almost all banks and investment brokers offer ethical funds (Karlsson & Möller 2007 p. 55).

Nowadays, many investors require that their investments are not used for unethical business purposes (Boatright 2008 p. 119). In the Swedish financial market, there are approximately a hundred ethical funds that together administer more than 120 billion SEK. Ethical funds therefore represent ten per cent of the fund savings in Sweden (aktiespararna.se 2011).

2.2 Research problem

Investment decisions are often handled in the context of an objective finance theory with the purpose of maximizing profit and minimize risk (Bodie et al. 2011 p. 188). The theoretical methods are often technical and do not consider the complexity of investment decisions and the effects on society (Boatright 2008 p. 8). The basic strategy to minimize risk is to diversify an asset portfolio by spreading investments over several assets (Bodie et al. 2011 p. 225). When the number of electable assets is reduced, the composition might result in a less diversified portfolio due to the restraints of choosing only ethical assets. In theory, a less diversified portfolio will have a higher risk than a well-diversified portfolio (Karlsson & Möller 2007 p. 93). In other words, fairness and ethical choice is in conflict with efficiency, resulting in an inevitable equity-efficiency trade off (Boatright 2008 p. 31).

Proponents for ethical investments claim that, even though the number of assets is limited, return and risk are not negatively affected negatively and propose that ethical companies in most cases reveal more public information. The result is less scandals and disasters, which in turn makes the businesses and those ethical businesses stock market prices more stable (Karlsson & Möller 2007 p. 93).

Earlier studies of ethical fund performance provide different results. Empirical studies conducted in the U.S. exhibit that an ethical approach portfolio yields similar or slightly weaker performance than their unrestricted portfolio counterparts. (Otten et al. 2002 p. 1751-1767). Other studies claim that the return from ethical assets is not statistical significantly different from other assets (Goldreyer et al. 1999 p. 24).

2.3 Purpose

The purpose of this study is to evaluate the performance of eight ethical mutual funds provided by the four major Swedish banks. The authors have chosen to limit the examination to a specific time period; 3th of November 2008 until 3th of November 2011, during a major economic crisis[1] in order to examine the ethical funds' performance during volatile times. Performance is compared to the market by using a suitable market index. The funds are additionally compared against each other by using risk- and return measures.

2.3.1 Question formulations

We intend to answer the following questions:

- **What is the outcome of the ethical funds compared to their suitable market index?**
    - **Is each fund's performance different from market performance in regard to statistical significance tests?**
- **Which bank has the best performing Swedish- and global ethical funds?**

[1] The crisis started with the Lehman Brothers bankruptcy in 2008.

2.4 Problem delimitation

The study is delimited to ethical funds exhibited by the four large Swedish banks; Nordea, Skandinaviska Enskilda Banken (SEB), Svenska Handelsbanken and Swedbank. In order to have a manageable amount of funds, the study is delimited to only one global and one Swedish ethical fund from each bank. All funds have a low deposit price in order to focus on funds selected by small investors. The study will only consider the selected time period and only make conclusions based on the parameters outlined.

The study does not criticise the banks' definition of ethical funds, although this definition is vague and differs between researchers. The study only focuses on the funds' actual results according to the index and do not confirm if the funds are really ethical in a wider perspective.

3 Financial and statistical theory

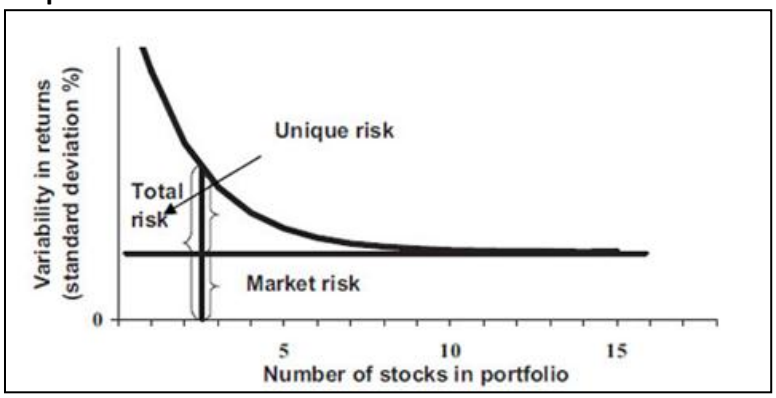
This chapter specifies theory and different ratios that will be used to evaluate the funds' performance. In the first section diversification strategy and the portfolio optimization are clarified. Thereafter, different risk measurements and ratios are defined. In the last section the econometric principle is specified.

3.1 Diversification strategy

Investments in a portfolio imply at least two kinds of risks, systematic- and non-systematic risk. Systematic risk, market risk and beta risk are the same measure (Bodie et al. 2011 p. 225). The opposite is firm-specific risk, non-systematic risk or unique risk. The total risk, σ_i^2, is the systematic risk, $\beta_i^2\sigma_m^2$, plus the non-systematic risk, $\sigma^2(e_i)$ (Bodie et al. 2011 p. 278). Diversification is a strategy that reduces the non-systematic risk of a portfolio. Systematic risk i.e. macro factors such as crisis, cannot be reduced by diversification. There are mainly two strategies to diversify; the naïve- and the efficient strategy (Bodie et al. 2011, ch. 7).

The naïve strategy spreads the investments into different assets and can reduce the non-systematic risk. When the amount of assets rises above approximately 10-15, the effect of diversification dies out (Bodie et al. 2011 p. 225). See Graph 01.

Graph 01. Benefits of diversification



Source: Youthmagz (2011)

In the article *How many stocks make a diversified portfolio*? by Statman (1987) he argues that an amount between 30 to 40 assets would be the appropriate number of assets to construct a well diversified portfolio, in contradiction to Bodie et al.

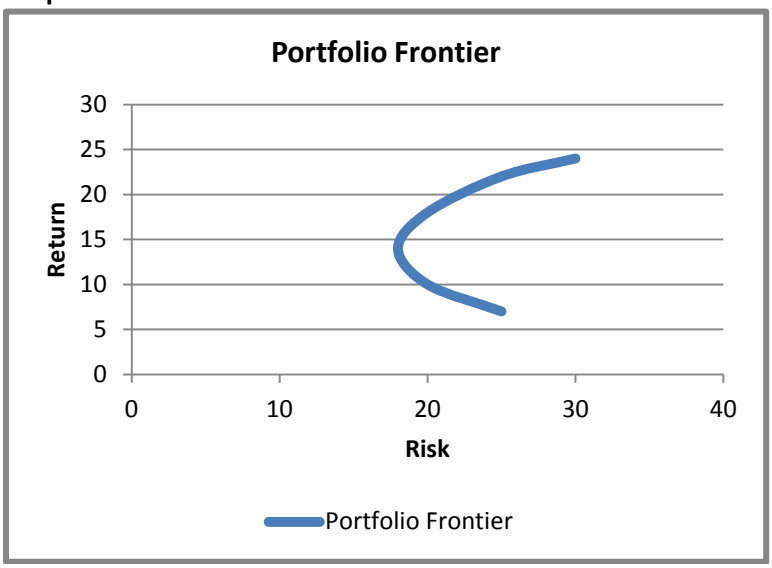
The efficient strategy postulated that one should invest in assets having low correlation between each other (Bodie et al. 2011 p. 227), see following section 3.2 Portfolio optimization.

3.2 Portfolio optimization

Portfolio opportunity set or Portfolio frontier is a combination of assets with different weights. Different weights provide different outcomes along the opportunity set. The correlation between the assets determines the shape of the curve. High correlation presents almost a straight efficient frontier and low or negative correlation provides a more convex curve towards the y-axis (backward shaped). This implies that a more convex curve is more reduced to risk (Bodie et al. 2011 p. 233).

At the point closest to the y-axis the minimum variance is defined. This point is the combination of the assets with the lowest risk. The portfolio opportunity set above this point is the efficient frontier, which provides the best risk-return combination. Outcomes on the efficient frontier are candidates for an optimal portfolio (Bodie et al. 2011 p. 233).

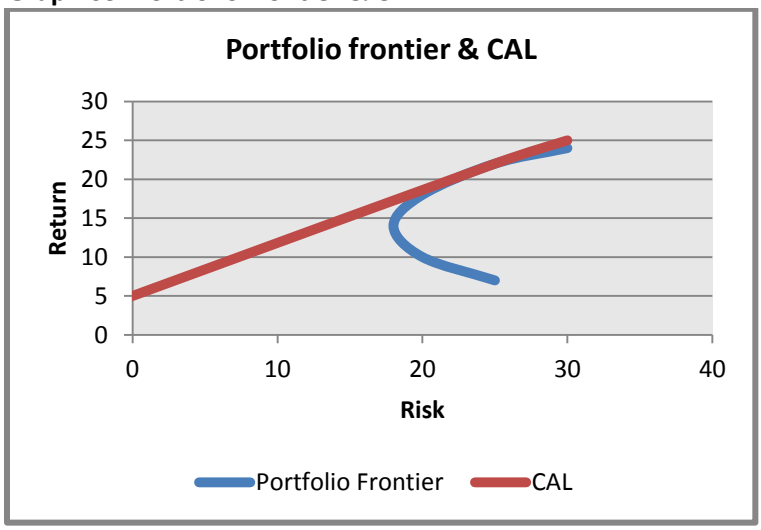
Graph 02. Portfolio frontier



Source: Fictional figures, illustration made by authors

To define the optimal portfolio, a risk free asset is added to the model. A capital allocation line, CAL, is drawn from the y-axis, starting at the risk free rate, to tangent the efficient frontier. Where the line tangents the efficient frontier, the optimal portfolio is defined. The slope of the CAL is termed the *reward-to-volatility* i.e. Sharpe ratio (Bodie et al. 2011 p. 239).

Graph 03. Portfolio frontier & CAL



Source: Fictional figures, illustration made by authors

3.2.1 The capital asset pricing model (CAPM) and the single index model (SIM)

In financial theory, CAPM is one of the fundamental models used to calculate the expected return of an asset or a portfolio. Frequently, the model is used as a benchmark to market return (Bodie et al. 2011 p. 308).

Formula to calculate expected return: $$E(r_i) = r_f + b_i(r_m - r_f)$$

While CAPM is the theory about expected return, the Single Index Model is an empirical version used to calculate excess return. The market return in the model works as the only macroeconomic factor (Bodie et al. 2011 p. 277).

Formula to calculate Single Index Model: $$r_i - r_f = a_i + b_{i2}(r_m - r_f) + e_i$$

3.2.1.1 Passive and active management

The ascription *passive management* means that one holds a highly diversified portfolio without putting effort into improving the investment performance through analysing the assets. A more *active management* is defined by, for example, trying to identify a mispriced asset in order to improve the investment performance (Bodie et al. 2011 p. 240).

3.3 Portfolio statistics

3.3.1 Geometric mean

The geometric mean is called a time-weighted average return because each past return receives an equal weight in investment calculation. If an investor has losses one year, he or she has less capital to invest the next year to generate return. This mean is suitable for calculating the actual performance of the portfolio of long-term data (Bodie et al. 2011 p. 159).

Formula to calculate geometric mean:

$$GM = (\prod(HPR)^{1/N}) - 1$$

HPR= Holding period return

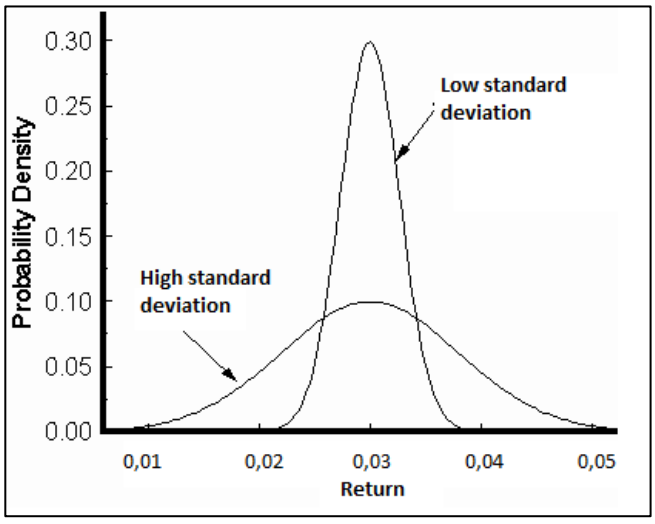
3.3.2 Standard deviation

Standard deviation i.e. total risk explains the variation from the average expected return and is the square root of the variance. A low standard deviation indicates that the observed value is close to the average return (Bodie et al. 2011 p. 156). Another way of explaining the standard deviation is the spread of the normal distribution, where a low standard deviation demonstrates a concentrated normal distribution (Hill et al. 2010 p. 29). See Graph 04.

Formula to calculate standard deviation of a sample:

$$\sigma = \sqrt{\frac{1}{N}\sum(r_i - \bar{r})^2}$$

Graph 04. Normally distributed



Source: Fictional figures, illustration made by authors

3.3.3 Covariance

The covariance measures how much two variables vary together on average. A positive covariance indicates that the variables move in the same direction and the relationship is reversed for a negative covariance. If the covariance is equal to zero, it indicates that there is no correlation between the two variables (Bodie et al. 2011 p. 278).

Formula to calculate covariance: $$s_{12} = b_1 b_2 s_m^2$$

3.3.4 Beta

The systematic risk, beta risk, measures the degree of how much the stock/portfolio and the market move together. A beta value equal to one denotes that the stock/portfolio and the market have the same pattern. If the beta value is equal to minus one it denotes that the stock/portfolio and the market move in opposite directions and if it is equal to zero it denotes that the stock/portfolio and the market do not move together at all (Bodie et al. 2011 p. 310).

Formula to calculate beta: $$\beta = \frac{Cov(r_i, r_M)}{\sigma_m^2}$$

3.3.5 Sharpe and Treynor ratio

The Sharpe ratio is defined as the slope of the capital allocation line, CAL. It describes the additional return for one unit of risk that is taken. Thus, the ratio is a trade-off between return and risk, the greater the ratio is, the greater is the return per every unit of risk (Bodie et al. 2011 p. 161).

Formula to calculate Sharpe ratio: $$SR_p = \frac{E(r_p) - r_f}{s_p}$$

The Treynor ratio is similar to the Sharpe ratio. It is a trade-off between risk and return, but uses the beta value instead of total risk. If all non-systematic risk is diversified away, the total risk equals the systematic risk. A portfolio is well-diversified if the Sharpe- and Treynor ratio give identical ranking (Bodie et al. 2011 p. 850).

Formula to calculate Sharpe ratio: $$TR_p = \frac{E(r_p) - r_f}{b_p}$$

3.4 The econometric concept

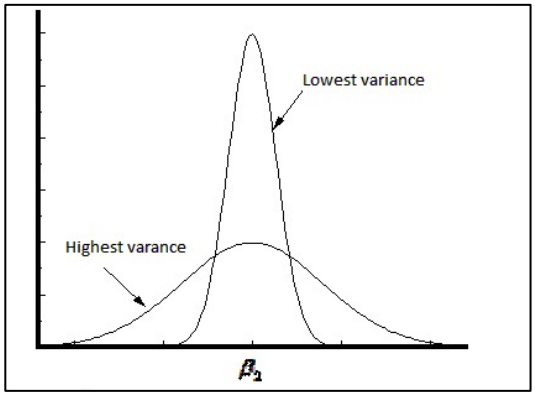
Econometrics is the application of a statistical method that intends to answer the question *"how much?"* (Hill et al. 2011 p. 3).

3.4.1 Least squares estimator/Ordinary least squares, OLS

The b_2 (OLS) is an estimation of the parameter b_2 from the model. To get the best estimation of b_2, the OLS have to be the best linear unbiased estimator, BLUE. *Best* is the OLS with the lowest variance (see Graph 05). *Unbiased* is the OLS with the centre of the bell-shaped curve above the mean (see Graph 06). If all the assumptions hold (see following section, 3.4.1.1) b_2 (OLS) is an unbiased estimator of b_2 (Hill et al. 2011 p. 47).

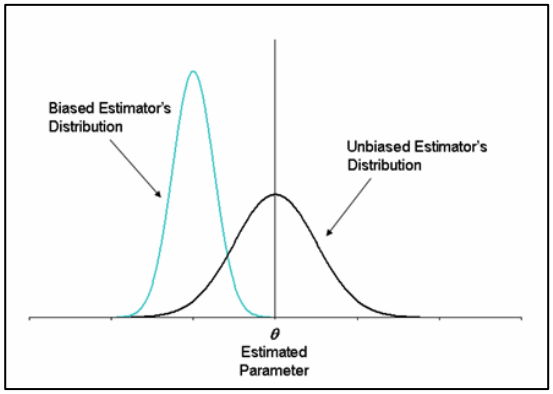
Estimation of the equation: $y = b_1 + b_2 x + e \rightarrow \hat{y} = b_1 + b_2 x + \hat{e}$

Graph 05. Best linear OLS



Source: Weibull (2008)

Graph 06. Unbiased or biased OLS



Source: Weibull (2008)

3.4.1.1 Assumptions of the simple linear regression model

1. The random error, *e*, represents all other factors that will effect y, except x. If the error term is put into the simple regression function, the simple linear regression model is expressed: $y = b_1 + b_2 x + e$
2. The expected value of the random error *e* is: $E(e) = 0$
3. The variance of the random error is: $Var(e) = s^2 = Var(y)$, (*y* and *e* has the same variance, because they only differ by a constant)
4. The covariance between any pair of random errors is: $Cov(e_i, e_j) = Cov(y_i, y_j) = 0$
5. The variable *x* is not random and must take at least two different values
6. The values of *e* are normally distributed about their mean: $e \sim N(0, \sigma^2)$, (If the values of *y* are normally distributed)

(Hill et al. 2011 p. 47)

3.4.1.2 Violation of the assumptions

To be able to use OLS the model needs to be a linear function (assumption 1) and the variable *x* must take at least two different values and cannot be random (assumption 5). The regression must have a meaningful interpretation and on average be correct (assumption 2). The residuals must be normally distributed (assumption 6). It is essential that the variance is constant over time, otherwise *e* has *heteroskedasticity* (assumption 3). It is also essential that the covariance between random errors is equal to zero, otherwise e has *autocorrelation* (assumption 4) (Hill et al. 2011 ch. 4).

If assumption three and four are violated, the OLS is no longer BLUE and need to be adjusted. To correct assumptions three and four, a *robust standard error* or a *dynamic model* is required to do an estimation of the regression. A robust standard error is also named the HAC standard error, heteroskedasticity and autocorrelation consistent standard error. The dynamic model adds lags in compensating for the heteroskedasticity and autocorrelation (Hill et al. 2011 p. 309).

4 Methodology

This chapter ought to give the reader an outline of the method and a description of the data material used in the study. One section in this chapter will discuss criticism of the method.

From the four large Swedish banks, one Swedish and one global ethic funds were selected, see data description section 4.3 for further information. The purpose is to study funds during a volatile time. Therefore, the time period stretches from the Lehman Brothers' collapse in 2008 until 2011. The time period is three years back from the first trading day in November 2011 (2008-11-03 until 2011-11-03). We collected daily price data for all ethical funds from Svenska Handelsbanken's webpage. The administrative costs are already withdrawn from the daily prices. In order to achieve a reliable price, the dividend is added manually to the daily prices for the funds that do not reinvest dividend payment. A few funds automatically reinvest their dividend payment. The funds' daily prices were recalculated into an index to be able to compare the funds' outcomes with the market index and each other, illustrated in graphs. The daily prices were also recalculated into daily return to estimate financial measures and regressions.

To make an apt comparison, a suitable index for each fund was used. Market indices were collected from the database, DataStream. The Swedish stock exchange market index, SIX30RX, was compared with the Swedish funds and MSCI world gross index was compared with the global funds. The market indices were recalculated to the same base date as the eight funds. The risk free rate exemplified by treasury security was collected from the Swedish Riksbank's webpage.

To examine the funds' outcome, the tool "problem solver" in Excel was used to estimate the variance, standard deviation, beta value, annually average return, as well as Sharpe- and Treynor ratios for the eight funds.

4.1 Single index model

Throughout all estimations, analyses were made through the single index model, which is based on the capital asset pricing model. The risk premium was calculated for each fund, the Swedish market and the global market return. Further on, the risk premium was used to create a regression of each fund and a suitable market index.

Single Index Model: $r_i - r_f = a_i + b_{i2}(r_m - r_f) + e_i$

4.1.1 Null-hypothesis test

A null hypothesis tests were used to determine if the funds' beta value is significantly different or less than the market beta value. We used the software STATA as a tool when testing the hypothesis. First we had to check if there were any violations of the assumptions, for the best linear unbiased estimator in the data. If we determined that violations existed we saw to correcting them. In time series data it is always necessary to test for heteroskedasticity and autocorrelation. Tests that are made in STATA are called the Breusch-Pagan Test (heteroskedasticity) and the Breusch–Godfrey test (autocorrelation). After these tests were finished and it is determined if the data was violated or not, a new regression was formulated with the Newey-West method and with the right number of lags. The new values resulting from the tests, a robust standard error, were used in the null-hypothesis to test if the beta values were significantly different and significantly less than the market beta value.

4.2 Criticism

In this study all Swedish funds are compared with the SIX30RX and all global funds with the MSCI world gross index, as we have come to the conclusion that those indices are most suitable for the funds. However, the choice was deemed most suitable for an all-around comparison for our funds. It might be the case that other indices would correlate better with some of the funds and consequently provide other results.

The alpha and beta values in this study are calculated with the use of historical values and are not a prediction of the future. The CAPM and SIM are estimated with a future alpha- and a future beta value, which imply that the original CAPM and SIM are modified throughout this study. On the other hand, this study only discusses the historical outcome and will not make any statement about the future.

4.3 Data description

4.3.1 Funds

All funds are categorized as mutual funds with a low deposit payment (Handelsbanken.se 2011). The similarity of all chosen funds is that they are all restricted by the Global Ethical Standards, GES, whose purpose is to systematically screen companies with respect to international settlements agreements and guidelines on the environment, human rights and corruption (ges-invest.com 2011). No investments are made in companies with business concepts related to weapons, alcohol, tobacco, gambling or pornography. A company is not selected if more than five per cent of the production or earnings originate from the mentioned areas (Handelsbanken.se 2011). A fund can be categorised as a portfolio since it is a collection of financial assets (Bodie et al. 2011 p. 36).

4.3.1.1 Mutual funds

A mutual fund has at least 75% of its capital invested in stocks. The combination of stocks can be spread all over the world (global) or concentrated in a particular region, in one country or in a specific sector (Nilsson 2007 p. 34). Another approach is that the fund only invests in a specific category of companies, for example companies that have environmental principles or achieve ethical standards (aktiespararna.se 2011).

4.3.2 Swedish funds

4.3.2.1 Handelsbanken Sverige index etisk (HSwe)

The fund has had a dividend payment, in March of every year during the selected time period. The main sectors for investment are “industrial and services” and “financial and property”, which account for almost 60% of all sectors. The fund comprises 239 different assets and the three principal holdings are Hennes & Mauritz AB (8.44%), Nordea Bank AB (8.34%) and Ericsson B (7.7%). The fee for this fund is 0.65% per year (Handelsbanken.se 2011)

4.3.2.2 Nordea etiskt urval Sverige (NSwe)

The fund manages by a “Stock-picking-price-theory”[2] and aims to find under-priced companies regardless of sector. In November of every year during the selected time period, this fund’s dividend payment is distributed. Its main investment sectors are “industrial and

[2] Definition by Nordea bank

services" and "material", which account for approximately 50% of all the investment sectors. The fund comprises 27 different assets and the three principal holdings are Telia Sonnera AB (7.78%), Skanska AB (6.52%) and SEB AB (5.93%). The fee for this fund is 1.5% per year (Handelsbanken.se 2011).

4.3.2.3 SEB etisk Sverigefond – lux utd (SEBSwe)

In May every year during the specific selected time period, this fund has had a dividend payment. The main investment sectors are "industrial and services" and "financial and property", which account for approximately 55% of all investment sectors. The fund comprises 37 different assets and the three principal holdings are Hennes & Mauritz AB (9.96%), Ericsson (9.05%) and Nordea Bank AB (7.57%). The fee for this fund is 1.3% per year (Handelsbanken.se 2011).

4.3.2.4 Banco etisk Sverige/Swedbank Robur etisk Sverige (SweS)

This fund has had a dividend payment in May or October of every year during the selected time period. The main investment sectors are "industrial and services" and "financial and property", which account for approximately 55% of all sectors. The fund comprises 45 different assets and the three principal holdings are Hennes & Mauritz AB (9.92%), Ericsson (9.26%) and Nordea Bank AB (6.63%). The fee for this fund is 1.4% per year (Handelsbanken.se 2011).

4.3.3 Global funds

4.3.3.1 Handelsbanken Global index etisk (HGlob)

The dividend payment is reinvested. The main investment sectors are financial and information technology, which account for approximately 35% of all investment sectors. The fund comprises 818 different assets and none of those have larger weight than 2% (Handelsbanken.se 2011). The fee for this fund is 0.65% per year. The main countries invested in are; the North America (56.67%), Euro countries (13.8%) and Japan (11.74%) (Avanza.se 2012).

4.3.3.2 Nordea etiskt urval Global (NGlob)

Investments are made in companies all over the world. This funds dividend payment is distributed in October during the selected time period. The main investment sectors are "information technology" and "energy", which account for approximately 35% of all investment sectors. The fund comprises 276 different assets, and the three principal

holdings are International Business Machine Corp. (3.87%), Exxon Mobile Corp. (2.67%) and Apple (2.54%). The concentration of the assets is in the U.S. with 47.49% (Handelsbanken.se 2011). The fee for this fund is 1.6% per year. The main countries invested in are; the North America (48.7%), Euro countries (15.06%) and the UK (10.4%) (Avanza.se 2012).

4.3.3.3 SEB etisk Global indexfond – lux ack (SEBGlob)

Investments are done in companies all over the world. Dividend payment is reinvested. The main investment sectors are "financial and property" and "health care", which account for approximately 35% of all investment sectors. The fund comprises 285 different assets and the three principal holdings are Nestlé (2.73%), International Business Machine Corp. (2.63%) and General Electric Co (2.53%). The concentration of the assets is in the U.S. with 29.71%. (Handelsbanken.se 2011). The fee for this fund is 0.4% per year. The main countries invested in are; the North America (32.85%), Euro countries (23.87%) and the UK (14.05%) (Avanza.se 2012).

4.3.3.4 Swedbank Robur ethica Sverige Global (SweGlob)

Investments are done in companies all over the world. In December every year during the selected time period, this fund has had a dividend payment. The main sectors are "industrial and services" and "financial and property", which account for approximately 40% of all investment sectors. The fund comprises 145 different assets and the three principal holdings are Hennes & Mauritz AB (4.90%), Ericsson (3.88%) and Nordea Bank AB (3.6%). The fund is global but have high concentration of assets in Sweden. (Handelsbanken.se 2011). The fee for this fund is 1.4% per year. The main countries invested in are; Sweden (45.08%), the North America (27.42%) and Euro countries (8.06%) (Avanza.se 2012).

4.3.4 Market indices

4.3.4.1 SIX30 return index (SIX30RX)

This index measures the performance of the thirty most traded stocks on the Swedish stock exchange market and is a reflection of the market as a whole. SIX30RX includes dividend payments (six-telekurs.se 2011). The SIX30RX is performing slightly above the OMX30[3], see appendix A1.

4.3.4.2 MSCI world gross index

This index measures the performance of stock exchange markets in developed countries. The term "gross index" implies that dividend payments are included. The following twenty-four markets are incorporated: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Israel, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom, and the United States. The concentration of the assets is in the U.S. with 52,9% (MSCI.com 2011).

4.3.5 Treasury security

The risk free rate used in this study is the one-month treasury security, supplied by the Swedish Riksbank (riksbanken.se 2011).

[3] OMX30 is an index of the thirty most traded stocks on the Swedish Stock Exchange Market.

5 Result

This chapter begins with the statement of the econometrics and follows with an illustration of the outcome of the funds and the market. In the end of this chapter, all results from calculations of risk and return are specified in tables and are evaluated.

5.1 Econometrical reliability

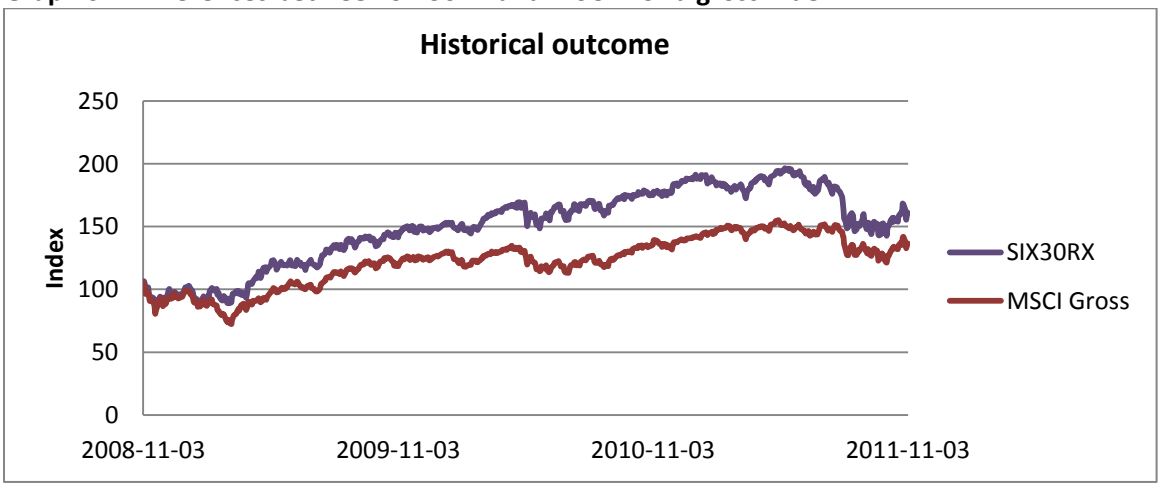
Assumptions of the simple linear regression are fulfilled and the test results are therefore reliable.

1. The model is linear in the parameters: $r_i - r_f = a_i + b_{i2}(r_m - r_f) + e_i$
2. The model is a meaningful interpretation because it is on average correct, considering assumption five; the variable x is not random and takes at least two different values.
3. The variance of the random error term is adjusted with a robust standard error. See appendix section 9.4
4. The covariance is adjusted with a robust standard error. See appendix section 9.4
5. The estimator is unbiased the variable *x* is not random and takes at least two values.
6. The values of the error term, the residuals, are normally distributed. See appendix section 9.5

5.2 Comparison between indices

The Swedish market index has a superior historical performance than the global market index. See Graph 07.

Graph 07. Differences between SIX30RX and MSCI world gross index



Source: Handelsbanken.se 2011, illustration made by authors

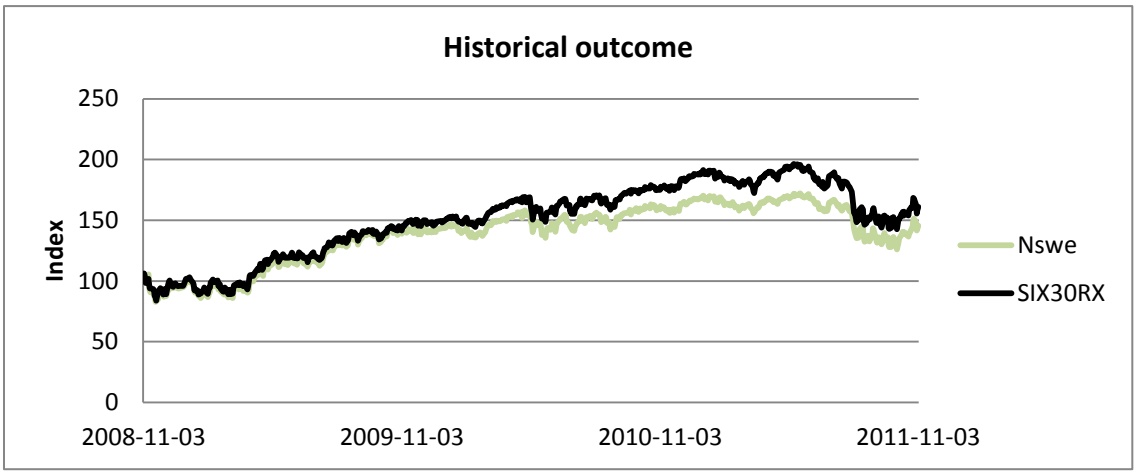
5.3 Comparison between fund and index

The following graphs show the outcome for the best and weakest performing Swedish and global funds. The historical outcome is in index form with the same starting date for all funds and market indices. The Swedish funds are compared with SIX30RX and the global funds are compared with MSCI world gross index.

5.3.1 Swedish funds

All Swedish funds performed similarly to each other. During the first year, all funds were performing close to SIX30RX but during the two last years the market outperformed all funds. The best performing fund managed by Nordea and the weakest performing fund managed by Swedbank are shown in graphs 08 and 09. See appendix A2 and A3 for illustrations of the other two funds managed by Handelsbanken and SEB.

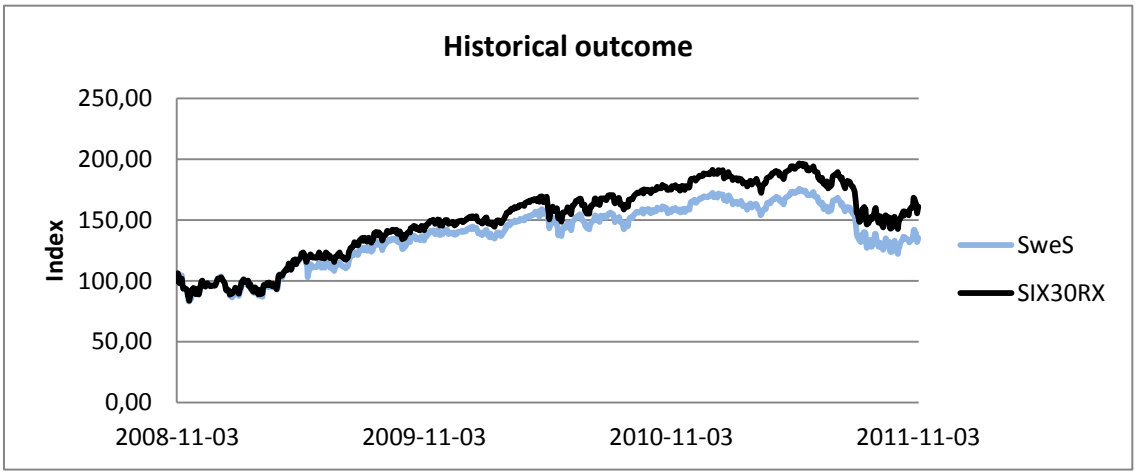
Graph 08. Nordea's Swedish fund versus Swedish market index



Source: Handelsbanken.se 2011, illustration made by authors

Graph 08 illustrates: The best performing Swedish fund managed by Nordea.

Graph 09. Swedbank's Swedish fund versus Swedish market index



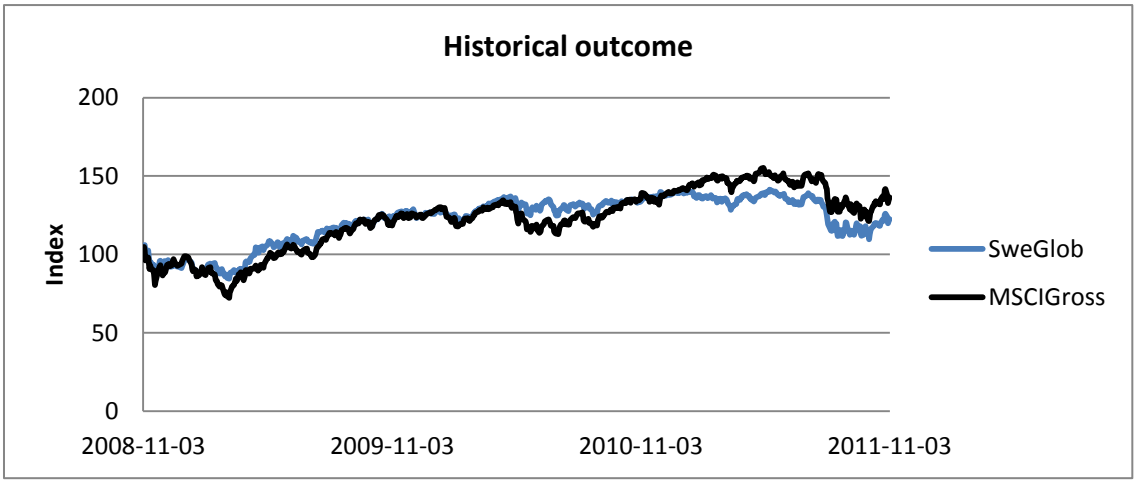
Source: Handelsbanken.se 2011, illustration made by authors

Graph 09 illustrates: The weakest performing Swedish fund managed by Swedbank.

5.3.2 Global funds

The best performing fund managed by Swedbank and the weakest performing fund managed by SEB are shown in Graphs 10 and 11. See appendix A4 and A5 for illustrations of the two other funds managed by Handelsbanken and Nordea.

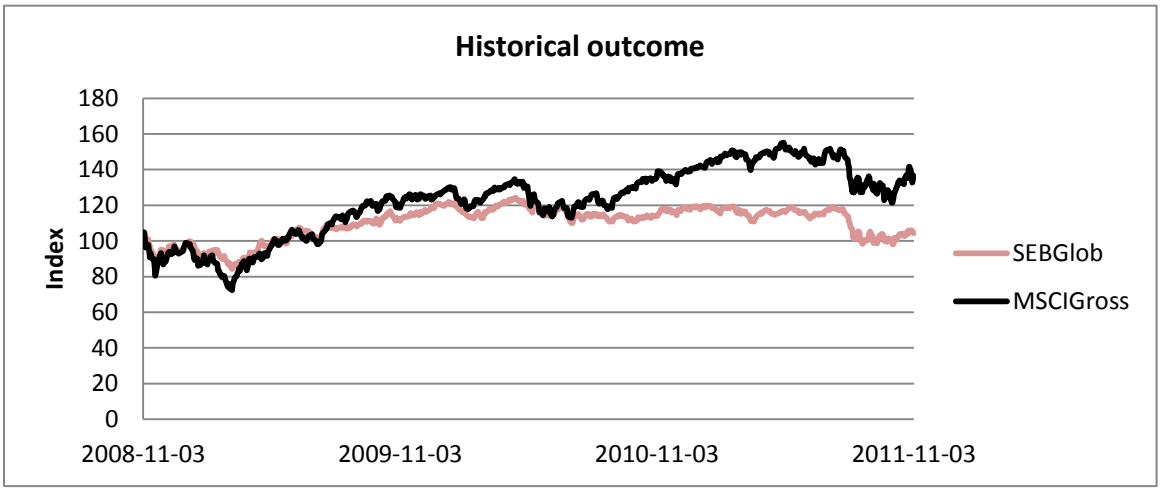
Graph 10. Swedbank's global fund versus global market index



Source: Handelsbanken.se 2011, illustration made by authors

Graph 10 illustrates: The fund managed by Swedbank performed slightly better than the market index until November 2010. During the remaining time period, the fund performed similar but slightly below index. The fund performance did actually flattened out (at November 2010) and almost had a negative performance, despite the fact that the market index performance increased. During the last drop in 2011 the fund and market index had the same pattern.

Graph 11. SEB's global fund versus global market index



Source: Handelsbanken.se 2011, illustration made by authors

Graph 11 illustrates: The fund managed by SEB performed better or similar to market index during 2008 until the middle of 2009. In the middle of 2010, the fund's performance flattened out and the market index were increasing during the same time. The pattern is similar to Graph 10. The fund followed downturn patterns within the market that occurred in the middle of 2011.

5.4 Beta values

The beta value is calculated from the first difference of the fund's price and explains how well the fund's outcome follows the market index. If the market is changing by one unit, the fund is on average changing by their beta value. The SIX30RX and the MSCI world gross index are equal to one since they reflect the market indices in the study. The treasury security reflects the risk free rate in the study and have a beta value close to zero because of its stable condition with almost no fluctuation in price.

5.4.1 Swedish funds

Table 01. Beta value Swedish funds

	HSwe	NSwe	SEBSwe	SweSwe	SIX30RX	T-bills
Beta value	**0,837**	**0,806**	**0,844**	**0,889**	1,00	0,00

Source: Handelsbanken.se 2011, estimations made by authors

Table 01 illustrates: The beta values for all the Swedish funds are similar to each other and are approximately equal to 0.8. The fund managed by Swedbank has the highest and the fund managed by Nordea has the lowest beta value.

5.4.2 Global funds

Table 02. Beta value global funds

	HGlob	NGlob	SEBGlob	SweGlob	MSCI Gross	T-bills
Beta value	**0,274**	**0,320**	**0,154**	**0,578**	1,00	0,00

Source: Handelsbanken.se 2011, estimations made by authors

Table 02 illustrates: The beta value for all global funds was very low, but still positive, and had a larger range between each other than the Swedish funds had. In comparison to the Swedish funds beta values, the global funds overall had a low beta value. The fund managed by Swedbank has the highest and the fund managed by SEB has the lowest beta value.

5.4.3 Significance test for the beta values

Even though the Swedish funds, Graphs 08 and 09, appear to perform similar to the suitable market index, statistic tests are made to state if the funds beta values are significantly different from the market index or not. The global funds, Graphs 10 and 11, assume to have a beta value significantly different from the market beta value, in regard to the observations of the illustrations of the funds' performances. Under normal circumstances the global funds, on the other hand, expects to have a quite high beta value because of the large number of assets.

These statistic tests are made by a regular t-test, but with a robust standard error to adjust for heteroskedasticity and/or autocorrelation. All funds either have both heteroskedasticity and autocorrelation or only autocorrelation, therefore a robust standard error is used in all t-tests. All calculations are clearly stated in appendix section 9.4.

The result of the t-tests states that all funds' beta values were significantly different and lower than the suitable market index. In other words, all eight funds were performing significantly below their suitable market index with a significance level of five per cent.

5.5 Average return

Geometric mean is a suitable measure to calculate average return because it is a time-weighted measure. Furthermore, all values of the mean will be the geometric mean, also named average return. In order to compare the average return to the excessed return using the SIM model, a risk premium was calculated for every fund.

Notice, the particular time period of the study begins after the Lehman Brothers bankruptcy in the end of 2008. The stock exchange markets had suffered hard losses and were on the "bottom" when the observations started, this have consequences of the results on the average return. The market

generally went up and why the average return may appear abnormally high. The illustrations of the funds' performances and average return might give a surprisingly optimistic result, bare this in mind when looking at the results.

Table 03. Average return Swedish funds

		HSwe	NSwe	SEBSwe	SweSwe	SIX30RX	T-bills
Geometric Mean %	Annually	11,665	12,508	11,504	10,094	15,872	0,663
	Risk Premium	11,002	11,845	10,841	9,431	15,210	

Source: Handelsbanken.se 2011, estimations made by authors

Table 03 illustrates: All four Swedish funds have an average return below SIX30RX. The fund managed by Nordea has the highest average return and the fund managed by Swedbank has the lowest average return.

5.5.1 Global funds

Table 04. Average return global funds

		HGlob	NGlob	SEBGlob	SweGlob	MSCI Gross	T-bills
Geometric Mean %	Annually	2,884	2,737	1,427	6,765	10,362	0,663
	Risk Premium	2,221	2,074	0,764	6,102	9,699	

Source: Handelsbanken.se 2011, estimations made by authors

Table 04 illustrates: The four global funds have an average return below MSCI world gross return. The fund managed by Swedbank has the highest average return and the fund managed by SEB has the lowest average return.

In general, all Swedish funds have approximately 11% in annual return in comparison to the global funds that are close to 2%. Swedbank´s Global fund is the only exception, with almost 7% in annual return. Notice that the Swedish market index, SIX30RX performs approximately five percentage points higher than the global market index, MSCI world gross return.

5.6 Excess return by the single index model

The single index model is the theoretical method used to calculate the excess return and can be used as a benchmark to the average return. The excess return is the return less the risk free rate. The alpha values are close to zero and therefore specified in the appendix table A6 and A7 in section 9.2. The main focus of this study is to examine the beta values and therefore the alpha values will not be discussed any further.

5.6.1 Swedish funds

Table 05. Excess return Swedish funds, single index model

	HSwe	NSwe	SEBSwe	SweSwe
Excess return, SIM %	12,338	12,393	12,236	12,286

Source: Handelsbanken.se 2011, estimations made by authors

Table 05 illustrates: According to the model, the Swedish fund managed by Nordea yields the highest return and even though it is marginal, the fund managed by SEB yields the lowest return.

5.6.2 Global funds

Table 06. Excess return global funds, single index model

	HGlob	NGlob	SEBGlob	SweGlob
Excess return, SIM %	2,935	2,424	1,448	4,396

Source: Handelsbanken.se 2011, estimations made by authors

Table 06 illustrates: According to the model, the global fund managed by Swedbank yields the highest return and the fund managed by SEB yields the lowest return.

5.7 Standard deviation

The return of the funds is normally distributed and the standard deviation is therefore a meaningful interpretation of the variation around its mean, see appendix section 9.3.

5.7.1 Swedish funds

Table 07. Standard deviation Swedish funds

	HSwe	NSwe	SEBSwe	SweSwe	SIX30RX
Standard Deviation %	25,736	23,838	23,424	23,822	29,958

Source: Handelsbanken.se 2011, estimations made by authors

Table 07 illustrates: All Swedish funds have a standard deviation similar to each other. The fund managed by Handelsbanken has the highest standard deviation, 25.736% and thereby carries the highest risk with the largest spread around its mean. Although, the fund managed by SEB has a similar standard deviation as compared to the other funds it has the lowest value, 23.424%.

5.7.2 Global funds

Table 08. Standard deviation global funds

	HGlob	NGlob	SEBGlob	SweGlob	MSCI Gross
Standard Deviation %	8,784	8,427	9,256	15,174	19,516

Source: Handelsbanken.se 2011, estimations made by authors

Table 08 illustrates: The global fund managed by Swedbank carries with it the highest risk with a standard deviation of 15.174% and the fund managed by Nordea carries the lowest risk with a standard deviation of 8.427%.

5.8 Sharpe and Treynor ratio

5.8.1 Swedish funds

Table 09. Sharpe and Treynor ratio Swedish funds

	HSwe	NSwe	SEBSwe	SweSwe	SIX30RX
Sharpe Ratio	0,411	0,451	0,418	0,332	0,572
Treynor Ratio	0,131	0,147	0,128	0,106	0,152

Source: Handelsbanken.se 2011, estimations made by authors

Table 09 illustrates: The Swedish fund managed by Nordea has the highest Sharpe- and Treynor ratio and the fund managed by Swedbank has the lowest values. This infers that the fund managed by Nordea has the steepest capital allocation line and yields the highest return per increment of risk. The fund managed by Swedbank yields the lowest return per increment of risk and therefore has the least steep capital allocation line.

5.8.2 Global funds

Table 10. Sharpe and Treynor ratio global funds

	Hglob	NGlob	SEBGlob	SweGlob	MSCI Gross
Sharpe Ratio	0,135	0,125	0,046	0,315	0,246
Treynor Ratio	0,081	0,065	0,049	0,106	0,097

Source: Handelsbanken.se 2011, estimations made by authors

Table 10 illustrates: The global fund managed by Swedbank has the highest Sharpe- and Treynor ratio and the fund managed by SEB has the lowest values.

6 Analysis

6.1 Outcome funds versus market

6.1.1 CAPM

When using a benchmark such as the CAPM, there are some important issues to take notice of. Even though the CAPM is one of the most significant "innovations" in financial economics, the model is still just a model. What is common for all models such as CAPM is that they do not exemplify the entire truth regarding financial performance reality, they just provides a fraction or a hint of the real outcomes. (Hill et al.: 2010, p 285) In the Journal of Financial Economics, Richard Rolls (1977) discusses the use of CAPM as a benchmark. He states that it is almost impossible to construct a portfolio that can be described as the *true market portfolio*, were every single asset on the market is included. When using the SIX30RX and MSCI world gross index during the analysis of the Swedish and Global funds, we are actually using a *specific* portfolio was actually used as a benchmark and not the true market portfolio. The consequence of having an unobservable underlying market portfolio is that the CAPM is empirically untestable. Every test result from CAPM that includes an approximation of the market opens itself up to criticism regarding Roll´s postulations. The test result of this study is exposed to this type of criticism and must be observed when further analyses are made originating from this type of test result.

6.1.1.1 Geometric excess return versus SIM excess return

All Swedish funds carry a higher risk premium$_{SIM}$[4] than the risk premium$_{GM}$[5]. The global fund managed by Swedbank carries a higher risk premium$_{GM}$ than the risk premium$_{SIM}$. All other global funds carry a lower risk premium$_{GM}$ than the risk premium$_{SIM}$.

Our calculation is strengthened by the theoretical concepts, the model matches the empirical results. The fund with the highest risk premium$_{SIM}$ also has the highest risk premium$_{GM}$. The exception is the global fund managed by Swedbank, which has a higher risk premium$_{GM}$ than the risk premium$_{SIM}$.

The result of the global funds (discussed above) can be explained by the large influence the beta value has when estimating the empirically single index model. Alpha value (see appendix section 9.2) and market value are almost equal for all funds and that leaves a central weight to the beta value. The beta value differs between the global funds and might have a significant impact of the excess

[4] The excess return calculated by the single index model
[5] The excess return calculated by the geometric mean

return results. The global fund managed by Swedbank carries the highest beta value and as a consequence also yields the highest excess returns by the single index model. There is just a marginal difference between Swedish funds beta values and therefore it is difficult to make a strong conclusion out of the result.

6.1.1.2 Beta value

To be consistent with the theory of CAPM, the beta value should be a forecasted beta value. In this study this is not taken into consideration. Instead, a beta value calculated based on historical data is used in the single index model. The estimation of the model will not reflect the true outcome as much as a model with a forecasted beta value should have done.

One method used to observe how well the eight funds are following the market is to study the beta values. The beta value depends on how the composition of the portfolio is related to the composition of the market index. A portfolio whose structure likens that of the market index should have a beta value close to one and thereby have similar movements as the market. Despite the fact that the global funds studied are comprised of a large number of assets, three of the funds have very low beta values in this study. In the middle of 2010, all four global funds suddenly started performing considerable lower than the MSCI world gross index. Hence, it is obvious that something happened on the market (see discussion in next section). Graph 08, 09 and 10 illustrates a pattern that has flattened out and this must be the reason for the global funds' low beta values. The low beta values are a consequence of the uncertain economic situation around the world indicative of the time period analysed.

A beta value is not consistent over time, indicated by the ups and downs in the outcome. A particular time period will have a significant impact on the beta value result due to different slope changes during different time periods. If the beta values of the global funds were constructed from the end of 2008 to middle of 2010, when the funds follow the market index very well, the beta values would probably have been higher. This is why the chosen time period has such a significant effect on the beta value result.

In general, the Swedish funds have closer fluctuated in correlation with the market index than the global funds and therefore have had higher beta values, closer to one. This appears to be the case even though the Swedish funds comprise fewer assets than the global funds. Although, the chosen index used in the analysis of the Swedish funds might have been more suitable than the MSCI world gross index has been for the Global funds. The Swedish index SIX30RX covers a smaller market (one

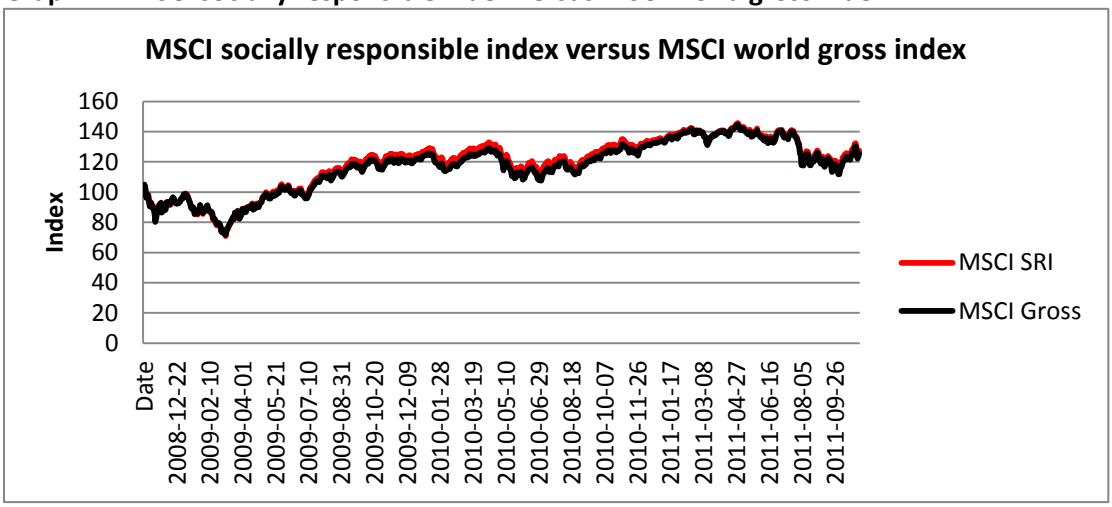
country), this can be one explanation for why it is a better match to the Swedish funds than the MSCI gross index is for the global funds. The global market index covers a much larger market, it reflect 24 countries.

6.1.2 What happened with the global funds 2010?

In 2010, a sudden outcome disturbance affected the global funds (with the exception of the fund managed by Swedbank). The funds' indices stopped corresponding to the market index and instead became a flat lined. One reason for the flat line could be that, at the time, an imminent crisis in the Europe was coming occurring in the middle of 2010. In May 2010 the European Union approved a 700 billion euro bailout package for European countries that were experiencing problems in reaching their budgetary goals. During the same period, the global funds analysed in this study started to diverge from the MSCI world gross index. This phenomenon might partially be explained by the fact that the global funds are comprised of a higher concentration of assets in the European countries than the MSCI world gross index and therefore were more affected of the economic situation in Europe. After all, MSCI world gross index is an index that ought to reflect the market outcome. In contrast, the funds discussed, invest in an amalgamation of assets that yield the most profit. It could be the case that managers of the global funds were afraid to invest in assets in exposed European countries resulting in an outcome difference between the funds and the MSCI world gross index.

The study is restricted to evaluating ethical funds and one might think that those funds overall perform less favourable than funds without restrictions, certainly during economic instability. The ethical funds are restricted to only invest in ethical assets that can make them less diversifiable, see discussion section 6.3 Further analysis. This is not the case, the MSCI socially responsible index performs similar to the MSCI world gross index, see Graph 12. There are no obvious indications in the outcome of the MSCI socially responsible index that the global funds' outcomes during 2010 have been a consequence of their ethical restrictions. The reason why the global funds no longer follow the market index during 2010 and forward must be correlated to factors other than just their ethical approach association.

Graph 12. MSCI socially responsible index versus MSCI world gross index



Source: Handelsbanken.se 2011, illustration made by authors

6.2 Best performing fund

6.2.1 Risk and return

When observing the risk measure standard deviation there is a noticeable difference between the global and the Swedish funds. The global funds have a standard deviation of 8 to 15 per cent, while the Swedish funds have a standard deviation of 23 to 25 per cent. The Global funds yield a return between 1.4 and 6.8 per cent and the Swedish funds yield a return between 10.1 to 12.5 per cent. Overall, the global funds are comprised of a larger number of assets than the Swedish funds and this might explain the differences in risk and return between the Swedish and the global funds. Thus, a large number of assets reduce risk and risk is further diminished because the global funds invest in a broader market and not just in one country, the Swedish market. However, the Swedish market outperformed the global market during the time period analysed. This reality helps explicate why the Swedish funds in this study yielded higher returns.

6.2.2 Relationship between risk and return

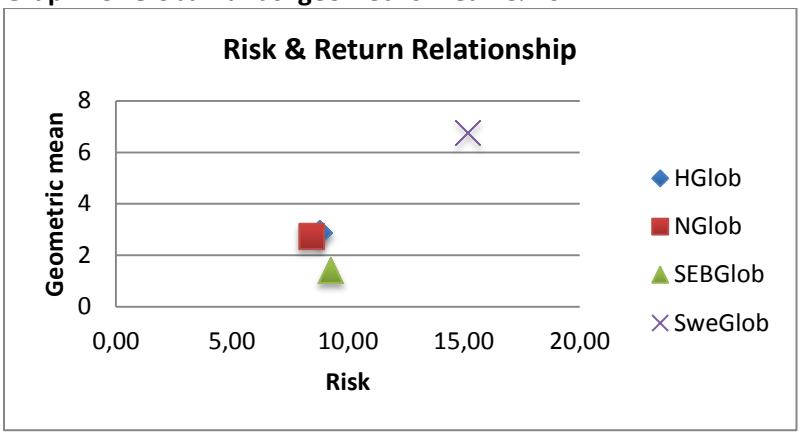
6.2.2.1 Global funds

The global funds follow the basic financial theory about a positive trade-off between risk and return. In contrast, the Swedish funds are not in line with the theory. Financial theory claims that a portfolio with high return generally has high risk. This statement is confirmed in the article *Risk, Return and equilibrium: empirical tests* by Fama & Mac Beth (1973). The authors conclude that they could not reject the hypothesis that there is a linear relationship between risk and return. On average, it seems that a positive trade-off between risk and return exists.

The global fund managed by Swedbank yielded the highest geometric return and consistently carried the highest risk. Oppositely, the global fund managed by SEB carried the lowest risk and consistently yielded the lowest return, see Graph 13 for illustration.

It is interesting to note that Swedbank's global fund is largely comprised of investments made in Swedish assets, 45%. In contrast, the other global funds have their major shares invested in the U.S. The Swedish SIX30RX outperformed the global MSCI world gross index and that is one reason to why this particular fund has had a better outcome than the other global funds, the Swedish market performed in general better than the global market did.

Graph 13. Global funds' geometric mean & risk



Source: Handelsbanken.se 2011, illustration made by authors

6.2.2.2 Swedish funds

It seems like the Swedish funds in the study have a weak relationship between risk and return; the fund managed by Handelsbanken has the highest risk but the fund managed by Nordea has the highest return. The fund managed by SEB has the lowest risk but the fund managed by Swedbank has the lowest return. In this case, the theory of risk and return relationship makes no sense.

One reason for why the Swedish funds do not follows the risk and return relationship could be lack of an efficient diversification because of the restrictions of only invest in ethical funds. It could also be an effect of misplaced assets by the fund manager. A manager that takes high risk would like to have higher return. Notice, there are just a small difference in risk and in return between the Swedish funds, the fund managed by Handelsbanken have a standard deviation of 25.7%, which is close to the other funds with an standard deviation around 23.5%. The consequence is that it is difficult to make a strong conclusion out of numbers that looks almost the same for all Swedish funds.

6.2.3 Ratios

The Sharpe- and Treynor ratios adjust return to standard deviation and beta value and because of that, the ratios provide a result exemplifying the best performing fund. The global fund managed by Swedbank yields the highest return and carried the highest risk and therefore also the highest Sharpe- and Treynor ratios. The global fund managed by SEB has the lowest ratios because of the higher risk taken to the relatively low return.

The Swedish funds' risk and return relationship was not consistent with the basic financial theory and the ratios will therefore determine more appropriately which fund is the best as opposed to just analysing risk or return. Based on ratio analysis, Nordea has the best performing fund (highest ratios) and Swedbank has the weakest performing fund (lowest ratios).

The theory states that diversified portfolios should have the same ranking between Sharpe- and Treynor ratios, i.e. the portfolio with the highest Sharpe ratio should also have the highest Treynor ratio. Ratio correlation is found to be relevant regarding the funds in the study, they all have identical ranking, which implies that all funds are diversified. Moreover, the global funds appear more diversified than the Swedish funds due to the closer number between the ratios, see Table 09 and 10.

6.3 Further analysis - diversification

In previous analysis section results were summarized and briefly discussed. The subsequent section provides a better understanding of what the particular results signify and discusses the result from a wider perspective.

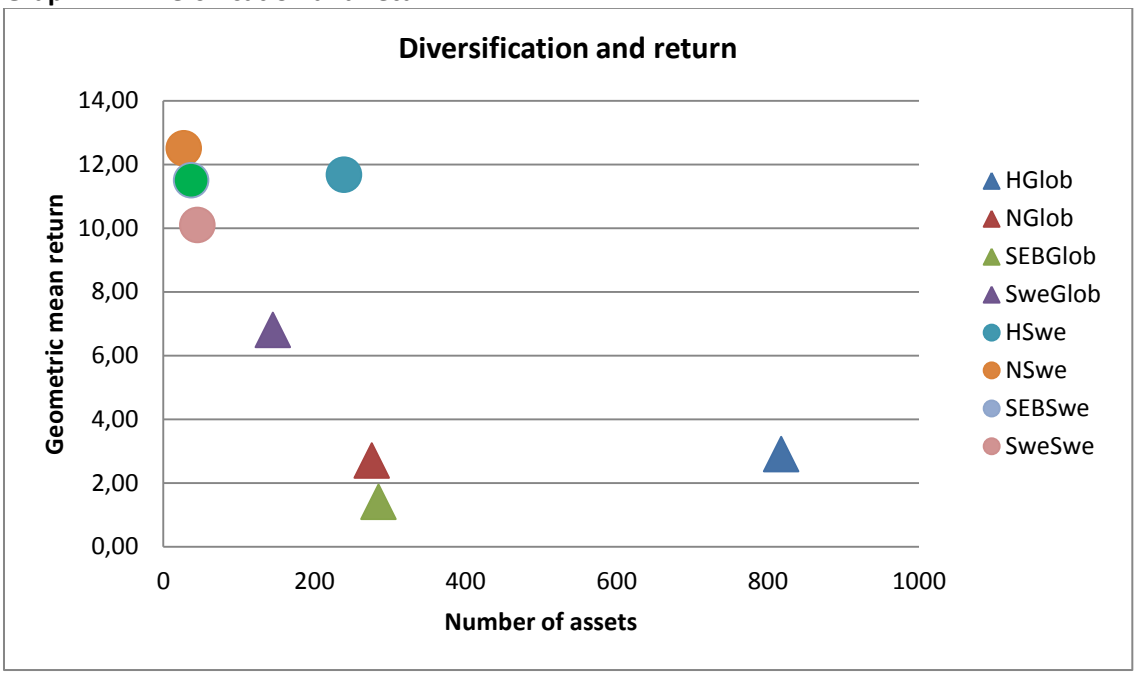
6.3.1 Diversification – naïve strategy

According to Bodie (2011) a portfolio is well-diversified when there are approximately fifteen assets in the portfolio and Stateman (1987) argues that an amount between 30 to 40 assets would denote the appropriate number of assets to construct a well-diversified portfolio. In this study, all funds have at least 30 assets and therefore can be considered well-diversified due to number of assets. The only exception is the Swedish fund managed by Nordea, which have 27 assets and according to Stateman is not classified as well-diversified.

6.3.1.1 Return in relation to number of assets

The fact that the Swedish fund managed by Nordea yields the highest return is interesting because this fund simultaneously has the least number of assets. With less than 30 assets this fund is not even a well-diversified portfolio according to Stateman (1987). Likewise, the global fund managed by Swedbank yields the highest return and has the lowest numbers of assets. If the Swedish and global fund managed by Handelsbanken is ignored, there seems to be a negatively but not perfect relationship between number of assets and return, see Graph 15. This concept is also discussed in Bryne and Stephen´s study and is strength by empirical evidence, a higher number of assets tend to lower the risk and at the same time decrease the return because of the risk and return relationship.

Graph 14. Diversification and return



Source: Handelsbanken.se 2011, illustration made by authors

6.3.2 Diversification – efficient strategy

The funds have restraints imposed upon them, investments are only made in ethical assets because of the GES. This can enhance the theoretical statement: the fund may be well-diversified with many assets, but not in an efficient way. When adding more restrictions into the decision making of a portfolio, opportunity for an *efficient* diversification decreases. GES may have affect on the possibility to invest in assets with low correlation. With this restriction, the managers of a fund may have to invest in similar companies with high correlations, for example ones with assets from the same industry/sectors.

The global funds have better efficient diversification due to investors' opportunity to invest in worldwide assets in contrast to Swedish funds that only invest in Swedish assets. This implies that

the Swedish funds are more exposed to one particular market risk (the Swedish), by only investing in one market. If the Swedish market goes into a recession, for example like the extreme recession situation Greece[6] is currently experiencing, the Swedish funds would have performed worse than the actual outcome observed in this study. If so, the global funds with a worldwide spread of assets have a much better protection against the risk of a single market collapsing or have really low performance.

6.3.3 Fees

The yearly fee of a fund is affecting the index of the fund negatively with the same amount as the size of the fee. When comparing the index of the fund with the index of the market this needs to be considered. In this study the funds' return is not high enough to covering the fee and still performs in the same level as the market index. If the Swedish fund managed by Nordea, which is the fund with the highest return, would not have the 1,5% fee this found would maybe outperformed the market. In other words, if one would have constructed a portfolio with the same assets and weights, one might have a ethical portfolio outperforming the market!

If the managers of the funds arrange asset investments in the fund, there will be a lot of transaction costs incurred. In addition, higher transaction costs are associated with a larger number of assets. When the European crisis hit the market in 2010, transaction costs of moving a huge number of assets could be the reason to why outcomes flattened out.

[6] Greece close to facing a bankruptcy

7 Conclusion

The eight ethical funds in the study are outperformed by their market index with a statistic significance level of five per cent. However, the study concludes that ethical funds in general did not performed less the market due to comparison between MSCI socially responsible index and MSCI world gross index.

Whether this is a consequence of ethical restrictions, or if a volatile time period affected the investments within the funds is difficult to determine. The study concludes that ethical restrictions interfere with the theory of portfolio optimization and thereby the composition of assets to achieve an efficient diversification could be affected to.

The beta values of the global funds turned out to be unexpectedly low, which may be the result of the European crisis that occurred in the middle of 2010 and indirect also a consequence of the additional transaction costs that occur when swapping investments.

According to the result of the study, Swedbank manages the best performing global fund and Nordea manages the best performing Swedish fund.

8 Further research

What did really happen with the global funds in 2010? This is an interesting inquiry that could be further invested. It would be interesting to add more macro factors to the single index model and make a multi factor model instead. By doing so, it would be possible to find additional reasons for the strange global fund outcomes in 2010. For example, how much did the exchange rate of the U.S. dollar and the Euro affect the outcome?

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Handelsbanken open webpage http://handelsbanken.se/ *Product information and indices for:*

Handelsbanken Sverige Index Etisk (HSwe)
Handelsbanken Global Index Etisk (HGlob)
Nordea Etiskt Urval Sverige (NSwe)
Nordea Etiskt Urval Global (NGlob)
SEB Etiskt Sverigefond – Lux utd (SEBSwe)
SEB Etisk Global Indexfond – Lux ack (SEBGlob)
Banco Etisk Sverige/Swedbank Robur Etisk Sverige (SweS)
Swedbank Robur Ethica Sverige Global (SweGlob)

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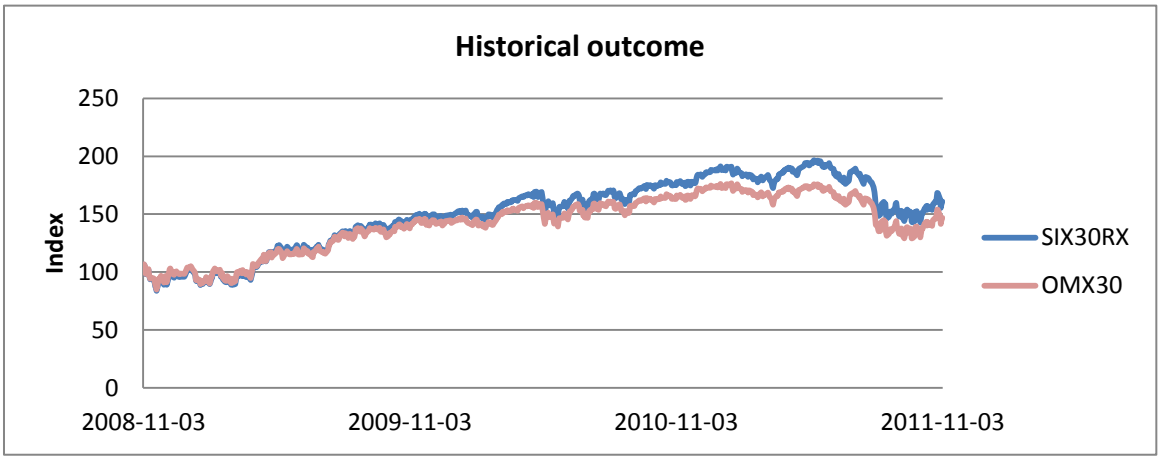
9 Appendix

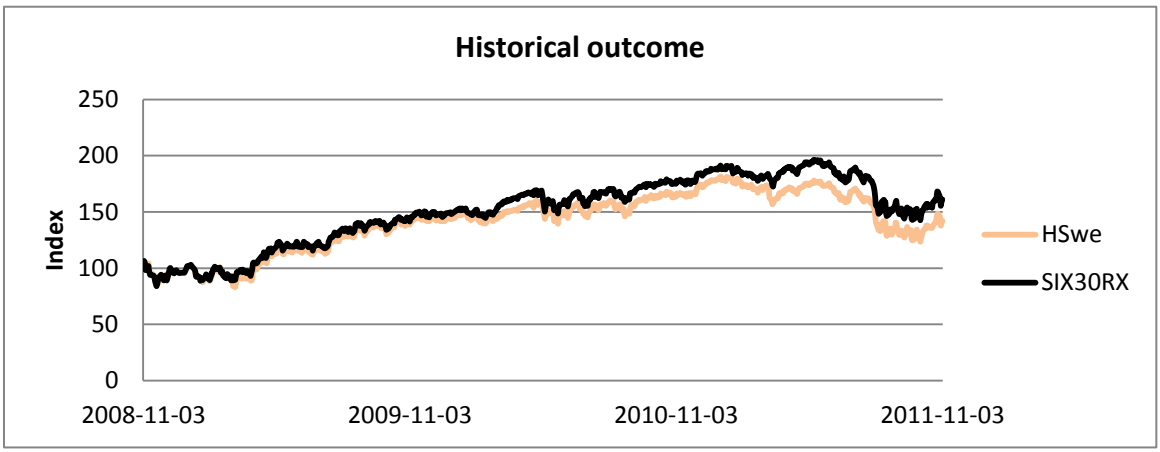
9.1 Historical outcome

A1. Differences between OMX30 and SIX30RX



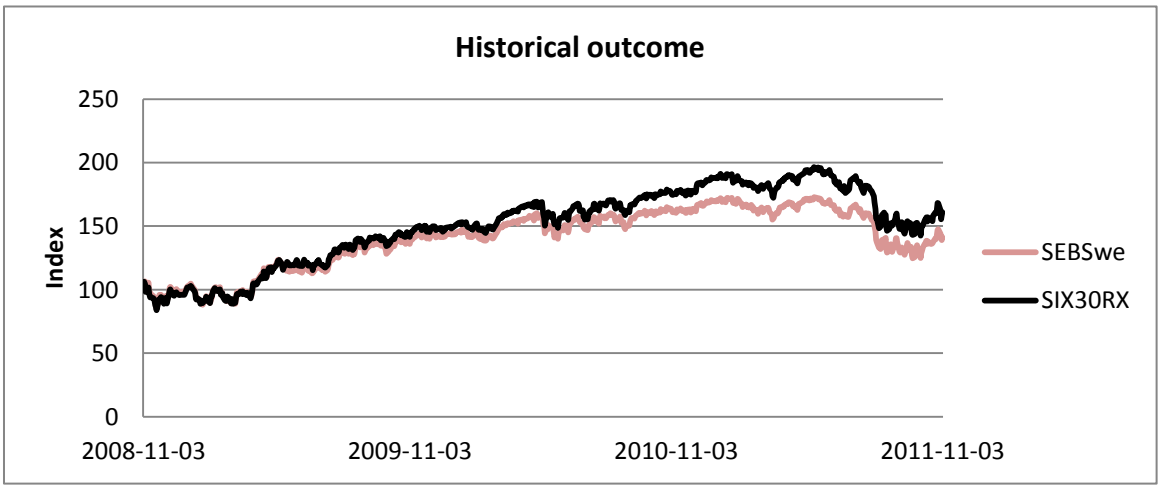
Source: Handelsbanken.se, illustrations by authors

A2. Handelsbanken's Swedish fund versus Swedish market index



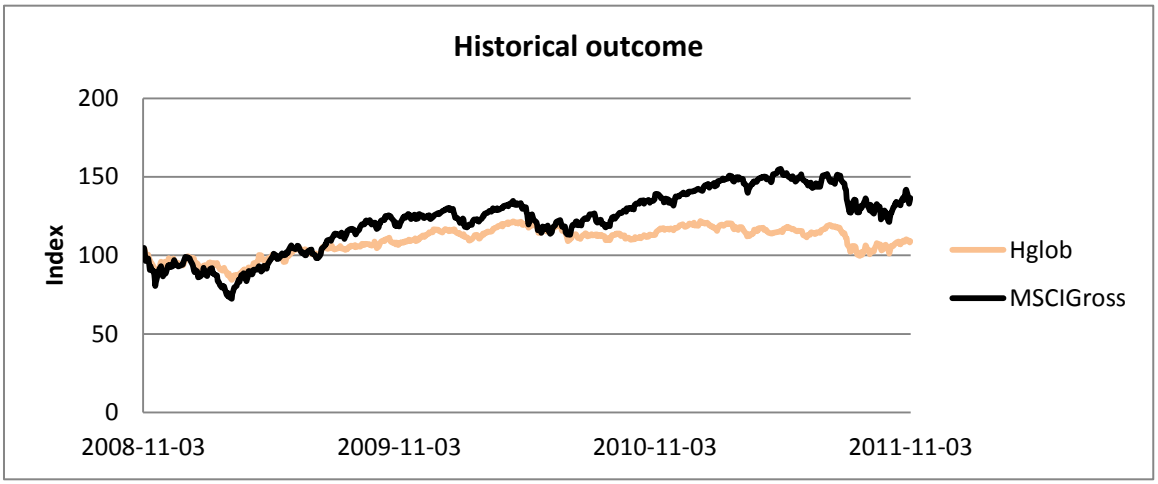
Source: Handelsbanken.se, illustrations by authors

A3. SEB's Swedish fund versus Swedish market index



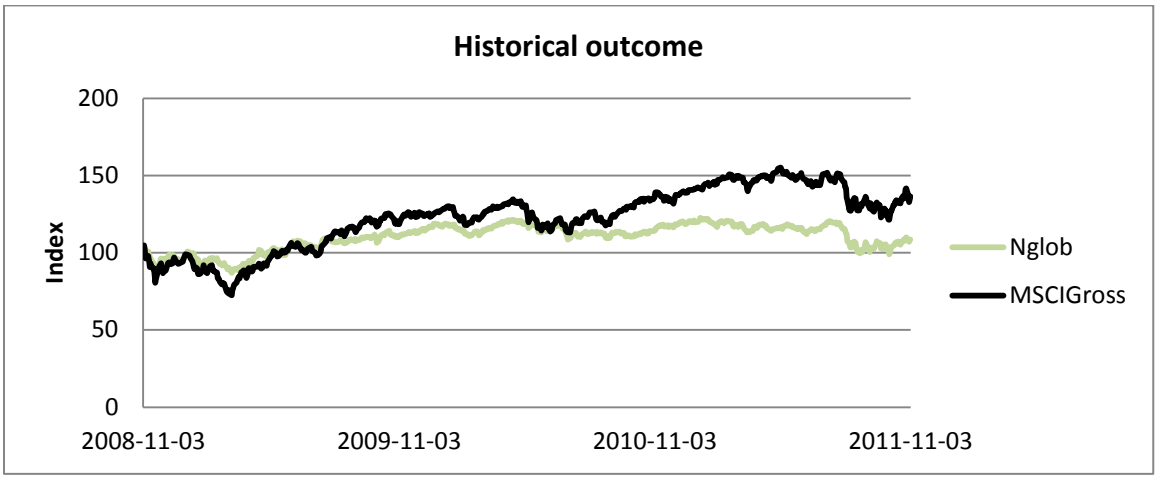
Source: Handelsbanken.se, illustrations by authors

A4. Handelsbanken's Global fund versus Global market index



Source: Handelsbanken.se, illustrations by authors

A5. Nordea's Global fund versus Global market index



Source: Handelsbanken.se, illustrations by authors

9.2 Alpha value

A6. Alpha values for the Swedish funds

	HSwe	NSwe	SEBSwe	SweSwe
Alpha	-0,0039	0,0013	-0,0060	-0,0123

Source: Handelsbanken.se, estimations by authors

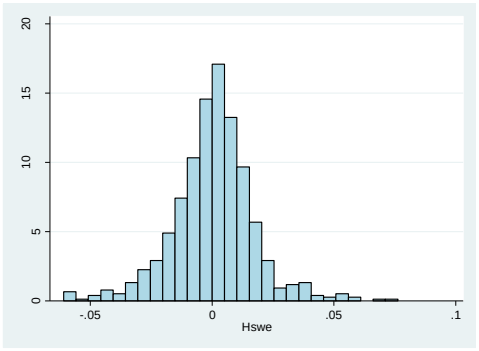
A7. Alpha values for the global funds

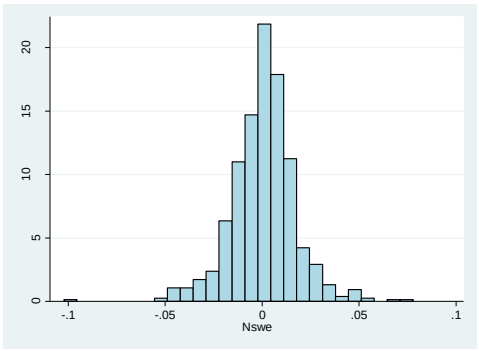
	HGlob %	NGlob %	SEBGlob %	SweGlob %
Alpha	0,0028	-0,0068	-0,0005	-0,0121

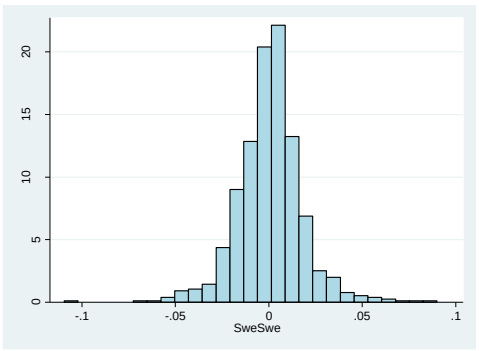
Source: Handelsbanken.se, estimations by authors

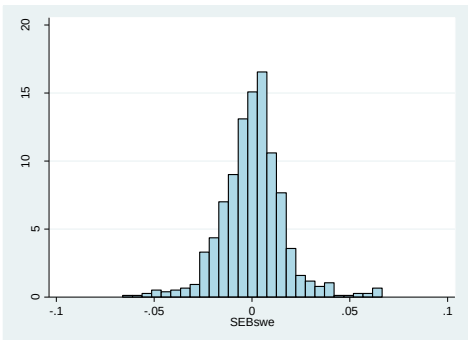
9.3 Normal distribution of the return

The normal distribution of the return of the Swedish and Global funds:

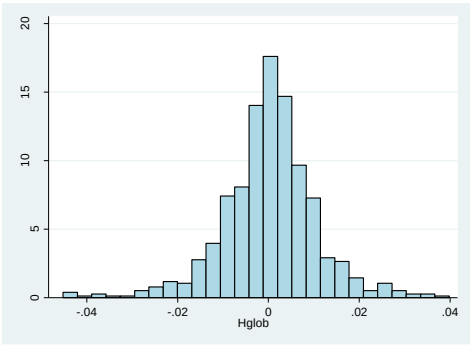


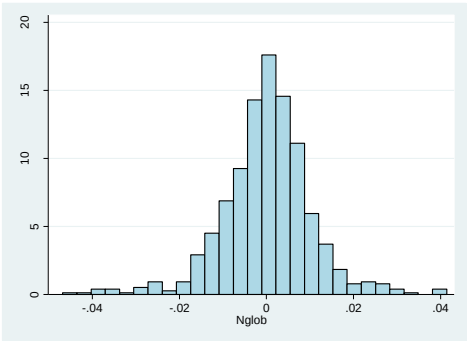


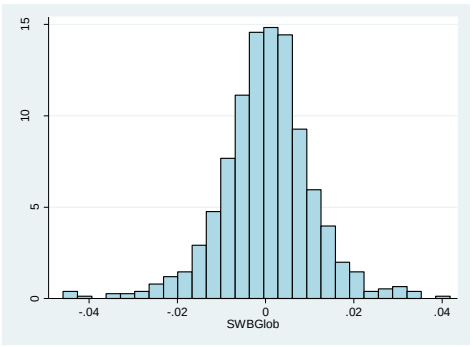


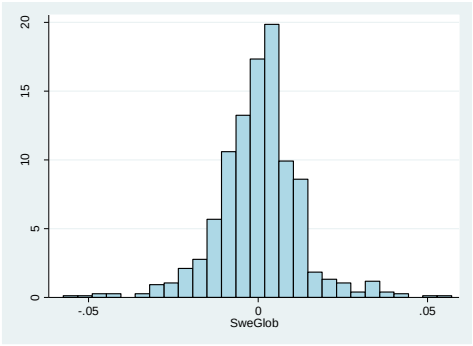


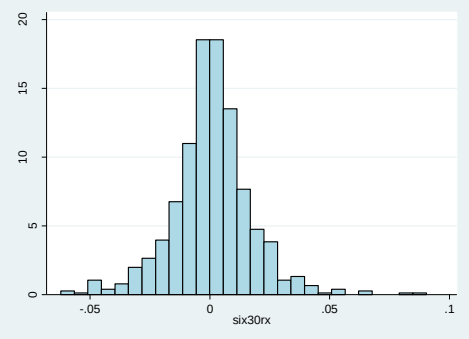
The normal distribution of the return of the Global funds:

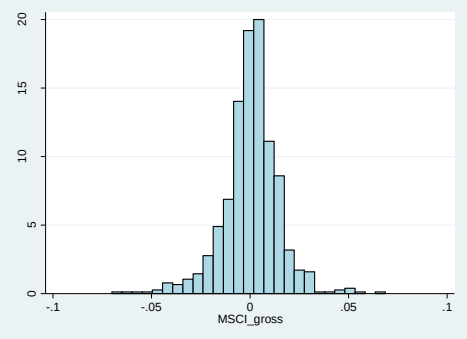












Source: Handelsbanken.se, estimations by authors

9.4 Significance test

In this part the significant tests are specified.

The first test is to find out if there is heteroskedasticity or/and autocorrelation in the ordinary regression. The significant level and critical value is the same for every test:

9.4.1.1 Test for heteroskedasticity and autocorrelation

Test statistics: F-value from STATA output, heteroskedasticity- or autocorrelation test

Significance level: $\alpha = 0.05$

Critical value: $F_{\alpha, K-1, N-K} = F_{0.05, 2-1, 756-2} = 3.84$ (Table 4)

Reject H_0 if: F-value > Critical value

9.4.1.1.1 Null-hypothesis test for heteroskedasticity

H_0 $Var(e) = \sigma^2 = Var(y)$

H_1 Variance is not constant

9.4.1.1.2 Null-hypothesis test for autocorrelation

H_0 $Cov(e_i, e_j) = \text{cov}(y_i, y_j) = 0$

H_1 There is covariance between any pair of random errors

9.4.1.2 Test if beta value of the fund is equal to the market beta

H_0 $\beta_2 = 1$

H_1 $\beta_2 \neq 1$

(Two-sided test)

Test statistics: $t = \dfrac{b_2 - \beta_2}{se(b_2)}$ → All data has heteroskedasticity or/and autocorrelation and therefore robust standard error, HAC is used to correct.

$$se(b_2)\ to\ se_{HAC}(b_2) = \frac{s}{S_x^2} + 2 w_1 w_2 \text{cov}(e_1, e_2)$$

Significance level: $\alpha = 0.05$

Critical region: $\pm t_{\alpha/2,N-K} = \pm t_{0.05/2,756-2} = \pm 1.96$ (Table 2)

Reject H_0 if: $t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} > 1.96$ *or if* $t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} < -1.96$

Find right numbers of lags: $m = 0.75T^{1/3} = 0.75 * 756^{1/3} = 6.83 \approx 7$

9.4.1.3 Test if beta value of the fund is less the market beta

$H_0\ \beta_2 = 1$
$H_1\ \beta_2 < 1$ (One-sided test)

Test statistics: $t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)}$

Significance level: $\alpha = 0.05$

Critical region: $t_{\alpha,N-K} = t_{0.05,756-2} = 1.645$ (Table 2)

Reject H_0 if: $t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} < 1.645$

Find right numbers of lags: $m = 0.75T^{1/3} = 0.75 * 756^{1/3} = 6.83 \approx 7$

9.4.2 Handelsbanken's Swedish fund and SIX30RX

```
. regress HSwe_RP SIX30RX_RP
```

Source	SS	df	MS
Model	.148552402	1	.148552402
Residual	.066745579	754	.000088522
Total	.215297981	755	.000285163

```
Number of obs =     756
F(  1,   754) = 1678.14
Prob > F      =  0.0000
R-squared     =  0.6900
Adj R-squared =  0.6896
Root MSE      =  .00941
```

HSwe_RP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIX30RX_RP	.8368454	.0204282	40.97	0.000	.7967424	.8769484
_cons	-.0000432	.0003425	-0.13	0.900	-.0007157	.0006292

9.4.2.1 Test for heteroskedasticity and autocorrelation

9.4.2.1.1 Null-hypothesis test for heteroskedasticity

```
. estat hettest, fstat

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of HSwe_RP

         F(1 , 754)    =     9.97
         Prob > F      =   0.0017
```

Result: 9.97 > 3.84 → Reject H_0. Rejecting H_0: the data do not have a constant variance, since the data has heteroskedasticity.

9.4.2.1.2 Null-hypothesis test for autocorrelation

```
. estat bgodfrey, small

Breusch-Godfrey LM test for autocorrelation
```

lags(*p*)	F	df	Prob > F
1	96.681	(1, 753)	0.0000

H0: no serial correlation

Result: 96.68 > 3.84 → Reject H_0. Rejecting H_0: the data has a covariance between any pair of random errors and therefore has autocorrelation.

9.4.2.2 Test if beta value of the fund is equal to the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey  HSwe_RP SIX30RX_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F(  1,   754)  =    702.35
                                                    Prob > F       =    0.0000
```

HSwe_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIX30RX_RP	.8368454	.0315768	26.50	0.000	.7748564	.8988344
_cons	-.0000432	.0001943	-0.22	0.824	-.0004246	.0003381

Calculation:

$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.8368454 - 1}{0.0315768} = -5.17$$

Result: -5.17 < -1.96 → Reject H_0. → $\beta_2 \neq 1$, the fund index is not equal to market index, with a significance level of 5%.

9.4.2.3 Test if beta value of the fund is less the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey  HSwe_RP SIX30RX_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F(  1,   754)  =    702.35
                                                    Prob > F       =    0.0000
```

HSwe_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIX30RX_RP	.8368454	.0315768	26.50	0.000	.7748564	.8988344
_cons	-.0000432	.0001943	-0.22	0.824	-.0004246	.0003381

Calculation: $$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.8368454 - 1}{0.0315768} = -5.17$$

Result: -5.17 < 1.645 → Reject H_0. → $\beta_2 < 1$, the fund index is significant less than the market index, with a significance level of 5%.

9.4.3 Handelsbanken's global fund and MSCI world gross index

```
. regress Hglob_RP MSCI_RP
```

Source	SS	df	MS	Number of obs = 756
Model	.011723579	1	.011723579	F(1, 754) = 126.21
Residual	.070037396	754	.000092888	Prob > F = 0.0000
				R-squared = 0.1434
Total	.081760975	755	.000108293	Adj R-squared = 0.1423
				Root MSE = .00964

Hglob_RP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
MSCI_RP	.2743747	.0244227	11.23	0.000	.2264301	.3223192
_cons	8.36e-06	.0003507	0.02	0.981	-.0006802	.0006969

9.4.3.1 Test for heteroskedasticity and autocorrelation

9.4.3.1.1 Null-hypothesis test for heteroskedasticity

```
. estat hettest, fstat

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of Hglob_RP

         F(1 , 754)    =     0.00
         Prob > F      =   0.9591
```

Result: 0.00 < 3.84 → Do not reject H_0. The data do not have heteroskedasticity.

9.4.3.1.2 Null-hypothesis test for autocorrelation

```
. estat bgodfrey, small

Breusch-Godfrey LM test for autocorrelation
```

lags(p)	F	df	Prob > F
1	20.192	(1, 753)	0.0000

H0: no serial correlation

Result: 20.192 > 3.84 → Reject H_0. By rejecting H_0 the data has covariance between any pair of random errors and therefore has autocorrelation.

9.4.3.2 Test if beta value of the fund is equal to the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey  Hglob_RP  MSCI_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F( 1,   754)   =     76.95
                                                    Prob > F       =    0.0000
```

Hglob_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
MSCI_RP	.2743747	.0312772	8.77	0.000	.212974	.3357753
_cons	8.36e-06	.0002817	0.03	0.976	-.0005447	.0005614

Calculation: $$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.2743747 - 1}{0.0312772} = -23.2$$

Result: -23.2 < -1,96 → Reject H_0. → $\beta_2 \neq 1$, The fund index is not equally to market index, with a significance level of 5%.

9.4.3.3 *Test if beta value of the fund is less the market beta*

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey  Hglob_RP  MSCI_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F(  1,   754)  =     76.95
                                                    Prob > F       =    0.0000
```

Hglob_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
MSCI_RP	.2743747	.0312772	8.77	0.000	.212974	.3357753
_cons	8.36e-06	.0002817	0.03	0.976	-.0005447	.0005614

Calculation: $$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.2743747 - 1}{0.0312772} = -23.2$$

Result: -23.2 < 1.645 → Reject H_0. → $\beta_2 < 1$, The fund index is significantly less than the market index, with a significance level of 5%.

9.4.4 Nordea's Swedish fund and SIX30RX

```
. regress  NSwe_RP SIX30RX_RP
```

Source	SS	df	MS		
Model	.137979169	1	.137979169	Number of obs	= 756
Residual	.069001231	754	.000091514	F(1, 754)	= 1507.75
				Prob > F	= 0.0000
Total	.2069804	755	.000274146	R-squared	= 0.6666
				Adj R-squared	= 0.6662
				Root MSE	= .00957

NSwe_RP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIX30RX_RP	.8065144	.0207706	38.83	0.000	.7657394	.8472894
_cons	7.53e-06	.0003483	0.02	0.983	-.0006761	.0006912

9.4.4.1 *Test for heteroskedasticity and autocorrelation*

9.4.4.1.1 Null-hypothesis test for heteroskedasticity

```
. estat hettest, fstat

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of NSwe_RP

         F(1 , 754)   =     2.94
         Prob > F     =   0.0866
```

Result: 2.94 < 3.84 → Do not reject H_0. The data do not have heteroskedasticity.

9.4.4.1.2 Null-hypothesis test for autocorrelation

```
. estat bgodfrey, small

Breusch-Godfrey LM test for autocorrelation
```

lags(p)	F	df	Prob > F
1	117.331	(1, 753)	0.0000

H0: no serial correlation

Result: 117.331 > 3.84 → Reject H_0. Rejecting H_0: the data has covariance between any pair of random errors and therefore has autocorrelation.

9.4.4.2 Test if beta value of the fund is equal to the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey   NSwe_RP   SIX30RX_RP, lag(7)

Regression with Newey-West standard errors          Number of obs   =       756
maximum lag: 7                                      F(  1,   754)   =    550.91
                                                    Prob > F        =    0.0000
```

NSwe_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIX30RX_RP	.8065144	.0343614	23.47	0.000	.7390591	.8739698
_cons	7.53e-06	.00019	0.04	0.968	-.0003654	.0003804

Calculation:

$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.8065144 - 1}{0.0343614} = -5.63$$

Result: -5.63 < -1.96 → Reject H_0. → $\beta_2 \neq 1$, the fund index is not equal to market index, with a significance level of 5%.

9.4.4.3 Test if beta value of the fund is less the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey   NSwe_RP   SIX30RX_RP, lag(7)

Regression with Newey-West standard errors          Number of obs   =       756
maximum lag: 7                                      F(  1,   754)   =    550.91
                                                    Prob > F        =    0.0000
```

NSwe_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIX30RX_RP	.8065144	.0343614	23.47	0.000	.7390591	.8739698
_cons	7.53e-06	.00019	0.04	0.968	-.0003654	.0003804

Calculation:

$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.8065144 - 1}{0.0343614} = -5.63$$

Result: -5.63 < 1.645 → Reject H_0. → $\beta_2 < 1$, the fund index is significant less than the market index, with a significance level of 5%.

9.4.5 Nordea's global fund and MSCI world gross index

```
. regress   Nglob_RP  MSCI_RP
```

Source	SS	df	MS		
Model	.015992978	1	.015992978	Number of obs	= 756
Residual	.066212484	754	.000087815	F(1, 754)	= 182.12
				Prob > F	= 0.0000
				R-squared	= 0.1945
				Adj R-squared	= 0.1935
Total	.082205462	755	.000108881	Root MSE	= .00937

Nglob_RP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
MSCI_RP	.3204635	.0237464	13.50	0.000	.2738465	.3670804
_cons	-.0000197	.000341	-0.06	0.954	-.0006891	.0006498

9.4.5.1 Test for heteroskedasticity and autocorrelation

9.4.5.1.1 Null-hypothesis test for heteroskedasticity

```
. estat hettest, fstat

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of Nglob_RP

         F(1 , 754)    =     0.13
         Prob > F      =   0.7209
```

Result: 0.13 < 3.84 → Do not reject H_0. The data do not have heteroskedasticity.

9.4.5.1.2 Null-hypothesis test for autocorrelation

```
. estat bgodfrey, small

Breusch-Godfrey LM test for autocorrelation
```

lags(*p*)	F	df	Prob > F
1	21.954	(1, 753)	0.0000

```
H0: no serial correlation
```

Result: 21.954 > 3.84 → Reject H_0. By rejecting H_0 the data has covariance between any pair of random errors and therefore has autocorrelation.

9.4.5.2 Test if beta value of the fund is <u>equal</u> to the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey   Nglob_RP  MSCI_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F(  1,   754)  =    115.17
                                                    Prob > F       =    0.0000
```

Nglob_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
MSCI_RP	.3204635	.0298615	10.73	0.000	.261842	.379085
_cons	-.0000197	.0002713	-0.07	0.942	-.0005523	.000513

Calculation:

$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.3204635 - 1}{0.0298615} = -22.76$$

Result: -22.76 < -1.96 → Reject H_0. → $\beta_2 \neq 1$, the fund index is not equal to market index, with a significance level of 5%.

9.4.5.3 Test if beta value of the fund is <u>less</u> the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey   Nglob_RP  MSCI_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F(  1,   754)  =    115.17
                                                    Prob > F       =    0.0000
```

Nglob_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
MSCI_RP	.3204635	.0298615	10.73	0.000	.261842	.379085
_cons	-.0000197	.0002713	-0.07	0.942	-.0005523	.000513

Calculation:

$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.3204635 - 1}{0.0298615} = -22.76$$

Result: -22.76 < 1.645 → Reject H_0. → $\beta_2 < 1$, the fund index is significant less than the market index, with a significance level of 5%.

9.4.6 SEB's Swedish fund and SIX30RX

```
. regress  SEBSwe_RP  SIX30RX_RP
```

Source	SS	df	MS		
Model	.151131924	1	.151131924	Number of obs	= 756
Residual	.050694613	754	.000067234	F(1, 754)	= 2247.84
				Prob > F	= 0.0000
				R-squared	= 0.7488
				Adj R-squared	= 0.7485
Total	.201826537	755	.00026732	Root MSE	= .0082

SEBSwe_RP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIX30RX_RP	.8440798	.0178033	47.41	0.000	.8091298	.8790297
_cons	-.0000642	.0002985	-0.22	0.830	-.0006502	.0005218

9.4.6.1 Test for heteroskedasticity and autocorrelation

9.4.6.1.1 Null-hypothesis test for heteroskedasticity

```
. estat hettest, fstat

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of SEBSwe_RP

         F(1 , 754)   =     7.50
         Prob > F     =   0.0063
```

Result: 7.5 > 3.84 → Reject H_0. Rejecting H_0: the data do not have a constant variance, since the data has heteroskedasticity.

9.4.6.1.2 Null-hypothesis test for autocorrelation

```
. estat bgodfrey, small

Breusch-Godfrey LM test for autocorrelation
```

lags(p)	F	df	Prob > F
1	152.257	(1, 753)	0.0000

H0: no serial correlation

Result: 152.3 > 3.84 → Reject H_0. By rejecting H_0 the data has covariance between any pair of random errors and therefore has autocorrelation.

9.4.6.2 Test if beta value of the fund is equal to the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey  SEBSwe_RP SIX30RX_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F(  1,   754)  =    811.36
                                                    Prob > F       =    0.0000
```

SEBSwe_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIX30RX_RP	.8440798	.0296331	28.48	0.000	.7859067	.9022529
_cons	-.0000642	.0001536	-0.42	0.676	-.0003659	.0002374

Calculation:

$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.8440798 - 1}{0.0296331} = -5.26$$

Result: -5.26 < -1,96 → Reject H_0. → $\beta_2 \neq 1$, the fund index is not equal to market index, with a significance level of 5%.

9.4.6.3 Test if beta value of the fund is less the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey  SEBSwe_RP SIX30RX_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F(  1,   754)  =    811.36
                                                    Prob > F       =    0.0000
```

SEBSwe_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIX30RX_RP	.8440798	.0296331	28.48	0.000	.7859067	.9022529
_cons	-.0000642	.0001536	-0.42	0.676	-.0003659	.0002374

Calculation:

$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.8440798 - 1}{0.0296331} = -5.26$$

Result: -5.26 < 1.645 → Reject H_0. → $\beta_2 < 1$, the fund index is significant less than the market index, with a significance level of 5%.

9.4.7 SEB's global fund and MSCI world gross index

```
. regress  SEBglob_RP MSCI_RP
```

Source	SS	df	MS		
Model	.003723136	1	.003723136	Number of obs	= 756
Residual	.080375941	754	.000106599	F(1, 754)	= 34.93
				Prob > F	= 0.0000
				R-squared	= 0.0443
				Adj R-squared	= 0.0430
Total	.084099078	755	.00011139	Root MSE	= .01032

SEBglob_RP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
MSCI_RP	.154621	.0261632	5.91	0.000	.1032595	.2059824
_cons	.0000105	.0003757	0.03	0.978	-.0007271	.0007481

9.4.7.1 Test for heteroskedasticity and autocorrelation

9.4.7.1.1 Null-hypothesis test for heteroskedasticity

```
. estat hettest, fstat

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of SEBglob_RP

         F(1 , 754)    =     0.02
         Prob > F      =   0.8972
```

Result: 0.02 < 3.84 → Do not reject H_0. The data does not have heteroskedasticity.

9.4.7.1.2 Null-hypothesis test for autocorrelation

```
. estat bgodfrey, small

Breusch-Godfrey LM test for autocorrelation
```

lags(p)	F	df	Prob > F
1	5.568	(1, 753)	0.0185

H0: no serial correlation

Result: 5.57 < 3.84 → Reject H_0. By rejecting H_0 the data has covariance between any pair of random errors and therefore has autocorrelation.

9.4.7.2 Test if beta value of the fund is equal to the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey   SEBglob_RP  MSCI_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F(  1,   754)  =     16.41
                                                    Prob > F       =    0.0001
```

SEBglob_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
MSCI_RP	.154621	.0381726	4.05	0.000	.0796837	.2295582
_cons	.0000105	.0003302	0.03	0.975	-.0006376	.0006587

Calculation:
$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.154621 - 1}{0.0381726} = -22.15$$

Result: -22.15 < -1.96 → Reject H_0. → $\beta_2 \neq 1$, the fund index is not equal to market index, with a significance level of 5%.

9.4.7.3 Test if beta value of the fund is less the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey   SEBglob_RP  MSCI_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F(  1,   754)  =     16.41
                                                    Prob > F       =    0.0001
```

SEBglob_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
MSCI_RP	.154621	.0381726	4.05	0.000	.0796837	.2295582
_cons	.0000105	.0003302	0.03	0.975	-.0006376	.0006587

Calculation:
$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.154621 - 1}{0.0381726} = -22.15$$

Result: -22.15 < 1.645 → Reject H_0. → $\beta_2 < 1$, the fund index is significant less than the market index, with a significance level of 5%.

9.4.8 Swedbank's Swedish fund and SIX30RX

```
. regress  SwedSwe_RP  SIX30RX_RP
```

Source	SS	df	MS		
Model	.167557578	1	.167557578	Number of obs	= 756
Residual	.075172608	754	.000099698	F(1, 754)	= 1680.64
				Prob > F	= 0.0000
Total	.242730187	755	.000321497	R-squared	= 0.6903
				Adj R-squared	= 0.6899
				Root MSE	= .00998

SwedSwe_RP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIX30RX_RP	.888766	.0216795	41.00	0.000	.8462066	.9313254
_cons	-.000126	.0003635	-0.35	0.729	-.0008396	.0005876

9.4.8.1 Test for heteroskedasticity and autocorrelation

9.4.8.1.1 Null-hypothesis test for heteroskedasticity

```
. estat hettest, fstat

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of SwedSwe_RP

         F(1 , 754)    =     6.77
         Prob > F      =   0.0095
```

Result: 6.77 > 3.84 → Reject H_0. Rejecting H_0: the data do not have a constant variance, since the data has heteroskedasticity.

9.4.8.1.2 Null-hypothesis test for autocorrelation

```
. estat bgodfrey, small

Breusch-Godfrey LM test for autocorrelation
```

lags(p)	F	df	Prob > F
1	126.843	(1, 753)	0.0000

H0: no serial correlation

Result: 126.84 > 3.84 → Reject H_0. By rejecting H_0 the data has covariance between any pair of random errors and therefore has autocorrelation.

9.4.8.2 Test if beta value of the fund is equal to the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey   SwedSwe_RP SIX30RX_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F( 1,   754)   =    694.48
                                                    Prob > F       =    0.0000
```

SwedSwe_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIX30RX_RP	.888766	.0337255	26.35	0.000	.822559	.954973
_cons	-.000126	.000188	-0.67	0.503	-.0004951	.0002432

Calculation:

$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.888766 - 1}{0.0337255} = -3.3$$

Result: -3.3 < -1.96 → Reject H_0. → $\beta_2 \neq 1$, the fund index is not equal to market index, with a significance level of 5%.

9.4.8.3 Test if beta value of the fund is less the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey   SwedSwe_RP SIX30RX_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F(  1,   754)  =    694.48
                                                    Prob > F       =    0.0000
```

SwedSwe_RP	Coef.	Newey-West Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIX30RX_RP	.888766	.0337255	26.35	0.000	.822559	.954973
_cons	-.000126	.000188	-0.67	0.503	-.0004951	.0002432

Calculation:
$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.888766 - 1}{0.0337255} = -3.3$$

Result: -3.3 < 1.645 → Reject H_0. → $\beta_2 < 1$, the fund index is significant less than the market index, with a significance level of 5%.

9.4.9 Swedbank's global fund and MSCI world gross index

```
. regress  SweGlob_RP MSCI_RP
```

Source	SS	df	MS		
Model	.052094638	1	.052094638	Number of obs	= 756
Residual	.06020897	754	.000079853	F(1, 754)	= 652.38
				Prob > F	= 0.0000
				R-squared	= 0.4639
				Adj R-squared	= 0.4632
Total	.112303608	755	.000148747	Root MSE	= .00894

SweGlob_RP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
MSCI_RP	.5783762	.0226443	25.54	0.000	.5339228	.6228295
_cons	.0000341	.0003252	0.10	0.916	-.0006043	.0006725

9.4.9.1 Test for heteroskedasticity and autocorrelation

9.4.9.1.1 Null-hypothesis test for heteroskedasticity

```
. estat hettest, fstat

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of SweGlob_RP

         F(1 , 754)    =     0.22
         Prob > F      =   0.6391
```

Result: 0.22 < 3.84 → Do not reject H_0. The data do not have heteroskedasticity.

9.4.9.1.2 Null-hypothesis test for autocorrelation

```
. estat bgodfrey, small

Breusch-Godfrey LM test for autocorrelation
```

lags(p)	F	df	Prob > F
1	40.394	(1, 753)	0.0000

Result: 40.39 > 3.84 → Reject H_0. By rejecting H_0 the data has covariance between any pair of random errors and therefore has autocorrelation.

9.4.9.2 Test if beta value of the fund is equal to the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey  SweGlob_RP MSCI_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F(  1,   754)  =    314.13
                                                    Prob > F       =    0.0000

------------------------------------------------------------------------------
             |             Newey-West
SweGlob_RP   |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      MSCI_RP|   .5783762    .032633    17.72   0.000     .5143137    .6424386
       _cons |   .0000341   .0002475     0.14   0.890    -.0004518     .00052
------------------------------------------------------------------------------
```

Calculation:

$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.5783762 - 1}{0.032633} = -12.92$$

Result: -12.92 < -1.96 → Reject H_0. → $\beta_2 \neq 1$, the fund index is not equal to market index, with a significance level of 5%.

9.4.9.3 Test if beta value of the fund is less the market beta

The robust standard error is defined by regress with Newey west and right number of lags.

```
. newey  SweGlob_RP MSCI_RP, lag(7)

Regression with Newey-West standard errors          Number of obs  =       756
maximum lag: 7                                      F(  1,   754)  =    314.13
                                                    Prob > F       =    0.0000

------------------------------------------------------------------------------
             |             Newey-West
SweGlob_RP   |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      MSCI_RP|   .5783762    .032633    17.72   0.000     .5143137    .6424386
       _cons |   .0000341   .0002475     0.14   0.890    -.0004518     .00052
------------------------------------------------------------------------------
```

Calculation:

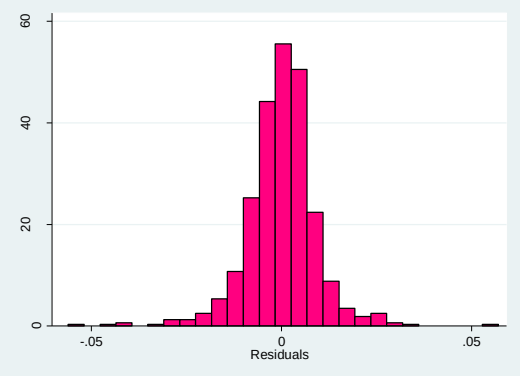
$$t = \frac{b_2 - \beta_2}{se_{HAC}(b_2)} = \frac{0.5783762 - 1}{0.032633} = -12.92$$

Result: -12.92 < 1.645 → Reject H_0. → $\beta_2 < 1$, the fund index is significant less than the market index, with a significance level of 5%.

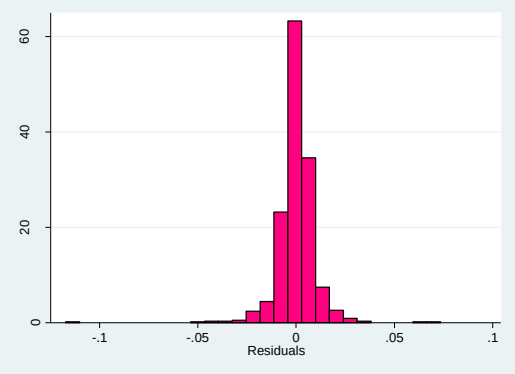
9.5 Residuals

Residuals of the regression with fund risk premium and market risk premium

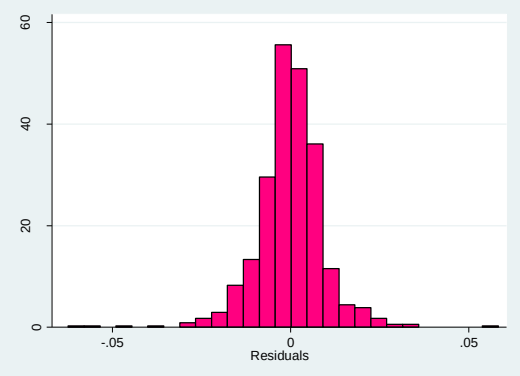
Residuals of the regression with Handelsbanken Swedish fund risk premium and SIX30RX risk premium



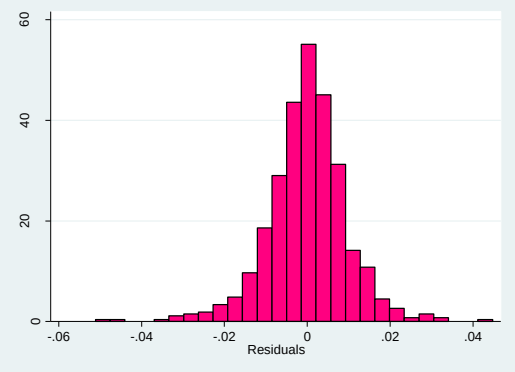
Residuals of the regression with Swedbank Swedish fund risk premium and SIX30RX risk premium



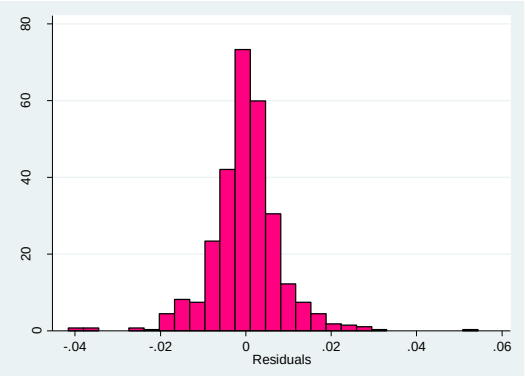
Residuals of the regression with Nordea Swedish fund risk premium and SIX30RX risk premium



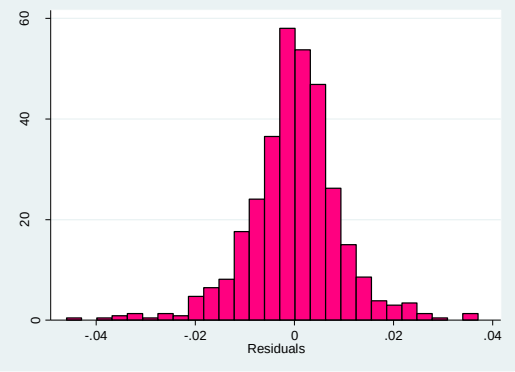
Residuals of the regression with Handelsbanken Global fund risk premium and MSCI world gross index risk premium



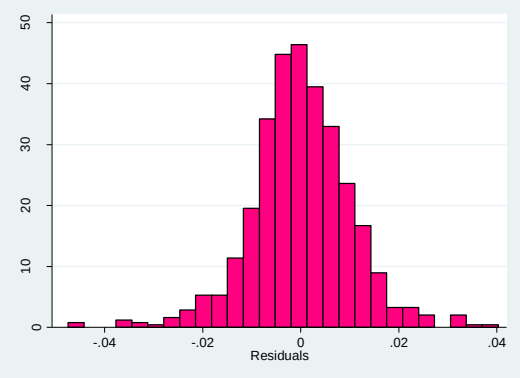
Residuals of the regression with SEB Swedish fund risk premium and SIX30RX risk premium



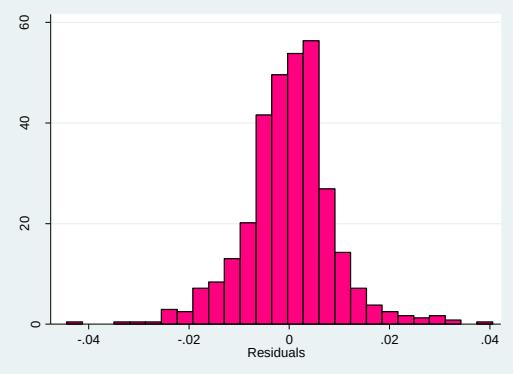
Residuals of the regression with Nordea Global fund risk premium and MSCI world gross index risk premium



Residuals of the regression with SEB Global fund risk premium and MSCI world gross index risk premium



Residuals of the regression with Swedbank Global fund risk premium and MSCI world gross index risk premium



Source: Handelsbanken.se, illustrations by authors