# Abstract

| | |
|---|---|
| Title: | Style based analysis – A study on Swedish equity funds |
| Authors: | Jimmy Andtfolk, Erik Karlsson, Anders Lindberg |
| Tutor: | Göran Anderson |
| Key words: | Style based analysis, Fund, Forecasting, PPM, Index |

### *Purpose of the study*

Selecting funds is a difficult task. Although relevant since everyone working in Sweden has to invest in funds within the Swedish pension system. In order to support the selection Style based analysis can be used. This is a tool developed by William F. Sharpe for analyzing equity funds' historical asset allocations, with only returns as input. Our purpose is *to test to which extent a Style based analysis is useful for the Swedish equity fund market.*

### *Methodology*

In order to fulfill our purpose, we used a quantitative approach, based on formerly developed theories, mainly the Style based analysis. We chose to analyze Swedish oriented equity funds within the pension system that have been active since at least 1995. After having applied these restrictions we ended up with 15 funds. Further, we chose relevant indices to represent the asset classes in which the funds invest. For the Style based analysis we used the Maximum Likelihood method, a convenient method when performing multiple linear regressions with restrictions.

### *Results*

We tested our models relevance from several perspectives, and found it to be useful for the Swedish Equity fund market. It could both analyze the funds historical asset allocations, and forecast coming returns Ex Post reasonably well. Furthermore, we discovered two areas where the model can be of special interest. When choosing funds within a specific segment, for instance Swedish oriented equity funds, the Style based analysis can be used to analyze the differences between the funds within the segment. We also noticed that the Style based analysis can be a useful tool when studying whether or not a fund is an index follower.

# Table of contents

# 1   Introduction

*In this chapter we will introduce our field of study, and discuss why and how it is relevant for an investor. The discussion will lead to a formulation of the purpose of the study.*

Today, almost every person in Sweden can be considered an investor. Not only private investments are held but also everyone who works get a certain amount of their wage put away within the pension system[1].

If investing privately, the portfolio's composition and risk profile has to be considered in order to match the investor's individual preferences. To compose and manage an asset portfolio can be quite complicated. Different assets are to be weighted and their combination affects the result[2]. A more convenient way might be to invest money in a fund where a professional manager does the work. Regarding the money put away for the pension, this is the only alternative available[3].

Selecting a fund to invest in might be difficult. At the end of 2002 almost 1100 funds were offered solely on the Swedish market. At first sight many of the funds, at least within a certain category, may look somewhat similar. In reality the funds differ in several perspectives, e.g. regarding investment strategies and size of fees.

At mid-year of 2002 a majority of the Swedish population (84 % of age 18-74 years) had capital invested in funds, directly, or indirectly via the pension system[4]. Consequently vast amounts of money are invested in funds. During 2002 total savings in the Swedish market amounted to over SEK 70 billion. Of these savings almost 20 billion derived from investments made within the pension system[5].

In the pension system equity funds are often mentioned as superior in the long run compared to bond and money market funds[6]. Maybe because of this, as of the end of 2002, a big part of the assets within the pension system was invested in equity funds (49%). Balanced funds represented (48 %), and merely 3 % of net assets consisted of bond funds, money market funds and other various funds[7].

## 1.1   Discussion of problem

About 500 equity funds are offered within the Swedish pension system. For a person not familiar with the financial markets, the choice between these financial products is difficult. Nevertheless, the decision is important, as it affects the level of wealth obtained when retiring.

When selecting funds in the pension system one gets information on how the funds have performed historically. Unfortunately it is hard to pick funds just on historical

---

[1] www.ppm.nu
[2] Haugen, 2001, p. 57
[3] www.ppm.nu
[4] Fondbolagens förening, "Hur ser fondsparandet ut i Sverige och vad tycker fondspararna?", 20020917
[5] Fondbolagens förening, "Hushållen ökade sitt direktsparande i fonder under 2002", 20030204
[6] Fondbolagens förening, "5 myter om pension", 20030213
[7] Fondbolagens förening, "Fund saving by category", 2002

return data since many funds, although under the same category in the pension system, has very different investment strategies. Thus, just because fund A has performed better than fund B, this does not imply that the managers of fund A are more skilled. It might be that fund A mainly invests in a specific segment of the market that has developed especially well. Hence, this information is not enough as a decision rule. A more detailed analysis of the funds strategies may be needed. This can be done with Style based analysis, first introduced by William F. Sharpe in 1988[8]. The model can, based on historical returns, estimate the asset allocation of the fund. Through this analysis, it is possible to see how the funds have invested more precisely.

Historical asset allocations are very interesting to study. However, from an investor perspective the main interest is not of historical but of future returns. Of course, we cannot with assurance make statements about the funds future performances. If so, we would certainly not publish these, but make ourselves rich. However, by testing how well the model could forecast in the past, a judgment of the models ability to forecast future returns can be made.

## 1.2 Purpose of the study

The purpose of our study is *to test to which extent a Style based analysis is useful for the Swedish equity fund market*.

With useful we do not only mean how well it can be used to explain the funds historical returns, which is the basic idea of the model. Since investors are more interested in future returns, we will also test if the model is an accurate tool for forecasting.

## 1.3 Delimitations of the study

In order to limit the workload, we have made some practically needed delimitations:

- We will only study equity funds that are included in the Swedish pension system. This limitation makes our study interesting not only for private investors, but also for everyone enrolled in the governmental pension system.

- In addition, we will only include equity funds within the segments focusing on the Swedish market. This limitation is necessary to keep the amount of funds at a reasonable level. Also, even if not theoretically logical[9], we believe that a lot of people want to invest in at least one Swedish oriented fund within the pension system.

- We will not study eventual changes of fund managers or strategies.

---

[8] Sharpe, 1988
[9] This is in Finance terms called the "Home Country Bias". Further information can be given in most basic Finance textbooks.

## 1.4  Choice of perspective

We choose the perspective of the external investor, interested in or currently investing, in equity funds. This perspective is consistent with the idea behind the Style based analysis[10]. It is also convenient, for reasons explained in chapter 5.

## 1.5  Target group

The target group of our work is primarily people with some basic knowledge in financial economics and statistics. However, we will exert ourselves to use vocabulary and explanations that can be understood by a larger group of people.

## 1.6  Essay Outline

Our study is structured as follows:

- Table of contents
- Introduction
- Methodology
- Introduction to equity funds
- Theory
- Empirical method
- Analysis of results
- Concluding discussion
- List of reference
- Appendix A – Multiple linear regression
- Appendix B – Fund descriptions
- Appendix C – Out of sample fund descriptions
- Appendix D – Index descriptions
- Appendix E – Index correlation matrix

---

[10] Sharpe, 1992

# 2 Methodology

*In this chapter we will describe the methodology used in order to fulfill the purpose of the study. We will discuss the methodological approach, the data used, reliability and validity and what alternative approaches there might be.*

## 2.1 Methodological approach

Our study will be based on a quantitative approach. The quantitative method formalizes and structures analyses, which leads to a high degree of control by the researcher[11]. We find this method convenient as we are going to analyze many different objects over long time periods[12]. Furthermore, this method allows us to draw generalized conclusions regarding the whole population.

When evaluating the usefulness of the Style based analysis we are using a deductive approach. This approach is characterized by the use of existing models and theories to analyze the reality[13]. We find the method convenient as we have no intentions of developing own theories. We believe that this would be too difficult at our academic level.

## 2.2 Data

### 2.2.1 Literature

We gathered information concerning the chosen field of study by:

- using databases such as Econlit, Elin, Libris and Affärsdata
- making use of different search engines on the Internet (Google, Yahoo, Altavista etc.)
- studying the bibliographies of articles and literature that we considered relevant reading
- searching for relevant articles in previously written master theses at the department of Business Administration and the department for Economics at the university of Lund
- literature suggestions from our tutor.

All the data that we will use in the model are secondary data. How we choose and collect it will be explained in chapter 5.

---

[11] Holme & Solvang, 1997, p. 14
[12] ibid, p. 78
[13] ibid, p. 51

## 2.3 Reliability and validity

The fact that a study has high validity implies that the study measures what it is supposed to. The reliability is dependent on how the measurements are performed and the accuracy in the treatment of information[14]. That is, the degree of reliability concerns whether the information we gathered is trustworthy or not and how we manipulated this data in our analysis.

Quantitative studies often have problems with validity[15]. As this approach involve distance to the analyzed objects there is a risk that these objects do not reflect what we intend to investigate. This problem is accentuated when studying non-experimental data where the collection process is not under your own control[16]. We aimed to strengthen the validity of our study through reading material from different authors active in the field of study. This approach enabled us to create a picture of which model to use. Despite of this we are aware of that our model is not flawless, and we discuss its shortcomings in chapter 4.

We regard the reliability of the data as high. When possible, data has been double-checked. Taking into consideration that the Swedish Financial Supervisory Authority (Finansinspektionen) surveys the funds we believe that the risk for funds to hand out incorrect data is mitigated.

The reliability and relevance of our model on a more operative level will be discussed thoroughly in chapter 4 and 5.

## 2.4 Alternative approaches

The methodological approach has a determining effect on the upcoming results[17]. It is important to be aware of this when choosing a certain approach to solve a problem.

An alternative to our selective choice regarding equity funds included in the pension system would have been to choose the same number of mutual funds randomly. However we thought of the mutual funds included in the pension system as an interesting group of funds to investigate, as it will increase the number of potential readers.

Instead of doing a purely quantitative analysis of the equity funds performance we could have added a qualitative section in order to increase the dept in our thesis. Through interviews with fund managers we could have obtained information about the funds activities, which could have facilitated our analysis. However these types of combinations of quantitative and qualitative investigations have proved to be somewhat complicated. There is a risk of not obtaining the same degree of precision

---

[14] Holme & Solvang, 1997, p. 163
[15] ibid, p. 83
[16] Hill, Griffiths, Judge, 2001, p.12
[17] Holme & Solvang, 1997, p. 11

and structure in qualitative data as in quantitative data[18]. We therefore consider that a purely quantitative approach is more convenient for our purposes.

---

[18] ibid, p. 87

# 3   Introduction to equity funds

*After a short introduction to Mutual funds in general, we give a short presentation of mutual fund savings in Sweden. After follows a discussion regarding the regulatory authorities and restrictions imposed on Swedish Equity funds.*

## 3.1   The nature of mutual fund savings

Mutual funds make it possible for savers to take part of the return of financial instruments in a relatively simple and hopefully cost efficient manner[19]. Capital from many investors is collected by the management company of the fund making it possible for small investors to enjoy the economies of scale that comes with pooling savings[20]. An important feature of the mutual funds is the possibility for small savers to diversify risks[21]. Another aspect is the time. Since a professional manager does the work, the investor can enjoy the outcome of his/her work, with a minimum time effort[22].

## 3.2   Recent development of the Swedish mutual fund market

Savings in investment funds have declined in Sweden in recent years. The principal explanation for this development is the downfall in the equity markets in the beginning of 2000. As a majority of the fund savings is invested in equity funds this downfall resulted in a severe decrease of the value of the fund savings as a whole. The figure below shows allocation of savings in mutual funds in Sweden as of March 31, 2003.[23]
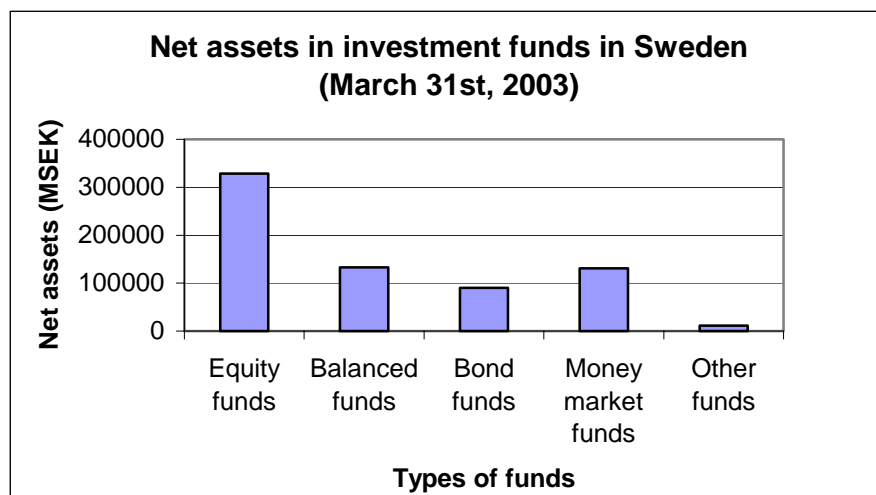


**Table 1: Net assets in Swedish Mutual Funds March 31, 2003**

---

[19] http://www.finans.regeringen.se/

[20] ibid

[21] Ross, Westerfield & Jaffe, 2002, p. 354

[22] ibid

[23] http://www.fondbolagen.se

### 3.3 Regulatory authorities

In Sweden funds are regulated in coherence with the Swedish Mutual Funds Act (1990:1114) (Lagen om Värdepappersfonder), which is based on the UCITS (Undertakings for Collective Investments In Transferable Securities) directives constituted by the European Union[24]. The Swedish Mutual Funds Act is complemented with the directives given by the Swedish Financial Supervisory Authority, which is responsible for supervising fund management companies. Additionally the Swedish Investment Funds Association (Fondbolagens Förening) publishes recommendations in several areas[25].

Authorization to manage mutual funds is granted by the Swedish Financial Supervisory Authority. Swedish fund management companies are allowed to operate freely in the EEA (European Economic Area) zone, since they fulfill the UCITS Directive.[26]

In addition, a mutual fund has its own fund rules, which are constituted by the management company. The fund rules specify issues such as underlying investment strategies, dividend policies, principles for calculations and the fees charged by the management company[27]. The fund rules have to be approved by the Financial Supervisory Authority. If the management wants to change the rules, the changes have to be submitted to the Financial Supervisory Authority for approval.

### 3.4 Laws and regulations

Earlier, mutual funds were regulated through the Mutual Funds Act (Aktiefondslagen) as of 1974 and the Investment Incentive Funds Act (Lagen om Aktiesparfonder) from 1978. The present Swedish Mutual Funds Act is more demanding regarding the information requirements of the mutual funds investment strategies[28].

The definition of a mutual fund given in the first section of the Swedish Mutual Funds Act is as follows:

*A mutual fund is a fund consisting of securities and other financial instruments. The fund is formed by means of capital contributions from the public and owned by those so contributing*[29].

Furthermore, a mutual equity fund is defined as a mutual fund investing more than 75% of its capital in stocks[30].

In order to guarantee risk diversification the Swedish Mutual Funds Act prescribes that a mutual equity fund should not invest more than 5 % of its capital into one single

---

[24] http://www.fondbolagen.se
[25] ibid
[26] http://www.finans.regeringen.se/
[27] The Swedish Mutual Funds Act (1990:1114), section 9
[28] http://www.fondbolagen.se
[29] The Swedish Mutual Funds Act (1990:1114), section 1
[30] http://www.morningtar.se

asset. However, mutual equity funds may be allowed to invest up to 10 % in individual stocks. This is only allowed for 40% of the funds capital. Taking these restrictions together a mutual equity fund has to have a portfolio consisting of at least 16 different stocks[31]. An exception is made for index funds, which are allowed to invest up to 20 % of its capital in a single share[32].

Additionally there are restrictions imposed on mutual funds regarding what kind of securities they are allowed to hold. The mutual funds may invest in securities and other financial instruments which are, or which within one year are intended to be:

* listed on a Swedish or foreign stock exchange
* listed on an authorized market place
* the subject of regular trading in some other regulated market open to the public.[33]

The holdings of a mutual fund can also include securities and financial instruments other than those specified above. These other securities are allowed to constitute a maximum of 10 % of the value of the fund[34].

Furthermore, units of a fund have to be of equal size and give equal rights to the property belonging to the fund. The value of the unit is equal to the value of the fund divided by the number of units. The value of the fund shall be accounted in accordance with the principles set out in the rules of the fund.[35]

Because of our choice of funds within the pension system, also the law controlling this authority ("Lag (1998:710) med vissa bestämmelser om Premiepensionsmyndigheten") is of interest. The major implication of our interest here regards PPM's criterion that a Swedish oriented equity fund is a fund with a minimum of 75% of the assets invested in Swedish listed stocks or other assets related to the development of the Swedish markets.

---

[31] http://www.ppm.nu/
[32] http://www.finans.regeringen.se/
[33] The Swedish Mutual Funds Act (1990:1114), section 18
[34] ibid
[35] The Swedish Mutual Funds Act (1990:1114), section 30

# 4   Theory

*In this chapter we will describe and discuss the theories used in the study. The chapter starts with a description of Style based analysis. Further we discuss how this approach can be used for forecasting. Finally we discuss potential problems and what criticism that has been expressed concerning the method.*

## 4.1   The basics of Style based analysis

The fundamental idea is to estimate to what extent the fund's return has been sensitive to movements in returns of different asset classes[36]. To give a practical example, it is likely that a mutual fund whose main strategy is to invest in Nordic equities is more sensitive to changes in Nordic stock indices, than a fund whose main focus is the Pacific. In general form, our factor model for a fund looks like:

$$y_t = (\beta_1 x_{t1} + \beta_2 x_{t2} + ... + \beta_K x_{tK}) + e_t$$

$y_t =$ return of the fund under the period
$\beta_k =$ sensitivity to factor k under the period
$x_{tK} =$ return of asset class k under the period
$e_t =$ the return not explained by the factors, could be skill or return from classes not included in the model.

There are some restrictions in the model that can be interpreted as the investment limitations a fund manager has.

- No intercept is specified (The fund will not give any return if the assets has not)
- The coefficients must lie between 0 and 1 (The fund cannot invest more than 100 % of its capital in one single asset)
- The coefficients must sum up to 1 (The fund has to invest all of its capital into something)

The method for estimating the sensitivity coefficients is a multiple linear regression. For a reader not acquainted with this method, we refer to Appendix A for further explanation. Calculating the factor coefficients gives an estimated model on how the fund has invested historically. How good the model is depends on several things. The model only explains a certain part of the fund's historical return. If it explains close to all of the return of the fund, the model has high explanatory power, and vice versa. A measure for this is the $R^2$ value, which measures how much of the variance in the funds return that the model can explain. The formula for the $R^2$ is:

$$R^2 = 1 - \frac{Var(e_t)}{Var(y_t)}$$

---

[36] Sharpe 1992

Where the var($e_t$) / var($y_t$) represent the part of the variance unexplained. Hence, the $R^2$ will be a value on how much of the variance the model explains. A measure close to 1 means that it explains almost all of the variance, and a number close to 0 means almost no explanatory power. Naturally, it is important for us to achieve high $R^2$ values.

However, there may be other problems with the model than just low explanatory power. Other problems that might occur are discussed in chapter 4.5.

## 4.2   Method of estimation

As stated, the technique of estimation is a multiple linear regression. For such regressions, the standard method of use is the OLS method[37]. However, when having restrictions for the coefficients, this method is not applicable. Instead, we will use a method called the Maximum Likelihood. The intuitive concept behind the Maximum likelihood model is that an event occurs because it is most likely to. The coefficients are seen as quantities, with a specific fixed value, which is not known. The method then tests possible outcomes of the parameters within the given restrictions in order to maximize the probability of obtaining the values actually observed[38]. We will not discuss the formulas or derivation of formulas for the method here. A more detailed explanation can be found in any intermediary econometrics textbooks.

The Maximum Likelihood estimators have some desirable properties, which are:

- Consistency
- Asymptotically efficiency; which means that for large number of observations, no other consistent estimator has a smaller variance
- Asymptotically normality, that is, for large number of observations they closely approximate the normal distribution, even if the observation from which the observations were drawn was not normal.[39]

## 4.3   Uses of Style based analysis

The model obtained can be used for several different purposes. Since the model generates, hopefully, a more adequate benchmark, it is possible to evaluate to what extent the manager has added value to the fund[40]. You can also compare the funds and try to categorize them within different investment styles such as growth/value, large/mid/small capitalization[41], and so forth[42]. Our focus will be to generally conclude about the models usefulness, from an investor perspective, which will include forecasting ability and ability to explain historical returns. While it is interesting to see how the fund has invested historically, it is even more interesting to be able to make predictions about the future.

---

[37] Ordinary Least Squares, for explanation, please refer to any basic Econometrics textbook
[38] http://www.ai.mit.edu, p. 4
[39] Ramanathan, 1998, p. 73
[40] See for example Sharpe 1992, Kahn & Rudd 1995
[41] Capitalization is the market value of the company (number of stocks outstanding * price per stock)
[42] See for example Mayes, Jay & Thurnston, 2000, or Brown & Goetzmann,1996

## 4.4 Style based analysis for forecasting

As we have discussed above, Style based analysis is a way of studying historical returns in order to try to analyze the funds investment strategies, or the types of assets invested in. As stated, we are not only interested in studying the history of the fund, but also to make statements and predictions about the funds future performance. This is a difficult task, since predictions about the future always are hard to quantify. However, some studies prove that the past contains valuable information that can be used for predictions of future fund performance[43]. One way of testing the historical forecasting ability of the model is the *Ex-Post* forecast[44]. The logics of this approach is that it seems reasonable to think that if our model previously has been a good forecasting tool, it may also be so in the future.

Assume that data from 1995 to 2000 is available. Instead on running the regression for all our data, we only use the data from 1995 to 1998, period $T_1$. Then we use the model obtained here to make forecasts for 1999 and 2000, period $T_2$. Since we have the outcome we can study the deviations between the real data and our forecasts. These results provide us with a true test on the model's forecasting ability[45]. Finally we run the regression for all the data, i.e. from 1995 to 2000, and use the results to make forecasts about the future, the *Ex Ante* data depicted as period $T_3$ below:



**Table 4.1: Ex post forecasting**
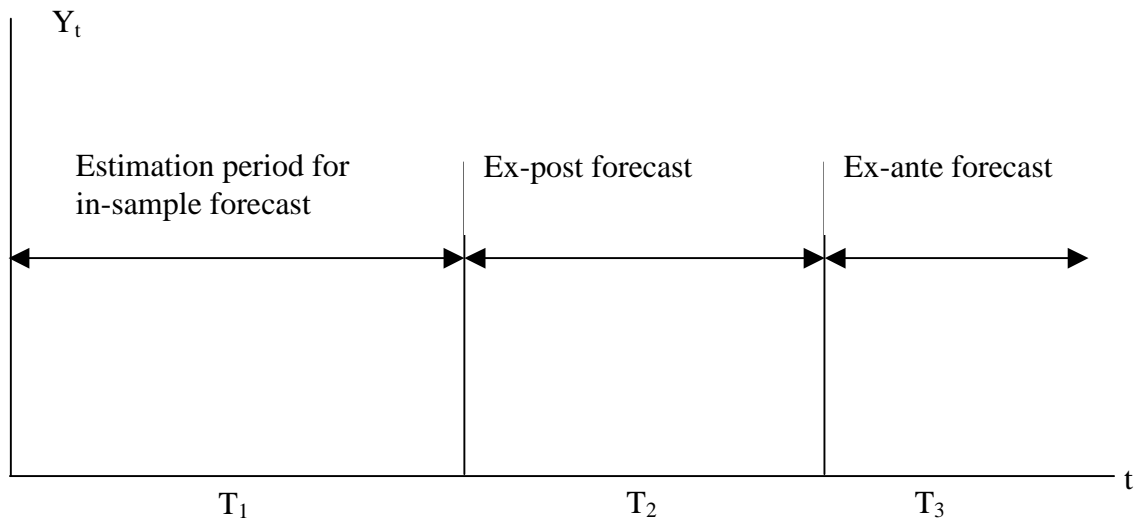
The process of forecasting contains four major steps:

1. Run regression on some of your data to receive a test model
2. Use the model to predict Ex Post values
3. Test how the model worked (compare Ex Post estimates with actual outcome)
4. Run regression on all data to be able to predict future values.

---

[43] Elton and Gruber, 1996
[44] Ramanathan, 1998
[45] Ramanathan ,1998, p. 600

Step 1 and 4 are Style based analysis regressions, explained above. Step 2 and 3 will be discussed below.

### 4.4.1  Step 2 – Use the model to forecast future values

There are two major approaches for using the model to forecast future values. Either you assume an econometric approach, which means using the historically calculated coefficients from step 1 to make forecasts. The other approach is to base your forecasts on the past values on the dependent variable and the error terms that may be serially correlated. This is called time series forecasting.

These are just the basic approaches, and can be combined in order to get a more complete model. In the econometric approach, you can for example add lagged variables to account for autocorrelation, adding some of the qualities of a time series approach. Generally, it has been found that econometric models are better suited for forecasting long term effects, and that time series models are superior for short term forecasting[46]. It should be noted that this is a rule of thumb; it differs a lot from case to case what is best suitable. In case of a large and significant autocorrelation, a time series approach may be better, and when there is less autocorrelation, an econometric approach may be preferable.

We will use an econometric approach, but we will carefully look for evidence of autocorrelation. If considerable autocorrelation will be found, we will add lagged variables to the model to enhance its forecasting ability.

### 4.4.2  Step 3 – Test how well the model worked

When using a Maximum Likelihood method for estimating the coefficients, whilst having a large number of observations, the estimators can be approximated as normally distributed. Our method for forecasting will then be to set up a confidence interval for the forecasts, in which 95 % of the estimations should be. We will then calculate which percentage of all the estimates that actually was within the specified interval. If this number is close to 95% (over 95 is even better, lower is worse), the model can be stated as being useful for forecasting Ex Post. If this will also be the case in the future, we leave to the reader or user of the model to decide.

### *4.5  Forecasts rely on market view*

It seems convenient to be able to predict the future. However, for the model to work for forecasting, one first has to make predictions about the development of the markets covered in the model. This makes the model less valuable, and complicates the picture drastically. Practically, the forecasts have low value if you do not have an adequate and well-analysed market view. If you have this, the model can be of great help for measuring your expected return, and also your maximum loss if things do not turn out the way you expect.

---

[46] Ramanathan 1998, p. 599

## *4.6   Problems with our approach*

Previously we have explained the logics behind our model, and how it may be used for forecasting. Still, there are several problems with our model that has to be considered when using the model for decision support. We will discuss these problems in the last part of this chapter.

### 4.6.1   Average values under the period

There are several problems to keep in mind when using Style based analysis. An important point we want to stress is that our factors are the average factors under the period studied. If the fund changed strategy during this period, the result will be an average of the strategies used. This will be especially problematic when forecasting. If the model is an average, it might not be so good for forecasting, since the current strategy could be significantly different from the one reflected in the model. If an investor wants to use the model for forecasting, he/she should be attentive to historic or future changes in the fund's investment strategies since this will reduce the relevance of the model for the fund.

### 4.6.2   Lack of information

Another problem concerns the data that we build our model on. One should be aware of that the forecasts rely on old values of the dependent variables. If forthcoming values will deviate largely from the ones we have used, the validity of our model will be negatively affected. This is something one has to be aware of when discussing the model's ability to forecast. This can easily be illustrated in a diagram:

Y $\qquad\qquad\qquad\qquad \alpha + \beta_1x + \beta_2x + \beta_3x + \dots + + \beta_nx + t*s_y$

$\qquad\qquad\qquad\qquad\qquad \alpha + \beta_1x + \beta_2x + \beta_3x + \dots + \dots + \beta_nx$
$\qquad\qquad\qquad\qquad\qquad$ (our fitted model)

Average y

$\qquad\qquad\qquad\qquad\qquad \alpha + \beta_1x + \beta_2x + \beta_3x + \dots + + \beta_nx - t*s_y$

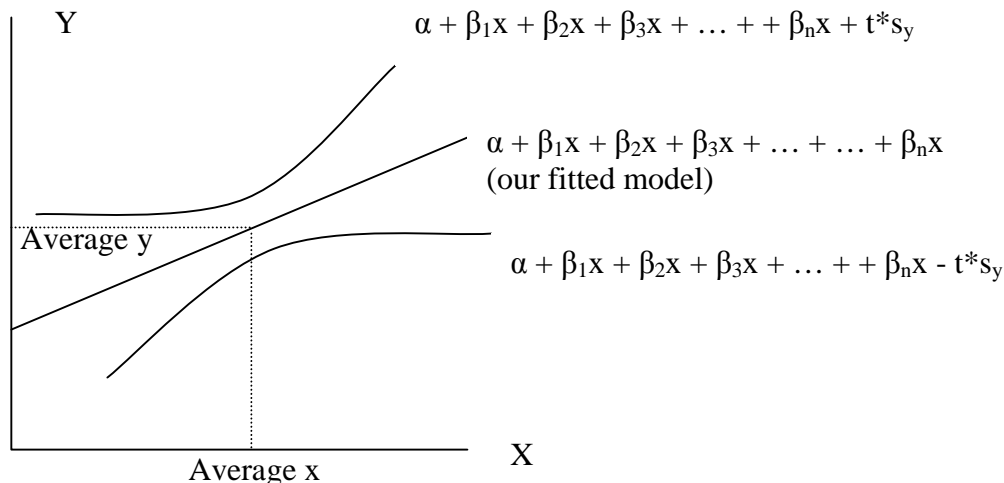$\qquad\qquad\qquad\qquad$ X

Average x

**Table 4.2 Lack of info when forecasting**

The curves around the forecasted value line are confidence interval bands for the forecasts[47]. The intuitive interpretation of this is that the further away from your average values, the less information you have; hence your forecasts will be less

---

[47] For further explanation see Ramanathan, 1998, pp. 119

precise. In our case this can be interpreted as if future returns move around the values experienced, it is more likely that our model can be used for forecasting. If instead the changes of return are greater (both positively or negatively) then measured, our model will loose its forecasting ability from the fact that we do not know how the fund managers will act. When forecasting, due to our large number of values, we instead approximate that these confidence interval bands are straight, i.e. no increased variance when the actual values moves away from the average.

### 4.6.3 Multicollinearity

An issue connected to the calculus of the multiple linear regression is multicollinearity, which can appear when the asset classes used move in a similar way. The model then has a problem with sorting out which of the asset classes that has actually affected the funds return. If for example the Swedish and the European index move very similarly, the model can not say if the fund has invested in Swedish or European stock. This problem is reduced if the number of observations is large. We will be attentive to this problem; hence a correlation matrix is attached in Appendix E.

### 4.6.4 Heteroskedasticity

A problem often encountered in regression analysis is heteroskedasticity. Technically, it means that the variance of the error term is not stable, but varies with one of the dependent variables or over time in time series analysis. A simplified hands on explanation may be that the larger the house is, the more the price of it varies, both positively (luxury house) and negatively (badly maintained). However, we do not find any reason for this in our models. Pragmatically, it would mean that the fund manager is taking larger and larger or smaller and smaller risks the longer time has passed, which seems unreasonable to believe.

### 4.6.5 Acts like or consist of?

A built-in problem with the model is that one can never make statements about what the fund *has actually consisted of*; one can only state that *it acts like* it consisted of these assets[48]. This problem is related to the choice of asset classes. If relevant asset classes are chosen, this problem will be reduced to a minimum. On the other hand, if asset classes are chosen without care, there is a significant risk of achieving a spurious regression, a regression that seems to produce good results, but actually is only a result of coincidence. We try to mitigate this by studying the information available about the funds holdings thoroughly, as will be explained in chapter 5 below.

---

[48] Lhabitant 2002, p. 423

## *4.7   Negative aspects of Style based analysis*

Sharpe's Style based analysis strongly influenced performance analysis of mutual funds, both in theory and practice[49]. However, the style analysis has been subject to criticism in recent years.

Several authors point out that the vagueness in the definitions of the different style categories is a problem. This could lead to misclassifications that could reduce the validity of the style analysis[50]. Buetow et al stress that a single asset may exhibit characteristics that satisfy more than one style classification[51]. The use of style indices when evaluating managers is then said to be problematic because the results will not truly represent the managers underlying investment style[52]. We avoid this problem by using asset classes instead of styles, i.e. real assets instead of for example macro- or high yield -style.

### 4.7.1   Relevance of Style based analysis

It is apparent that the style analysis elaborated by Sharpe has several drawbacks. However, our purpose is to evaluate the usefulness of a relatively simple model that could be used by investors based on external information. We realise that the use of existing indices lead to approximations that will reduce the usefulness of the results. The independent variables will never be able to explain the complete scope of transactions made by the equity fund manager. Building our own more specified indices is much more time-consuming. As the equity funds generally do not reveal their investment strategies in detail we believe that it is questionable if the increased validity from building own indices is worthwhile. Furthermore, considering the perspective of the investor, we argue that if the model is not applicable keeping a reasonable amount of work, it is not applicable at all.

---

[49] Buetow, Johnson & Runkle, 2000, p.1
[50] diBartolomeo, 1997
[51] Buetow, Johnson & Runkle, 2000
[52] ibid

# 5　Empirical methodology

*In this chapter we give a description of our practical method of choosing and manipulating the data. We will describe the collection process and the rationale behind the chosen data.*

## 5.1　Selection of equity funds

As stated, we have delimited the purpose of this thesis to include equity funds focusing on the Swedish market and included in the Swedish pension system. The definition of an equity fund and PPM's criterion declaring an equity fund focusing on Swedish markets is presented in chapter 3.

Having complied with the selection criteria set up by PPM we ended up with 44 equity funds. Of the 44 funds selected, 17 had existed under the examined time period of 1995-2002. Further we decided to reject two of the remaining funds as they had gone through mergers and reorganization, something that could have had an impact on the funds investment strategies. Hence, 15 Swedish oriented equity funds included in the PPM-system fulfilled the criteria in order to be included in our study. These funds are presented in Appendix B where we briefly describe their investment strategies.

Data regarding fund returns were obtained from Morningstar. Morningstar is a well renowned company that manages fund information. Fund return data concerning the funds used for out of sample testing (SEB Asien (exkl Japan), SEB Europa and SEB Nordamerika Mellanstora bolag) was extracted from the SIX Trust system. This data was also extracted on a monthly basis. For all our data, both funds and indices, we used closing values in order to get consistency.

### 5.1.1　Survivorship bias

Survivorship bias is often discussed when performing quantitative analysis in Finance. In our study, this would mean that poorly performing funds, which have left the market, are not included in the study. It would certainly be interesting to see how they have invested historically as well. However, with our purpose and choice of perspective, such information is not very relevant. Since we take the perspective of a potential investor, this investor cannot, per definition, invest in something that is not possible to invest in anymore. Because of this, we argue that the survivorship bias is not an issue for us. There is one reservation though; if our results are used for evaluating skill, the survivorship bias becomes a problem that has to be handled more thoroughly.

## 5.2　Choice of time period

We determined our studied time period to start at 1995 and last until end of 2002. The chosen period covers both a boom and a recession in the stock markets. As

observations are extracted on a monthly basis we obtain 96 observations, a number that can be considered large enough for statistical inference as discussed in chapter 4. We also think that using weekly or daily data will be harder, due to different holidays in various markets. This negative effect will be smaller if monthly data is used.

## 5.3  Choice of asset classes and indices

Initially we studied the qualitative descriptions of the funds investments strategies in order to get a picture of what assets they hold. The process is important since it will determine which indices that will be chosen.

We used three main sources of data for this process:

- Morningstar's website where we got information about the funds holdings at a certain date (see appendix B)
- The funds prospectus
- Paying attention to the different regulations limiting each funds investment possibilities.

Since the funds are obliged to invest in Swedish related securities we choose to use several asset classes covering this market in order to get a diversified picture of their investments here. We also observed that their main investments outside Sweden are in the EMU area, the US and the UK. None of the funds claim that they invest in Asia. However we felt that this is such an important area in an economic context, we initially included an index for this as well.

Representing the asset classes, we choose indices owned and managed by well-respected financial institutions. Note that an EMU index was chosen instead of one covering the whole of Europe; the purpose of this is that the index will not include the Swedish market or the UK market, as we wanted to cover these with separate indices. The index data was collected by using the Bloomberg system. Our chosen asset classes and their corresponding indices are summarized in the table below.

| **Asset class** | **Index** (our abbreviation in parenthesis) | **Short index description** |
|---|---|---|
| Small-Capitalization stocks, Sweden | Carnegie Small Cap index, Sweden (Small) | Small-cap companies listed on Stockholm stock exchange[53] |
| Mid-Capitalization stocks, Sweden | Carnegie Mid Cap index, Sweden (Mid) | Mid-cap companies listed on Stockholm stock exchange[54] |
| Large-Capitalization stocks, Sweden | Carnegie Large Cap index, Sweden (Large) | Large-cap companies listed on Stockholm stock exchange[55] |
| EMU stocks | EMU Morgan Stanley index (EMU) | Measures equity market performance within EMU[56] |
| UK stocks | UK Morgan Stanley index (UK) | The UK market[57] |
| US stocks | US Morgan Stanley index (US) | The North American market[58] |
| Asian stocks | Asia Morgan Stanley index (Asia) | The Asian market[59] |
| Short-term fixed income securities, Sweden | OMRX T-Bill (T-Bill) | Reflects the value-growth regarding a portfolio of treasury bills[60] |
| Long-term fixed income securities, Sweden | OMRX T-Bond (T-Bond) | Reflect the value-growth regarding a portfolio of treasury bonds[61] |

**Table 5.1: Assets classes and corresponding indices**

### 5.3.1 Dealing with non-stationarity

Problems with non-stationary data are often encountered in time-series; because of this we converted the data into changes in percent for both funds and indices. This also eases the interpretation of the coefficients.

### 5.3.2 Dealing with multicollinearity

Checking that the indices joint correlations were on a reasonable level mitigated the problem of multicollinearity discussed in chapter 4. A correlation matrix can be found in Appendix E. The largest correlations found were around 0,8. We argue that this is sufficiently small making further action unnecessary[62].

---

[53] http://www.carnegie.se

[54] ibid

[55] ibid

[56] http://www.morganstanley.com

[57] ibid

[58] Ecowin

[59] http://www.morganstanley.com

[60] http://www.stockholmsborsen.se

[61] ibid

[62] Hill, Griffith & Judge, 2001

### 5.3.3 Excluding the Asian index

When performing the study, the coefficients for the Asian index was zero or so small, we chose to exclude this index in our final analysis. This is also a result in line with the stated investment policies. However we wanted to be certain that this actually was the case.

## *5.4 Forecasting*

Regarding our forecasting, we first calculated the coefficients for the time period 1995 until 2000, and then forecasted the last two years with these coefficients. We also included a one-month lag, in order to take autocorrelation into consideration, to improve the short-term forecasting ability of our model.

We have not excluded any outliers in our samples. We argue that this would hurt the robustness of our model, as it would lower its ability to explain or forecast extreme values. We argue that, if we want to achieve usefulness, it is especially important that the model works well when the markets are at their extreme. If we would remove outliers, we would further restrict the model to work under such circumstances.

## *5.5 Implementing the model*

Our calculations were made in Excel, which is a convenient tool for solving this kind of problems. For the Maximum likelihood calculations we used the Solver function, restricting Excel to follow our stated restrictions from chapter 4.

We will not discuss how the Solver algorithm in Excel works. We establish that the starting values used, is sometimes important, because it may affect the outcome. Depending on how the data material looks like, it may exist local optimums that the algorithm may stop at, without having reached the best combination, called the global optimum[63]. Yet, this is rather a mathematical debate, and a somewhat complex one, so we will not discuss this matter any further. To be certain that we have reached the global optimum, we have used reasonable starting values. Furthermore, we tested several different starting values, to minimize the risk of not reaching the global optimum.

When forecasting, we used the same function for the data set covering the time period 1995 to 2000. We then approximated a 95 % confidence interval, in line with our approximations in the theory chapter, and calculated how many observations the model could forecast in an appropriate manner.

---

[63] http://www.nist.gov

# 6 Analysis of results

*This chapter is divided into two parts. We start with a discussion regarding the usefulness of the model. After follows an analysis of the values the model returned.*

## 6.1 Usefulness of model

### 6.1.1 Ability to explain the returns of the funds

As can be seen in the table below, the models ability of explaining the funds return is, on average, high. The average $R^2$ value is over 83 %. We consider this a sufficiently large part to make our model useful in practise. These results are almost as good as Sharpe's study of the American market, where the average $R^2$ value was 92 %[64].

There is one fund that distinguishes itself. The $R^2$ value for Odin Sverige was by far the lowest one with an explanatory power of only 60 % (cursive in the table). It could be argued that our approach does not work for Odin. On the other hand, for a reader well acquainted with the Swedish fund market; this result is not too surprising. Odin has positioned itself as a stock-picking fund, not trying to follow indices, but instead picking stocks they believe undervalued[65]. Of course all funds to some extent try to choose undervalued stocks, but for Odin, this is the only criterion. Therefore, their returns are less sensitive to movements in the standard indices we use. We emphasize that the low $R^2$ value is in line with their investment policy, and an indication that they follow their outspoken strategy. Hence, in this case, the lack of information is information in itself. All the funds, their coefficients, and their $R^2$ are presented in the table below:

| | Med | Large | Small | Bond | T-bill | USA | EMU | UK | $R^2$ |
|---|---|---|---|---|---|---|---|---|---|
| **Aktie-Ansvar Sverige** | 5,92 | 33,58 | 16,03 | 11,80 | 0,00 | 0,00 | 32,66 | 0,00 | **88,23** |
| **Aragon Småbolag** | 0,00 | 9,51 | 90,49 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **79,00** |
| **Aragon Sverige** | 0,00 | 45,97 | 54,03 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **74,25** |
| **Carlson Småbolagsfond** | 0,00 | 0,00 | 87,58 | 3,55 | 1,19 | 0,00 | 4,67 | 3,01 | **88,69** |
| **Carlson Sverige** | 14,47 | 42,45 | 9,55 | 0,00 | 0,00 | 0,00 | 13,33 | 20,20 | **76,49** |
| **Didner & Gerge Sverige** | 19,78 | 36,94 | 26,29 | 0,00 | 0,00 | 0,00 | 16,99 | 0,00 | **84,75** |
| **Folksam Sverige** | 9,83 | 30,97 | 16,50 | 4,70 | 0,00 | 0,00 | 34,35 | 3,65 | **89,52** |
| **Handelsbanken Reavinst** | 19,48 | 38,88 | 11,98 | 0,00 | 0,00 | 0,00 | 29,67 | 0,00 | **89,37** |
| **Handelsbanken Småbolag** | 2,28 | 1,38 | 84,98 | 8,13 | 0,00 | 0,00 | 3,23 | 0,00 | **87,52** |
| **HQ Strategi** | 13,31 | 34,34 | 9,42 | 16,02 | 0,00 | 0,00 | 24,04 | 2,87 | **88,44** |
| **HQ Sverige** | 13,30 | 35,46 | 15,98 | 8,34 | 0,00 | 0,00 | 26,91 | 0,00 | **90,92** |
| **Länsförsäkringar Sverige** | 3,93 | 39,14 | 14,43 | 0,12 | 0,00 | 0,00 | 39,77 | 2,62 | **89,66** |
| **Nordea Allemansfond Beta** | 1,87 | 35,37 | 14,93 | 0,33 | 0,00 | 0,00 | 39,05 | 8,44 | **89,78** |
| *Odin Sverige* | *38,57* | *0,00* | *30,34* | *0,62* | *12,08* | *0,00* | *0,00* | *18,39* | *60,24* |
| **Skandia Sverige** | 14,88 | 37,32 | 6,43 | 0,00 | 6,82 | 0,00 | 29,07 | 5,49 | **88,20** |
| **Average** | 10,51 | 28,09 | 32,60 | 3,58 | 1,34 | 0,00 | 19,58 | 4,31 | **84,34** |

**Table 6.1: Sensitivity coefficients and explanatory power of the model for the funds (values in %)**

---

[64] Sharpe, 1992

[65] See for instance Affärsvärlden "Förvaltarnas spår stigande börs 2003", 021219, and Affärsvärlden "Därför sopar småfonderna banan med bjässarna", 020619

### 6.1.2  Out of sample fund test

No matter how good the model appears for our investigated funds, it may be that it gives the same high $R^2$ values for all funds, even if it should not. Hence, it might look good, but is actually incapable of separating a Swedish oriented fund from a fund focusing on US Equity or commodities. For that reason, we have tested the model for three out of sample funds, with investment strategies towards the US, Europe and Asia respectively. The results are presented below:

|  | Med | Large | Small | Bond | T-bill | USA | EMU | UK | R2 |
|---|---|---|---|---|---|---|---|---|---|
| **SEB Asien (exkl Japan)** | 0,00 | 15,61 | 0,00 | 0,00 | 0,00 | 32,40 | 0,00 | 51,99 | **35,32** |
| **SEB Nordamerika** | 0,00 | 2,02 | 13,95 | 0,00 | 0,00 | 45,73 | 18,94 | 19,36 | **63,73** |
| **SEB Europa** | 0,00 | 0,28 | 3,08 | 0,00 | 8,82 | 0,00 | 50,86 | 36,96 | **85,28** |

**Table 6.2: Sensitivity coefficients and explanatory power for out of sample funds (values in %)**

The model cannot explain much of the returns in the Asian Fund. For the North American oriented Fund, the $R^2$ value is larger, and according to the model 46 % of its assets are located in the US. Since our index only covers the US, this is not a perfect measure. As for the European fund, the $R^2$ value is very high, 85 %. The majority of its assets seem to be located in the EMU area and in Great Britain. These results matches the funds stated investment strategies well, which are summarized in Appendix C.

The results support the notion that our model works well for Swedish oriented funds. If the model instead is used for funds that do not focus on Swedish assets (SEB Nordamerika and SEB Europa), the explanatory power of the model decreases. If it is used for funds focusing on areas we do not cover at all (SEB Asien), the model will have even lower explanatory power, indicating that the model lacks the asset classes in which the tested fund invests.

### 6.1.3  Forecasting ability

For all our funds, the estimated 95% confidence interval band included 90 % of the observations, when we included all indices. We also included a one-month lagged variable for autocorrelation reasons. This implies that the residuals are not perfectly normally distributed, or that changes in strategies during the time period worsens the forecasts to some extent. Low $R^2$ values also affect the model's forecasting ability negatively. For Odin Sverige, we considered the explanatory power too low. If this fund is removed the average rises to 91 %. This seems fairly close to our predicted 95 % for us to claim that the model has had good forecasting ability historically. We also believe that the number would rise slightly higher, if the approximation of constant variance were not made. Below the models forecasting ability for the individual funds is summarised, although we will refrain from analysing the differences between the funds.

|  | Forecasting ability |
|---|---|
| **Aktie-Ansvar Sverige** | 0,96 |
| **Aragon Småbolag** | 0,75 |
| **Aragon Sverige** | 0,75 |
| **Carlson Småbolagsfond** | 0,96 |
| **Carlson Sverige** | 0,96 |
| **Didner & Gerge Sverige** | 0,83 |
| **Folksam Sverige** | 0,92 |
| **Handelsbanken Reavinst** | 0,92 |
| **Handelsbanken Småbolag** | 1,00 |
| **HQ Strategi** | 0,92 |
| **HQ Sverige** | 1,00 |
| **Länsförsäkringar Sverige** | 0,88 |
| **Nordea Allemansfond Beta** | 0,96 |
| **Odin Sverige** | 0,79 |
| **Skandia Sverige** | 0,92 |

**Table 6.3: Forecasting ability for the individual funds**

### 6.1.4 Summarising discussion of usefulness

Not one single approach can be used for drawing conclusions about the relevance of the model. There are several aspects that have to be considered, such as reliability of results, robustness of the model out of sample, and forecasting ability. It cannot be stated with statistical significance or by other rules "de jure", that our model is relevant. On the other hand, since our different approaches above point in the same direction, we argue that it at least looks like that the model does its job in an appropriate way. We will settle with this and let the readers themselves make a judgement.

## *6.2 Results of our tests*

### 6.2.1 Swedish or foreign holdings

One can see that the funds are most sensitive to the Swedish indices used. The average values are 11 % for medium size companies, 28 % for large companies, and 33 % for small companies. This makes a total of 72 %, where none of the funds have less than 50 % (Nordea Allemansfond Beta is lowest with 52 %). Hence, all funds included in our test are in a category that properly indicates what they mainly invest in.

However, there are still large differences within the group. To illustrate one aspect of this, we calculate the funds total investments in Swedish related assets (stocks and bonds), and see how the funds are sensitive to Sweden, compared to Foreign (which here means the EMU, the UK and the US).

|                          | SWEDISH | FOREIGN |
|--------------------------|---------|---------|
| **Aktie-Ansvar Sverige** | 67,34   | 32,66   |
| **Aragon Småbolag**      | 100,00  | 0,00    |
| **Aragon Sverige**       | 100,00  | 0,00    |
| **Carlson Småbolagsfond**| 92,33   | 7,67    |
| **Carlson Sverige**      | 66,47   | 33,53   |
| **Didner & Gerge Sverige** | 83,01 | 16,99   |
| **Folksam Sverige**      | 62,00   | 38,00   |
| **Handelsbanken Reavinst** | 70,33 | 29,67   |
| **Handelsbanken Småbolag** | 96,77 | 3,23    |
| **HQ Strategi**          | 73,09   | 26,91   |
| **HQ Sverige**           | 73,09   | 26,91   |
| **Länsförsäkringar Sverige** | 57,62 | 42,38 |
| **Nordea Allemansfond Beta** | 52,51 | 47,49 |
| **Odin Sverige**         | 81,61   | 18,39   |
| **Skandia Sverige**      | 65,45   | 34,55   |

**Table 6.4: Sensitivity to Swedish contra foreign assets (values in %)**

Some of the funds invest exclusively, or almost exclusively, in Sweden. These funds are the Aragon funds, Carlson Småbolag and Handelsbanken Småbolag. On the other hand, some of the funds invest a significant part outside Sweden, such as Länsförsäkringar Sverige and Nordea Allemansfond Beta. This is information that was hard to extract from the funds qualitative descriptions (which are presented in short version in Appendix B). This result is also interesting, as the funds are obliged to invest 75 % of its holdings in Swedish related assets in order to be classified as a Swedish mutual equity fund (as discussed in chapter 3). The result shows that the funds may not live up to this requirement.

## 6.2.2  Stocks or bonds

Another way of examining the funds could be to study to which extent they invest in risk free assets (bonds and T-bills in our case). This is an important topic, since the ratio between risk carrying and risk free investments are of vital consideration for a lot of investors[66]. Below we summarize to which extent the funds are sensitive to stocks versus bonds:

---

[66] Actually, it is the only consideration according to the CAPM, which can be studied in every basic textbook in Finance.

|                             | STOCKS | BONDS |
| --------------------------- | ------ | ----- |
| **Aktie-Ansvar Sverige**    | 88,20  | 11,80 |
| **Aragon Småbolag**         | 100,00 | 0,00  |
| **Aragon Sverige**          | 100,00 | 0,00  |
| **Carlson Småbolagsfond**   | 95,26  | 4,74  |
| **Carlson Sverige**         | 100,00 | 0,00  |
| **Didner & Gerge Sverige**  | 100,00 | 0,00  |
| **Folksam Sverige**         | 95,30  | 4,70  |
| **Handelsbanken Reavinst**  | 100,00 | 0,00  |
| **Handelsbanken Småbolag**  | 91,87  | 8,13  |
| **HQ Strategi**             | 83,98  | 16,02 |
| **HQ Sverige**              | 91,66  | 8,34  |
| **Länsförsäkringar Sverige**| 99,88  | 0,12  |
| **Nordea Allemansfond Beta**| 99,67  | 0,33  |
| **Odin Sverige**            | 87,31  | 12,69 |
| **Skandia Sverige**         | 93,18  | 6,82  |

**Table 6.5: Sensitivity to stocks contra bonds (values in %)**

As the results imply, some of the funds invest exclusively in stocks, while other hold bonds up to 16 % of total assets. This information is important from a total portfolio outlook, since most investors have an idea on how much risk carrying assets they are prepared to take on.

# 7 Concluding discussion

*Here we will summarize our results, and consider what relevance they may or may not have in practice for the individual investor. We will round off by making suggestions to further studies.*

## 7.1 Usefulness of the model

We consider the model to be useful under two main conditions. First the user needs to have a good intuitive understanding of how the model works. This does not mean that he/she needs to have an MSc in Econometrics. Basic knowledge in Statistics and a good hand with numbers is enough. The second requirement is a good knowledge about the market and the funds that are examined. We saw in the Odin case, that some knowledge about the funds is needed, to be able to explain why a certain fund diverges from the others. If both these requirements are fulfilled, the model is a useful tool for getting a more detailed picture of the funds investment strategies.

## 7.2 Suggestions on areas of usage

As stated in chapter 4, several uses of the model has been discussed in articles and papers. We will not cover all of these, but instead discuss two perspectives we have identified as especially useful for the Style based analysis.

### 7.2.1 Style based analysis as a positioning tool

It is easy to find a Swedish oriented equity fund. Within the Swedish pension system, it is just to choose any fund listed under this category. However, all Swedish oriented equity funds are not alike, and it is here the model can be of interest. If correctly used, the Style based analysis can separate the different funds within a category. In our case we showed how this could be done regarding sensitivity to Swedish versus foreign assets, and to risk carrying contra risk free assets. However, these were just examples, and can be made for any dimension of interest. Consequently, we see the model as a tool for an investor to study how the different funds are positioned within the selected segment.

This is not something new though. Morningstar uses a Style box for this kind of positioning within a category as well. Although useful, we argue that their approach has some flagrant flaws. Their Style box is static (always value/growth and small cap/large cap on the axes) and builds on moment pictures of the funds holdings. We believe that the Style approach, which uses far more data input, is information richer. A Style based analysis is also more dynamic than the Style box offered by Morningstar. With a Style based analysis as foundation, one could create style boxes with the variables preferred by the investor.

### 7.2.2 Style based analysis for index dependency analysis

A current topic is often if a fund is an index follower or not. Some funds market themselves as index followers, and have low fees. Other charges more and uses a

stock picking strategy, which demands more analysis. However, we imagine that some funds market themselves as stock pickers, charging a large fee, but still just follows index more or less. Here, we believe that the Style based analysis is a good tool for discovering such intentions. In our case, it could be seen that the outspoken stock picker Odin Sverige also followed index less than the others.

## 7.3  Suggestions to further studies

Sharpe divided the large company class into value and growth categories, built on their market-to-book value. We believe that the same approach would possibly raise the models explanatory power for Swedish funds as well. It would also be desirable to test more different indices to see which gives the best results. There are other suppliers of indices that might just do as good, or even better.

Another area where the Style based analysis can be very useful is skill evaluation. When the aggregated index for the individual fund is obtained, measurements on performance and skill can be done. It would certainly be appealing to see which funds on the Swedish markets that have the most skilled managers.

Another area where further studies are needed is strategy and/or manager changes. It would be interesting to see when and how the funds change strategy. One could for example study if it happens after a long period of low returns, when the managers are changed, or when the markets turn.

Since we evaluated the models ability to forecast Ex Post, it would be exciting to see how well our calculated sensitivities of today would be useful for forecasting over, say, the next three years.

# 8 List of references

*Articles*

Affärsvärlden, "Därför sopar småfonderna banan med bjässarna", 20020619

Affärsvärlden, "Förvaltarna spår stigande börs 2003", 20020219

Fondbolagens förening, "5 myter om pension", 20030213

Fondbolagens förening, "Fund saving by category", 2002

Fondbolagens förening, "Hur ser fondsparandet ut i Sverige och vad tycker fondspararna?", 20020917

Fondbolagens förening, "Hushållen ökade sitt direktsparande i fonder under 2002", 20030204

*Financial information systems*

The Bloomberg system

Ecowin

The Six Trust system

*Published references*

Bailey, "Gaming manager benchmarks", Journal of Portfolio Management, 1993

Brown & Goetzmann, "Hedge funds with style", NYU Stern School of Business and Yale School of Management, 2001

Buetow, Johnston & Runkle, "The inconsistency of return-based style analysis", Journal of portfolio management, 2000

diBartolomeo & Witkowski, "Mutual fund misclassification: Evidence based on style analysis", Financial Analysts Journal, 1997

Elton & Gruber, "The persistence of risk-adjusted mutual fund performance", The Journal of Business, 1996

Haugen, "Modern investment theory", Prentice Hall, Upper Saddle River, 2001

Hill, Griffith & Judge, "Undergraduate econometrics", Wiley, NY, 2001

Holme & Solvang, "Forskningsmetodik om kvalitativa och kvantitativa studier", Studentlitteratur, Lund, 1997

Jaganathan & Ben Dor, "Understanding mutual fund and hedge fund styles using return based style analysis", Kellog School of management, 2002

Kahn & Rudd, "Does historical performance predict future performance?", Financial Analysts Journal, 1995

Lhabitant, "Assessing Market Risk for hedge funds and hedge funds portfolios", Union Bancaire Privee, 2002

Mayes, Jay & Thurston, "A return-based style analysis examination of asset classes", Journal of Financial Planning, 2000

Ramanathan, "Introductionary econometrics: with applications", Dryden, Forth Worth, 1998

Ross, Westerfield & Jaffe, "Corporate Finance", McGraw-Hill, NY, 2002

Sharpe, "Asset Allocation: Management Style and Performance Measurement", Journal of Portfolio Management, 1992

Sharpe, "Determining a Fund's Effective Asset Mix", Investment Management Review, 1988

*Electronic references*

(During the time of our study, information has been gathered on a continuous basis from the below mentioned electronic references)

http://www.ai.mit.edu
http://www.aktieansvar.se
http://www.aragon.se
http://www.carnegie.se
http://www.cim.se
http://www.dgfonder.se
http://www.finans.regeringen.se
http://www.folksam.se
http://www.fondbolagen.se
http://www.handelsbanken.se
http://www.hqfonder.se
http://www.lansforsakringar.se
http://www.morganstanley.com
http://www.msci.com
http://www.nist.gov
http://www.nordea.se
http://www.odinfonder.se
http://www.ppm.nu
http://www.rgk.se
http://www.seb.se
http://www.skandia.se
http://www.stockholmsborsen.se

*Other sources*

Sveriges Rikes Lag, "The Swedish Mutual Fund Act (1990:1114)"

Sveriges Rikes Lag, "The Mutual Funds Act (1974)"

Sveriges Rikes Lag, "The Investment Incentive Funds Act (1978)"

## *Appendix A – Multiple linear regression*

In this appendix, we will briefly introduce the reader to the fundamentals of a multiple linear regression which is a statistical method used in our study. First we will describe the single linear regression, then we will develop the discussion to include multiple linear regression.

### Simple linear regression

Economic theory often suggests relationships between economic variables. The linear regression is a way of testing if there actually exist such a relationship between two variables, and to quantify this relationship. Take for example food consumption and income. We want to test whether the income affects the food spending of households (a logical assumption would be that the more you earn the more you spend on food). Below is a chart with data samples of a number of households and their food spending each month[67].
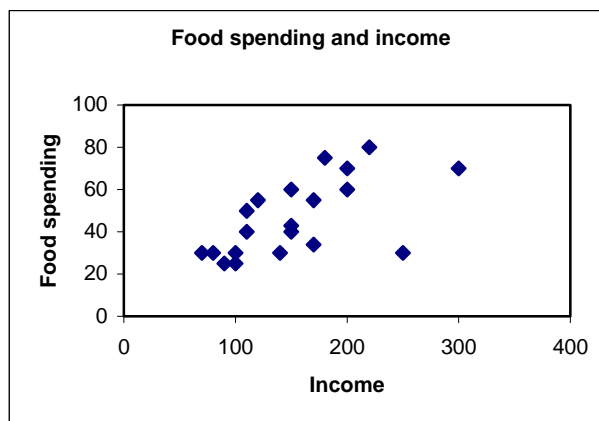


One can see with the naked eye that when income rises, so is, on average, also the food spending. A way of quantifying this relationship is to fit a line, that lies as close as possible to the data samples:



---
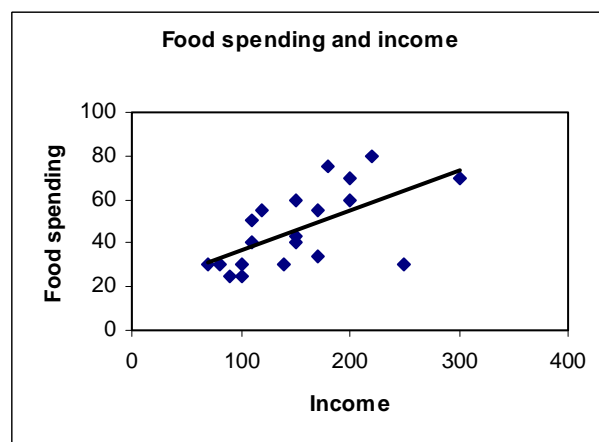
[67] This data is made up by the authors.

The normal procedure for fitting this line to the data is called Ordinary Least Squares (OLS) and its idea is to minimize the squared distances between the line and the sample values[68]. After this is done you get an equation for the fitted line:

$$y_t = \alpha + \beta_1 x_{1t}$$

The parameter $\alpha$ is the intercept term, interpreted as y's expected value if the independent parameter were zero (where the line would break the y-axis at $x = 0$). The $\beta_1$ is the slope of the line, and can be interpreted as how much y raises, on average, when x raises one unit. When one estimates a value of y with the model (i.e. the fitted line), the real value may deviate from the predicted for several reasons[69]. This deviation is captured in an error term, giving you an equation:

$$y_t = \alpha + \beta_1 x_{1t} + e_t$$

Referring to our model above, the error term is the distance between any point and the estimated line in the y-axis.

## Multiple linear regression

A multiple linear regression is a way of testing a relationship between several variables and one variable called the dependent variable. The relationship has the form of:

$$y_t = \alpha + \beta_1 x_{t1} + \beta_2 x_{t2} + ... + \beta_K x_{tK} + e_t$$

Where K is the number of variables that affect the independent variable y. Each parameter $x_t$ affects y with the magnitude of its $\beta_t$ (given that all the other variables remain the same). Otherwise, the logics behind the model follow the logics behind the model with only one dependent variable.

---

[68] Hill, Griffith, Judge, 2001
[69] For further discussion, refer to any basic Econometrics text book

## *Appendix B – Fund descriptions*

### Aktie-Ansvar Sverige (2002-06-30[70])

The fund has an ethical investment strategy. The fund invests foremostly in large export companies noted at the Stockholm stock exchange[71]. The company's risk profile is relatively low.[72]

Below the funds static holdings last update is listed:

| Major regions | % |
|---|---|
| Europe, not EMU | 82.2 |
| EMU | 8.4 |
| Great Britain | 7.3 |

| Portfolio composition | |
|---|---|
| Cash | 12.3 |
| Stocks | 87.7 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

### Aragon Småbolagsfond (2002-12-31)

The fund invests in small- and mid sized companies in the Swedish stock market. The risk profile of the fund is high[73].

| Major regions | % |
|---|---|
| Europe, not EMU | 100.0 |

| Portfolio composition | |
|---|---|
| Cash | 5.7 |
| Stocks | 94.3 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

### Aragon Swedish Equities Selection Fund (2002-06-30)

The fund invests in Swedish stocks noted at the A- and the O-list. The fund is strategically over-weighted in growth stocks.[74]

| Major regions | % |
|---|---|
| Europe, not EMU | 86.8 |
| EMU | 5.3 |
| Great Britain | 4.1 |

| Portfolio composition | |
|---|---|
| Cash | 1.3 |
| Stocks | 97.9 |

### Carlson Småbolagsfond (2002-12-31)

The fund follows different investment strategies depending on changes in the external environment.[75]

| Major regions | % |
|---|---|
| Europe, not EMU | 99.6 |
| EMU | 0.4 |

| Portfolio composition | |
|---|---|
| Cash | 3.0 |
| Stocks | 97.0 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

---

[70] The date indicates the latest update of the funds investments holdings available in Morningstar's database.

[71] http://www.aktieansvar.se

[72] http://www.morningstar.se

[73] http://www.nordiska.com

[74] http://www.nordiska.com

[75] http://www.morningstar.se

## Carlson Sverigefond (2002-12-31)

The fund invests in Swedish stocks. The portfolio is well diversified between different sectors.[76]

| Major regions | % |
|---|---|
| Europe, not EMU | 87.3 |
| Great Britain | 9.0 |
| EMU | 3.8 |

| Portfolio composition | |
|---|---|
| Cash | 0 |
| Stocks | 100 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

## Didner & Gerge Aktiefond Sverige (2002-12-31)

The fund invests in different business sectors and different markets. At least 90% of the investments shall be in the Swedish market.[77]

| Major regions | % |
|---|---|
| Europe, not EMU | 88.8 |
| EMU | 11.2 |

| Portfolio composition | |
|---|---|
| Cash | 3.3 |
| Stocks | 96.7 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

## Folksam Aktiefond Sverige (2002-12-31)

The fund invests in stocks noted at the Stockholm stock exchange. The fund invests most of its capital in mid sized and large Swedish companies. Limited investments in options and smaller companies might occur.[78]

| Major regions | % |
|---|---|
| Europe, not EMU | 87.6 |
| Great Britain | 7.8 |
| EMU | 4.0 |

| Portfolio composition | |
|---|---|
| Cash | 3.0 |
| Stocks | 97.0 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

## Handelsbanken Reavinstfond (2002-12-31)

The fund invests in Swedish companies listed at the Swedish stock exchange. Handelsbanken Reavinstfond aims partly at making profits on short-term fluctuations in Swedish stocks. [79]

| Major regions | % |
|---|---|
| Europe, not EMU | 87.5 |
| Great Britain | 8.5 |
| EMU | 3.9 |

| Portfolio composition | |
|---|---|
| Cash | 0.8 |
| Stocks | 99.2 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

---

[76] http://www.morningstar.se
[77] http://www.morningstar.se
[78] http://www.folksam.se
[79] http://shb.newmedia.se

## Handelsbanken Småbolagsfond (2002-12-31)

The fund invests in small and mid sized Swedish companies. The investments are made in companies where the market value represent less than 0,5% of the total value of the Stockholm stock exchange. The companies might be listed at the A- or the O-list. The fund may also invest in non listed companies to a limited extent.[80]

| Major regions | % |
|---|---|
| Europe, not EMU | 98.8 |
| EMU | 1.2 |

| Portfolio composition | |
|---|---|
| Cash | 6.0 |
| Stocks | 94.0 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

## HQ Strategi (2002-12-31)

The fund invests in different markets and business sectors, but Swedish stocks constitute the major part of the portfolio. The fund may also invest in fixed income securities. [81]

| Major regions | % |
|---|---|
| Europe, not EMU | 96.7 |
| North America | 2.9 |
| EMU | 0.3 |

| Portfolio composition | |
|---|---|
| Cash | 18.5 |
| Stocks | 81.5 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

## HQ Sverigefond (2002-12-31)

The fund invests in Swedish stocks without restrictions regarding business sectors or companies. The fund may also invest in fixed income securities. [82]

| Major regions | % |
|---|---|
| Europe, not EMU | 95.0 |
| Great Britain | 5.0 |

| Portfolio composition | |
|---|---|
| Cash | 5.3 |
| Stocks | 94.7 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

## Länsförsäkringar Sverigefond (2002-12-31)

The fund invests in companies listed at the Swedish stock exchange. The major part of the portfolio consists of stocks in well-known Swedish companies.[83]

| Major regions | % |
|---|---|
| Europe, not EMU | 84.7 |
| Great Britain | 9.7 |
| EMU | 4.2 |

| Portfolio composition | |
|---|---|
| Cash | 0.4 |
| Stocks | 99.6 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

---

[80] http://shb.newmedia.se

[81] http://www.hqfonder.se

[82] http://www.hqfonder.se

[83] http://www.morningstar.se

## Nordea Allemansfond Beta (2002-12-31)

The fund invests in the Swedish stock exchange with focus on large international growth companies. The fund may invest up to 25 per cent in foreign stocks.[84]

| Major regions | % |
|---|---|
| Europe, not EMU | 68.4 |
| EMU | 14.7 |
| North America | 8.7 |

| Portfolio composition | |
|---|---|
| Cash | 5.3 |
| Stocks | 94.0 |
| Fixed income securities | 0.7 |
| Other | 0.0 |


## ODIN Sverige Acc (2002-12-31)

The fund invests in Swedish stocks. Odin has an outspoken stock-picking strategy and avoids following indices.[85]

| Major regions | % |
|---|---|
| Europe, not EMU | 98.5 |
| EMU | 1.4 |
| North America | 0.2 |

| Portfolio composition | |
|---|---|
| Cash | 2.7 |
| Stocks | 96.4 |
| Fixed income securities | 0.9 |
| Other | 0.0 |


## Skandia Aktiefond Sverige (2002-12-31)

The fund invests in listed Swedish stocks. The portfolio consists of two parts, one is based on stocks in larger Swedish companies, the other consists of stocks in small- and mid sized Swedish companies.[86]

| Major regions | % |
|---|---|
| Europe, not EMU | 88.6 |
| Great Britain | 8.6 |
| EMU | 2.8 |

| Portfolio composition | |
|---|---|
| Cash | 1.6 |
| Stocks | 98.4 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

---

[84] http://www.nordea.se

[85] http://www.odinfonder.se

[86] http://www.morningstar.se

## *Appendix C – The out of sample fund descriptions*

### SEB Europa (2003-03-31)

The fund invests in European stocks and related securities in different sectors.

Below their static holdings the last update is listed:

| Major regions | % |
|---|---|
| Europe, not EMU | 18.9 |
| EMU | 50.3 |
| Great Britain | 31.0 |

| Portfolio composition | |
|---|---|
| Cash | 0.7 |
| Stocks | 99.3 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

### SEB Asien (exkl Japan) (2003-03-31)

The fund invests in Asian stocks and related securities in different sectors.

| Major regions | % |
|---|---|
| Asia, 4 tigers | 82.3 |
| Asia, non 4 tigers | 14.7 |
| Great Britain | 1.7 |

| Portfolio composition | |
|---|---|
| Cash | 2.7 |
| Stocks | 95.8 |
| Fixed income securities | 0.0 |
| Other | 1.6 |

### SEB Nordamerika Medelstora Bolagsfond (2003-03-31)

The fund invests in North American stocks and related securities in small- and medium sized companies.

| Major regions | % |
|---|---|
| Nordamerika | 100 |

| Portfolio composition | |
|---|---|
| Cash | 10.2 |
| Stocks | 89.8 |
| Fixed income securities | 0.0 |
| Other | 0.0 |

## *Appendix D – Index descriptions*

All indices are denominated in local currency. All equity indices, both Swedish and foreign, are rebalanced on a quarterly basis.

### Swedish indices

The selection for the indices is the market value of the listed companies. The Swedish companies with a market value between SEK 4,32-15,12 Billion are represented within the Mid Cap Index. Hence, companies below this are represented in the Small Cap, and companies above this market value are in the Large Cap. The indices are calculated by SIX.[87]

### T-bill and T-Bond indices

The Stockholm Stock Exchange owns the OMRX indices. The OMRX family includes interest-index such as OMRX T-bill and T-bond. Treasury bonds carrying benchmark-status that is emitted by the Swedish national debt office Riksgäldskontoret are used to calculate the OMRX T-Bond index. In analogy treasury bills by the same emitter are used to calculate the OMRX T-bill index.[88]

### Foreign indices

The MSCI regional indices are constructed by aggregating the MSCI country indices. In a country index every listed security in the market is identified and screened by size and liquidity.

The MSCI EMU is declared as a regional country index constructed to measure equity market performance within the EMU. As of April 2002 the index consisted of eleven developed market country indices, namely: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain.

The MSCI UK is a country index constructed to measure equity market performance in the United Kingdom.

The MSCI US is an index constructed to measure equity market performance in USA.[89]

The MSCI Asia is an index constructed to measure equity market performance in Asia.[90]

---

[87] www.carnegie.se
[88] www.rgk.se
[89] www.msci.com
[90] ibid

## *Appendix E - Index correlation matrix*

Values over 0,8 are bold.

|       | Mid      | Large    | Small    | Bond     | T-bill   | USA      | EMU      |
|-------|----------|----------|----------|----------|----------|----------|----------|
| Large | **0,815488** |          |          |          |          |          |          |
| Small | **0,837876** | **0,822432** |          |          |          |          |          |
| Bond  | -0,00011 | -0,01764 | -0,13854 |          |          |          |          |
| T-bill | 0,015896 | -0,03738 | -0,02624 | 0,36198  |          |          |          |
| USA   | 0,628169 | 0,724784 | 0,545572 | 0,139929 | 0,102908 |          |          |
| EMU   | 0,769747 | **0,833591** | 0,738766 | 0,002746 | -0,03164 | 0,761733 |          |
| UK    | 0,623262 | 0,643545 | 0,56479  | 0,035026 | 0,086617 | 0,769461 | **0,814979** |