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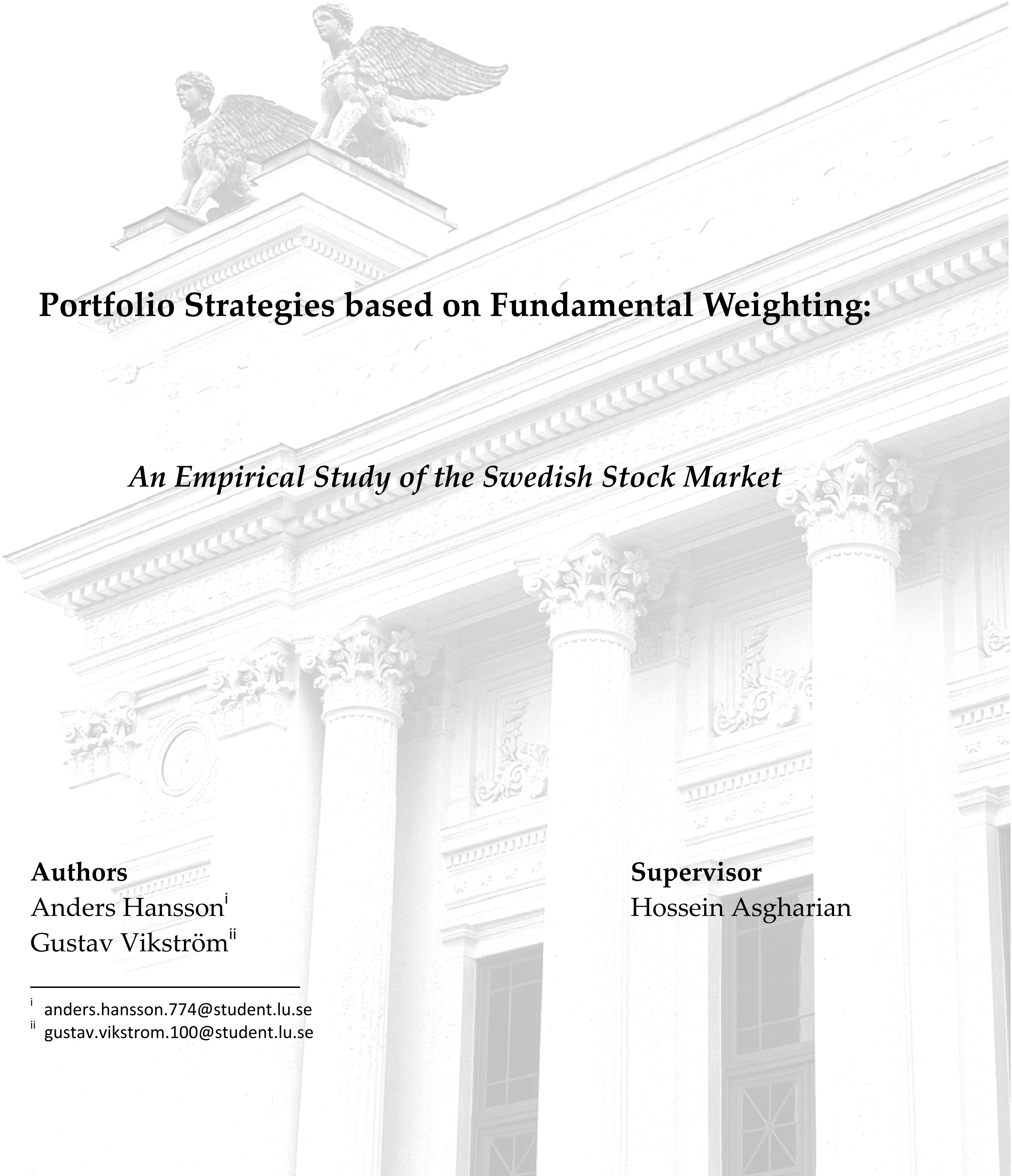

Portfolio Strategies based on Fundamental Weighting:

An Empirical Study of the Swedish Stock Market

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Five key words Market value-weighted, fundamental weighting, active extension, index and mean-variance.

Purpose The aim of this study is to investigate if portfolios whose composition is based on fundamental values (FVs) outperform a market value (MV)-weighted benchmark portfolio in terms of mean-variance efficiency on the Swedish stock market. We also seek to answer if an investment strategy, which focuses on the difference in composition between these two weighting methods, can further enhance the assumed benefits by the use of active extension.

Methodology A quantitative study with a deductive approach has been performed. Data from non-financial firms listed on the Swedish stock market 1980 to 2009, have been studied in order to compose portfolios based on FVs. A MV-weighted portfolio has been constructed as a benchmark.

Theoretical perspectives Our thesis is based on studies which argue that the market often fails to price stocks at their true value. Hence, a MV-weighted index will not be mean-variance efficient and consequently an inappropriate proxy for the theoretical market portfolio of the CAPM. Our theoretical perspectives are further based on studies which imply that historical FVs may indicate a firm's ability to generate future value. The benefits of active extension are also discussed.

Empirical foundation FV-weighted portfolios outperformed the MV-weighted portfolio on the Swedish stock market during the period 1983-2008. Portfolios only including stocks that are the most overweighted in the FV-weighted portfolios relative to their weight in the MV-weighted portfolio, have performed even better. Our statistical evidence is relatively weak however, in particular for the latter claim. In some cases it may have been possible to further improve the return to risk ratio through shorting and taking additional long positions, but we have found little to no statistical evidence to prove this.

Conclusions Our results indicate that the market has made systematic errors in the valuation of stocks, putting too little emphasis on fundamental values. This is evident during the TMT-bubble in particular, but to a lesser extent also during the other time periods of the study.

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1 INTRODUCTION

1.1 Background

The development of the stock market is something that concerns an overwhelming majority of the people in Sweden. Statistics presented by the Swedish Investment Fund Association (2009, p. 6) show that 74 percent of the Swedish population between ages 18 and 74 years have money invested in the fund market. If investments in the Swedish premium pension system (PPM) are included the number increases to a noteworthy 98 percent. The total value of the investments made by the Swedish people in the fund market is enormous and has increased from SEK 1 billion in 1979 to SEK 1,200 billion in thirty years' time. Most of this capital is invested in actively managed mutual funds, whose objective is to generate a yield which exceeds the return of a comparative index.

The typical comparative index is market value (MV) weighted and includes all stocks in the segment in which the fund is operating. However, many fund managers have difficulties in beating their comparative index when the return is adjusted for dividends. Poor performance normally leads to fewer investors and lower profits. In order to minimize the risks of underperforming, mutual fund companies often prefer to play safe. One way is to offer passively managed index funds, which are constructed to track or match the components of a specific index. These funds, which have gained in popularity over the last few years, are mainly run by computers and have low operating expenses. In this way the administrative costs of the fund can be cut which is a strong marketing tool in order to get new investors (Lindmark 2005).

Among those funds which still are classified as actively managed, several fund managers behave as their goal is to track and not outperform their comparative index. The fear of failure and losing customers make them plainly avoid taking investment decisions which diverge too much from the composition of the comparative index (Lindmark 2003). In this way the chances to perform slightly better than their comparative index still exist and the risk for investment decisions which turn out to be really poor is reduced. Thus, many actively managed mutual funds more or less imitate the comparative index which they actually are trying to outperform. This contradictive behaviour and lack of independency leads to an actively managed fund market which is rather homogeneous in terms of investment strategy.

With a growing interest for index funds combined with a large number of actively managed funds whose primary concern is to avoid disappointments, we conclude that the confidence of a MV-weighted index as the guiding star for investments is massive. Even though investing in conformity with a market index could be seen as lack of courage, it does not have to be wrong according to many financial academics and practitioners. One of the most renowned and established financial theories is the capital asset pricing model (CAPM). This model is widely used among professional investors and the back-bone of the portfolio theories taught in the academic world (Fama & French 2004). The CAPM argues that all investors should hold the market portfolio since it is mean-variance optimal. However, in practice it is impossible to invest in the theoretical market portfolio, since it consists of all risky assets in the world. Therefore a substitute is needed and a broad MV-weighted stock index is usually used as a proxy. Hence, imitating MV-weighted indices is more or less in accordance with what practitioners of the CAPM advocate.

Criticism of using a MV-weighted index as a proxy for the theoretical market portfolio has been raised by Roll (1977, p. 129-176) among others. If the MV-weighted index deviates from the theoretical market portfolio by not being mean-variance efficient, the CAPM will be ineffective as a result. Since it is impossible to obtain the theoretical market portfolio, a true empirical test of the model and the convenience of using a proxy cannot be made.

Other researchers who question the reliability of the CAPM, and consequently the accuracy of a MV-weighted index as a proxy, are Froot et al. (1992) and Schleifer et al. (1990). They argue that investors do not behave rationally and prefer the same level of utility, as the CAPM presupposes. According to Froot et al. investors have overconfidence in their ability to interpret information and Schleifer et al. show evidence of flocking behavior on the market. Irrational behavior affects the market's skill in making correct predictions of future cash flows, which constitutes the present MV of a company.

If the market lacks the skill to make correct predictions of the future, it will have negative consequences for a MV-weighted market index. Overvalued stocks will be over-weighted and companies which are undervalued will receive too small weights. The MV for firms which are mispriced may in the long run be adjusted, but at the expense of lower return in the short-term. Thus, if the market fails in pricing stocks correctly, even if just marginally, there must by definition be a more mean-variance efficient way of constructing market indices.

The investment strategy company Research Affiliates investigates whether indices based on capital-indifferent measures of firm size are more mean-variance efficient than those based on MV. They demonstrate in their empirical study "Redefining indexation" (2005) that indices weighted by fundamental metrics of size such as sales, book value and earnings obtain significantly higher return than a MV-weighted index without increased risk. The index method is called fundamental indexing (FI). Based on the findings the authors state that historic fundamental values (FVs) may be underestimated indicators of future cash flow (Arnott et al. 2005).

We have not found any study made by a researcher which investigates the benefits of FI on the Swedish stock market. However, empirical studies by Runsten (1998) and Skogsvik (2008) strengthens the idea of weighting indices based on FVs as Research Affiliates advocates. By using several regression models Runsten shows that earnings reported in financial statements in Sweden are containing information about a company's ability to produce future value. He also provides evidence of correlation between growth in book value of equity and changes of MV in long term stocks. Assuming that the market adjusts for mispricing in a long-term perspective this implies that also book value of equity may have a predictive power of a company's ability to generate value in the future. Skogsvik finds that past return on equity (ROE) has high accuracy in predicting decreases in earnings on the Swedish stock market and a combination of ROE and other accounting ratios could predict increases. He reaches the conclusion that several accounting ratios may be useful when predicting the future value of firms.

1.2 Problem discussion

We do not believe that the actors on the market possess the skill to make error-free predictions of the future. Nobody behave rationally in all situations. The mind of the human being is too complex in its nature and differs too much between different individuals in order to make well-balanced predictions of a future that no one can reveal. The consequence is a market where stocks sometimes are not priced correctly and thus is inefficient. Further, we believe FI is more mean-variance efficient in comparison to MV-weighted indices. We do not argue that the method of weighting indices based on FVs will generate a *true* imitation of the theoretical market portfolio, but believe it will entail a more correct image than traditional indices based on MV.

The results of Research Affiliates, made on the US market, show that FI during the period 1962-2004 generated a return which was 2-3 percent higher annually without increased risk, in comparison to a MV-weighted index (Arnott et al. 2005, p. 86). The difference in return must lie in the difference in composition. This raises the interesting question whether a strategy, entirely based on the differences in composition between the two methods, can further enhance the assumed benefits of FI? We have not found any Swedish or international study, which focus on these differences.

Strategies based on active extension have gained in popularity among fund managers in the last couple of years. The aim is to improve alpha or differently expressed; enhance the skill-based returns of the fund manager. Analysts who practice active extension do not believe in an efficient market and argue that abnormal returns are possible (Beatrix 2007, p. 2-3). Until a few years back, this strategy was mainly available for pension funds and institutional investors. Today investment firms as Goldman Sachs and Merrill Lynch include mutual funds based on active extension in their spectra of funds for all customers (Tergesen 2006, p. 98).

The aim of active extension is to enhance the fund manager's expectations of the market, without increased net market exposure. Simply explained the strategy combines two risky strategies, leverage and short sales. It uses financial leverage from short positions in poor performing stocks to buy stocks which are expected to outperform the market. The strategy is also known as 1X0/X0 funds and most common is 130/30 funds. The ratio 130/30 means that the investor shorts stocks to a value of 30 percent of the portfolio and uses this capital to take additional long positions in stocks that are believed to generate high returns. Since the investor has positions of 30 percent short and 130 percent long the net exposure to the market is 100 percent. The advocators of this strategy insist that the benefits of active extension, in terms of increased return, are greater in relation to possible risk adjustments (Johnson, G. et al. 2007).

Active extension is best suited for a quantitative investment approach where the investor ranks all stocks after a certain criteria that generates alpha. A comparison of the differences in composition between FI versus MV-weighted portfolios is a typical way of producing a quantitative ranking criterion. This leads us to a two folded question which we find most interesting:

Is it possible to achieve abnormal return on the Swedish stock market by the use of FI? If so, can active extension further enhance the positive effects of FI if a strategy which compares the differences in composition between portfolios weighted by FV versus MV is used?

1.3 Purpose

The aim of this study is to investigate if portfolios whose composition is based on FI outperform a MV-weighted benchmark portfolio in terms of mean-variance efficiency on the Swedish stock market. We also seek to answer if investment strategies which focus on the differences in composition between these two weighting methods, and the use of active extension, can further enhance the assumed benefits of FI.

1.4 Delimitations

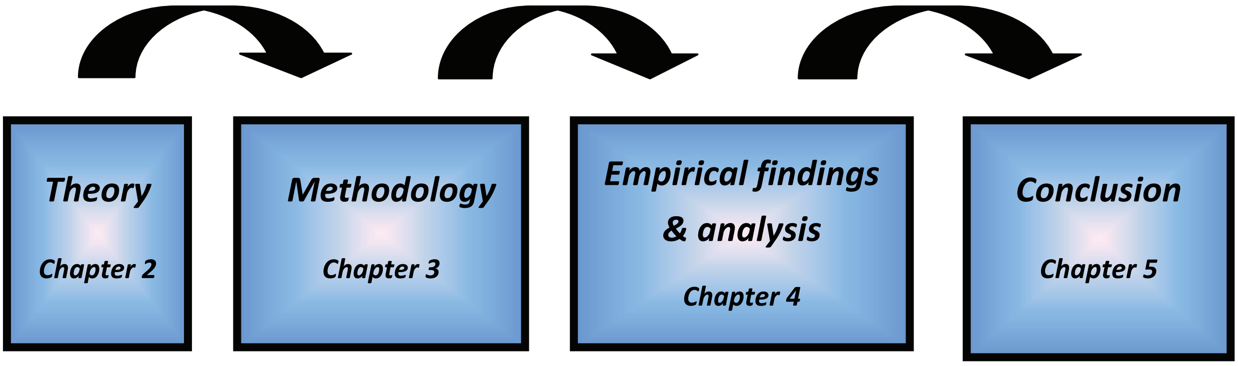
The construction of the portfolios in this study is based on non-financial firms listed on the Swedish stock market during the time period of 1980 to 2009. Small firms, which are not among the 100 largest firms in terms of MV, are excluded every time the portfolios are rebalanced. This is done in order to strengthen the reliability of the study in a practical sense. Small firms are often associated with low turnover and high spread. Trading with these stocks will generate high transaction costs and consequently lower the interest of the study for professional investors and other practitioners.

The portfolios are based on the following variables:

- *Net sales*
- *Cash dividends paid*
- *Funds from operations (FFO)*
- *Equity capital and reserves*
- *Pretax income*
- *Earnings before interest and taxes (EBIT)*
- *Earnings before interest, taxes and depreciation (EBITDA)*
- *Published after-tax profit*
- *Number of employees*
- *Market value (benchmark portfolio)*

We do not intend to focus on the practical implementations of the portfolios based on FVs versus the benchmark portfolio or the use of active extension. Hence, the results may alter if a more precise analysis of aspects such as transaction costs, liquidity, taxes, operating costs and shortage of short supply would be done.

1.5 Thesis outline



- **Chapter 2:** An overview of the theoretical framework is presented, with focus on modern portfolio theory and the rationale behind active extension strategies.
- **Chapter 3:** Methodology and data collection are described, discussed and evaluated.
- **Chapter 4:** Based on the theoretical framework the empirical findings of the study are presented and analysed.
- **Chapter 5:** The thesis ends with a conclusion of the study where suggestions for future research within related areas also are given.

2 THEORETICAL FRAMEWORK AND LITERATURE REVIEW

In this chapter the theoretical context of the thesis is presented. This is done in three steps. First, fundamental theories regarding the modern portfolio theory are discussed to illustrate the disadvantages of investing in a MV-weighted index. Second, we suggest an alternative way of indexing based on FVs, which results in an investment model based on active extension. Finally, different portfolio evaluation models are presented.

2.1 Background Modern Portfolio Theory

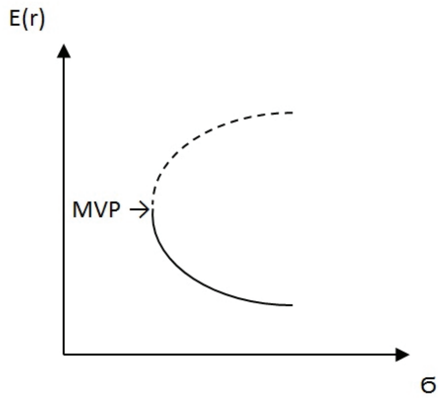
When Harry Markowitz presented his article "Portfolio Selection" in 1952 he laid the foundation of modern portfolio theory (MPT) with his pioneering work of the Mean-Variance Model. Together with the Efficient Market Hypothesis (EMH), partly developed in the 1960s by Eugene Fama, these two theories are considered to be the backbone of MPT (Smimou et al. 2008, p. 1038). The ideas of MPT had – and still have – an enormous impact on financial investors, analysts and academics all over the world.

2.2 Mean-Variance Portfolio Theory

The simplicity of the Mean-Variance theory is striking. By assuming that the preference of an investment only depends on its mean and variance and that the returns of securities are normally distributed random variables, all other features can be left out. A front of different portfolios can be constructed, where each portfolio minimizes the level of risk (variance) at a certain level of expected rate of return.

The portfolio front can be divided into two parts, separated by the point called MVP in the diagram. MVP stands for Minimum-Variance-Portfolio and is the portfolio which has the lowest risk (variance) of all portfolios. The crosshatched half above the MVP is called the *efficient frontier* and the front below constitutes the *inefficient frontier*. The efficient frontier consists of a set of portfolios that generate the largest expected rate of return for a given level of risk and outperform all corresponding portfolios on the inefficient frontier.

Figure 1: Mean-Variance Model



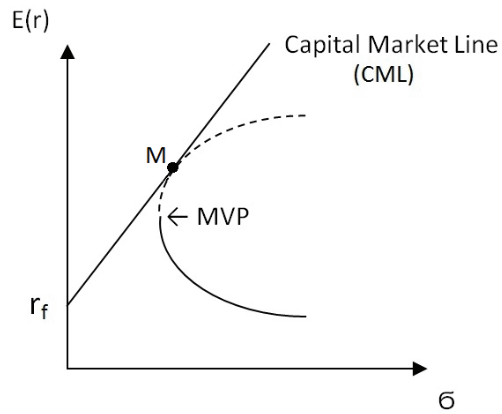
Markowitz assumed that all investors are rational, risk averse and have homogenous behavior. He also assumed that variance is a sufficient determination of risk. Given these assumptions, Markowitz argued that all investors only are interested in holding portfolios on the efficient frontier. Further, as the efficient frontier is constituted of several different portfolios, the individual investor's choice of portfolio will depend on his or her risk aversion according to Markowitz.

2.3 The capital market line

By introducing the possibility to borrow or lend in a risk-free asset combined with holding a portfolio on the efficient frontier, an extension of Markowitz´ mean-variance model can be made. This further development was initiated by Tobin (1958), Sharpe (1963) and Lintner (1965) among others. By adding a risk-free asset to Markowitz' model the identifying of the optimal risky portfolio is no longer dependent on the individual investor´s risk aversion. It implicates that a straight line can be added to figure 1, starting from the point where the expected return equals the risk-free rate of return (r_f) and being a tangent to the efficient frontier. The line is called the *capital market line* (CML) (Arnold 2002, pp. 270-271).

The CML represents all possible allocations of funds between the risk-free asset and the tangency portfolio *M*. An investment along this line dominates an investment on the original efficient frontier, given the same level of risk (Arnold 2002, pp. 269-270). In a perfect capital market investors are, regardless risk aversion, only interested in holding portfolio *M* among the risk-bearing securities. This means, given the assumption made for the mean-variance model, that all traded risky assets in the world with a value must be included in portfolio *M*, since all risky assets must be held by someone. In equilibrium the weight of each risky asset in portfolio *M* is decided according to their individual MV. Hence, the portfolio *M* is equal to the *market portfolio*.

Figure 2: Capital Market Line



The rational investor is only interested in investments along the CML, since it comprises all possible efficient portfolios. A very risk averse investor will allocate all or the major part of the funds in r_f. A less risk averse investor will however place most of his or her funds in the market portfolio, while a very mildly risk averse investor is willing to borrow at the risk-free rate to finance purchases of the market portfolio above point *M* on the CML. This means that the degree of risk aversion has no impact on the investor´s selection of risky assets and only affects his or her choice of allocations between r_f and *M*.

2.4 The Capital Asset Pricing Model

The ideas of Markowitz´ mean-variance model (1952) and the CML laid the foundation of a theory which has dominated the financial scene since it first was presented – the Capital Asset Pricing Model (CAPM). It was developed by Sharpe (1964), Lintner (1965) and Mossin (1966) among others and describes how individual assets can be priced by looking at the relationship between risk and expected return. The major difference between the CAPM and earlier models in MPT is that the CAPM offers a more precise way of defining risk and is not only looking at standard deviations. Risk is divided into *unsystematic* (diversifiable) and *systematic* (undiversifiable). According to the CAPM only the latter is rewarded by increased return and is constituted by factors such as interest rates, exchange rates, recessions, turbulent political events, wars and other macroeconomic forces which are affecting all companies to a greater or lesser degree.

The formula of the CAPM is rather simple. The only parameters which have to be estimated are *risk-free rate*, *beta* and *risk premium*. The expected return for a security is equal to the risk-free rate plus the beta value of the security multiplied with the market risk premium:

$$E(r_i) = r_f + \beta_i\left[E(r_M) - r_f\right]$$

Where:

$E(r_i)$= Excepted rate of return on security *i*

r_f = Risk free rate

β_i = Beta of security *i*

$E(r_M)$ = Expected market return

In practice it is impossible to find a totally risk-free asset. However government bonds are as close to a risk-free asset you can get and often the yield on a 90-day treasury bill is used as a proxy (Olson et al. 2008, p. 631). Beta describes how sensitive an asset is in relation to the market portfolio and is a measure of systematic risk. The beta value of a specific security is measured by calculating the covariance of the security with the market portfolio divided by the variance of the market portfolio. A beta value below 1 indicates that a security is less volatile than the market (Arnold 2002, p. 299). Risk premium equals the expected return of a security minus the rate of a risk-free asset. The risk premium for a security is calculated by multiplying the beta value of the security with the risk premium of the market portfolio (Arnold 2002, p. 301).

2.4.1 Assumptions of the CAPM

The CAPM is based on a number of assumptions regarding the individual investor and the capital market. Here are some of them (Arnold 2002, p. 308):

- All investment decisions are based on the mean-variance criteria.
- All investors have homogenous behavior and the same expectations of the market regarding return and risk.
- All information is free and accessible.
- All investors are rational and risk averse.
- All investor strive for maximization of utility.
- All investors are skilled in estimating returns and standard deviations.
- Transaction costs and taxes do not exist.
- Unlimited possibility to borrow or lend at the risk-free rate of return.

2.5 Criticism of the CAPM

Four decades after it was first presented the CAPM is still widely used among professional investors and the back-bone of the portfolio theories taught in the academic world (Fama & French 2004). However, the CAPM has not gained its position without being subject to discussions and criticism regarding its reliability. In order to get a wider understanding of the CAPM we will now bring forward some of the shortcomings of the CAPM.

2.5.1 Can the market portfolio be identified?

The identifying of the market portfolio is a keystone in the CAPM and a fundamental condition in order to find an optimal portfolio on the CML. However, in practice it is impossible to invest in the theoretical market portfolio, since it consists of all risky assets in the world. Therefore a substitute is needed. Often a broad stock index is used as a proxy, but if this index deviates from the ideal market portfolio by not being mean-variance efficient, the CAPM will be ineffective as a result (Arnold 2002, p.295-296). Hence, it is crucial that the index used is as mean-variance efficient as possible.

Roll (1977) argues that the impossibility of obtaining the market portfolio is a weak point in the CAPM since a true empirical test of the CAPM never can be made. Roll´s criticism is not mainly aimed at the CAPM as a theory, but rather at the impossibility of using the model in practise. Empirical tests of the CAPM using a proxy for the market portfolio will further result in reliability problems regarding beta estimations, since beta should be based on the returns of the theoretical market portfolio.

2.5.2 Technical problems of measuring beta

The true beta coefficient is unobservable, since future risk only can be predicted by estimations. The procedure to estimate beta is therefore fundamental in the theory of the CAPM in order to get a reliable result. By regressing the return of a security on the return of the market portfolio, using time-series data, a value of the beta coefficient can be measured. This value is however very sensitive to various factors such as which stock index is selected as a proxy for the market portfolio, how the calculations of return are done and the choice of estimation period (Brailsford & Josev 1997). The CAPM does not give a clear answer on which method to use when measuring beta. The consequence is that the beta value of a stock varies depending on the method used in the estimation procedure.

What also makes the use of beta questionable is the fact that historical data are used for estimating a relationship in the future (Arnold 2002, p. 306-307). There is an obvious problem using an ex ante theory which describes expected returns and future beta, with ex post testing. Levy (1971) examines the stationarity of the beta coefficient and provides evidence suggesting that individual stock betas are not stable across contiguous sample periods. Hence, historical variations in return will not explain future estimations of beta in a sufficient way according to Levy. Similar conclusions are made by Blume (1971), Groenewold and Fraser (1999).

Other studies made by for example Altman et al. (1974), Baesel (1974), Blume (1975) and Roenfeldt et al. (1978) also show that beta shifts, but tends to be more stable when the estimation period is extended. Blume (1971, 1975) even states that beta has a tendency of moving toward the great mean of all betas over time. This means that the underlying level of risk of a company will move toward the riskiness of the average company. The logic behind this could be that the risk of companies often is high initially and decreases as the company reaches a more mature stage.

The instability of beta is a major reliability problem for the CAPM and there are at least two possible sources of shifting betas. Fabozzi and Francis (1980) bring forward measurement errors as one source, caused by large random statistical estimation errors in the calculating procedure. The CAPM does not indicate whether daily, weekly, monthly or annual observations of returns should be used, neither the length of the time interval studied, which opens up for uncertainty in the estimated beta. The second source has to do with the fact that beta is used as a single index of systematic risk, even though stocks have multiple sources of systematic risk. Companies are not acting in a static environment and changes in operational strategies, leverage and market environment are all example of factors which can make beta shift.

2.5.3 Changes in parameters

The CAPM is based on parameters measured at a single point in time; hence it is a static one-period model. An investment based on the CAPM is therefore only valid as long as the values of the parameters do not change. However, many of the investment decisions made are based on a time period of many years or even longer. In practise the CAPM is therefore facing a problem, when for example the risk-free rate of return changes during the investment period (Arnold 2002, p. 307).

2.5.4 Is beta the only factor influencing the return on securities?

The CAPM is a single factor model assuming that the expected return of a security is only determined by the value of its beta. The explanatory power of beta has, however, been lively discussed among academics and practitioners and the debate will probably continue for many years. A number of studies have been published on the subject and we present some of them on the following pages. It appears that beta cannot fully explain the systematic risk of a security and there seems to be more factors affecting the return of stocks. Multi-factor models allowing for more than one systematic risk factor, like Stephen Ross´ (1976) arbitrage pricing theory (APT) and the three-factor model of Fama and French (1996), have therefore attracted more attention as researchers have highlighted the flaws of the CAPM (Arnold 2002, p. 314-315).

2.5.5 Are all investors rational?

One of the cornerstones of the CAPM is that all investors are rational in their behavior. This assumption constitutes the foundation of the idea that all investors will buy the market portfolio. How solid is this theoretical assumption? Even if we assume that all relevant information is free and accessible, we have to question whether the individual investor is able to analyse all information correctly. Froot et al. (1992) show that investors have overconfidence in their ability to interpret information and therefore behave irrationally. They have a tendency to selectively choose information which goes along with their investment ideas and neglect relevant information.

Another aspect which challenges the assumption of rationality is that many investors have characteristics of flocking behavior (Schleifer and Summers 1990). Investors often act like a herd and follow the general trend of the market. Hence, a movement in the market could be enhanced due to herding speculators. The enhanced reaction of the market could be interpreted as an evidence of the accuracy of the trend, which could lead to a valuation of the market which strongly differs from its true value.

2.6 Empirical studies on the CAPM

A theory can struggle with technical problems, but it is highly interesting to find out whether the same theory can work in practise or not. Many studies have been made to test if the CAPM works in practise. Here are some of the results.

2.6.1 The Black, Jensen and Scholes test (1972)

Black, Jensen and Scholes (1972) performed a test of the CAPM including all stocks traded on the New York Stock Exchange during the period 1926-1965. The aim of the study was to test the relationship between betas and expected rate of return. They ranked all the stocks by beta and constructed ten different portfolios based on the beta level of each stock. The results showed that the relationship was highly significant and positive. They also found that almost 100 percent of the cross-sectional differences in the average returns of the portfolios were explained by differences in the beta coefficient. Their study gave a strong support for the CAPM and the idea that beta is the only factor affecting the differences in expected rates of return.

2.6.2 Further empirical studies by Fama and MacBeth (1973, 1974)

Fama and MacBeth (1973, 1974) tried to develop the earlier studies made of Black et al. (1972). The major difference between these two studies was that Fama and MacBeth did not compute beta and average rates of return in the same time period. Instead they tried to investigate whether the CAPM could predict *future* rates of return by using beta estimated in *previous* periods. The results of Fama and MacBeth were positive for the supporters of the CAPM. According to their observations it appears that beta can be used to predict the future rate of return of a portfolio in subsequent periods. The relationship between beta and returns were however not perfect, but still Fama and MacBeth stated that there was little or no evidence of non-linearity in the relationship between beta and the rate of return.

2.6.3 Fama & French (1992)

Almost 20 years after Fama published his studies together with Macbeth (1973, 1974) he wrote a new article on the same subject, this time together with French (1992). Again the US stock market was studied and the time period was 1963-1990. While the former study had been in favour of the CAPM, this new article gave the opposite effect. Fama and French discovered that the relation between beta and average return was not reliable after taking the size of the firms into consideration. The results did not support the notion that beta is the only determinant parameter which explains the variability in stock returns. Fama and French instead found that two other factors; the ratios earnings per share to stock price and book value per share to stock price, have some explanatory influence. If the book value and earnings are high relative to the MV, Fama and French stated that the average returns tend to be higher. According to Fama and French their observations indicate that there are alternative measures of risk other than beta, which is a statement in conflict with the CAPM. The results of Fama and French are however in some ways controversial regarding the interpretation of the data and survival bias, which Kothari et al. (1995) among others have called attention to.

2.6.4 Studies of the CAPM on the European market

Another attack on the reliability of the CAPM has come from Corhay et al. (1987). They reported evidence of seasonality changes in the CAPM-based risk premium in three European stock exchanges, using the Fama and MacBeth methodology (1973). Investors in the stock exchanges in London, Paris and Brussels and New York were not always compensated for investing in portfolios with higher beta during the time period 1969-1983. The relationship between beta and average return varied and was not significant and positive for all months of the year. Another study made on UK equities by Strong and Xu (1997) even found a negative relationship between beta and average return for the period 1973-1992.

2.7 The Efficient Market Hypothesis

We have now briefly described the theory of the CAPM and some of the assumptions which the CAPM relies on. One of these assumptions was that the market portfolio, which all investors will hold, is mean-variance efficient. This idea resulted in the strengthening of another theory, namely the *efficient market hypothesis* (EMH) (Arnold 2002, p. 285). The EMH states that stock prices fully incorporate and reflect all available information revealed and therefore all firms are priced at their fair value. Any new information will immediately and rationally be incorporated into the stock price and interpreted correctly by the market. Therefore changes in stock prices only occur when new information is given, which by definition is impossible to forecast. Due to this efficiency no investor has the possibility to make a return which is greater than the return of the market portfolio without investing in a portfolio with higher risk than the market portfolio (Arnold 2002, p. 604).

It is important to understand that the EMH does not state that the rational investor can make perfect predictions about the future. It only assumes that the existing stock prices are unbiased and fully reflect all available information known to the market at present time (Arnold 2002, p. 604). Depending on which information is reflected in the stock prices Fama (1970) graded market efficiency in three different categories – *weak*, *semi-strong* and *strong*.

1. **Weak-form efficiency** - stock prices are assumed to fully reflect all information in *past price movements*. Analysing the past history of the stock prices will not gain any advantage for an investor. Trading strategies based on technical analysis or charting becomes ineffective.

2. **Semi-strong form efficiency** - stock prices are assumed to fully reflect *all publicly available information*. This grade of efficiency does not only include past history of the stock prices, but also all the relevant publicly available information which affect the value of a firm. This could be accounting reports, technological breakthroughs, news about the state of the global economy and so on. It is pointless studying publicly available information, since the market adjusts the stock prices the moment the information is released.

3. **Strong-form efficiency** - stock prices are assumed to fully reflect *all information*, even that which is private. Individuals who possess insider information are not able to make any abnormal profits, since the market already has taken this information into consideration.

2.7.1 Does the EMH hold?

The EMH is highly controversial and has engaged academics, investors and businessmen for many years. The bare thought of finding inefficiency in the market and becoming rich or famous has resulted in a number of studies and attempts to test the EMH. If the EMH holds it means that it is impossible to find undervalued or overvalued stocks and any trading strategy trying to get abnormal returns is pointless. However, many of the studies made (as we will see later in this chapter) have shown evidence of investment strategies which achieve abnormal performance. Even if these possibilities to outperform the market by theory should disappear the moment they are presented, the academic opinion is that the market is not strong-form efficient (Arnold 2002, p. 642). This has severe consequences for the practitioners of the CAPM who argue that a passive investment strategy, only holding a broad MV-weighted market index (as a proxy for the market portfolio), generates the optimal risk-return in combination with a risk-free asset. If the market is not able in correctly pricing the shares, overvalued stocks will be over-represented in a MV-weighted index and the proportion of undervalued stocks will be too small. A MV-weighted index will then not be mean-variance efficient and hence not tangent to the efficient frontier.

2.8 Value investing

Many researchers have produced evidence of semi-strong inefficiency and we will present a small selection of articles published on this topic which focus on *value investing*. Before we do that we have to understand the basics behind value investing. This investment strategy is based on the idea to select stocks which are traded for less than their intrinsic value. The investor identifies these stocks by comparing the market price of the company to its FVs. FVs can be represented by cash flow, dividends, sales, earnings and other data found in the financial reports of the companies.

Value investors claim that the market has too much focus and attention on news that is not based on FVs. As a result the market has a tendency to overreact to both good and bad news, leading to a mispricing of stocks compared to their long-term FVs. However, the term value investing is broad and comprises investors who base their analysis on estimations of future growth and cash flow, but also those who only study present or historical FVs. The most common characteristics studied in value investing are however price-to-earnings ratio (P/E), book-to-market ratio and dividend yield relative to the share price (Arnold 2002, p. 620).

Depending on the characteristics of the firm, stocks can be divided into two different categories:

1. **Growth stocks** are shares in a company whose future return are expected to be above the average rate of the market. These stocks do usually reinvest retained earnings and seldom pay any dividend. The high expectations are reflected in the market price of the stocks. Growth stocks therefore usually tend to be traded at a higher price relative to its fundamentals compared to value stocks. However, there is no equal sign between growth stocks and growth companies, since the stock of a growth company can be overvalued and no longer seen as a growth stock (Haugen 2001, p. 156 & 563).

2. **Value stocks** are shares that tend to grow slower than the average rate of the market. As a consequence the market is not willing to pay a high price for the low estimated future returns of the stock. Value stocks are usually mature companies which pay high dividends and tend to be traded at a lower price relative to its fundamentals compared to growth stocks (Haugen 2001, p. 156 & 563).

2.8.1 Empirical studies on value investing

A number of studies have been made on strategies based on value stocks and many of them are showing evidence of inefficiency in the market (Arnold 2002, p.620). Basu (1977) studied the investment performance of stocks on the New York Stock Exchange in relation to their P/E ratios. The research included over 1400 industrial firms, traded between 1956 and 1971. Basu showed that portfolios with low P/E ratios generated higher risk-adjusted return in comparison to high P/E securities and makes the conclusion that P/E ratio information is not fully incorporated in stock prices. Lakonishok et al. (1994) show that a variety of investment strategies involving buying value stocks have outperformed growth stocks during the period 1968 to 1990 on the U.S. market.

Studies made on markets outside the United States indicate the same anomaly in the CAPM and inefficiency in the market. In a UK study Levis (1989) does not only report of evidence documenting a P/E ratio effect, but also that investment strategies based on dividend yield show evidence of semi-strong inefficiency. The data used in the study is from London Stock Exchange during the period 1956 to 1985. Another research, made on the stock market in Japan by Chan et al. (1991), find a significant positive relationship between expected returns and two other fundamental variables; cash flow yield and book to market ratio during the time period 1971 to 1988. A more recent study by Truong (2009) states that abnormal return consistently can be achieved from investing in shares with a low P/E ratio, indicating a mispricing phenomenon in the market. This study is made on the New Zealand Stock Exchange and cover the time period 1997 to 2007.

Similar findings regarding value investing are made by Fama and French (1998). In a study on the markets in United States, Australia and other major countries from Asia and Europe (including Sweden), Fama and French show that value stocks outperform growth stocks. The time period studied is 1974 to 1994. The accounting ratios used in the study are book-to-market equity, earnings-to-price, cash flow-to-price and dividend-to-price.

2.8.2 Are value stocks riskier than growth stocks?

The evidence found of inefficiency in the market has been subject to discussions and the question whether value stocks are riskier than growth stocks (Arnold 2002, p. 621)? One of the suggested explanations is that value stocks might be penalized with higher cost of capital due to their lower expected growth rate in comparison to companies with strong prospects. This leads to greater distress risk and in the end increased risk of bankruptcy. According to Fama and French (1992, 1993 and 1996) this could explain the findings that high book-to-market stocks outperform low book-to-market stocks. Fama and French further state that the CAPM is not able to explain a risk premium based on distress risk. They instead propose a three-factor model where return is determined by the risk-free rate plus firm size, book-to-market and the market premium ($r_M - r_f$). Similar conclusions regarding the premium for distress risk is made by Vassalou and Xing (2004) who also believe companies with high book-to-market ratio are more risky. Dichev (1998) is of another opinion and provides evidence suggesting that distress risk is not rewarded by higher return. According to Dichev anomalies like the book-to-market effect could therefore not be a result of a distress factor. Furthermore, Griffin and Lemmon (2002) argue that anomalies in the CAPM is an effect of mispricing and show evidence that neither distress risk nor a three-factor model can explain abnormal return.

The issue whether value stocks are riskier than growth stocks has also been studied by Lakonishok et al. (1994) and Haugen (1995). They found that value strategies are able to outperform the market because the market consistently seems to overestimate the future growth rates of growth stocks relative to value stocks. The researchers did not find any evidence that the abnormal return for value stocks could be explained as a reward for increased risk. Haugen (1995) even claim that value stocks are less risky in comparison to growth stocks.

2.9 Is there a more appropriate proxy for the theoretical market portfolio?

We have now presented a number of studies which are showing evidence of market inefficiency which apparently not is explained by the CAPM. We therefore assume that the market is inefficient and that the market does not have the ability to price stocks "correctly". Hence, a MV-weighted index containing mispriced stocks will by definition not be mean-variance efficient. Consequently it should not be used as a proxy for the theoretical market portfolio in the CAPM. We also conclude that investment strategies based on FVs historically have been able to "beat" the market. We therefore put the question whether an index, based on FVs, is more mean-variance efficient than a MV-weighted index and a more appropriate proxy for the theoretical market portfolio?

2.9.1 Do historical fundamental values have predictive powers?

FVs presented in financial statements are reports from the past. If an index, based on historical data, is more mean-variance efficient than a MV-weighted index it implies that information found in financial statements may indicate a firm's ability to generate future value.

An empirical study by Runsten (1998) supports this theoretical line of thought. In his doctoral thesis Runsten discusses the association between FVs and stock prices in the Swedish stock market. The study covers the time period 1966 to 1993 and comprises nearly all listed stocks on the Stockholm Stock Exchange. By using several regression models Runsten makes the conclusion that the reported earnings in the fiscal reports are not only containing information about the value created during the last period, but also information about a company's ability to produce future value (p. 302). Hence, historical earnings should be seen as a feasible indicator of future earnings. He also provides evidence of correlation between growth in book value of equity and changes in MV for long-term stocks (p. 303). Assuming that the market adjusts for mispricing in a long-term perspective this implies that also book value of equity may have a predictive power of a company's ability to generate value in the future.

Further, Runsten states that in times when the stock market grows strongly, share prices tend to have no or little relationship with FVs. According to Runsten an explanation may be that the market does not fully consider FVs when pricing stocks. This inefficiency in the market could be declared as an anomaly, possible for investors to exploit (p. 304).

Another similar study is made by Skogsvik (2008), also using Swedish data. Skogsvik tests whether information from financial statements can be used to predict future company profitability and uses return on equity (ROE) as the prediction variable. All listed manufacturing companies on the Stockholm Stock Exchange are included and the study covers 1970 to 1994. Skogsvik finds that past ROE has a very high accuracy in predicting decreases in earnings and a combination of ROE and other accounting ratios more correctly predict increases. Skogsvik reaches the conclusion that several accounting ratios may be useful when predicting the future value of firms.

2.9.2 The built-in error in MV-weighted indexing

Assume that the market only consists of two different companies, firm A and firm B. These two firms are identical in terms of FVs such as book value, dividends, sales, number of employees etc. The firms are both traded at the stock market and have the same number of shares outstanding. Let us also assume that the "true" value of each stock for firms A and B is €100. (The true value is defined as the net present value of all future cash flows to the investor. This value is of course impossible for the market to know, since the market only does predictions and estimations). Suppose that the chance is 50 percent that the market will either overvalue or undervalue the stocks by €20 relative to their true values. Hence, a possible scenario is that stock A is traded at €120 and stock B at €80 in the beginning of the year. Let us assume that one stock of each firm is purchased since we want to hold the market portfolio. When the year has ended we assume that the stocks are traded at their true values, i.e. €100. The return on our investment, based on a MV-weighted approach is:

Initial investment:	200 Euro (stock A: €120, stock B: €80)
Number of stocks purchased:	Stock A: 1.0 Stock B: 1.0
Value at the end of the year:	200 Euro (stock A: €100, stock B: €100)
Rate of return:	**0 %**

A MV-weighted index will always suffer a built-in error as long as the market's price differs from the true value. "Overvalued" stocks will be over-represented and stocks which are traded below their true value will be underweighted. Even if the market's ability in pricing stocks is good and only differs slightly from the true value, a MV-weighting approach will be associated with a negative return bias. In order to eliminate this inherent bias when constructing indices a weighting method which is independent of stock prices is needed. Let us assume that we in the previous example invested our €200 using FI (assuming it is possible to buy fractions of shares). Our rate of return would then be:

Initial investment:	200 Euro (stock A: €100, stock B: €100)
Number of stocks purchased:	Stock A: €100/€120≈0.83 Stock B: €100/€80=1.25
Value of stock A at the end of the year:	(€100/€120) * €100 ≈ €83.33
Value of stock B at the end of the year:	(€100/€80) * €100 ≈ €125
Total value at the end of the year:	208.33 Euro (€83.33 +€125)
Rate of return:	**4.17 %**

2.10 Study by Research Affiliates

The American investment management firm Research Affiliates presented in 2005 a study regarding indexing based on FVs. The authors Arnott et al. constructed several different indices where each company's weight were based on fundamental measures such as earnings, book value, gross dividends, sales and total company employment instead of using the traditional index variable MV. A separate index was made for each fundamental variable and all indices consisted of 1 000 traded companies on the U.S. market. The time period covered was 1962 to 2003 and the indices were rebalanced on the 1st of January each year. According to Research Affiliates all indices based on FI generated significant improved risk-return characteristics relative to a MV-weighted index and the performance was robust across time. The FI indices outperformed their MV-weighted counterparts by an average of 1.97 percent per annum, with similar or lower risk (Arnott 2005, p. 86-90).

Arnott et al. argue that the empirical findings of their study show evidence that FI is superior to traditional MV-weighted indices in terms of mean-variance efficiency. They also state that FI is highly interesting for mutual fund managers, since indices based on FVs have similar liquidity as a MV-weighted index. However, the authors do stress the fact that the transaction costs by definition are higher with FI than MV-weighting. The weights of a MV-weighted index are adjusted automatically, as they are a direct result of the stock prices. A portfolio based on FI must on the other hand adjusts its composition by selling or buying shares, since the portfolio weights alter as the stock prices move or when new information concerning FVs is released. Still, the transaction costs for FI are rather similar to those of MV-weighting according to Arnott et al., if the rebalancing of the portfolios is kept to once a year (2005, p. 2).

2.11 Concluding comments regarding alternative indexing

Based on the researchs presented in this thesis we argue that the market is not rational and that its ability to make correct predictions of the future is very limited. We also believe that the market does not fully incorporate publicly available information from financial statements in the stock prices and that FVs may have a predictive power of future returns. Several studies are showing evidence that strategies based on FVs are generating abnormal returns. We therefore question why investors on the stock market shall invest in a MV-weighted index, which is based on irrational behavior, and use it as a proxy for the theoretical market portfolio in the CAPM. We argue that an index based on FV such as earnings, cash flow, dividends and other accounting data is more likely to be mean-variance efficient than an index based on MV. Furthermore, FI is entirely based on rules that do not rely on human interventions which decrease the risk of irrational decisions.

2.12 Further exploiting possibilities for investors using FI

Assuming that FI is preferable in terms of mean-variance efficiency, we see further exploiting possibilities. Let us illustrate this with a very simplified example. Suppose we have two indices – MV and FV. MV is a MV-weighted index based on current MV and FV is based on historical FVs from financial statements. The risk levels for the two indices are equal. Both indices are constructed from the same market which only consists of stocks from five companies and we rebalance the indices once a year. Suppose the weights of each firm in the indices on the rebalancing day are as follows:

	Index MV	Index FV
Stock A:	33 %	36 %
Stock B:	27 %	24 %
Stock C:	26 %	27 %
Stock D:	10 %	8 %
Stock E:	4 %	5 %

After one year we assume index MV has generated a return of 7.0 percent and index FV a return of 8.0 percent. The only difference between the two indices is that the weight of each stock differs. Hence, the difference in performance must be a result of the differences in the weights of each individual stock. We therefore conclude that an investment strategy which only focuses on exploiting the differences between MV and FV might be able to enhance the superior result of FV. We call this strategy *enhanced fundamental indexing* (EFI).

2.13 Enhanced fundamental indexing

EFI is a ranking method which is entirely based on the differences between FI and indexing based on MV. It requires that the indices start out from the same selection of stocks otherwise a direct comparison cannot be made. Let us continue using the previous example by supposing €100 is invested in both index MV and FV on the day of the rebalancing. The individual value of each stock in our two portfolios would then be:

	Index MV	Index FV
Stock A:	€33	€36
Stock B:	€27	€24
Stock C:	€26	€27
Stock D:	€10	€8
Stock E:	€4	€5

If all stocks are ranked based on the differences in absolute values between MV and FV we will get the following result:

	Difference in Euro	(Index FV minus index MV)
Stock A:	€3	(€36-€33)
Stock C:	€1	(€27-€26)
Stock E:	€1	(€5-€4)
Stock D:	-€2	(€8-€10)
Stock B:	-€3	(€24-€27)

Assuming FV outperforms MV the results indicate that most of our money should be invested in stock A and that stock B definitely should be avoided. However, these observations are based on differences in absolute values. The consequence of this ranking method is that larger firms are likely to be overrepresented at both the top and the bottom of the ranking system. This since the chances of greater variation in absolute values normally is higher for firms with a large value. A small firm, which is strongly mispriced by the market, will therefore have less chance of getting a strong position in an EFI portfolio in comparison to a slightly undervalued large firm. We therefore argue that a ranking method based on absolute values will not fully incorporate the advantages of EFI.

2.13.1 EFI based on differences in percent

By making a quantitative ranking system which is based on the differences in weights, expressed as a percentage, we believe EFI will improve its performance. Using the same data as in previous example, but now studying the differences in percentage our ranking will be:

	Difference in percent	$\left[\left(\frac{\textbf{Index FV}}{\textbf{Index MV}}\right) * \mathbf{100}\right] - \mathbf{100}$
Stock E:	25 %	(€5/€4*100)-100
Stock A:	9.1 %	(€36/€33*100)-100
Stock C:	3.8%	(€27/€26*100)-100
Stock B:	-11.1 %	(€24/€27*100)-100
Stock D:	-20 %	(€8/€10*100)-100

Stock E is now recommended as a "strong buy" and stock D seems to be most overvalued, even though both of these stocks are regarded as small firms. We argue that this way of ranking stocks captures the differences between MV and FV in a more efficient way than using absolute values.

The next step in defining EFI is to decide which weight each stock shall be given. The ranking system suggests that we shall avoid buying stock B plus D and invest all our money in the other three stocks. Giving all stocks with a negative value a weight of 0 % in our portfolio will neglect important information though, which can be exploited. We therefore suggest an investment strategy which allows for negative weights by taking short positions in the market.

2.14 Benefits of short selling

Short selling is an important investment tool for investors on the stock market. By having the possibility of taking both long and short positions, a new set of investment opportunities is given to the investor. Extended investment views such as EFI can better be expressed and the possibilities to construct a more mean-variance efficient portfolio compared to the MV-weighted index should increase.

One of the key benefits of short selling is the possibility to under-weight stocks expected to perform poorly to any extent. If the possibility of short selling does not exist, as in a long-only strategy, the only way to under-weight a stock versus a MV-weighted index is by not holding it. This is a very crucial advantage for short selling. The reason is that the weight of each stock in a MV-weighted index usually is very small. The effects of not holding one of the smaller stocks will therefore be almost negligible for a long-only investor, whereas a manager with no short sell constraint has remarkably greater abilities to under-weight. Furthermore, the few larger firms which can be substantially under-weighted may be in different sectors of the market, resulting in reduced possibilities to diversify for long-only managers.

Another aspect of short selling is that the majority of the investments in the market are made on the long side. Hence, the analyses of the market made by investors are mostly focused on finding potential "winners" and not "losers". According to Lo and Patel (2008) this behavior could lead to inefficiencies in the part of the market which deals with short positions. Jacobs and Levy (1993) and

Miller (2001) give support to these exploiting possibilities on the short side by suggesting that overvalued stocks are more frequent on the market than undervalued stocks.

2.15 Active extension

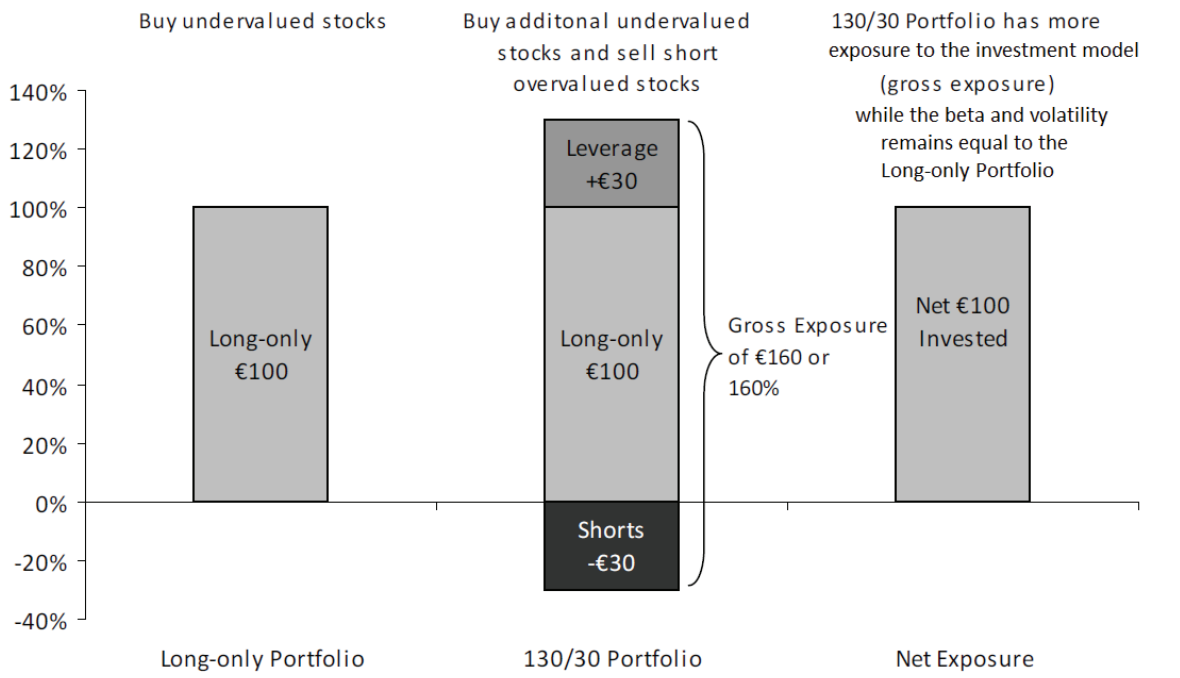
We have now concluded that our EFI ranking procedure is likely to benefit from using short selling, hence an *active extension* strategy can be used. Active extension is a strategy that uses financial leverage by shorting stocks expected to perform poorly and buy stocks which have a high expected future return. In other words the short sale constraint which managers of traditional long-only portfolios face is relaxed.

In active extension fund managers usually rank all stocks in a certain market from “best” to “worst” based on an investment model they believe will generate abnormal return. The manager then takes long positions in the top rated stocks and sells short the bottom rated stocks. The proceeds from the short positions are reinvested and used to take additional long positions in the top rated stocks. Differently from a long-only manager, active extension therefore requires skills of both picking “losers” and “winners”. Investment models using a quantitative approach are particularly well suited to active extension since this approach both specifies over- and undervalued stocks (Johnson, G. et al. 2007).

The idea of using active extension is to have a gross exposure to the market which is higher than 100 percent, but still have a net exposure which is similar to a strategy only taking long positions. It is also important that the volatility and the beta of an active extension portfolio are comparable to its long only counterpart. These characteristics make active extension to an investment product which primarily is aimed at traditional long-only investors and not to compete with hedge funds (Johnson, G. et al. 2007).

The investment procedure can further be described as follows. Assume a fund manager has €100 to invest. After ranking all stocks the manager decides to have short positions in the market to a value of 30 percent, i.e. €30. Stocks worth €30 are sold short and the money received is added to the initial €100. The fund manager can now take long positions in stocks for a total of €130. The result will be a portfolio that has long positions to a value of 130 percent of the initial value and short positions of 30 percent. As long as the money received from the short selling is fully reinvested in long positions the net exposure to the market will remain 100 percent (130 - 30). However, the gross exposure to the market will be 160 percent (130 + 30). The example is illustrated in figure 3 on the following page.

Figure 3: Setting up an active extension portfolio



Source: Modified copy of G. Johnson et al. 2007, p. 34

This investment structure is often referred as a *130/30 strategy* among fund managers and 130/30 is also the most frequently used ratio in active extension. The ratio can however in theory be any number up to 200/100 (Thomas 2007).

2.15.1 Previous studies on mean-variance efficiency of long-short strategies

The fundamental question is whether active extension gains efficiency in terms of a mean-variance framework by relaxing the long-only constraint? Brush (1997) argues that the answer to this question is yes. The mean-variance efficient frontier can be expanded by adding short selling to a long-only strategy. Also Jacobs et al. (1998, 1999) and S. Johnson et al. (2007) make the same conclusion and demonstrate that the result of a long-only constraint leads to a loss in efficiency. Grinold and Kahn (2000) use information ratio as a measurement for efficiency when analyzing the characteristics of long-short investing. They find efficiency advantages of long-short investing and that information ratios increase when the long-only constraint is relaxed.

2.15.2 Risks of active extension

The systematic risk of a portfolio is not dependent on whether active extension or long-only strategy is used, according to Sorensen et al. (2007). They argue that a manager who invest 130 percent in long positions and sell 30 percent of the initial value short, still have a net result of 100 percent long systematic risk as long as both positions have an average beta value of 1. The same observations are made by G. Johnson et al. (2007) in their empirical study testing the performance of active extension portfolios during 1994 to 2006. They find evidence that active extension portfolios maintain risk characteristics similar to long-only portfolios despite higher gross investment. However, active extension entails risks, not shared by unleveraged long-only strategies. The most obvious difference is that a long-only manager only risks to lose the money invested in the market, while there is no limit in the amount an active extension manager can lose in short positions without appropriate risk controls. According to Jacobs and Levy (2007) this specific risk can however be minimized by diversification and be regarded as unsystematic risk. They argue that as long as active extension investors practice proper diversification, unexpected losses should be balanced by unexpected gains. Jacobs and Levy also state that taking short positions allow for greater diversification compared to a long-only strategy. This due to the reason that an active extension manager has more funds to invest compared to a manager who is constrained from using short selling.

2.15.3 Costs associated with active extension

The operating expenses vary widely depending on the type of investment strategy used. Active extension is associated with higher costs relative to long-only strategies due to the use of short selling. Active extension funds, which are marketed in the European Economic Area, are obliged by regulations[1] to attain the enhanced structure through derivatives (International Association of Hedge Funds Professionals 2010). This is done with *total return swaps*. The total return swap market is strictly an institutional over the counter (OTC) market and there are no restrictions regarding the time length of the swaps. The counterparties swap the total return of an asset (in our case Swedish stocks) or basket of assets for periodic cash flows. These cash flows are determined by a reference rate, such as STIBOR[2] (3-months duration), +/- a basis point (b.p.) spread and a guarantee against any capital losses (Sprinchorn 2010).

The short and long spreads varies between stocks and over time, and large funds with long relationships with prime brokers (or other swap providers), will likely benefit from better rates. There is also a lot to negotiate on the legal side, such as the issue of collateral which requires additional labour force and increases costs. According to Sprinchorn (2010) the long spread typically lies between 20 and 50 basis points (often towards the lower end of the interval) for contracts based on Swedish stocks. The short spread is usually similar, but can be higher for smaller companies or if there is a special situation like rumours about new issue of stocks which causes an abnormally large interest in shorting the stock. On average the short spread is likely to be slightly higher than the long spread. For the short positions interest of STIBOR minus a spread is received, while for the long swaps STIBOR plus a spread has to be paid. This entails that the rate of STIBOR has no relevance for the costs of our active extension strategy. It is just affected by the short and long spreads.

In this study we assume a fixed spread for the whole time period of 40 b.p. (0,4 %) on the long side and 60 b.p. (0,6 %) on the short side. Further, we assume that the costs for the total return swaps are paid monthly and decided by the present MV of the portfolios[3]. Hence, the monthly costs for the total return swaps are:

Table 1: Costs associated with active extension

Active extension ratio	Cost long side	Cost short side	Monthly cost total return swaps
110/10	(0,1 * 40 b.p.)/12	(0,1 * 60 b.p.)/12	(10/12) b.p. * present MV
⋮	⋮	⋮	⋮
150/50	(0,5 * 40 b.p.)/12	(0,5 * 60 b.p.)/12	(50/12) b.p. * present MV

[1] The UCITS iii directive

[2] Stockholm Interbank Offered Rate

[3] Normally the total cost for total return swaps is based on daily MV of the underlying asset which generates compounded rate of interest. However, this was not possible to perform due to lack of daily data.

Depending on portfolio size, the assumed costs may be a conservative estimate today. The costs of using derivates, such as total return swaps, have likely been much higher in the past (in the case where it has been possible to take short positions and use these kinds of derivates at all).

Transaction costs are another type of costs which may increase when using active extension. This due to the fact that a portfolio using active extension has a gross exposure which exceeds 100 percent and that leads to higher turnover. The nature of short positions combined with an increased number of stocks to cover, also leads to higher monitoring costs compared to a long-only portfolio (Sorensen et al. 2007). However, in this study only costs associated with total return swaps are included in the calculations of the portfolio returns due to operational simplifications.

2.15.4 Which level of active extension is optimal?

The leveraged structure of a portfolio based on active extension varies depending on the size of gross exposure the investor is willing to take. As earlier mentioned 200/100 is the maximum long-short-ratio which is possible to construct in theory. However regulations and legislations for mutual funds, combined with collateral demands from brokerage firms when taking short positions, put restrictions on the possible level of gross exposure. Clarke, de Silva and Sapra (2004) investigated how efficiency in terms of yield and risk varied if no restrictions in leverage are assumed. They found evidence that the marginal positive effect in terms of yield and risk diminish when the gross exposure increases. The advantages of increasing the long-short-ratio from a long-only position to 120/20 are greater than going from 120/20 to 140/40. Thus, according to Clarke et al. there is no need to relax the long-only constraint fully in order to acquire the benefits of selling short. Further, G. Johnson et al. (2007) argue that active extension is more similar to a long-only strategy than a hedge fund strategy in terms of risk exposure. Thus, it is reasonable to assume that portfolios based on active extension should have a long-short-ratio which is regarded as moderate in order to attract investors which prefer long-only funds. We assume that a level of active extension up to 150/50 is a reasonable maximum, since the most dominant level of active extension among fund managers by far is 130/30 and very few fund managers exceed this ratio.

2.15.5 The supply of stocks possible to borrow

The capital invested in active extension is very small compared to the capital invested in traditional long-only funds. If funds based on active extension should substantially gain in popularity it could have a negative impact on funds based on this strategy. The reason is that the supply of stocks in the market which are possible to borrow is not infinite. Today the demand for short selling primarily comes from hedge funds. If the number of active extension funds should increase and a large proportion of capital is allocated to this segment, the short selling market could become overcrowded. It is possible that the market in that situation would meet the demand and that more investors would be willing to lend out stocks. However if the supply does not increase there is an obvious risk that the costs for borrowing stocks might rise. Higher borrowing costs would negatively affect the performance and the benefits of active extension funds in the long term.

Another aspect regarding the possibility to borrow stocks is the limited supply of different stocks available. One of the keys to active extension is that all kinds of stocks should be possible to underweight below 0 percent compared to a benchmark index. However, today the supply mostly consists of stocks with large MV. An increased demand for short selling small companies might constrain the ability for active extension managers to fully express their market views.

2.16 Evaluation of portfolio performance

Even though both the CAPM and the EMH have been under attack and challenged, beta is still the dominant measurement for risk among financial practitioners and academics when evaluating stocks and portfolios. However, there are other measurements which can be used in order to form an opinion of the skills of fund managers and not all of them include beta. We will now present the evaluation models used in this thesis.

2.16.1 Jensen's Alpha

A risk-adjusted performance measure which has a special relationship to the CAPM is the *Jensen differential performance index*. The measure was introduced by Jensen (1968) and is widely used among mutual fund analysts. It is a model which compares the return of a portfolio with the return predicted by the CAPM when risk is measured by beta. The differential return is often referred to as *Jensen's alpha* and shows the part of the return which cannot be explained by beta. The ex post Jensen's alpha is calculated as follows:

$$Jensen's\ alpha\ = \overline{r_p} - \left[r_f + \beta_p\left(\overline{r_M} - r_f\right) + \ \varepsilon_p\right]$$

Where: $\overline{r_p}$ = Average rate of return on portfolio *p* r_f = Risk free rate

β_p = Beta of portfolio *p* $\overline{r_M}$ = Average market return

ε_p = Error term

A positive value of the Jensen's alpha indicates that a fund manager has generated higher value for the investor relative to the benchmark index on a risk-adjusted basis. If the value on the other hand is negative, it indicates that the fund manager do not possess skills to pick stocks which "beat the market" (Elton et al. 2007, pp. 646-647).

2.16.2 Sharpe ratio

The *Sharpe ratio* is another risk-adjusted performance measure. It was developed by William Sharpe (1966) and tells us whether the return of a portfolio is a result of the manager's skill or due to excessive risk taking. The ratio measures the excess return per unit of risk for a portfolio. It is calculated by dividing the risk premium of the portfolio (the portfolio's return above the risk-free rate) by the standard deviation of the excess returns. The ex post Sharpe ratio formula is:

$$Sharpe\ ratio = \frac{\Sigma\left(\mathrm{r_{pt}} - \mathrm{r_{ft}}\right) / \mathrm{N}}{\sqrt{\mathrm{var}\left(r_p - r_f\right)}}$$

Where: r_{pt} = Rate of return on portfolio *p* in period *t* r_{ft}= Risk free rate in period *t*

N = Number of observations $\sqrt{\mathrm{var}\left(\mathrm{r_p} - \mathrm{r_f}\right)}$ = Portfolio std dev

The manager who has the highest Sharpe ratio is according to the model the most competent in picking stocks. A negative Sharpe ratio indicates that an investor gets higher risk-adjusted return by investing in a risk-free asset. When interpreting the Sharpe ratio the investor has to remember that the standard deviation of the portfolio return is a measurement of total risk. According to the CAPM only systematic risk is rewarded. Hence, a portfolio with high total risk but a low level of systematic risk is not sufficiently diversified (Elton et al. 2007, pp. 640-642).

2.16.3 Information Ratio

If an investor would like to evaluate the performance of a portfolio relative to a benchmark index and identify the volatility of the differential return the *information ratio* (Treynor & Black 1973) can be used. It is defined as the return of a portfolio above the return of a benchmark divided by the *tracking error*[4]. The formula for the ex post information ratio is:

$$Information\ ratio = \frac{\Sigma(\mathrm{r_{pt}} - \mathrm{r_{it}}) / \mathrm{N}}{\sqrt{\mathrm{var}(r_p - \mathrm{r_i})}}$$

Where: r_{pt} = Rate of return on portfolio *p* in period *t*

r_{it} = Rate of return on benchmark index in period *t*

$\sqrt{\mathrm{var}(r_p - r_i)}$ = Portfolio standard deviation

A high information ratio indicates that the portfolio manager regularly outperforms the benchmark index. It can be achieved through high return relative to the benchmark and a low tracking error.

[4] Tracking error is equal to the standard deviation of the difference between the portfolio return and the return of the benchmark.

3 METHODOLOGY AND DATA COLLECTION

3.1. Research Approach

The aim of this thesis is to empirically test whether the theoretically explained advantages of constructing indices based on FVs outperforms a MV-weighted approach and if the assumed differences can be enhanced by active extension. Hence a deductive approach is used (Rienecker et al. 2004, p.160). The empirical analysis of this thesis is based on a large amount of data from the Swedish stock market, for this reason a quantitative study is performed.

3.2 Data collection

The results of our study are based on a great number of data. All the data used is secondary data gathered from DataStream, SIX Trust, Bolagsverket, Sveriges Riksbank, Dagens Industri and OMX Nordic Exchange Stockholm. Costs associated with obtaining primary data forced us to rely on secondary data. The data had to be collected from different sources, since no database provided all necessary data.

Except for a MV-weighted portfolio used as benchmark, all portfolios are based on financial data primarily collected from DataStream, a financial database from Thomson Financial Limited. As DataStream do not provide financial reports of all Swedish companies, supplementary details were ordered from the Swedish authority Bolagsverket which provides annual reports for all listed firms in Sweden. The data from Bolagsverket mainly included small companies and constituted a marginal part of the total data. All data are adjusted for changes in accounting standards which have occurred during the time period of the study.

The MV-weighted portfolio is based on MV. The MV of each company was collected from the Swedish financial newspaper Dagens Industri during the time period 1983 to 2008. The reason for using a printed newspaper when gathering MV data is that we could not find any electronic database which offered a complete list of the MV of all Swedish listed stocks.

The return series used in this study are collected from the financial database SIX[5] Trust and are based on bid prices presented as monthly return series data. SIX Trust also provided information regarding all changes of names for the listed companies which had occurred during the time period studied.

Data regarding historical interest rates for Swedish treasury bills (90-day), issued by the Swedish National Debt Office were obtained from Sveriges Riksbank, which is the central bank of Sweden. This rate was used as a proxy for a risk-free rate.

OMX Nordic Exchange Stockholm provided information regarding each company's choice of financial year. This was necessary in order to distinguish the companies which use a split financial year.

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[5] Scandinavian Information Exchange

3.3. Criticism of data sources

DataStream, SIX Trust, Bolagsverket and Sveriges Riksbank are all established and well reputed sources. These databases are frequently used by academic researchers gathering information for empirical studies, which verifies high reliability. DataStream, SIX Trust and Bolagsverket have the advantage of including both currently traded companies as well as delisted firms. Some delisted firms are however missing in DataStream and SIX Trust. With few exceptions these companies are constituted by small firms listed during the 1980s and the beginning of 1990s. Many of these firms were only listed for a short time, often less than a year. The external validity of the results would have been higher if DataStream and SIX Trust had provided financial data for all delisted companies.

It is not unlikely that the missing data to a certain extent are an effect of survivorship bias. However, we do not believe it affects the reliability of our results to any higher degree, since our benchmark portfolio is based on the same sample of firms as the FV-weighted portfolios. If we instead had used a commercially produced index such as SIX RX as benchmark, all listed firms during the time period would have been included. In that way a comparison with the FV-weighted portfolios would have had less reliability, since the effects of survivor bias would increase.

The data collected from Dagens Industri has a lower degree of reliability. A newspaper can contain printing errors and the fact that the data have to be transmitted to a computer increases the risk of typing errors.

3.4 Sample and excluded observations

The process of defining our sample has been influenced by our ambition that the study shall be possible to realize in practice. The population of our study is defined by all listed firms represented on the Swedish stock market between the years 1983 to 2009. In those situations where a firm is represented by more than one class of shares, the stock with largest turnover was chosen to represent the company in our portfolios.

Bank and insurance companies were excluded from the population due to their different accounting policies[6] and restricted possibilities to make feasible comparisons of accounting data. One example is high leverage which is normal for bank and insurance companies, but which most likely indicates distress for non-financial firms. However, the number of stocks included in our portfolios is not equal to the total number of non-financial firms. The population includes a number of stocks which are not very liquid, i.e. have low turnover and high spread. Trading with these stocks is associated with high transaction costs. MV is highly correlated with trading liquidity which entails that stocks with low MV are likely to be associated with high transaction costs (Arnott et al. 2005, p.2). In order to construct portfolios with low transaction costs all stocks were ranked based on their total MV every time the portfolios were rebalanced. The 100 companies with the largest MV were picked to constitute the stocks included in the portfolios the coming 12 months. The limit of 100 stocks was set to secure that a sufficient number of stocks are represented in the portfolios in order to get statistically reliable results and exclude stocks with very low liquidity.

[6] See further Gregow (2008): ÅRL (1995:1554) 9 chapter 2 §, ÅRL (1995:1559) 9 chapter 2 § and ÅRL (1995:1560) 9 chapter 2 §.

All firms which use a split financial year[7] were excluded. The reason for excluding companies with a split financial year is that the weighting procedure of the portfolios is dependent on data from the annual reports of each firm. In order to make feasible comparisons the annual reports must be published within the same time period of the year, otherwise it would distort the findings. Companies with incomplete annual reports were also excluded due to the same reason. This could be firms which were newly established or recently had changed reporting period and therefore were not able to publish a complete annual report for the previous 12 months. Companies whose financial data are missing in the databases DataStream and SIX Trust were also excluded.

Some firms that are listed on the Swedish stock market do not have shares issued and are instead only possible to trade by depository receipts. These companies are global companies whose stocks are traded on a foreign exchange market, but often partly originated from a Swedish company. Examples of companies included in this category are ABB, Pfizer, Lundin Mining and Autoliv among others. We have chosen to exclude these companies in our portfolios since the MV of these Swedish depository receipts do not mirror the real MV of the firm. Let us explain this problem by using the Finnish mobile phone supplier Nokia as an example:

Nokia has previously been represented on the Swedish stock market by depository receipts, while the stocks have been listed on the Helsinki stock exchange. The MV of Nokia in our data is entirely based on the total value of the Swedish depository receipts. In the later part of the 1990s the interest in buying Nokia increased in Sweden and the number of depository receipts on the Swedish market escalated. During the time period of 1st of March 1996 to the last of February 1997 the MV of Nokia grew more than 22 times, from a value of 296 million SEK to 6747 million SEK (Dagens Industri 1996-1997). Even though the stock price increased by 102 percent during the period, the huge increase in MV was explained by the rise in number of depository receipts (Nokia did not execute any new share issue during the period). The conclusion is that stock price and MV for companies represented by depository receipts do not correlate as they should. Hence, the reliability of the study would have decreased if firms represented by depository receipts on the Swedish stock market would have been included.

3.5 Time period

The study stretches over a period of 26 years from 1983 to 2009 and includes data from the period 1980 to 2009. It would have been of interest to extend the time period studied in order to see if and how the results would differ. However, the databases used in this thesis (DataStream and SIX Trust) do not provide sufficient information for Swedish stocks before the investigated time period. It is possible to obtain earlier financial data from the Swedish authority Bolagsverket, as they provide annual reports for all listed firms in Sweden. High costs associated with ordering huge amount of reports from Bolagsverket made it impossible to extend the time period.

3.5.1 The variables of the portfolios

The selection of companies and their weights in the portfolios are decided by FVs, with the exception of a MV-weighted portfolio which is based on MV. The choice of fundamental variables, which constitute measures of firm size, is influenced by previous research presented in chapter 2. We

[7] A fiscal year that is different from the calendar year.

believe these variables mirror the fundamental size of the companies. The definitions of the FV-variables are made by DataStream. MV is defined by Dagens Industri. The measures of firm size are:

Market value (MV): includes the entire value of all the outstanding shares of a firm. A few Swedish companies are listed on a foreign stock market as well. The value of these shares is included in the MV.

Net sales: represent gross sales and other operating revenue less discounts, returns and allowances.

Cash dividends paid: represent the total common and preferred dividends paid to shareholders of the company.

Funds from operations (FFO): represent the sum of net income and all non-cash charges or credits. It is the cash flow of the company.

Equity capital and reserves: represents common shareholders' investment in a company.

Pretax income: represents all income/loss before any federal, state or local taxes. Extraordinary items reported net of taxes are excluded.

Earnings before interest and taxes (EBIT): represent the earnings of a company before interest expense and income taxes. It is calculated by taking the pretax income and adding back interest expense on debt and subtracting interest capitalized.

Earnings before interest, taxes and depreciation (EBITDA): represent the earnings of a company before interest expense, income taxes and depreciation. It is calculated by taking the pretax income and adding back interest expense on debt and depreciation, depletion and amortization and subtracting interest capitalized.

Published after-tax profit: represents the profit after-tax for the financial period as reported by the company, before minority interest, pre-acquisition profits and provision for preference and ordinary dividends.

Employees: represent the number of both full and part time employees of the company all over the world. It excludes seasonal employees and emergency employees.

3.5.2 Comments regarding the variables of the portfolios

Data in financial statements suffer from some reliability problems. Income measures can be dressed up temporarily by creative accounting in order to achieve bonuses for the management or for other short-term reasons. One year can also contain major non-periodic transactions, which have a temporary impact on the financial statement (Holmström 2005, pp. 52-58, 79-80). In order to minimize the effects of deviant data which are not representative for the performance of the company in the long run, we used an arithmetic average of the data from the last three years in our calculations. Therefore, in order to be included in the portfolios of the study all firms needed complete annual reports from the previous three years. In this way we stress the importance of stability in performance and make the financial statements less sensitive to sudden changes in the business cycle. Hence, newly established firms must survive three years in order to be included in the portfolios.

The use of an arithmetic average of the data also reduces the volatility in the portfolio weights in comparison to using year-to-year data. This result in lower transaction costs, since the turnover of the portfolios is reduced.

3.6 Portfolio construction

In this study three sets of portfolios are presented. The first group of portfolios investigate whether FI is more mean-variance efficient than an index based on MV (phase one). The aim of the second set of portfolios is to capture and enhance the assumed benefits of FI by comparing the differences in the structure of the FI portfolios and the benchmark portfolio (phase two). Finally, active extension is used in the construction of the last set of portfolios (phase three).

3.6.1 Portfolios based on FI (phase 1)

In the first phase several portfolios based on FVs are constructed, as well as a MV-weighted portfolio which is used as a benchmark. It is done using the following eight steps and the procedure is repeated every time the portfolios are rebalanced.

1. All firms listed on the Swedish stock market are ranked based on their total MV, and the 100 companies with the largest MV are singled out.
2. From the 100 largest companies banks and insurance companies are excluded.
3. All firms which only are represented by depository receipts are excluded.
4. All firms using a split financial year are excluded.
5. All firms with missing financial data are excluded.
6. In those situations where a firm is represented by more than one class of shares, only the class with largest turnover is included.

This leaves us with a group of stocks which constitutes the sample for all portfolios during the following 12 months.

7. The firms in the MV-weighted portfolio are given a weight based on current MV.
8. We then create FV-weighted portfolios based on a 3-year average value of the specific variable which constitutes firm size in the portfolio. If the 3-year average value is negative the firm will be given a weight of zero.

Let us explain step 8 in detail. Each FV-weighted portfolio is dependent on a specific variable such as book value, dividends, net sales, number of employees etc. Assume Ericsson AB's average sales volume for the last three years is X Swedish kronor (SEK). The total average value of sales for all companies in the portfolio during the same period is Y kronor. For the portfolio which is based on the variable *sales*, Ericsson AB will be given a weight of X/Y. Or if we put it in another way; for every Swedish krona invested in the portfolio based on the variable *sales*, X/Y will be invested in the stock of Ericsson AB.

3.6.2 Portfolios based on EFI (phase 2)

The difference in the construction procedure between the portfolios in phase one and this second phase are relatively small. All the steps (1-8) in the first phase are identical, but three more steps are added.

9. By dividing the weights in the FI portfolios with the corresponding weights in the MV-weighted portfolio we create a ranking for each fundamental variable (see further 2.13 *Enhanced fundamental indexing*). The company with the largest ratio between its FI weight and its weight in the MV-weighted portfolio is given the rank number one. To separate the companies which have not paid any dividends for the past 3 years we use the ranking for *published after-tax profit* as a tiebreaker. When we construct composite ranking lists we use the ranking for *dividends* as a tiebreaker.
10. The FV based ranking lists are divided into quartiles, with the number of stocks included in the top and bottom quartiles being rounded down to the nearest integer. If the top and bottom quartiles consist of less than ten stocks they will be extended to comprise ten stocks, since the major benefits of diversification are achieved when holding 10-15 securities (Arnold 2002, pp. 266-267).[8]
11. We then pick the stocks in the top quartile to constitute the firms which are included in the EFI portfolios. All these stocks are given an equal weight in order to achieve the benefits of diversification and to minimize unsystematic risk.

3.6.3 Portfolios based on active extension (phase 3)

In the last phase portfolios based on active extension are formed. Steps 1 to 11 are iterated and the procedure is complemented with one more step. (The active extension method is further described in chapter 2.15 *Active extension*).

12. All the stocks in the lowest ranked quartile are given equal weights. Short positions are then taken in all stocks in the lowest ranked quartile. The proceeds from the short positions are reinvested and used to take additional long positions in the top rated quartile.

3.6.4 Optimal level of active extension

As described in chapter 2.15.4 *Which level of active extension is optimal?* we assume that a leveraged ratio up to 150/50 is a reasonable maximum for active extension and also establish that 130/30 is most commonly used by fund managers. In order to define the optimal gross exposure we constructed portfolios with ratios of 110/10, 120/20, 130/30, 140/40 and 150/50. The sample of firms included in the portfolios was not changed whenever the ratio was adjusted. However, the ratios did alter during the time period due to changes in stock price and were only rebalanced back to their original ratio every 12 months.

3.6.5 Composite portfolios

A number of composite portfolios based on more than one fundamental variable were constructed. This was done with the intention of investigating whether the mean-variance efficiency would increase if combinations of different ranking lists were used in the ranking procedure of the firms.

[8]For the years 1983 to 1989 we have less than 40 stocks on our ranking lists.

The returns of the composite portfolios were compared and among the top performing portfolios, risk was measured.

We obtained composite ranking lists by calculating a score for every stock based on its ranking on the underlying EFI-ranking lists. Further, we allowed the underlying ranking lists to have different weights. The stock with the lowest total score was given the rank number one on the new composite ranking. To prevent any two stocks from getting the same score we added 0.0001 to the weight of the ranking list based on *cash dividends*.

Let us explain by an example: Assume that a certain stock gets the following position in the EFI-ranking lists of the nine different variables which are included in the study: 2 (cash dividends)-2-17-55-21-12-9-19-4. If all variables are given the weight 1, the total score for that stock would be: (2*1.0001)+2+17+55+21+12+9+19+4=141.0002. If we instead give cash dividends the weight 2, but keep all other weights at 1 the score would be 143.0002 (since we multiply the ranking number of cash dividends by 2.0001 instead of 1.0001).

In order to find the most optimal combination Monte Carlo simulation was used. In our first simulation we only allowed the fundamental variables to have the weights 0, 1 or 2 (adding 0.0001 to the weight for cash dividends to get a tiebreaker). If we had had the computer knowledge it would of course have been preferable to write a script that tested all possible combinations (instead of testing a large number of random combinations). The reliability of the results would then also increase. However, since the number of iterations in our Monte Carlo simulation far exceeded the number of possible combinations we are confident that there was no 0-1-2 combination with higher mean-variance efficiency.

According to our simulations the optimal combination consists of these three variables:

Table 2: Composite portfolio 1	
Fundamental variable	**Weight**
Cash dividends paid	2.0001
Equity capital and reserves	1
Employees	1

Allowing integer values from 0 to 10 we then ran a new simulation with the variables in composite portfolio 1, and found that 7.0001-1-4 outperformed all other combinations.

Table 3: Composite portfolio 2	
Fundamental variable	**Weight**
Cash dividends paid	7.0001
Equity capital and reserves	1
Employees	4

Adding one other of the six remaining variables at a time, we then ran simulations with integer values from 0 to 7 being allowed. Doing this we only found one other combination which was more mean-variance efficient than composite portfolio 2. That combination was 6.0001-5-4-1 with the last number being the weight of the ranking for funds from operations.

Table 4: Composite portfolio 3	
Fundamental variable	**Weight**
Cash dividends paid	6.0001
Equity capital and reserves	5
Employees	4
Funds from operations	1

3.6.6 Rebalancing of the portfolios

The date for rebalancing the portfolios was set to the 1st of March each year. If the Swedish stock market was closed on the 1st of March, the following trading day was chosen. According to the rules and regulations for issuers on the OMX Nordic Exchange Stockholm, a listed company limited by shares is obliged to disclose the summarized financial statement[9] within two months from the expiry of the reporting period (OMX Nordic Exchange Stockholm 2009, p. 27). An overwhelming majority of the companies on the OMX Nordic Exchange Stockholm have a fiscal year identical to the calendar year. This means that the last of February also is the last day that the majority of the companies on the Swedish stock market could disclose a summarized financial statement. By choosing the first trading day of March for rebalancing the portfolios, the market should have had enough time to make adjustments in stock prices due to any new information given in the summarized financial reports.

The content in the summarized financial statement should be identical to the annual report, which normally is released a few months later. Rectifications are only accepted in extraordinary cases. The data provided by DataStream and Bolagsverket are based on annual reports. We therefore make the assumption that the information in the annual reports and the summarized financial statements is identical.

Any new relevant information concerning the companies in the portfolios that was given between the end of the reporting period and the day of rebalancing, did not affect the weights in the portfolios based on FVs. The MV-weighted portfolio did not face this problem since it was decided by the MV of each firm on the day of rebalancing. Hence, the MV-weighted portfolio has a small information advantage in comparison to the FV based portfolios.

If we on the other hand would have chosen to rebalance all portfolios the 1st of January it would have had a clear negative impact on the reliability of the results. Let us explain why. A rebalancing on the 1st of January had resulted in that any changes in our portfolio weights would have been based on information which was not yet available to the market at that time. In this way the portfolios based on FVs would get a distinct and unfair advantage compared to the MV-weighted portfolio, and the study would be of little value.

We have not been able to find historical quarterly reports for a substantial number of companies for the time period of the study. This forced us to restrict the rebalancing to once a year. Even if we would have had access to quarterly reports, we assume that the results would not likely change dramatically. Arnott et al. (2005, p. 85)[10] investigated the importance of rebalancing period in their study. The authors showed that monthly, quarterly and semi-annual rebalancing generated almost identical results as annual rebalancing. Since the turnover rate increases with more frequent rebalancing, Arnott et al. argue that annual rebalancing is preferable. We assume that the Swedish stock market in its nature is very similar to the US market and that the outcome would most likely be the same in Sweden. Furthermore, quarterly reports may as well fluctuate strongly due to seasonal effects and unexpected occurrences, which may be misleading for the year as a whole.

[9] The Swedish term is *bokslutskommuniké*

[10] For a more detailed presentation of the study by Arnott et al. (2005) see chapter 2.10 *Study by Research Affiliates*.

3.6.7 Delisted stocks

If a stock included in a portfolio was delisted, subject to buy-out or merger during the time period studied it was not replaced by another stock until the next regular date for rebalancing. The removal of one firm leads to marginal changes in the composition of the portfolios, but a full rebalancing would still be needed and increased transaction costs the comeuppance.

If a stock was removed on the long side we assumed that the released capital was reinvested in a general Swedish MV-weighted index fund[11] until the next ordinary date of rebalancing. To invest the released capital in a MV-weighted index fund keeps down the transaction costs and still produce a return which is close to the mean of the portfolio. The reason for not investing the released capital in bonds or treasury bills is simply that the stock market in the long run historically has been a more effective investment alternative than the bond market (Sveriges Aktiesparares Riksförbund 2009).

If a stock on the short side was delisted from the market or subject to a buy-out we practiced the same system and replaced the removed stock with the return of SIX RX[12].

3.6.8 Effective yield

A substantial number of the Swedish mutual fund managers make comparisons with indices which do not include dividends. In this way the fund managers appear in a good light, but these comparisons are misleading since mutual funds normally reinvest paid dividends. The returns of the portfolios in this study are all based on effective yield with no exceptions. We define the effective yield of a security as the return generated when all dividends paid directly are reinvested in the security. The effective yield of a portfolio is consequently equal to the sum of the effective yield of each share multiplied by the weight of the security.

3.6.9 Costs of active extension

For portfolios using active extension we assumed an additional cost due to the use of short and additional long positions. The size of the cost and how it is calculated is further explained in chapter 2.15.3 *Costs associated with active extension*. The cost was deducted monthly from the return of the active extension portfolios.

3.6.10 Evaluation of risk

In order to analyse the performance of the portfolios, risk was measured. In this study total risk is measured as standard deviation, systematic risk as beta and unsystematic risk as residual variance. The procedure for gathering the data when calculating risk is described in section *3.2 Data collection*.

Standard deviation

Standard deviation is a measurement of historical volatility and defines the dispersion of the rate of return in terms of deviation from the expected value. It is calculated as the square root of variance. High standard deviation indicates low stability of the portfolio and consequently high risk.

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[11] The return of SIX RX is used as a proxy.

[12] SIX Return Index (SIX RX) is a MV-weighted index consisting of all listed stocks included on the OMX Nordic Exchange Stockholm and includes dividends.

$$s = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2}$$

Where: s = Standard deviation

$\{x_1, x_2, \ldots, x_N\}$ = Observed values

$\bar{x}$ = Mean value of the observations

Note that we have not chosen to use Bessel's correction (the use of N − 1 instead of N) and therefore assume that our return series data represent the population. The reason is that our calculations of the standard deviation have to be consistent with the definition of the beta. If Bessel's correction had been used, the value of the beta for the market portfolio would not be 1 (Benninga 2008, p. 241).

Beta

To estimate the beta of a portfolio we calculated the covariance between the return series for that portfolio and the return series for SIX RX, using data for the whole time period, and divided by the variance of the return for SIX RX.

$$\beta_p = \frac{\mathrm{Cov}\,(\mathrm{r_p}, \mathrm{r_b})}{\mathrm{Var}\,(\mathrm{r_b})}$$

Where: β_p=Beta of portfolio *p*

r_p=Return of portfolio *p*

r_b=Return of the benchmark (SIX RX)

Beta is also equal to the slope of a least squares linear regression line where the return of portfolio *p* is the y-variable, and the return of the benchmark is the x-variable.

Residual variance

From the regression we use to estimate beta we also calculate residual variance. It is the standard error of y given x for the line we get when we estimate beta. Residual variance is a measure of unsystematic risk.

3.7 Evaluating the portfolios

High yield combined with low risk is what all investors strive for. Hence, effective yield in relation to risk is what really discloses the performance of a portfolio. Different statistical measures such as Jensen's Alpha, Sharpe ratio and information ratio were used in order to evaluate strengths and weaknesses. (See further 2.16 *Evaluation of portfolio performance*).

3.7.1 Performance hypothesis testing

The equality of two Sharpe ratios was tested using the transformed difference (Asgharian 2009, pp.49-50):

$$\widehat{sr}_{ij} = s_j m_i - s_i m_j$$

sr_{ij} is the mean of the asymptotic distribution, which is normal, and variance is given by:

$$\theta = \frac{1}{T}\left[\left(2s_i^2 s_j^2 - 2s_i s_j s_{ij} + \frac{1}{2}m_i^2 s_j^2 + \frac{1}{2}m_j^2 s_i^2 - \frac{m_i m_j}{2s_i s_j}\left(s_{ij}^2 + s_i^2 s_j^2\right)\right)\right]$$

Where: $m_i = \frac{1}{T}\sum_{t=1}^{T} d_{it}$ $\qquad s_i = \frac{1}{T}\sum_{t=1}^{T} d_{it} - m_i$ $\qquad d_{it} = \left(R_{it} - R_{ft}\right)$

and T is the number of observations, R_{it} is the return of portfolio i for period t, R_{ft} is the risk-free return for period t, and s_{ij} is the estimated covariance between the differential returns for portfolios i and j. This gives the test statistic:

$$z\left(sr_{ij}\right) = \frac{\widehat{sr}_{ij}}{\sqrt{\theta}} \sim N(0,1)$$

To test if an information ratio is different from zero is simple. The t-statistic can be calculated as the square root of the number of observations times the sample information ratio (Truman 2003, p. 2):

$$t = \sqrt{N} * IR$$

When we calculated this we used monthly information ratios rather than the annualised information ratios we present together with the t-values. Critical values were obtained from a t-distribution with N-1 degrees of freedom.

Jensen's Alpha was estimated through regression analysis. Ex post alpha is the estimate of the intercept term in the regression equation:

$$R_{pt} - r_{ft} = \alpha_p + \beta_p\left(R_{MVt} - r_{ft}\right) + \varepsilon_t$$

where for period t, R_{pt} is the return of the portfolio, r_{ft} is the risk free return, and R_{MVt} is the return of our MV-portfolio. β_p is the beta of the portfolio versus the MV-portfolio, and ε is the random error term (Lawton and Jankowski 2009, p. 60). The t-value is the coefficient of α divided by its standard error. To test if α is different from zero the t-ratio can be compared to critical values from a t-distribution with N-2 degrees of freedom (Brooks 2002, p. 88). For this testing we use monthly alphas.

All our tests of Jensen's Alphas, Sharpe ratios and information ratios are two sided.

3.7.2 Annualisation of performance measures

In our calculations we have been working with monthly data, but to facilitate comparison with other studies we present annualised performance measures as is common practice. To annualise standard deviations of return rates, Sharpe ratio, and information ratio we simply multiplied the monthly measures by the square root of 12. To annualise Jensen's Alpha we took [(1+monthly alpha)^12]-1.

3.7.3 Construction of indices

In order to evaluate the performances of the different portfolios we created indices. All indices were constructed in the same way. The starting date of our study is the 1st of March 1983. This date was given the value of 100. The return for the next twelve months was then multiplied with the index value from the previous period. This procedure can be illustrated as follows:

Suppose the effective yield for a portfolio during the time period 1st March 1983 until 28th of February 1984 is seven percent. The index value of 100 is then multiplied by 1,07 which results in a new index value of 107. Assume that the following 12 months generates a negative return of 4 percent. The value of the index the 28th of February 1984 will then be (107*0,96) = 102,72.

3.7.4 Portfolio composition

The composition of all portfolios was studied. This was done for the purpose of investigating how great the differences in structure are between the different portfolios and whether the weights of small companies are larger in EFI and active extension. First the ten largest companies in terms of MV were picked each year. Then the concentration of these ten firms was measured for each portfolio.

3.8 Operational simplifications

In the majority of all empirical studies there is a difference between what is possible to perform and what is theoretically desirable. In our thesis we have been forced to use a few operational simplifications due to the limited time frame of this study. We do hope these simplifications will not hinder a result which is close to the reality which we are trying to mirror. The operational simplifications include:

- Taxes and operating expenses (e.g. transaction costs, costs of administration) do not exist.[13]
- Short positions with the duration of 12 months are possible to take in all firms represented on the Swedish stock market during the whole time period.
- There are no restrictions regarding the size of the weights in the portfolios.
- Unlimited possibility to invest capital at the rate of SIX RX.
- Our investment decisions have no effect on the stock prices.
- The present legal rules and regulations on the OMX Nordic Exchange Stockholm are assumed to have been identical during the whole time period.
- The content of the summarized financial statements are assumed to be identical with the content of the annual reports.

[13] Exception made for costs related to total return swaps which are included in the study.

3.9 Validity

The conclusions of this thesis are based on the study we have performed. Validity is a measurement of how well the operational simplifications do constitute a mirror of the reality we are trying to evaluate (Bäck et al. 1992, p.66). The operational simplifications of this thesis are relatively extensive due to a limited amount of time and difficulties in finding appropriate data. The results of this study should therefore not be seen as established facts, but instead as a study of a subject which needs further research.

The method of evaluating portfolio performance by estimating mean-variance efficiency is a well established method among financial academics and practitioners. Therefore, the chosen method of estimating the mean-variance efficiency of the portfolios is regarded to be valid.

Our study of using active extension combined with an investment model based on EFI has, to our knowledge, not been practiced in a similar manner before. To construct the active extension portfolios some assumptions had to be made. The assumptions are, as far as possible, based on the reality which fund managers in Sweden are facing. We therefore argue that the method of constructing active extension portfolios is believed to be valid.

The validity of the data used in this thesis would be higher if only one source or primary data was used. However, the financial data provided by the different sources originate from the same annual reports and stock prices originate from the Swedish Stock Exchange[14]. We believe the room for interpretation of the primary data is very restricted due to strict and standardized rules of financial reporting. The firm specific information provided by DataStream, SIX Trust and Dagens Industri should therefore not differ from the primary data to a considerable degree. In order to test the validity of the data, some observations were cross referenced with primary data and found to be correct.

Further, the validity of the data would increase if we had used information from summarized financial statements instead of annual reports. This due to the fact that we rebalance the portfolios before all annual reports are released. Hence, there is a small risk that we have rebalanced the portfolios based on information not known by the market the 1st of March each year. However, the information provided in the summarized financial statements are in most cases identical to the later published annual reports. It is only under very specific circumstances that modifications are allowed. We therefore believe that the use of information taken from annual reports have not affected the validity of the data to a considerable degree.

Our ambition has been to include all stocks listed on the Swedish stock market in the study. Due to reasons explained in chapter 3.4 *Sample and excluded observations* this was not possible. However, we still believe the representation of stocks included in the portfolios do mirror the Swedish stock market in a sufficient way and that the validity of the study is good. The majority of the stocks excluded are very small companies left out in order to make the investment strategy attractive for investors who value low transaction costs. We believe the need of minimizing transaction costs is justified in order to construct a competitive portfolio strategy, even though it will affect the size of the sample.

[14] OMX Nordic Exchange Stockholm (former Stockholmsbörsen)

3.9.1 Internal validity

The internal validity determines the causal relation between the independent variable and dependent variable, i.e. if changes in the dependent variable are caused by changes in the independent variable or by other disturbing factors (Ryan et al. 2003, p. 122-123). We argue that all variables which are based on FVs, except *employees*, have a clear and unambiguous relation to stock price and that the internal validity is high. A poor and unexpected result in these variables would have a negative impact on the stock price and vice versa.

Concerning the variable *employees* we have not found any sufficient theoretical explanation to the relationship to stock price. Using our FV based approach based on absolute values benefits firms with redundant employees. This is of course illogical and wrong. Instead companies which are making the organization more efficient by keeping down the number of employees should be rewarded. One explanation could be that employees might be closely related to another single fundamental explanatory variable or a combination of variables not tested in this study. We therefore believe the internal validity of the variable *employees* to be low.

3.9.2 External validity

The external validity determines whether the results can be generalized to other settings and samples outside the context of the study (Ryan et al. 2003, p. 123-124). This study does only include stocks on the Swedish market. However, we believe that the lack of rationality and the exaggerated focus on an uncertain future when pricing stocks is quite general in the world. The nature of the Swedish stock market could therefore be seen as rather typical for the global stock market. Hence, the findings presented in this thesis should be relevant in an international perspective and the external validity sufficient in terms of environmental changes.

3.10 Reliability

A study is deemed to have high reliability if the results of the study are identical whenever the study is iterated, independent of time (Bryman 2002, p. 44).

3.10.1 The time period of the study

The global financial world has gone through some radical changes the last three decades and the Swedish stock market is no exception. The situation for the players in the market is very different today compared to the early 1980s. Here are some of the changes:

- The introductions of computers and new information systems which provide immediate data for buyers and sellers have revolutionized the market and the turnover has increased drastically.
- The number of professional analysts has increased providing more information to the market.
- The spectrum of actors on the market has become broader and is now including a large group of private investors and not only professional fund managers and institutions.
- The possibilities of purchasing stocks in markets abroad have increased markedly due to international deregulations. This has led to a growing number of foreign shareholders on the Swedish stock market, whose interests and perspectives sometimes differ from Swedish owners.

- International accounting legislations and regulations have led to more transparency and openness on the market.
- More capital belonging to Swedish investors have been allocated to the stock market due to domestic deregulations and amendments[15].
- New tax reforms and fiscal regulations.
- The Swedish stock market has experienced a huge increase in value during the time period.

With reference to the above section we believe that the market has become more efficient and that the information asymmetry between different players on the market has substantially diminished. Further, we find it hard to believe that the massive increase in turnover and inflow of new capital to the Swedish stock market will continue to grow at the same level in the future. All these changed conditions have a clear negative impact on the reliability of the results of our study. This is one of the crucial dilemmas and a weakness when using ex post testing in order to draw conclusions about the future. There is no guarantee that history will repeat itself.

3.10.2 The composition of the composite portfolios

The composition of the composite portfolios is a result of Monte Carlo simulation; hence any conclusions made based on the performance of these portfolios might not be reliable. There is a risk that the characteristics of these portfolios are a product of data mining. The findings for these portfolios should therefore be interpreted with caution.

3.10.3 The impact of our study

A rational financial market should adopt new profit-making strategies the moment they become known. If all actors on the market try to take advantage of a certain strategy, the advantage should disappear immediately. We argue that the market is rational enough to adapt successful strategies so that the conditions for a strategy generating abnormal return will change. If the results of our study will be pointing to a more efficient investment strategy than those used by mutual fund managers today, there is a clear risk that the exploiting possibilities will diminish and the reliability of our study decrease.

We would also like to stress the importance that we in this thesis study the past and that the portfolio strategies we describe is based on nothing but historical data. Hence, the conclusions we make are no guarantee for what the future will bring or that history will repeat itself. If the reader intends to practice our strategy in reality she must therefore ask herself how likely it is that the Swedish stock market's development will be a mirror of the past?

[15] Examples: currency deregulation (1989), major tax reform (1991), introduction of individually pension saving system (1994), pension savings reform (2000). Source: The Swedish Investment Fund Association (2009).

4 EMPIRICAL FINDINGS & ANALYSIS OF RESULTS

This chapter presents the empirical findings of the study and analyses of the results. The main results are presented in three steps. First the performances of the portfolios based on FI versus the MV-weighted portfolio (MV) are discussed. Then the results of the portfolios based on EFI are presented and finally the outcomes of the portfolios using active extension are shown.

All constructed portfolios in the tables are named after the variable which defines firm size in the weighting procedure of each portfolio. As reference, data for the risk free rate and SIX RX are presented.

4.1 Performance of portfolios based on FI

Table 5: Return characteristics of portfolios based on FI, 1983-2009

Portfolio/Index	Ending value of 1 SEK	CAGR	Std dev	Beta vs. SIX RX	R^2	Residual variance	Skewness	Kurtosis
Risk free rate	5.91 SEK	7.07%	1.11%	-	-	-	0.37	-0.99
SIX RX	17.87	11.73	22.04	1.00	-	-	-0.28	1.45
Market value (MV)	13.04	10.38	24.11	1.07	0.96	0.00019	-0.08	1.88
FI:								
FFO	23.78	12.96	23.19	1.00	0.90	0.00047	0.03	3.37
Dividends	27.61	13.61	23.24	1.00	0.90	0.00045	0.06	3.43
Net sales	25.93	13.34	24.59	1.05	0.89	0.00056	0.12	2.81
Pretax income	21.37	12.50	22.81	0.99	0.91	0.00040	0.02	3.75
After-tax profit	20.54	12.33	22.86	0.99	0.91	0.00039	0.01	3.66
EBIT	21.27	12.48	23.27	1.00	0.90	0.00043	0.12	3.82
EBITDA	22.73	12.76	23.41	1.01	0.91	0.00044	0.11	3.61
Eq. cap. & res.	25.99	13.35	23.53	1.01	0.90	0.00045	0.16	3.74
Employees	27.80	13.64	23.83	1.01	0.87	0.00060	0.09	2.81

Notes: R^2 and residual variance are calculated with SIX RX as benchmark.

Table 5 shows that all portfolios based on FI outperform the MV-portfolio for the time period 1983 to 2009. The compound annual growth rate (CAGR) for the portfolios based on FI is 1.95 to 3.26 percentage points (pps) higher than the CAGR of the MV-portfolio. The FI portfolios exhibit standard deviations and betas which are similar or in general lower than the MV-portfolio, indicating lower risk for FI. The result may be surprising for supporters of growth stocks. *Dividends* for example, favours mature, low-risk companies whose forecasts are not that promising in terms of growth. Nevertheless this variable is one of the top performing portfolios within the group and outpaces MV.

The value of R-squared (R^2) is high for the FI-portfolios, which means that most of the portfolios' performance patterns can be explained by the movements of the market (SIX RX). The residual variance, which is a measurement of unsystematic risk, is only slightly higher for the portfolios based on FI.

Looking at the skewness and kurtosis of the portfolios we can conclude that the FI-portfolios are rather normally distributed (a normal distribution has a skewness of zero and a kurtosis of 3). The degree of skewness is slightly lower for the MV-portfolio, while the kurtosis is 1.88.

Table 6: Risk-adjusted performance measures of portfolios based on FI, 1983-2009

Portfolio/Index	SR	z-value[16]	IR[17]	t-value[18]	J's α [19]	t-value[20]	Beta vs. MV
SIX RX	0.305	1.47	0.149	0.76	-	-	-
MV	0.247	-	-	-	-	-	1.00
FI:							
FFO	0.347	1.64	0.283	1.44	0.0263	1.85*	0.92
Dividends	0.372	2.01**	0.358	1.83*	0.0323	2.23**	0.92
Net sales	0.354	1.71	0.355	1.81*	0.0298	1.93*	0.97
Pretax income	0.331	1.49	0.234	1.19	0.0217	1.69*	0.91
After-tax profit	0.325	1.34	0.208	1.06	0.0203	1.54	0.91
EBIT	0.328	1.39	0.238	1.21	0.0215	1.59	0.92
EBITDA	0.338	1.58	0.281	1.43	0.0241	1.78*	0.93
Eq. cap. & res.	0.360	1.87*	0.342	1.75*	0.0296	2.08**	0.93
Employees	0.369	1.81*	0.345	1.76*	0.0331	2.05**	0.93

*Notes: *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.*

To test if the difference in performance between the portfolios based on FI and the MV-portfolio is statistically significant, we have used Sharpe ratio (SR), information ratio (IR) and Jensen's alpha (J's α). As can be seen in table 6 the SRs for the FI-portfolios range from 0.325 to 0.372, while the MV-portfolio has a value of 0.247. However, the difference is only significant for *dividends* (5% level), *equity capital & reserves* (10% level) and *employees* (10% level).

The IRs are all positive for the FI-portfolios and are significant (10% level) for *dividends*, *net sales*, *equity capital & reserves* and *employees*.

J's α, which measures the excess return from a CAPM-based approach, shows that six out of eight FI-portfolios have an alpha which is significant at the 10% level (d*ividends*, *equity capital & reserves* and *employees* are significant at the 5%-level).

Beta (vs. MV), is below 1 for all FI-portfolios. This is not surprising since FI favors companies which have a history of strong financial results and these are normally mature firms with low risk.

[16] H_0: SR=SR (MV), H_1: SR ≠ SR (MV)
[17] Benchmark = MV
[18] H_0: IR=0, H_1: IR≠0, 311 degrees of freedom (df)
[19] Benchmark = MV
[20] H_0: α=0, H_1: α≠0, 310 df

Table 5 and table 6 show that over the full period FI outperforms the MV-portfolio from a mean-variance perspective. However, the positive difference in performance is not statistically significant for all FI-portfolios. Only *dividends*, *equity capital & reserves* and *employees* have significant results for all three performance measures (10% level). Why *employees* is among the top performing portfolios is hard to say. Normally, the market put value in a slim and effective organization and a large labour force is not necessarily a healthy sign. One explanation could be that firms with many employees experience a pressure from the owners to rationalize. Cuts in labour costs are rewarded by the market and this aspect might have been a contributive reason to the result. Another possibility is that a large working force often is associated with long-term plans, an element which normally strengthens a firm's chances to survive in the long run. The result of *employees* may also be closely related to another fundamental variable, or a combination of variables, not tested in this study.

4.2 Performance of portfolios based on EFI

Table 7: Return characteristics of portfolios based on EFI, 1983-2009

Portfolio/Index	Ending value of 1 SEK	CAGR	Std dev	Beta vs. SIX RX	R^2	Residual variance	Skewness	Kurtosis
Risk free rate	5.91 SEK	7.07%	1.11%	-	-	-	0.37	-0.99
SIX RX	17.87	11.73	22.04	1.00	-	-	-0.28	1.45
MV	13.04	10.38	24.11	1.07	0.96	0.00019	-0.08	1.88
EFI:								
FFO	31.31	14.16	23.96	0.91	0.70	0.00147	-0.38	1.53
Dividends	48.86	16.13	24.78	0.96	0.72	0.00143	0.24	3.93
Net sales	40.84	15.34	24.17	0.90	0.68	0.00158	-0.27	1.85
Pretax income	32.04	14.27	22.81	0.87	0.70	0.00131	-0.2	2.89
After-tax profit	28.93	13.82	22.89	0.87	0.70	0.00132	-0.2	2.75
EBIT	32.05	14.27	23.68	0.89	0.68	0.00150	-0.29	2.21
EBITDA	40.03	15.25	24.31	0.92	0.69	0.00151	-0.16	2.25
Eq. cap. & res.	35.69	14.74	24.84	0.94	0.69	0.00160	0.03	3.04
Employees	41.09	15.36	23.45	0.89	0.71	0.00135	-0.25	1.53
Composite 1	67.94	17.62	24.32	0.92	0.69	0.00152	0.25	3.71
Composite 2	79.42	18.32	24.05	0.91	0.70	0.00147	0.00	2.55
Composite 3	83.95	18.58	24.17	0.91	0.69	0.00150	-0.03	2.50

Notes: R^2 and residual variance are calculated with SIX RX as benchmark.

The aim of the second set of portfolios is to capture and enhance the assumed benefits of FV-weighting by comparing the differences in the structure of the FV-weighted portfolios and the benchmark portfolio based on MV. As can be seen in table 7 the use of EFI has a clear positive effect on the return. The CAGR for the FV-weighted portfolios increases by 1.20 to 2.52 pps. The composite portfolios (see chapter 3.6.5 *Composite portfolios*) are showing a noteworthy CAGR of 17.62 to 18.58 pps, on average 7.8 pps higher than the MV-portfolio.

Even though the CAGR increases the changes in standard deviations of the EFI-portfolios are minor. Three EFI-portfolios (*net sales*, *EBITDA* and *employees*) actually exhibit a lower variance in their returns compared to the corresponding FI-portfolio. The beta value decreases for all EFI-portfolios, but at the same time R^2 declines as well. The lower beta could be explained by the fact that EFI favours firms with solid financial statements more strongly than FI, since poor performing companies are left out of the EFI-portfolios. The drawback of including fewer securities is mirrored in the increase of residual variance.

The distributions of the return series are still assumed to be approximately symmetric. The values of kurtosis have decreased slightly, which in general is positive for a risk averse investor who prefers a return distribution with fewer outlier events.

Table 8: Risk-adjusted performance measures of portfolios based on EFI, 1983-2009

Portfolio/ Index	SR	z-value[21]	z-value[22]	IR (MV)[23]	t-value[24]	IR (FI)[25]	t-value[26]	J's α[27]	t-value[28]	Beta vs. MV
SIX RX	0.305	1.47	-	0.149	0.76	-	-	-	-	
MV	0.247	-	-	-		-	-	-	-	1.00
EFI:										
FFO	0.390	1.18	0.51	0.229	1.17	0.127	0.65	0.0465	1.64	0.81
Dividends	0.452	1.78*	1.08	0.367	1.87*	0.277	1.41	0.0630	2.24**	0.85
Net sales	0.431	1.46	0.87	0.288	1.47	0.156	0.80	0.0582	1.96*	0.80
Pretax income	0.401	1.31	0.82	0.226	1.15	0.162	0.82	0.0462	1.76*	0.78
After-tax profit	0.383	1.14	0.69	0.196	1.00	0.137	0.70	0.0423	1.59	0.78
EBIT	0.395	1.20	0.75	0.226	1.15	0.163	0.83	0.0476	1.67*	0.79
EBITDA	0.426	1.48	1.03	0.296	1.51	0.235	1.20	0.0563	1.96*	0.82
Eq. cap. & res.	0.403	1.28	0.51	0.267	1.36	0.148	0.75	0.0519	1.75*	0.83
Employees	0.438	1.59	0.82	0.298	1.52	0.146	0.74	0.0568	2.07*	0.79
Composite 1	0.508	2.17**	-	0.432	2.20**	-	-	0.0775	2.68***	0.82
Composite 2	0.538	2.39**	-	0.470	2.40**	-	-	0.0844	2.92***	0.81
Composite 3	0.545	2.44**	-	0.482	2.46**	-	-	0.0870	2.98***	0.81

*Notes: *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.*

When evaluating the performances of the EFI-portfolios with risk-adjusted measures we find that EFI outperforms the MV-portfolio (table 8). For a majority of the portfolios the differences in

[21] H_0: SR (EFI)=SR (MV), H_1: SR (EFI)≠SR (MV)
[22] H_0: SR (EFI)=SR (corresponding FI portfolio), H_1: SR (EFI)≠SR (corresponding FI portfolio)
[23] Benchmark = MV
[24] H_0: IR=0, H_1: IR≠0, 311 df
[25] Benchmark = the corresponding FI portfolio
[26] H_0: IR=0, H_1: IR≠0, 311 df
[27] Benchmark = MV
[28] H_0: α=0, H_1: α≠0, 310 df

performance are not statistically significant though. Of the single-variable EFI-portfolios it is only *dividends* which exhibits significant results at the 10% level for SR, IR and J's α. The excess returns of the composite portfolios are on the other hand significant at the 5% level for both SR and IR, and highly statistically significant (1% level) for J's α.

In comparison to FI the portfolios based on EFI exhibit a greater SR and J's α. The IR (benchmark MV) for EFI decreases slightly for seven portfolios, but when the corresponding FI-portfolio is used as benchmark all values are positive. The differences in performance between EFI and FI are not statistically significant.

4.3 Portfolios based on active extension

4.3.1 Optimal level of active extension

The difference in performances between portfolios based on active extension with a ratio of 110/10, 120/20, 130/30, 140/40 and 150/50 are small (see further *Appendix*, table A.1 + A.2). In general the return improved as the gross exposure increased, but when risk was considered the risk-adjusted measures showed minor differences between the portfolios. Since the risk-adjusted performance measures do not give a clear indication which ratio to prefer, we choose to focus on 130/30. It is by far the most used ratio among fund managers who practice active extension, hence this ratio is chosen in the presentation of the results.

4.3.2 Performance of portfolios based on active extension (130/30)

Table 9: Return characteristics of portfolios based on active extension, 1983-2009

Portfolio/ Index	Ending value of 1 SEK	CAGR	Std dev	Beta vs. SIX RX	R^2	Residual variance	Skewness	Kurtosis
Risk free rate	5.91 SEK	7.07%	1.11%	-	-	-	0.37	-0.99
SIX RX	17.87	11.73	22.04	1.00	-	-	-0.28	1.45
MV	13.04	10.38	24.11	1.07	0.96	0.00019	-0.08	1.88
130/30:								
FFO	33.86	14.51	25.77	0.86	0.53	0.00259	-0.4	1.25
Dividends	65.32	17.44	27.35	0.94	0.58	0.00264	0.63	5.39
Net sales	58.72	16.96	26.15	0.88	0.55	0.00258	-0.22	1.79
Pretax income	31.19	14.15	25.02	0.82	0.52	0.00253	0.04	3.64
After-tax profit	28.27	13.72	25.15	0.83	0.53	0.00251	0.00	3.52
EBIT	32.75	14.36	26.31	0.85	0.51	0.00286	-0.14	2.35
EBITDA	41.07	15.36	26.97	0.89	0.53	0.00289	-0.06	2.33
Eq. cap. & res.	42.32	15.49	28.25	0.94	0.54	0.00306	0.32	4.37
Employees	57.94	16.90	25.10	0.89	0.60	0.00209	-0.25	1.16
Composite 1	98.72	19.32	26.97	0.89	0.53	0.00288	0.49	4.28
Composite 2	125.58	20.43	26.44	0.87	0.53	0.00277	0.17	2.71
Composite 3	129.71	20.58	26.77	0.88	0.52	0.00286	0.14	2.65

Notes: R^2 and residual variance are calculated with SIX RX as benchmark.

The last set of portfolios constructed in this study is based on active extension (130/30) and are presented in table 9. The aim of this investment strategy is to improve the effects of a successful investment model, in our case EFI. Hence, the evaluation of the portfolios based on active extension will focus on whether the positive effects of EFI are enhanced or not through active extension.

The effect on the CAGR in comparison to EFI is not as strong as when investment strategy is changed from FI to EFI. It is still positive for 10 out of 12 portfolios, but the 130/30 portfolios based on *pretax income* and *after-tax profit* show a small negative change.

Looking at the risk measures standard deviation increases for all portfolios, beta decreases slightly and the residual variance continues to rise. The explanatory power of the beta is rather low according to R^2 and should be interpreted with caution. The skewness is still quite small and the kurtosis of the return series is on a reasonable level, which suggests rather few outliers in the historical return series.

Table 10: Risk-adjusted performance measures of portfolios based on active extension, 1983-2009

Portfolio/ Index	**SR**	**z-value** [29]	**z-value** [30]	**IR (MV)** [31]	**t-value** [32]	**IR (EFI)** [33]	**t-value** [34]	**J's α** [35]	**t-value** [36]	**Beta vs. MV**
SIX RX	0.305	1.47	-	0.149	0.76	-	-	-	-	-
MV	0.247	-	-	-	-	-	-	-	-	1.00
130/30:										
FFO	0.393	0.96	0.07	0.215	1.10	0.141	0.72	0.0580	1.56	0.75
Dividends	0.473	1.59	0.54	0.370	1.88*	0.301	1.54	0.0825	2.19*	0.84
Net sales	0.471	1.49	1.22	0.331	1.69*	0.409	2.09**	0.0802	2.13*	0.77
Pretax income	0.382	0.89	-0.39	0.190	0.97	0.065	0.33	0.0533	1.48	0.73
After-tax profit	0.366	0.79	-0.36	0.171	0.87	0.073	0.37	0.0494	1.37	0.74
EBIT	0.384	0.88	-0.27	0.206	1.05	0.121	0.62	0.0577	1.49	0.75
EBITDA	0.413	1.09	-0.31	0.259	1.32	0.127	0.65	0.0667	1.70*	0.78
Eq. cap. & res.	0.409	1.08	0.15	0.276	1.41	0.249	1.27	0.0679	1.68*	0.83
Employees	0.478	1.67*	1.31	0.348	1.77*	0.415	2.12**	0.0760	2.25**	0.78
Composite 1	0.536	1.90*	0.67	0.427	2.18**	0.347	1.77*	0.1023	2.58**	0.79
Composite 2	0.579	2.16**	0.97	0.471	2.40**	0.397	2.03**	0.1130	2.87***	0.76
Composite 3	0.580	2.16**	0.82	0.476	2.43**	0.389	1.98**	0.1150	2.88***	0.77

*Notes: *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.*

[29] H_0: SR (130/30 portfolio)=SR (MV), H_1: SR (130/30 portfolio)≠SR (MV)
[30] H_0: SR (130/30 portfolio)=SR (corresponding EFI portfolio), H_1: SRs not equal
[31] Benchmark = MV
[32] H_0: IR=0, H_1: IR≠0, 311 df
[33] Benchmark = the corresponding EFI portfolio
[34] H_0: IR=0, H_1: IR≠0, 311 df
[35] Benchmark = MV
[36] H_0: α=0, H_1: α≠0, 310 df

As can be seen in table 10 the SRs for the portfolios based on active extension are fairly similar to EFI. Eight portfolios improve their ratio and four have a small negative difference. The differences are not statistically significant. The IR, using corresponding EFI-portfolio as benchmark, is positive for all portfolios. The result is significant (5% level) for the 130/30 portfolios based on *net sales*, *employees* and for *composite 2 + 3*. As for J's α the value improves for all portfolios in comparison to EFI. The result of J's α is significant at the 5 % level for 4 out of 12 portfolios (8 out of 12 at the 10% level).

Active extension does not improve the results of all portfolios based on EFI. This can be explained by the increased operating expenses for active extension, included in our calculations. For some portfolios the positive effects of active extension are substantial. Our results do not tell whether the performances primarily are an effect of successful short or long positions in the portfolios, or a combination. Further studies need to be done in this area.

4.4 Performance in shorter time periods

How robust are the findings of the study? In order to investigate this question the study is divided into shorter time periods. In this chapter a selection of these results are presented. We have chosen to present portfolios we felt stood out in one way or another and excluded some which were highly correlated with a portfolio we have included. For example did we omit portfolios based on pre-tax profit since they are very similar to the portfolios based on published after-tax profit which we have included. It is difficult to test the robustness for shorter periods due to fewer observations and not many conclusions can be made with statistical significance from our findings. The distributions of the return series are in general more skewed and the range of kurtosis is wider. Hence, the findings of the shorter time periods should be interpreted with caution.

4.4.1 Selection of shorter time periods

Table 11: CAGR – shorter time periods

Portfolio/Index	Mar 1983 - Feb 1991	Mar 1991 - Feb 1997	Mar 1997 - Feb 2003	Mar 2003 - Feb 2009	Full period
Risk free rate	11.56%	8.91%	3.91%	2.70%	7.07%
SIX RX	17.17	19.35	0.21	9.44	11.73
MV	14.85	18.90	-3.10	10.72	10.38

We have chosen to divide the full period into four sections. A minimum of six years were chosen in order to cover both times of growth and recession in the market. As can be seen in table 11 all periods show strong performance in the stock market, except 1997 to 2002 which incorporates the technology/media/telecommunications (TMT) bubble.

4.4.2 Relative return

Table 12: Relative return vs. MV (based on ending value) – shorter time periods

Portfolio/Index	Mar 1983 - Feb 1991	Mar 1991 - Feb 1997	Mar 1997 - Feb 2003	Mar 2003 - Feb 2009	Full period
Risk free rate	0.79	0.59	1.52	0.64	0.45
SIX RX	1.17	1.02	1.22	0.93	1.37
MV	1.00	1.00	1.00	1.00	1.00

FI:	Mar 1983 - Feb 1991	Mar 1991 - Feb 1997	Mar 1997 - Feb 2003	Mar 2003 - Feb 2009	Full period
Dividends	1.04	1.10	1.47	1.25	2.12
Net sales	1.06	1.06	1.49	1.19	1.99
After-tax profit	1.03	1.04	1.54	0.96	1.58
Eq. cap. & res.	1.08	1.07	1.46	1.19	1.99
Employees	1.08	1.11	1.60	1.11	2.13
EFI:					
Dividends	1.70	1.24	1.72	1.03	3.75
Net sales	1.85	0.89	1.97	0.97	3.13
After-tax profit	1.24	0.96	1.80	1.03	2.22
Eq. cap. & res.	1.60	0.84	1.73	1.18	2.74
Employees	1.54	1.17	1.83	0.96	3.15
Composite 1	1.59	1.40	1.77	1.32	5.21
Composite 3	1.90	1.43	1.91	1.24	6.44
130/30:					
Dividends	1.92	1.47	1.70	1.04	5.01
Net sales	2.10	0.98	2.41	0.91	4.50
After-tax profit	1.23	1.01	1.88	0.93	2.17
Eq. cap. & res.	1.85	0.83	1.72	1.23	3.24
Employees	1.74	1.43	1.97	0.90	4.44
Composite 1	1.78	1.72	1.72	1.44	7.57
Composite 3	2.23	1.77	1.88	1.33	9.94

Table 12 shows the relative performance of the portfolios in comparison to the MV-weighted portfolio. The most interesting observation is the extraordinary development of the FV-weighted portfolios during 1997 to 2002. This period includes the unguarded optimism for stocks within the dotcom sector in the late 1990s, the climax in March 2000 when the TMT bubble burst, and the years after when most of the TMT firms were wiped out. Since FV portfolios do not favour promising companies with poor financial statements, the TMT bubble had less effect on these portfolios in comparison to the MV-weighted portfolio.

The results indicate that investors might be able to detect assumed bubbles in the stock market, only by studying the relative performance of portfolios based on MV and FVs. The investors should be alarmed whenever the difference in performance between a portfolio based on MV and a FV-weighted portfolio is large due to a strong bull market for the MV-weighted portfolio.

As for the other three periods the results of the FI-portfolios are strong, only *after-tax profit* fails to beat the MV-weighted portfolio in all periods. Portfolios based on EFI outperform the FI-portfolios the first period, but during 1991-1996 and 2003-2008 the results are mixed. Hence, based on table 12 we cannot state that the advantages of using EFI relative FI are robust over the full period. A majority of the portfolios based on active extension show a return greater than the EFI-portfolios, but the results are again not robust.

4.4.3 Risk-adjusted performance

In table 13 the portfolios in the shorter time periods are evaluated by SR, IR and J's α. The return during period 1997-2003, which was outstanding in table 12, becomes more modest when it has been adjusted for risk. This might seem confusing since the FV-weighted portfolios exhibit a lower variance in their return series during the third period in comparison to the MV-weighted portfolio. The standard deviation ranges from 17.73 to 24.02 for the FI-, EFI- and 130/30 portfolios, while the MV-weighted portfolio shows 29.48 percent. The reason for the change in performances is simply a matter of the dramatic fluctuations of the differential return that occurred during the period. The MV-weighted portfolio demonstrated a remarkable increase in value the first three years (March 1997 to February 2000) and outperformed the other portfolios, but the following years the FV-weighted portfolios outpaced MV.

Looking at all periods we find that the FI-portfolios outperform the MV-weighted portfolio, but the difference is only significant in the last period (*dividends + equity capital and reserves*). The EFI-portfolios beat the portfolios based on FI in the first and third period, but during the other two periods the results are varying. Statistical significance is only valid for a few portfolios and only in the first period.

If we study the difference in performance between the portfolios based on active extension and the EFI-portfolios, the findings are again mixed. The first half of the study advocate a strategy based on active extension with sporadic significant results, while the relative performance of the EFI-portfolios is improved in the second half. The last two periods do not include any statistically significant findings.

Table 13: Risk-adjusted performance measures – shorter time periods

Portfolio/ Index	**Mar 1983 - Feb 1991**			**Mar 1991 - Feb 1997**			**Mar 1997 - Feb 2003**			**Mar 2003 - Feb 2009**		
	SR	**IR**	**J's α**	**SR**	**IR**	**J's α**	**SR**	**IR**	**J's α**	**SR**	**IR**	**J's α**
SIX RX	0,34	0,33	-	0,53	0,01	-	-0,01	0,38	-	0,44	-0,42	-
MV	0,25	-	-	0,49	-	-	-0,09	-	-	0,48	-	-
FI: [37]												
Dividends	0,27	0,22	0,01	0,51	0,37	0,01	0,09	0,34	0,04	0,67 ***	1,12 ***	0,04 ***
Net sales	0,27	0,23	0,01	0,48	0,26	0,00	0,11	0,42	0,05	0,60	0,74	0,03
After-tax profit	0,26	0,14	0,00	0,50	0,22	0,00	0,12	0,44	0,05	0,45	-0,21	0,00
Eq. cap. & res.	0,29	0,33	0,01	0,49	0,29	0,00	0,08	0,35	0,04	0,62 **	1,06 **	0,03 **
Employees	0,29	0,29	0,01	0,52	0,37	0,01	0,16	0,48	0,06	0,56	0,25	0,02
EFI: [38]												
Dividends	0,53 **	0,91 **	0,07 **	0,53	0,32	0,03	0,21	0,21	0,05	0,49	-0,36	0,01
Net sales	0,58 **	0,77 **	0,09 **	0,37	-0,15	-0,01	0,32	0,31	0,08	0,43	-0,43	0,00
After-tax profit	0,36	0,41	0,03	0,43	-0,04	0,00	0,25	0,13	0,06	0,49	0,19	0,01
Eq. cap. & res.	0,49	0,57	0,07	0,33	-0,18	-0,03	0,21	0,18	0,05	0,59	0,00	0,03
Employees	0,47	0,50	0,06	0,54	0,11	0,04	0,26	0,13	0,07	0,43	-0,26	0,00

[37] **SR** H_0: SR (FI)=SR (MV). **IR** (benchmark=MV), H_0: IR=0 (95 df 1983-91, 71 df the other time periods). **J's α** (benchmark=MV), H_0: α=0 (94 df 1983-91, 70 df the other time periods). Two sided tests.

[38] **SR** H_0: SR (EFI)=SR (MV). **IR** (benchmark=corresponding FI portfolio), H_0: IR=0 (95/71 df). **J's α** (benchmark= MV), H_0: α=0 (94/70 df). Two sided tests.

	Mar 1983 - Feb 1991			Mar 1991 - Feb 1997			Mar 1997 - Feb 2003			Mar 2003 - Feb 2009		
EFI:	**SR**	**IR**	**J's α**	**SR**	**IR**	**J's α**	**SR**	**IR**	**J's α**	**SR**	**IR**	**J's α**
Composite 1	0,49	-	0,07 *	0,61	-	0,06	0,23	-	0,05	0,70	-	0,06
Composite 3	0,57	-	0,09 **	0,63	-	0,06	0,30	-	0,07	0,66	-	0,05
130/30: [39]												
Dividends	0,57	0,57	0,09 **	0,57	0,66	0,07	0,20	-0,01	0,05	0,48	0,08	0,02
Net sales	0,62	0,55	0,11 **	0,42	0,50	0,02	0,47	0,59	0,11	0,38	-0,17	-0,01
After-tax profit	0,35	0,12	0,03	0,43	0,25	0,01	0,29	0,13	0,06	0,39	-0,26	0,00
Eq. cap. & res.	0,54	0,61 *	0,09 *	0,33	0,25	-0,03	0,20	0,04	0,05	0,59	0,28	0,04
Employees	0,52	0,56	0,08	0,65 *	0,84 **	0,08	0,31	0,35	0,08	0,37	-0,18	0,00
Composite 1	0,52	0,49	0,09 *	0,66	0,79 *	0,09	0,21	0,00	0,05	0,74	0,43	0,07
Composite 3	0,62	0,67 *	0,12 *	0,70	0,87 **	0,11	0,28	0,03	0,07	0,69	0,36	0,06

*Notes: *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.*

4.5 Correlation of the portfolios

The correlation between the MV-weighted portfolio and SIX RX is as high as 0.980 over the full period. The high degree of correlation indicates that the portfolio based on MV is a reasonable reference for the Swedish stock market.

The portfolios based on FI are all highly correlated with the MV-weighted portfolio and the correlation ranges from 0.941 to 0.959. An interpretation of this close relationship is that the FI-portfolios also are mainly concentrated in large-cap stocks, maintaining the major benefits of a traditional MV-weighted index in terms of trading liquidity.

If we study the correlation between the FI-portfolios we also find high values; 0.968 up to 0.999. Not surprisingly, the higher value (0.999) is measured between variables which are very closely related to each other in terms of accounting definition: *EBIT* vs. *EBITDA* and *pretax income* vs. *after-tax profit*.

If we study the correlation between the EFI-portfolios and the MV-weighted portfolio we get lower values. The correlation is still very similar for all the FV-weighted portfolios, but measures from 0.795 to 0.829. Between the EFI-portfolios the correlation ranges from 0.902 to 0.989.

Finally, the portfolios based on active extension show a correlation with the MV-weighted portfolio which measures from 0.687 to 0.752. The decline is expected due to the major differences in

[39] **SR** H_0: SR (130/30 portfolio)=SR (corresponding EFI portfolio). **IR** (benchmark=corresponding EFI portfolio), H_0: IR=0 (95/71 df). **J's α** (benchmark=MV), H_0: α=0 (94/70 df). Two sided tests.

weighting method of FI, EFI and active extension. The correlation between the 130/30 portfolios ranges from 0.800 to 0.985.

4.6 Portfolio composition

We have earlier assumed that EFI and active extension are strategies which open up for greater weights for small firms, in comparison to MV-weighted portfolios and FI. In order to confirm this assumption the concentration of the ten firms with the largest MV was measured each year for all portfolios. The average value of the full period is presented below in table 14.

Table 14: Average concentration of the 10 largest firms (MV), 1983-2009

MV		64,32%	
	FI	***EFI***	***130/30***
FFO	61,70%	23,03%	24,59%
Dividends	57,51%	19,40%	19,30%
Net sales	58,70%	17,21%	16,29%
Pretax income	59,66%	17,94%	18,33%
After-tax profit	58,05%	17,78%	17,28%
EBIT	58,27%	17,00%	15,53%
EBITDA	59,25%	16,98%	15,17%
Eq. cap. & res.	57,19%	13,80%	9,99%
Employees	56,75%	13,95%	12,40%
Composite 1	-	18,96%	17,59%
Composite 2	-	19,81%	18,74%
Composite 3	-	19,03%	17,26%

On average the ten largest firms had a share of 64.32 percent in the MV-weighted portfolio. Over the full period the mean value of firms represented in the portfolios is 54 (see further *Appendix*, figure A.1). This means that the remaining 44 companies only constituted less than 36 percent of the total portfolio value. The concentration of the ten largest firms is lower for all portfolios based on FI, but the differences are not that remarkable. As expected the weights of the larger firms decrease strongly when EFI and active extension are practiced. We therefore conclude that smaller companies constitute a much larger part of our portfolios based on EFI and active extension. However, this structural difference may have a negative effect on the liquidity of the portfolios using EFI and active extension and we suggest further research on this area.

5. CONCLUSION

The purpose of this thesis was two folded. We aimed to explore whether portfolios whose composition is based on FI outperform a MV-weighted benchmark portfolio in terms of mean-variance efficiency on the Swedish stock market. We also sought to answer if EFI and the use of active extension can exploit and enhance the assumed benefits of FV-weighting. Our study does not give a general and straight answer, since many of the results are not statistically significant. However, as many previous studies show (see further chapter 2), we argue that the market often fails to price stocks at their true value and that the EMH does not hold at the semi-strong form of efficiency. Hence, a MV-weighted index is not mean-variance efficient and consequently an inappropriate proxy for the theoretical market portfolio of the CAPM. Our results indicate that indexation based on FVs is more mean-variance efficient than MV-weighting. The findings also suggest that EFI and active extension are investment strategies which may generate abnormal return, assuming the future will resemble the past.

Over the full period all FV based portfolios generated a CAGR which outperformed the MV-weighted benchmark portfolio. The risk level was in general similar to the benchmark portfolio, except for slightly higher values for the portfolios based on active extension. Our findings support earlier studies (see further chapter 2) which imply that historical FVs may indicate a firm's ability to generate future value.

There is a chance that the excess return of the FV-weighted portfolios are due to additional exposure to risk not captured fully by standard deviation and beta. The basic concept of FI and EFI is to favour stable companies with strong financial statements – firms which normally are associated with low risk. Hence, we argue that the superior performance is more likely to be driven by inefficiencies in stock prices and that a weighting system based on MV suffers from a built-in structural negative return bias. In contrast to the CAPM we believe that the market occasionally behaves irrationally and that stocks with strong perceived growth opportunities often get overvalued. Whether the market will find more accurate tools to predict cash flows in the future we cannot tell, but its foreseeing ability has not proven to outperform FI and EFI in the past. We do not state that the entire excess return necessarily is derived from one factor, i.e. FVs. The price inefficiency might be a result of several factors. For example the composition of EFI and active extension enables greater shares of the portfolio for smaller companies and it is possible that the "size effect" has influence on the results. However, we do argue that the main factor behind the generated CAPM alpha is a greater emphasis on FVs and that FVs should be considered to a greater extent when valuing firms.

What is also evident is that the risk of bubbles in the market would probably decrease if investors showed more interest in FVs and less in promising growth opportunities. This characteristic of FV-weighting may actually be one of the most important qualities of the method. In the study, the major part of the excess return was generated in the strong bear market which occurred in the subsequent crash of the TMT bubble, where the FV-weighted portfolios showed substantially less volatility than the benchmark. Another aspect is that the use of FI might be used as a complementary analytic tool to identify bubbles in the market, simply by comparing the performance of portfolios based on MV and FI. If the return of the MV-weighted portfolio is far beyond the performance of the FI-portfolios, it could be a sign of an overheated market.

As an investment strategy we believe EFI is preferable to FI. The results of the risk-adjusted measures used in the study show that EFI is superior to FI. The differences in performance are not statistically significant though and the suggested benefits of EFI should be interpreted with caution. Whether active extension further enhances the results of EFI is more uncertain. The investment strategy improves the results of some of the portfolios based on EFI, but not all. A possible explanation is that some variables might be more efficient in finding undervalued firms than overvalued, and vice versa. We therefore believe that the method could be improved by using different ranking systems for selecting short and long positions. We would also like to stress that the additional transaction costs associated with active extension, as used in this study, are estimated and may vary between different investors due to different trading volumes. Hence, the preferable choice of investment strategy could differ depending on the investor's position in the market

The use of EFI and active extension could be even more appealing if you are not confined to the small Swedish market. Even if our EFI-portfolios and active extension portfolios should have obtained at least 90% of the diversification benefits, they suffer from some small unsystematic risk due to a relatively low number of stocks (in particular during the first half of our time period). With a larger number of stocks to pick from, without including really small companies, this problem could be reduced. It would also be possible to include a smaller percentage of the ranked stocks without adverse effects on diversification. An investor could for example include only the top decile, rather than the top quartile as we have done. Logically this should improve results. A larger number of stocks to pick from could also allow some consideration to finding a balance between different sectors.

Although the FV-weighted portfolios show strong results, the investment method suffers from the fact that the portfolios only are rebalanced once a year. If a company shows extraordinary and unexpected results in the first quarterly report, our investment method will not adjust for this new information until three quarters later. The substance of this is that the performance might improve if the arithmetic average of the financial data is based on quarterly reports and not on summarized financial statements.

Finally, we do not state that MV-weighting should be avoided. The market has an ability to change and adapt to new relevant research. If it can be proven without a doubt that FI outperforms traditional MV-weighting in terms of mean-variance efficiency, the market will most likely put more emphasis on FVs when valuing firms. The presumed anomaly in the market of today will probably cease to exist, as would the benefits of FI and EFI. This scenario would lead to a more efficient market and that an index based on MV might be preferable as a substitute for the true market portfolio, as described by the CAPM.

5.1 Suggestions for further research

More research needs to be done in numerous directions on the effects of FI, EFI and active extension and this study has just scratched the surface. The topic is wide and rather complex and here are some suggestions for further research:

1. Would the results be the same on other stock markets than the Swedish? It should be necessary to go outside the relatively small Swedish market to verify or disprove our findings.

It would be particularly interesting to see if our composite portfolios would have performed well on other markets during the time period of the study, or if their outstanding performance on the Swedish market more likely is attributable to chance.

2. We believe that firm size should be decided by a combination of different FVs and not only by a single variable. In this way several aspects of firm size are considered in the valuation. This study does only include a small selection of possible fundamental variables and combinations. A study which involves additional fundamental variables and focuses on the correlation between the variables in order to find an optimal combination would be of great interest. Also combinations of variables in the shape of financial ratios, which do not include share price in the calculations (such as ROE, ROA, cash return on assets etc.), could be valuable to study.

3. What would the results be if another time period was used in the ranking procedure of the firms when calculating the arithmetic average of the financial data? Certain variables such as *employees* are not as easy to dress up and maybe the results would improve if some variables were based on an arithmetic average of the most recent quarterly reports and other on a longer time period?

4. The time period of the study covers nearly three decades and includes both strong and weaker periods in the Swedish stock market. The performance of FV-weighted portfolios in times of neutral, bear and bull market is a subject to look deeper into.

5. A particularly interesting issue which needs further research is the characteristics of the FV-weighted portfolios based on active extension. We believe some fundamental variables are more effective in identifying undervalued stocks, and others in discovering overvalued. If a significant difference in characteristics can be found, the ranking methods can be improved and a successful investment strategy the result.

6. We assume in this thesis that growth companies are overweighted in MV-weighted indices and that FV-weighted portfolios have a bias towards value companies. Hence, a research which determines whether this assumption holds is suggested. Another aspect, which also concerns the composition of the portfolios, is whether the “size effect” has an impact on the relative performance of the portfolios based on EFI and active extension.

7. A more detailed study of the effects of transaction costs, administration fees, liquidity and taxes is needed.

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Datastream Advance 4.0, Thomson Financial Limited

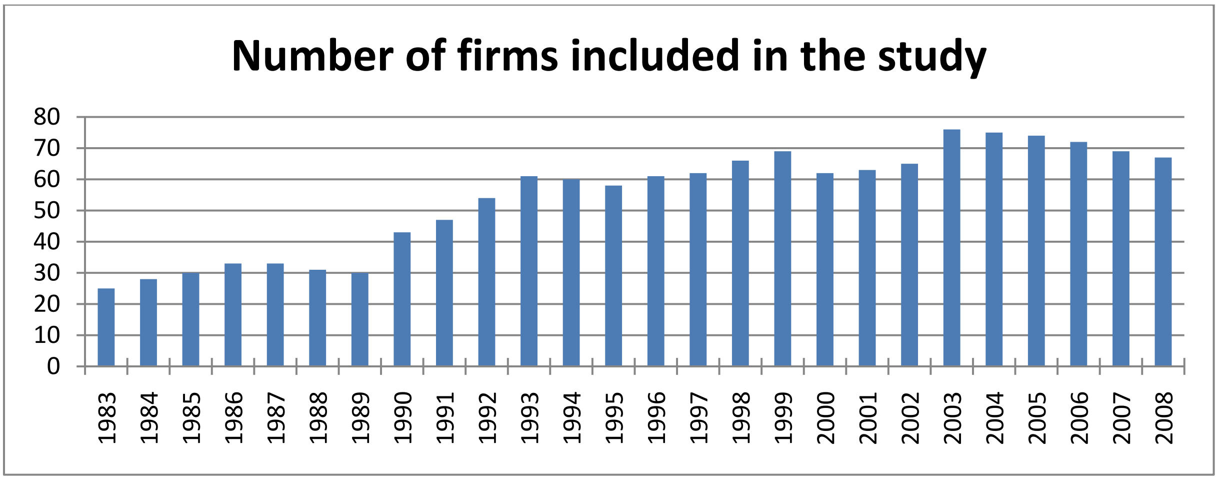
OMX Nordic Exchange Stockholm

SIX Trust, SIX (Scandinavian Information Exchange)

Sveriges Riksbank

APPENDIX

Figure A.1: Number of firms included in the study



The graph shows the number of firms which are included in the ranking lists each year. The smaller sample size during the 1980s is mainly due to lack of data and to a large number of companies with a split financial year. The minor decrease in the last five years of the study is as a result of a growing number of foreign companies listed on the Swedish stock market. The mean value of firms represented in the portfolios is 54 over the full period.

Table A.1: Return characteristics of portfolios based on active extension, 1983-2009

Portfolio/ Index	Ending value of 1 SEK	CAGR	Std dev	Beta vs. SIX RX	R^2	Residual variance	Skewness	Kurtosis
Risk free rate	5.91 SEK	7.07%	1.11%	-	-	-	0.37	-0.99
SIX RX	17.87	11.73	22.04	1.00	-	-	-0.28	1.45
Market value	13.04	10.38	24.11	1.07	0.96	0.00019	-0.08	1.88
110/10:								
FFO	32.78	14.36	24.43	0.89	0.64	0.00179	-0.39	1.44
Dividends	54.70	16.64	25.51	0.95	0.68	0.00177	0.37	4.45
Net sales	46.61	15.92	24.75	0.89	0.63	0.00188	-0.26	1.85
Pretax income	32.56	14.34	23.36	0.85	0.64	0.00164	-0.13	3.19
After-tax profit	29.29	13.87	23.48	0.85	0.64	0.00165	-0.14	3.04
EBIT	32.89	14.38	24.40	0.87	0.62	0.00189	-0.24	2.31
EBITDA	41.23	15.38	25.04	0.91	0.64	0.00190	-0.13	2.32
Eq. cap. & res.	38.45	15.07	25.83	0.94	0.64	0.00201	0.13	3.48
Employees	46.40	15.90	23.94	0.89	0.67	0.00157	-0.26	1.40
Composite 1	78.63	18.28	25.06	0.91	0.64	0.00190	0.34	3.96
Composite 2	94.53	19.12	24.71	0.90	0.64	0.00184	0.06	2.62
Composite 3	99.29	19.34	24.90	0.90	0.64	0.00188	0.04	2.57

120/20:	Ending value of 1 SEK	CAGR	Std dev	Beta vs. SIX RX	R^2	Residual variance	Skewness	Kurtosis
FFO	33.65	14.48	25.04	0.87	0.59	0.00216	-0.4	1.34
Dividends	60.26	17.07	26.36	0.95	0.63	0.00217	0.51	4.94
Net sales	52.61	16.46	25.41	0.89	0.59	0.00221	-0.24	1.83
Pretax income	32.29	14.30	24.10	0.83	0.58	0.00204	-0.05	3.43
After-tax profit	29.07	13.84	24.23	0.84	0.59	0.00204	-0.08	3.30
EBIT	33.13	14.41	25.28	0.86	0.56	0.00233	-0.19	2.35
EBITDA	41.59	15.42	25.93	0.90	0.58	0.00235	-0.09	2.33
Eq. cap. & res.	40.71	15.32	26.97	0.94	0.59	0.00250	0.22	3.91
Employees	52.03	16.42	24.49	0.89	0.64	0.00181	-0.26	1.27
Composite 1	89.10	18.85	25.95	0.90	0.58	0.00235	0.42	4.14
Composite 2	110.18	19.82	25.50	0.88	0.58	0.00227	0.12	2.67
Composite 3	114.84	20.01	25.76	0.89	0.58	0.00233	0.10	2.61
130/30:								
FFO	33.86	14.51	25.77	0.86	0.53	0.00259	-0.4	1.25
Dividends	65.32	17.44	27.35	0.94	0.58	0.00264	0.63	5.39
Net sales	58.72	16.96	26.15	0.88	0.55	0.00258	-0.22	1.79
Pretax income	31.19	14.15	25.02	0.82	0.52	0.00253	0.04	3.64
After-tax profit	28.27	13.72	25.15	0.83	0.53	0.00251	0.00	3.52
EBIT	32.75	14.36	26.31	0.85	0.51	0.00286	-0.14	2.35
EBITDA	41.07	15.36	26.97	0.89	0.53	0.00289	-0.06	2.33
Eq. cap. & res.	42.32	15.49	28.25	0.94	0.54	0.00306	0.32	4.37
Employees	57.94	16.90	25.10	0.89	0.60	0.00209	-0.25	1.16
Composite 1	98.72	19.32	26.97	0.89	0.53	0.00288	0.49	4.28
Composite 2	125.58	20.43	26.44	0.87	0.53	0.00277	0.17	2.71
Composite 3	129.71	20.58	26.77	0.88	0.52	0.00286	0.14	2.65
140/40:								
FFO	33.35	14.44	26.63	0.84	0.48	0.00308	-0.41	1.19
Dividends	69.63	17.73	28.45	0.94	0.53	0.00318	0.75	5.82
Net sales	64.85	17.41	26.95	0.87	0.51	0.00299	-0.2	1.75
Pretax income	29.28	13.87	26.12	0.80	0.46	0.00310	0.11	3.84
After-tax profit	26.90	13.50	26.23	0.82	0.47	0.00305	0.07	3.75
EBIT	31.74	14.22	27.47	0.84	0.45	0.00346	-0.09	2.33
EBITDA	39.62	15.20	28.15	0.88	0.47	0.00351	-0.03	2.33
Eq. cap. & res.	43.16	15.58	29.68	0.95	0.50	0.00371	0.41	4.88
Employees	64.08	17.35	25.77	0.88	0.57	0.00240	-0.24	1.05
Composite 1	106.69	19.68	28.14	0.88	0.47	0.00349	0.52	4.42
Composite 2	139.64	20.92	27.51	0.86	0.47	0.00335	0.19	2.81
Composite 3	142.65	21.02	27.90	0.87	0.47	0.00346	0.16	2.74

150/50:	Ending value of 1 SEK	CAGR	Std dev	Beta vs. SIX RX	R^2	Residual variance	Skewness	Kurtosis
FFO	32.09	14.27	27.61	0.82	0.43	0.00364	-0.42	1.20
Dividends	72.92	17.94	29.66	0.94	0.49	0.00379	0.85	6.24
Net sales	70.86	17.81	27.81	0.86	0.47	0.00345	-0.18	1.70
Pretax income	26.61	13.45	27.40	0.79	0.40	0.00378	0.16	4.09
After-tax profit	25.01	13.18	27.47	0.81	0.42	0.00369	0.13	4.01
EBIT	30.10	13.99	28.78	0.83	0.40	0.00414	-0.05	2.32
EBITDA	37.24	14.93	29.47	0.87	0.42	0.00422	-0.03	2.39
Eq. cap. & res.	43.11	15.58	31.25	0.96	0.45	0.00447	0.50	5.45
Employees	70.40	17.78	26.50	0.88	0.53	0.00274	-0.23	0.95
Composite 1	112.05	19.90	29.45	0.87	0.42	0.00420	0.52	4.62
Composite 2	150.88	21.28	28.72	0.84	0.42	0.00402	0.18	3.02
Composite 3	152.13	21.32	29.18	0.85	0.42	0.00417	0.14	2.96

Notes: R^2 and residual variance are calculated with SIX RX as benchmark.

Table A.2: Risk-adjusted performance measures of portfolios based on active extension, 1983-2009

Portfolio/ Index	SR	z-value[40]	z-value[41]	IR (MV)[42]	t-value[43]	IR (EFI)[44]	t-value[45]	J's α[46]	t-value[47]	Beta vs. MV
SIX RX	0.305	1.47	-	0.149	0.76	-	-	-	-	-
Market value	0.247	-	-	-	-	-	-	-	-	1.00
110/10:										
FFO	0.395	1.12	0.33	0.227	1.16	0.165	0.84	0.0507	1.63	0.79
Dividends	0.463	1.74*	0.79	0.372	1.90*	0.318	1.62	0.0698	2.24**	0.85
Net sales	0.447	1.49	1.41	0.307	1.56	0.421	2.15**	0.0657	2.04**	0.79
Pretax income	0.399	1.18	-0.09	0.216	1.10	0.091	0.46	0.0491	1.68*	0.76
After-tax profit	0.381	1.03	-0.11	0.190	0.97	0.092	0.47	0.0451	1.53	0.76
EBIT	0.394	1.10	-0.03	0.221	1.13	0.136	0.69	0.0513	1.62	0.78
EBITDA	0.425	1.35	-0.05	0.285	1.45	0.147	0.75	0.0601	1.88*	0.81
Eq. cap. & res.	0.408	1.22	0.38	0.273	1.39	0.266	1.36	0.0575	1.74*	0.83
Employees	0.453	1.64	1.45	0.318	1.62	0.420	2.14**	0.0632	2.15**	0.79

[40] H_0: SR (active extension portfolio) = SR (MV), H_1: SR (active extension portfolio) ≠ SR (MV)
[41] H_0: SR (active extension portfolio) = SR (corresponding EFI portfolio), H_1: SRs not equal
[42] Benchmark = MV
[43] H_0: IR = 0, H_1: IR ≠ 0, 311 df
[44] Benchmark = the corresponding portfolio based on EFI
[45] H_0: IR = 0, H_1: IR ≠ 0, 311 df
[46] Benchmark = MV
[47] H0: α = 0, H1: α ≠ 0, 310 df

110/10:	SR	z-value	z-value	IR (MV)	t-value	IR (EFI)	t-value	J’s α	t-value	Beta vs. MV
Composite 1	0.523	2.10**	1.00	0.435	2.22**	0.375	1.91*	0.0862	2.67***	0.81
Composite 2	0.557	2.34**	1.31	0.475	2.42**	0.427	2.18**	0.0943	2.93***	0.79
Composite 3	0.562	2.37**	1.18	0.485	2.47**	0.421	2.14**	0.0967	2.97***	0.80
120/20:										
FFO	0.396	1.05	0.2	0.222	1.13	0.153	0.78	0.0546	1.60	0.77
Dividends	0.470	1.67*	0.67	0.372	1.90*	0.310	1.58	0.0763	2.22**	0.84
Net sales	0.460	1.50	1.32	0.320	1.63	0.415	2.12**	0.0730	2.09**	0.78
Pretax income	0.393	1.04	-0.24	0.204	1.04	0.078	0.40	0.0515	1.59	0.75
After-tax profit	0.375	0.91	-0.24	0.181	0.92	0.083	0.42	0.0475	1.45	0.75
EBIT	0.390	0.99	-0.15	0.214	1.09	0.128	0.65	0.0546	1.56	0.76
EBITDA	0.421	1.22	-0.18	0.273	1.39	0.137	0.70	0.0636	1.79*	0.80
Eq. cap. & res.	0.410	1.16	0.26	0.276	1.41	0.257	1.31	0.0628	1.72*	0.83
Employees	0.467	1.66*	1.38	0.335	1.71*	0.418	2.13**	0.0696	2.21**	0.79
Composite 1	0.532	2.01**	0.83	0.433	2.21**	0.361	1.84*	0.0945	2.63***	0.80
Composite 2	0.571	2.26**	1.14	0.475	2.42**	0.413	2.10**	0.1039	2.91***	0.78
Composite 3	0.574	2.27**	1.00	0.483	2.46**	0.405	2.07**	0.1061	2.93***	0.78
130/30:										
FFO	0.393	0.96	0.07	0.215	1.10	0.141	0.72	0.0580	1.56	0.75
Dividends	0.473	1.59	0.54	0.370	1.88*	0.301	1.54	0.0825	2.19*	0.84
Net sales	0.471	1.49	1.22	0.331	1.69*	0.409	2.09**	0.0802	2.13*	0.77
Pretax income	0.382	0.89	-0.39	0.190	0.97	0.065	0.33	0.0533	1.48	0.73
After-tax profit	0.366	0.79	-0.36	0.171	0.87	0.073	0.37	0.0494	1.37	0.74
EBIT	0.384	0.88	-0.27	0.206	1.05	0.121	0.62	0.0577	1.49	0.75
EBITDA	0.413	1.09	-0.31	0.259	1.32	0.127	0.65	0.0667	1.70*	0.78
Eq. cap. & res.	0.409	1.08	0.15	0.276	1.41	0.249	1.27	0.0679	1.68*	0.83
Employees	0.478	1.67*	1.31	0.348	1.77*	0.415	2.12**	0.0760	2.25**	0.78
Composite 1	0.536	1.90*	0.67	0.427	2.18**	0.347	1.77*	0.1023	2.58**	0.79
Composite 2	0.579	2.16**	0.97	0.471	2.40**	0.397	2.03**	0.1130	2.87***	0.76
Composite 3	0.580	2.16**	0.82	0.476	2.43**	0.389	1.98**	0.1150	2.88***	0.77
140/40:										
FFO	0.387	0.87	-0.06	0.207	1.05	0.128	0.65	0.0610	1.51	0.73
Dividends	0.474	1.50	0.43	0.365	1.86*	0.293	1.49	0.0885	2.14**	0.83
Net sales	0.479	1.48	1.14	0.338	1.73*	0.403	2.05**	0.0872	2.15**	0.76
Pretax income	0.367	0.74	-0.54	0.174	0.89	0.051	0.26	0.0546	1.38	0.72
After-tax profit	0.354	0.66	-0.48	0.160	0.82	0.064	0.33	0.0510	1.29	0.72

140/40:	SR	z-value	z-value	IR (MV)	t-value	IR (EFI)	t-value	J's α	t-value	Beta vs. MV
EBIT	0.374	0.77	-0.37	0.198	1.01	0.113	0.58	0.0604	1.42	0.74
EBITDA	0.402	0.96	-0.43	0.245	1.25	0.117	0.59	0.0694	1.61	0.77
Eq. cap. & res.	0.405	1.00	0.04	0.274	1.40	0.241	1.23	0.0727	1.64	0.84
Employees	0.488	1.66*	1.24	0.358	1.83*	0.413	2.10**	0.0822	2.28**	0.78
Composite 1	0.536	1.78*	0.51	0.418	2.13**	0.332	1.69*	0.1098	2.52**	0.77
Composite 2	0.582	2.04**	0.79	0.463	2.36**	0.381	1.94*	0.1218	2.82***	0.75
Composite 3	0.581	2.03**	0.65	0.466	2.38**	0.372	1.89*	0.1235	2.81***	0.76
150/50:										
FFO	0.378	0.77	-0.19	0.197	1.00	0.116	0.59	0.0635	1.45	0.71
Dividends	0.471	1.41	0.31	0.358	1.83*	0.284	1.45	0.0942	2.09**	0.83
Net sales	0.485	1.45	1.05	0.344	1.75*	0.397	2.02**	0.0941	2.17**	0.75
Pretax income	0.349	0.59	-0.68	0.157	0.80	0.037	0.19	0.0552	1.26	0.70
After-tax profit	0.340	0.54	-0.6	0.149	0.76	0.055	0.28	0.0522	1.20	0.71
EBIT	0.363	0.67	-0.48	0.189	0.96	0.105	0.54	0.0628	1.36	0.73
EBITDA	0.389	0.83	-0.55	0.231	1.18	0.106	0.54	0.0717	1.52	0.76
Eq. cap. & res.	0.399	0.92	-0.07	0.270	1.38	0.232	1.18	0.0773	1.59	0.84
Employees	0.496	1.65*	1.17	0.366	1.87*	0.410	2.09**	0.0884	2.30**	0.78
Composite 1	0.531	1.66*	0.34	0.407	2.08**	0.315	1.61	0.1168	2.44**	0.76
Composite 2	0.580	1.92*	0.62	0.453	2.31**	0.364	1.86*	0.1301	2.75***	0.73
Composite 3	0.577	1.90*	0.47	0.454	2.32**	0.353	1.80*	0.1314	2.73***	0.74

Notes: *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table A.3: Annualised standard deviation & Beta vs. SIX RX – shorter time periods

Portfolio/Index	Mar 1983 – Feb 1991		Mar 1991 – Feb 1997		Mar 1997 – Feb 2003		Mar 2003 – Feb 2009	
	Std dev	Beta	Std dev	Beta	Std dev	Beta	Std dev	Beta
Risk free rate	0.48%	-	0.77%	-	0.12%	-	0.26%	-
SIX RX	22.14	1.00	21.27	1.00	25.50	1.00	18.24	1.00
Market value (MV)	22.79	1.00	23.20	1.08	29.48	1.14	20.05	1.08
FI:								
Dividends	23.54	1.03	26.57	1.21	21.87	0.79	20.13	1.07
Net sales	24.20	1.04	28.08	1.27	24.02	0.87	21.50	1.14
After-tax profit	23.62	1.03	25.19	1.14	22.52	0.83	19.21	1.02
Eq. cap. & res.	23.46	1.02	27.31	1.24	22.43	0.82	20.09	1.08
Employees	23.94	1.03	26.95	1.22	23.58	0.84	20.08	1.03
EFI:								
Dividends	23.81	1.01	33.15	1.39	18.57	0.56	21.00	1.02
Net sales	23.55	0.97	30.22	1.20	19.63	0.54	21.90	1.07
After-tax profit	23.42	1.00	28.07	1.16	17.73	0.47	20.71	0.99
Eq. cap. & res.	24.57	1.00	32.74	1.37	18.28	0.51	21.22	1.05
Employees	23.97	0.98	27.73	1.16	19.96	0.58	20.86	0.97
Composite 1	25.52	1.04	38.43	1.54	19.26	0.38	22.25	1.01
Composite 3	25.16	0.99	33.04	1.21	21.41	0.43	23.55	1.10
130/30:								
Dividends	25.61	1.05	30.93	1.20	19.51	0.27	22.79	0.97
Net sales	26.84	1.04	38.90	1.58	20.55	0.33	23.38	1.11
After-tax profit	25.70	1.00	28.93	1.13	22.12	0.54	22.42	0.98
Eq. cap. & res.	24.39	1.01	31.62	1.33	18.31	0.50	20.40	1.00
Employees	25.15	1.04	30.27	1.27	18.74	0.49	20.04	0.99
Composite 1	26.48	1.04	35.89	1.44	20.66	0.29	21.79	1.00
Composite 2	27.41	1.09	34.01	1.35	21.59	0.28	21.25	0.99