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Is the Risk-Return Tradeoff Hypothesis valid: Should an Investor hold Growth Stocks rather than Value Stocks?

A Portfolio Performance Evaluation Study of the Swedish Stock Market

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Abstract

This paper will examine if smaller companies outperform large ones in the backwashes of the crisis, i.e. if growth stocks are better off than value stocks when investing. I will investigate how well the three largest companies from Nasdaq OMX's small cap, mid cap and large cap managed to perform compared to the market index OMXSPI. Using the Capital Asset Pricing Model I will use the beta as a measure of risk to see if higher risk entails higher returns, as the risk-return tradeoff model assumes.

Three portfolios consisting of three companies each will be observed and compared. The samples observed will be: i) a portfolio consisting of the three largest companies at Nasdaq OMX small cap list, ii) a portfolio consisting of the three largest companies at Nasdaq OMX mid cap list and iii) a portfolio consisting of the three largest companies at Nasdaq OMX large cap list and an comparing index: OMXSPI. The three portfolios will be divided into two different measure groups: one where the three portfolios are equally weighted and one where the portfolios are weighted by its market capitalization, to investigate if there are any significantly large differences. Each one of the three portfolios will also be compared to an appropriate index.

The result supports the assumption of the risk-return tradeoff: the higher the risk, the higher the return. Given that the investor is willing to bear more risk, the return on the investment made will be higher. According to the research made I found that smaller companies do outperform larger ones, since the large cap portfolio had the lowest rate of return for the given time period. But the risk-return tradeoff assumption is not totally true: the small cap portfolio did not manage to outperform the mid cap, hence the best performance made after the crisis was by the mid cap portfolio. I therefore conclude that the risk-return tradeoff is partly true, that a mix of growth- and value stocks would generate the highest return and that more data need to be used to give more exact result.

Key words: CAPM, risk-return tradeoff, OMXSPI, beta, efficient markets, index

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我诚心的感谢我的导师张建华。他用他的耐心与知识，在我的论文写作过程中，给予了我很多非常好的建议和重要的帮助。

A good portfolio is more than a long list of good stocks and bonds. It is a balanced whole, providing the investor with protections and opportunities with respect to a wide range of contingencies.

-Harry Markowitz

Table of Contents

1. Introduction

The recent years of crisis has contributed to a volatile stock market for many investors. With the current sovereign debt crisis and the 2008 economic turmoil still affecting us, the common act for individual savers has been to leave the stock market, in favor to safer investment strategies such as investments in pure interest bearing papers, funds and saving accounts. A study made measuring historical equity returns between 1900-2000 shows Sweden on the first place in terms of highest average real return and highest average nominal return, followed by Australia and South Africa. Sweden also ranks high when the same study measured the standard deviation of real equity and bond returns: place fifth place prior to Germany, Japan, Italy and France. (E. Dimson, P. Marsch and M. Staunton, 2002).

The systematic risk, also known as the market risk, is the risk that cannot be diversified away. In times of crisis, this risk is of course the greatest source of concern since the systematic risk affects our financial markets (Hull, 2012). But has the stock market really disappointed investors who stayed during the crisis and the backwashes of it? To what extent is the Swedish stock market really affected? With last year's volatility and stock prices abnormalities, the question of market efficiency has been given rise to concern. But despite the backwashes of the crisis in 2008 and the current turbulence, stock prices at Nasdaq OMX have had increasing movements (Dagens Industri, 2013). If we assume that investors with different risk aversion; risk concerning the choice of company size, all kept their portfolios intact during the financial crisis and the backwashes of the crisis, who ended up with the most profitable portfolio: the one invested in companies from small cap, mid cap or large cap? And which one or which ones of the three portfolios did outperform the market portfolio for the same period of time?

The risk-return tradeoff theory basically assumes that the greater the expected risk, the greater the expected return. This assumption is a part of the *Modern Portfolio Theory* Harry Markowitz introduced, where he stated that all investors are risk avert and will chose a portfolio with lower risk when choosing between two portfolios with exactly the same rate of return (Markowitz, 1952). Consequently, can we conclude that higher risk; thus investing in growth companies i.e. companies listed on small cap or/and mid cap will generate a higher return than if investing in value companies i.e. companies from mid cap and/or large cap, as the risk-return tradeoff is stating? To investigate if this theory holds I will use two different ways of calculating the return: the simple return calculation method and the Capital Asset Pricing Model calculation method. By doing this I will be able to estimate whether stocks with higher risk managed to outperform stocks with lower risk, in terms of simple return- and the expected return-beta calculations, based on historical data.

1.1 Purpose

The purpose of the research is to evaluate if the concept of the risk-return tradeoff can be applied for three portfolios I created, consisting of the three largest companies from each list on Nasdaq OMX Nordic and hence, three portfolios with different risk levels and different focus: growth stock companies and value stock companies. Moreover I will compare the portfolios to the market index OMXSPI to see if they outperformed the market index. Each of the three portfolios will also be compared to an index containing similar sized company stocks. I will use the simple return calculations; also known as the holding-period return calculations and the expected return-beta relationship calculations. The result is thought to be an indicator of what size of companies from Nasdaq OMX Nordic investors should have invested in before the crisis.

1.2 Research questions

- Does the risk-return tradeoff theory hold: will growth stocks outperform value stocks, based on simple return calculations?
- Does the risk-return tradeoff theory hold: will growth stocks outperform value stocks, based on CAPM calculations?
- Which one/ones of the three portfolios managed to outperform the market index?
- Are there any differences in rate of return between the portfolios consisting of stocks equally weighted and the portfolios consisting of stocks weighted by its market capitalization?
- How did the three portfolios managed to perform compared to their chosen equivalent small-, mid and large cap indexes?

1.3 Thesis outline

The paper is constructed as follows: in section 2 I will introduce the theoretical framework used in the research, for the reader to get a deeper understanding about the models and the assumptions made. The main parts of this section are the introduction to *The Efficient Market Hypothesis* and *The Risk-return Tradeoff* as well as the basic assumption pro and against the model used in my calculations: *The Capital Asset Pricing Model*. Section 3 will cover the criteria for the data used, how the portfolios were created and any possible demarcations. Furthermore, section 4 will cover the methodology including the testing method as well as the hypothesis of the research. Lastly, in section 5 I will discuss the result of the research based on my calculations, followed by a conclusion and suggestions for further research in section 6.

2. Theoretical framework

2.1 Efficient Market Hypothesis

Basically the Efficient Market Hypothesis, EMH makes two predictions: 1) Security prices reflects all available information and adjusts to new information very quickly 2) Active traders will find it difficult to outperform passive strategies such as holding a market index portfolio (Bodie, Kane & Marcus, 2011 pp.371-408). With this assumptions made, according to the EMH, there should be no over- or underpriced securities; that is, no arbitrage opportunities exist. An efficient market is a competitive market, and sometimes called a *normal market* (Berk and DeMarzo, 2011). The basic idea behind the EMH when applied to stock market analysis is that the market aggregate the information of all investors and that information is reflected in the stock price. This leads to a market with fairly prices stocks, because all information is available to all investors.

When Maurice Kendall in his paper *The Analysis of Economic Time Series* in the 1950's found no evidence of stock markets following any sort of pattern, a lot of economists were disappointed. Kendall's research showed no proof of being logical or rational. But this was exactly what the research discovered: markets are rational **because** of the random price movements (Kendall, 1953). This discovery is a version of the random walk, which was introduced as early as 1900 by the French mathematician Louis Bachelier. His paper is known to be the first finance paper published with an advanced mathematical approach (Louis Bachelier, 1900). Only five years later Karl Pearson used the same term when publishing *The Problem of the Random Walk*; a statistical mathematic approach (Karl Pearson, 1905). The term *The Random Walk* was introduced to the broader audience in 1973 by Burton Malkiel when he wrote the book *A Random Walk Down Wall Street* (Malkiel,1973) a term he got from Eugene Fama who used that in his article *Random Walks in Stock Market Prices* (Eugene Fama, 1965).

The EMH was introduced by Fama 1970 in his article *Efficient Capital Markets: A Review of Theory and Empirical Work* (Eugene Fama, 1970) where he stated that all investors were rational, well-informed and profit-maximizing investors, trading in active markets. Furthermore Fama assumed that all information was free: no transaction costs or taxes existed. Fama based the idea about EMH on the random walk theory. He also stated that there are three different forms of efficiency when discussing available information, according to the EMH: i) weak-form efficiency ii) semi-strong form efficiency and iii) strong-form efficiency. The weak-form efficiency implies that stock prices only reflect all historical information; historical prices, trading volumes etcetera, and using only historical data to predict future stock price movements will not be possible. Hence, using the weak-form efficiency approach it is possible for technical analysis or time series analysis. But for fundamental analysis which proceeds from a company's financial figures such as historical stock prices, dividend and accounted profit, to forecast the company stock's future return, the semi-strong form efficiency could be applied. The semi-strong form includes all public information regarding the company's prospect in the stock price. This could concern information about patents, balance sheet composition, quality of management and accounting practices (Bodie, Kane & Marcus, 2011 pp.371-408). Because of this neither fundamental nor technical analysis could be applied. Finally, the strong-form version, which includes most information of all Fama's efficiency forms, also includes information only available to people inside the company, usually referred to as *inside information*. As opposed to the semi-strong form where insiders are able to make an excess return based on their exclusive information, the strong-form test does not allows anyone having confidential information. Applied to the real world, this last form could be seen as extreme, since there most probably are employees and management within companies having access to inside information: information used to make decisions regarding the company's finance, strategy etcetera. Then again, a lot of such information requires quick reaction from the insider, for her to be able to generate a profit.

2.2 Risk-return tradeoff

The risk-return tradeoff assumes that markets are efficient and no alpha-profit could be found: if a higher expected return can be found there will be a rush to buy this security and the price of the security will increase. If the investor then buys the security when the price has already risen, she can expect a *fair return* given the risk taken, but no more than that. Similarly a security with too high risk relative to the price, there will be a rush to sell and the price will decrease until the risk matches the return of the stock and equilibrium is reached. This is the basic assumption of the risk-return tradeoff: the investor expects higher return when taking on securities with higher risk.

The concept of the risk-return tradeoff is used to explain the relationship between risk and return. The hypothesis states that potential return increase when risk increases, and so this relationship is linear. Basically, an investor is only accepting taking on more risk if compensated by a higher rate of return. Markowitz explains this in his paper *Portfolio Selection: Efficient Diversification of Investments* by stating that an investor's utility function must be quadratic: $U = c + aR + bR^2$, this is, if an investor prefers smaller standard deviation to larger standard deviation (expected return remains the same) then $b < 0$, given that the investor a) maximize the expected value of some utility function and b) her choice among portfolios depends only on her expected return and standard deviation (Harry Markowitz, 1959).

Moreover, low levels of uncertainty are associated with low potential returns and vice versa and therefore the risk-return tradeoff states that an investor can only earn high returns if she is willing to take the risk of losing the investment made. This of course causing a discussion of risk aversion: all investors are risk averse, but the levels of risk aversion differ. The risk an investor takes on is the price she is paying for potential return: we assume that if the risk premium were zero, the investor would not be willing to invest any money in that portfolio. Thus, theoretically there must always be a positive risk premium in order to induce risk-averse investors to hold a risky portfolio instead of investing all her money in risk-free assets. (Bodie, Kane & Marcus, 2011 pp.157)

2.3 Risk aversion

Risk aversion is often measured by a utility measure ranking people to be i) risk-averse ii) risk- neutral or iii) risk lovers. Investors who are risk averse reject all investments that are *fair games* or worse. A fair game is a term frequently used in gamble theory and implies a game with an expected pay-off of zero. E.g. a game where the probability of $\frac{1}{3}$ to win 10 EUR and the probability of $\frac{2}{3}$ to lose 5 EUR, then the expected pay-off is $\left(\frac{1}{3}\right) 10 - \left(\frac{2}{3}\right) 5 = 0$. (Black, Hashimzade & Myles, 2009).

A risk-neutral investor has the risk measure of $A = 0$ and is only basing her investments strategies on the rate of return, overlooking the risk on the portfolio. Risk lovers are told to be willing to pay a fee to enter a fair gamble. A risk lover's utility function is strictly convex and so the marginal utility of wealth is increasing, hence $A < 0$. The risk aversion function states that higher utility values are assigned to portfolios with higher expected returns and lower utility values for higher volatility. $U = E(r) - \frac{1}{2}A\sigma^2$ where U is the utility value and A is the degree of the investor's risk aversion. For the function to work the expected return needs to be expressed as decimals and not percentages.

2.4. Capital Asset Pricing Model, CAPM

The Capital Asset Pricing Model (hereafter referred to as CAPM) is used to determine the expected return-beta relationship and is helpful when analyzing portfolios with different risks and returns. The CAPM implies that the expected return on a portfolio should be equal to the risk- free rate plus a risk premium.

CAPM is an expansion and simplification from Markowitz's portfolio theory and was introduced by Jack Treynor (1962 and 1963) and further developed by William Sharpe (1964), John Lintner (1965) and Jan Mossin (1966). It predicts, as the risk-return tradeoff does, that investors accept higher risk only if rewarded by higher returns. Using CAPM I can forecast if a portfolio's expected return is a *fair return* given the portfolio' risk.

To easier use and calculate CAPM some assumptions need to be taken into account. The assumptions are required to ensure that all investors are considered equal in terms of risk aversion and initial wealth. As discussed in section 2.3 investors have different levels of risk aversion but CAPM assumes that all investor are equally risk averse. The only risk remaining is the risk of the portfolio. Even though a lot of the assumptions cannot be applied in the real world they are needed to simplify for calculations. Therefore, when working with CAPM we assume following:

1. There are many investors and all investors are price-takers i.e. they act as if security prices are unaffected by their own trades, thus there are perfect competition on the market.
2. All investors invest for one same holding period. This assumption ignores all events before and after the holding period.

3. Investors can borrow and lend at the risk-free rate.
4. Investors pay no transaction costs (e.g. brokerage costs) and no taxes on returns.
5. All investors are rational, mean-variance optimizers as stated in Markowitz portfolio selection model*.
6. Homogenous expectations: all investors have the same information and analyze securities in the same way.

*Markowitz portfolio selection model assumes that investors are mean-variance optimizers, thus $E(r_A) \geq E(r_B)$ and $\sigma_A \leq \sigma_B$. This means that all investors seek to maximize their expected utility functions (Bodie, Kane & Marcus, 2011 pp.308-345).

Calculations with CAPM require some additional mathematical assumptions too:

1. All investors will hold a market portfolio hence a portfolio consisting of all traded risky assets. The proportion is calculated as:

$$Proportion\ of\ each\ stock = \frac{price\ per\ share \times numbers\ of\ shares\ outstanding}{total\ market\ value\ of\ all\ stocks}$$

2. The portfolio tangent the CAL (Capital Allocation Line).
3. The risk premium on the market portfolio will be proportional to its own risk degree.
4. The risk premium on individual assets will be proportional to the risk premium on the market portfolio and hence to the beta.

As stated in the 3rd mathematical assumption above one of the assumptions made is that investors can borrow and lend at the risk-free rate. CAPM assumes that any borrower must have an additional lender and therefore borrowing and lending in the world of CAPM cancel each other out. Therefore regarding risk aversion discussed in section 2.3, A will be equal to 1, since all borrowers have additional lenders. Moreover, looking at each investor's choice of portfolio proportion:

$$y = \frac{E(r_m) - r_f}{A\sigma_m^2}$$

then $A = 1$ leaving us with a variance and risk premium relationship of:

$$E(r_m) - r_f = \bar{A}\sigma_m^2$$

where $\bar{A}$ is substituting A, symbolizing a representing risk aversion measure for all investors. Since $A = \bar{A} = 1$ we can rearrange the equation and get *the reward-to-risk ratio*, or the *market price of risk* as the ratio also is known as, for investments in the market portfolio:

$$\frac{Market\ risk\ premium}{Market\ variance} = \frac{E(r_m) - r_f}{\sigma_m^2}$$

Since the principle of equilibrium assumes all investments to offer the same reward-to-risk relationship; that is if one stock's ratio would be better off than another stock's, investors would quickly rearrange their portfolios and equilibrium would again occur. Using CAPM we therefore can assume:

$$\frac{E(r_{stock}) - r_f}{cov(r_{stock}, r_m)} = \frac{E(r_m) - r_f}{\sigma_m^2}$$

Rearranging the equating we obtain the beta:

$$E(r_{stock}) - r_f = \frac{cov(r_{stock}, r_m)}{\sigma_m^2}\left[(Er_m) - r_f\right]$$

Where we recognize $\frac{cov(r_{stock}, r_m)}{\sigma_m^2}$ as beta, measuring the contribution of the stock to the variance of the market portfolio. Replacing that part with beta (see additional mathematical assumption number 4), we obtain the *expected return-beta relationship* for CAPM:

$$E(r_{stock}) = r_f + \beta_{stock}\left[E(r_m) - r_f\right]$$

Where r_{stock} is the average return on the stock, r_f is the average return from the risk-free asset, β_{stock} is the risk measurement and $E(r_m) - r_f$ is the risk premium. The expected return-beta relationship can be graphically viewed as the Security Market Line, see section 2.9. CAPM implies that risky investments should earn a premium above the risk-free rate and as we can see in the equation above the return on CAPM is based on the beta of the stock and the expected market return.

2.4.1. Drawbacks for CAPM

CAPM has been evaluated numerous of times and there are several researches made stating the model to be a strictly theoretical model which cannot be used in practice, only telling us what a risk premium should be. I will not go through the drawbacks in detail but only touch upon the most known criticism. First, there is the problem with stocks being extremely volatile and hence tests of average return, as CAPM, will be affected. Moreover, critics argue that the market index used in the researches is not really representing the market portfolio of CAPM. Finally, investors cannot actually borrow at the risk-free rate as CAPM assumes (Bodie, Kane & Marcus, 2011 pp.438).

The American economist Richard Roll has been known for his criticism towards the CAPM. According to him there are five major problems with the model:

1. There is a single testable hypothesis associated with the CAPM: the market portfolio is mean-variance efficient.
2. The CAPM relies on the assumption about markets being efficient, where there is a linear relation between the beta and the expected return. This relation is not independent since it has to rely on another assumption, namely the efficiency of the market portfolio.
3. In any sample of observations of individual returns there will be an infinite number of ex post mean-variance efficient portfolios using the sample-period returns and covariances. Betas calculated between these mean-variance portfolio and individual stocks will be linear related to average returns.
4. The CAPM cannot be tested unless the true market portfolio can be used. This means we need to use **all** stocks there are to include in the market portfolio, which in reality is an impossible task.
5. Using a market proxy instead of the real market portfolio creates a problem if the proxy is mean-variance but the real market portfolio is not, which may lead to the market proxy being inefficient. Moreover, using a market proxy which is highly correlated to other proxies and to the market portfolio but all of them not necessarily mean-variance efficient, will lead to different results when using different proxies, even though they are all highly correlated, because the mean-variance dilemma. This

problem is known as the *benchmark error*, where in this case the market proxy is the benchmark.

In summary Roll claims that it is impossible to create a truly diversified market portfolio. For more details I refer to Roll's paper "A Critique of the Asset Pricing Theory's Tests" (1977).

2.5 Sharpe-ratio

The Sharpe-ratio, also known as *the reward- to- volatility ratio*, measures the risk adjusted performance. The Sharpe-ratio tells us if higher return of an investment is a result of smart investments made or a result of excess risk. The greater ratio the better its risk-adjusted performance has been. Negative Sharpe-ratios indicating that an investor would have generated a greater return from a risk-free asset than from the investment made. The Sharpe-ratio is very well known and commonly used by investors as it allow for excess risk and not just excess return*.

The Sharpe-ratio is the slope of the Capital Allocation Line, CAL which depicts all available risk-return opportunity sets for an investor.

$$SR: \frac{Risk\ premium}{SD} = \frac{E(r_p) - r_f}{\sigma_p}$$

where r_p is the average return of the portfolio, r_f is the average return of the risk free asset and σ_p measures the risk of the portfolio.

*The Sharpe-ratio can be compared to Treynor's measure which also measures the excess return over the risk-free rate to the risk taken, $T = \frac{E(r_p)-r_f}{\beta_p}$. As seen in the formula given Treynor's measure uses systematic risk instead of total risk.

2.6 Variance

The portfolio variance is the sum of each stock's variance multiplied by the square of the portfolio weights adding two times the weighted average weight multiplied by the covariance of all stocks. The variance is the expected value of the square deviations.

$$\sigma_p^2 = w_i w_i Cov(r_{i,} r_i) + \ w_j w_j Cov(r_{j,} r_j) + 2 w_i w_j Cov\ (r_i, r_j)$$

The population variance of a random variable is:

$$Var(X) = E[(R - \mu)^2]$$

where $E(r)$ is the expected return on the stock and μ is the average arithmetic return on the stock. The variance of a portfolio can be explained by:

$$\hat{\sigma}_p^2 = \sum_s p(s)[r(s) - E(r)]^2$$

Where $p(s)$ is the probability of each scenario, $r(s)$ is the HPR (see section 4.1) in each scenario. Using historical data, the estimated variance of n observations is:

$$\hat{\sigma}_p^2 = \frac{1}{n}\sum_{s=1}^{n}[\,r(s) - \bar{r}]^2$$

2.7 Covariance

The covariance measures how much two random variables, in this case two securities, vary together. There are two methods when calculating for the covariance whereas one is based on deviations from expected returns and the other one is calculated by multiply the correlation between the two variables by the standard deviation of each variable. A positive covariances between two securities means that the two move in the same direction, and vice versa. Covariances equal to zero indicates no correlation between the two securities. The covariance can be viewed as the securities' beta times the market index risk:

$$Cov(r_i, r_j) = \beta_i \beta_j \sigma_m^2$$

2.8 The simple return

The *simple return* is used to calculate the realized return by converting stock prices from one time period to another. In this research I will use the simple return to convert daily stock prices into monthly stock prices. Algebraically, the formula is expressed as:

$$R_t = \frac{S_t - S_{t-1}}{S_{t-1}}$$

where R_t is the return of the stock, S_t is the stock price day 2 and S_{t-1} is the stock price day 1; as customary when calculating time series. The same calculation can also be viewed as:

$$HPR = \frac{Ending\ price\ of\ a\ share - Beginning\ price\ of\ a\ share}{Beginning\ price\ of\ a\ share}$$

where HPR is short for holding-period return.

2.9 The Security Market Line, SML

The expected return-beta relationship of the CAPM can be graphically viewed by the SML. Since the market beta is equal to 1 (see 2.12) the slope of the SML is the risk premium of the market portfolio, $E(r_m) - r_f$ and the intercept is the risk-free rate, r_f. We find the expected market return where beta is equal to 1. Underpriced stocks are plotted above the SML and overpriced stocks are plotted below the SML. The difference between the *fair price* and the expected rate of return is the *alpha*.

In equilibrium all risky assets are included in the market portfolio hence market beta is equal to 1. With all risky assets included there are no alpha profits to be made and therefore $a = 0$. The partial fraction is then:

$$\partial E(r_i)/\partial\alpha = E(r_i) - E(r_m)$$

$$\partial\sigma(r)/\partial\alpha = 0{,}5(\sigma m^2)^{-0{,}5}(-2\sigma m^2 + 2\sigma_{im})$$

$$= (\sigma_{im} - \sigma_m^2)/\sigma_m$$

$$\frac{\partial E(r)/\partial\alpha}{\partial\sigma(r)/\partial\alpha} = \frac{E(r_i)-E(r_m)}{(\sigma_{im}-\sigma_m^2)/\sigma_m}$$

Proceeding from the CML and *the price of risk*:

$$E(r_p) = r_f + \frac{E(r_m) - r_f}{\sigma_m} \times \frac{\sigma_{im}}{\sigma_m^2}$$

And since

$$\frac{\sigma_{im}}{\sigma_m^2} = \beta_i$$

$$E(r_i) = r_f + \beta_i(E(r_m) - r_f)$$

Therefore

$$CAPM = SML$$

2.10 Jensen's Alpha

Jensen's alpha is known as the abnormal return of a stock, hence the excess return from any equilibrium model such as the CAPM. Therefore, if CAPM functioning as it should the alpha would be equal to zero. By using the CAPM we can calculate what stocks are over-or underpriced, by solving for the alpha:

$$\alpha = E(r) - \{r_f + \beta[E(r_m) - r_f]\}$$

Large alphas indicate an underpriced stock; hence there is profit to be made from that stock. Alpha that equals to zero are stocks in equilibrium. The CAPM assumes markets to be in equilibrium and therefore also assumes no alpha profit. The alpha is the intercept of the Security Characteristic Line, SCL.

$$SCL: r_i - r_f = \alpha_i + \beta_i(r_m - r_f) + \epsilon_i$$

2.11 Standard deviation

The standard deviation is a measure of risk and based on the rate of return of the stock. The standard deviation, which is defined as the square root of the variance, measures how much of the variation that can be derived from the mean value. One important characteristic to notice is that the standard deviation does not distinguish between deviations above or below the mean; there is a "risk" for both increasing and decreasing values. Thus, if the volatility is normally distributed around the mean, then the standard deviation is a good measure. High values of standard deviation mean that the data deviates greatly from the mean whilst a low standard deviation indicates data close to the mean.

The standard deviation is defined as the square root of the variance:

$$\sigma = \sqrt{\sigma^2}$$

Based on the variance formula (see section 2.6) we can illustrate the formula for the standard deviation measurement as:

$$\sigma = \sqrt{\frac{1}{n}\sum_{s=1}^{n}[\,r(s) - \bar{r}]^2}$$

2.12 Beta

The beta explains how a stock's volatility is correlated to a benchmark's volatility, normally the market volatility. The formula for beta is:

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

where r_i measures the rate of return on stock i and r_m measures the rate of return on the market. The $cov\ (r_i, r_m)$ is the covariance between the stock and the market and the $var(r_m)$ is the variance of the market.

The market beta is always equal to 1 since there is only market risk to consider. This can be proved by the following calculation:

$$\beta_m = \frac{\mathrm{cov}\ (r_{m;}\, r_m)}{\sigma_m^2} \rightarrow \frac{\sigma_m^2}{\sigma_m^2} = 1$$

Hence,

$$\beta = 1\colon only\ market\ risk$$

$$\beta < 0\colon r_i\ moves\ opposite\ to\ the\ market\ average$$

$$\beta = 0\colon r_i\ is\ uncorrelated\ to\ the\ movements\ of\ the\ market\ average$$

$$\beta > 1\colon r_i\ moves\ in\ the\ same\ direction\ as\ the\ market\ average, but\ more\ volatile\ than\ the\ market$$

$$0 < \beta < 1\colon r_i\ moves\ in\ the\ same\ direction\ as\ the\ market\ average, but\ less\ volatile\ than\ the\ market$$

2.13 The risk premium and the risk- free rate

The risk premium is explained as the amount an investor is willing to pay to avoid risk (Black, Hashimzade & Myles, 2009). The risk premium can be viewed as:

$$U(W-\rho)=E\big[U(\widetilde{W})\big]$$

where U stands for utility, W is an investors initial wealth whereas $\widetilde{W}$ stands for the final wealth after investment made and ρ is the risk premium.

Calculations with CAPM require a risk premium and hence a risk-free rate. A risk-free rate is an investment free from any source of risk. Governmental obligations are commonly used to represent the risk-free rate. In this research is the Swedish 3-months Treasury bond rate will represent the risk-free rate (Riksbanken, 2013). Calculations made in this research regarding the risk premium will be calculated by subtracting the average mean of the risk- free rate from the market index average mean return:

$$\mathrm{RP}=\overline{r_m}-\mathrm{r_f}$$

The risk-free rate used is the Swedish 3-months T-bill rate. To get the monthly return on T-bills measured in percent, from the monthly price, I use

$$R_t=\frac{S_t}{100}/12$$

where S_t is the monthly price, divided by 100 to get the percentage value, divided by 12 months.

3. Data

3.1 Selection criteria

The raw data used for calculations in this research is selected from Swedish independent and transparent platforms and/or authorities. The data used to create the evaluated portfolios as well as data for the market index, are historical data from Nasdaq OMX Nordiq (2013).The T-bill rates originating from the Swedish Central Bank's website (Riksbanken, 2013). The stock prices do not include dividend paid throughout the years and I have used the closing price for all stock price data.

Since the purpose of the research is to compare different sized portfolios, hence different risky portfolios I am using data from the small-, mid- and large cap lists on Nasdaq. To create the three portfolios I have chosen the three largest companies from each list, to represent for the total of the companies in each list. To determine which are the largest companies I based my selection on market capitalization. Market capitalization is a company's total amount of shares outstanding multiplied by the stock price. Small cap includes companies with a market capitalization < 150 million EUR, mid cap 150 million EUR < market capitalization < 1 billion EUR and large cap includes companies with a market capitalization > 1 billion EUR.

The chosen companies must have been listed on Nasdaq OMX Nordic at least five years since the research will be based on the years of 2009-2012. The raw data consist of daily stock prices for this period, and were processed to monthly stock prices by using the simple return-calculation (see section 2.8).

Furthermore calculations with the CAPM require a market proxy. Since the chosen portfolios are from small-, mid-, and large cap I am using the OMXSPI index. (For further details regarding the choice of market proxy see 3.3) Nota bene that I am using the closing prices for the index, as opposed to the average prices for the stock prices.

3.2 Portfolio separation and demarcations

Appendix 2 presents the small-, mid-, and large cap portfolios based on market capitalization the 25th of March 2013 (Finansportalen, 2013). The companies written in italic with white background are those which do not meet the requirement regarding time being listed at Nasdaq OMX. The companies listed in small- and mid cap are the ones replacing these. (For further details see 3.2.1)

3.2.1 Delimitations

During the chosen time period there are several days where there are missing data for several of reasons. To be able to calculate properly, I chose to use the stock price the day before the day with the missing data. E.g. if there were missing data for the stock price of Nederman Holding 2010-06-03 I will use the stock price for 2010-02-29 instead. As mentioned, there are several days with missing data but only the ones where there are missing data for the last day in the month actually affects my calculations, since that will affect the calculations for the returns which are based on the stock prices for the last day of every month (more details about the calculation procedure in 3.1).

Moreover, for the indexes used, the OMX Small Cap Sweden PI index representing small cap companies; hence growth stocks companies, only have historical stock prices data beginning 2009-06-08. As a result of this, the OMX Small Cap Sweden PI index misses data for the first seven months of 2009. When calculating I have simply used the data available, starting from August 2009. Because of this, the calculations for this index might be perfectly correct, but it is leastways not misleading.

3.2.2. Criticism of data sources

Due to time constraint I chose three stocks each from small-, mid-, and large cap. To create portfolios to represent the each list I could have used more stocks: 5-10 stocks from each list to represent an average investor's portfolio. But using more than five stocks in Excel, and creating two different weighted portfolios from these stocks, would probably require a whole lot more time.

The data used tend to get old very quickly. I used data until the month of March 2013, but anyone following stock market prices on a daily basis can attest great fluctuations. And when stock prices changes, so does the market capitalization since it is calculated by outstanding shares times the stock price.

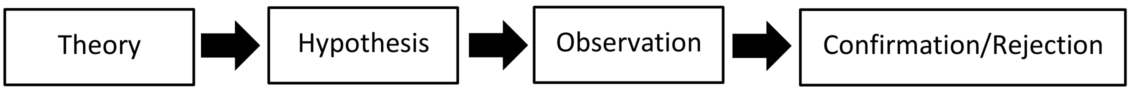
3.3. Market proxy

The market proxy used in this research is the OMXSPI (OMX Stockholm Price Index). Since my research is based on companies from small-, mid and large cap the OMXSPI is a good proxy covering all companies at Nasdaq OMX as opposed to the OMX30 index. OMXSPI weights all stocks listed at Nasdaq OMX together to one index while the OMX30 index only covers the 30 most traded stocks and hence only companies from the large cap. I chose to not use SIXRX or SIX30RX since those proxies allow for dividend.

4. Methodology

The purpose of the research is to investigate the rate of return from three different portfolios, created by a choice from Nasdaq OMX small-, mid and large cap, over a time period of four years; 2009-2012. The data for the research will mainly be collected from Nasdaq OMX, who lists all historical stocks prices for Swedish companies. A comparison will be made between the three portfolios created to investigate if my hypothesis is valid or not, for these portfolios, during this time period.

The research will be based on a deductive method where the researcher will start by collecting data and creating a hypothesis, then make predications from the theory based on the hypothesis and finally verifying the observations made empirically (Godfrey-Smith, 2003). I will have a theory about the result when starting my research and based on historical data I will most probably find patterns and answers, to be able to prove my hypothesis in the end. This method is commonly used in the research world when working with quantitative analysis. Using the deductive method, according to Snieder & Larner 2009, the steps for such a method can be viewed as:



4.1 Testing method

From the raw data the daily stock prices for the six chosen companies and the daily prices for the market index as well as for the risk-free rate chosen, will be calculated in Excel; firstly to monthly stock prices, secondly to monthly returns and thereafter to yearly returns. To convert stock prices daily into monthly I use the stock price of the last day in one month subtracted by the stock price of the last day in the month before, divided by the stock price of the last day in the month before. This calculation is sometimes also referred to as *the simple return*:

$$R_t = \frac{S_t - S_{t-1}}{S_{t-1}}$$

or

$$HPR = \frac{Ending\ price\ of\ a\ share - Beginning\ price\ of\ a\ share}{Beginning\ price\ of\ a\ share}$$

where HPR I short for holding-period return. Converted to apply my research, an example:

$$R_t = \frac{stock\ price\ last\ day\ in\ February\ year\ 1 - stock\ price\ last\ day\ in\ January\ year\ 1}{stock\ price\ last\ day\ in\ January\ year\ 1}$$

Calculations for the two weighted portfolios will be i) equally calculated by multiplying by one third: 0,3333 and by ii) a weight calculated from each stock's market capitalization:

$$Market\ capitalization = \frac{market\ capitalization\ of\ the\ company}{total\ market\ capitalization\ for\ the\ portfolio}$$

For further details regarding the stock's weights, see Table 1 and Appendix 1.

I will also calculate the risk for each single stock as well as for the portfolios, to be compared to the return. I will calculate the variance and also the standard deviation. Thereafter the Sharpe-ratio will be calculated: both monthly and yearly.

$$\hat{\sigma}^2 = \sum p(s)\,[r(s) - E(r)]^2$$

The accent above the variance tells us that the value is estimated. The formula is read as the sum of the probability of each scenario times the expected return subtracted from the HPR of each scenario raised to the second power.

The standard deviation, also called the volatility measure, simply is calculated as the root square of the variance. The standard deviation is a risk measure of the excess return.

$$\sigma = \sqrt{\sigma^2}$$

The Sharpe-ratio is in Excel calculated as subtracting the average mean of OMXSPI from the average mean of the stock and then divides this by the standard deviation of the stock. Mathematically the formula for the Sharpe-ratio is:

$$SR = \frac{E(r_p) - r_f}{\sigma_p}$$

where the risk premium is calculated by subtracting the risk-free rate from the expected return of the stock or the portfolio.

The formula for alpha in CAPM is commonly known as:

$$\alpha = E(r) - \{r_f + \beta[E(r_m) - r_f]\}$$

Last, the CAPM will be forecasted for each individual stock as well as for the two different portfolios. To do this I need to first calculate the risk premium by subtracting the average mean return of the Swedish 3-months T-bill rate from the average mean return of OMXSPI. The risk premium is used in calculations for forecasting, as opposed to knowing the actual rate of return. Since CAPM is a model used to forecasting I will use the risk premium instead of the excess return.

$$Risk\ premium = return\ of\ the\ market\ index - return\ of\ the\ T - bill\ rate$$

Furthermore, to forecasting the CAPM the formula require a value for each stock's beta. The result is then divided by the variance of the OMXSPI.

$$\beta = \frac{Cov(r_a, r_m)}{Var\ r_m}$$

The returns from CAPM for stocks and for the portfolios are then to be compared to the average return of the market index. Nota bene that the CAPM of the market index is equal to the average return of the market index, since we are adding the risk-free rate with the beta of the market; which always is equal to 1, multiplied by the expected return on the market subtracted by the risk-free rate. In summary, when the beta is equal to 1 there is only market risk and therefore the market index has a beta of 1. To prove that the beta always is equal to 1 for the market index, we can use following derivation:

$$\beta_m = \frac{\mathrm{cov}\,(r_{m;}\,r_m)}{\sigma_m^2} \rightarrow \frac{\sigma_m^2}{\sigma_m^2} = 1$$

Hence, the formula for the return on CAPM is:

$$E(r) = r_f + \beta_a[E(r_m - r_f)]$$

and applied to my research I can rewrite the return on CAPM to:

$$E(r) = average\ mean\ of\ the\ T - bill\ rate + (the\ stock's\ beta \times the\ average\ mean\ of\ the\ risk\ premium)$$

4.2 Hypothesis

Based on the theory about the risk-return tradeoff in section 2.2 my hypothesis is that growth company stocks will outperform value company stocks, over time, according to the risk-return tradeoff assumption. This hypothesis will be valid since investors require higher returns when taking on higher risk. For this hypothesis to be valid I assume that the market is efficient and that the investors are rational price-takers i.e. investors does maximize the discounted value of future returns (J.B. Williams, 1938).

5. Empirical Results

5.1 Results from the simple return calculations

Starting by presenting the results from the calculations made using the *simple return-calculations* (see 2.8) mean monthly and mean yearly returns can be found in Table 1A, Table 1B and Table 1C. Basically, the result for the weighted portfolios in Table 1B implies that the returns for the portfolios consisting of growth companies outperformed the portfolios consisting of value companies, in line with the risk-return tradeoff hypothesis. Consequently, the return from the portfolio consisting of small cap companies outperformed both the portfolio consisting of mid cap companies and the portfolio consisting of large cap companies. Moreover the portfolio including mid cap companies outperformed the portfolio consisting of large cap companies while the portfolio consisting of large cap companies did not outperform any other portfolio, over the time period.

But in Table 2B we can see that this statement is not valid for two of the years in the research: in 2009 the mid cap portfolio, both the equally weighted and the market capitalization weighted portfolio outperformed both the small cap- and the large cap portfolio, with a yearly return of 127,96% and 125,32% respectively. In 2011 when all portfolios had a negative yearly return the large cap portfolio performed slightly better than the mid cap. The average yearly return on the market (Table 2A) was 16,33%; greater than the average yearly return for the large cap portfolios: 1,86% and 1,51% but smaller than the average yearly return for the mid- and small cap portfolios: 42,47% and 41,86%, and 56,01% and 54,22% respectively. This also holds when looking at yearly returns in Table 2B; the large cap portfolios fail to outperform the market index except for the year of 2011 when the average market return was -16,73% and the return of the equally weighted portfolio and the portfolio weighted by market capitalization was -14,21% and -13,88% respectively. The risk-return tradeoff hypothesis does not apply to the chosen comparable indexes: OMX 30, OMX Mid Cap Sweden PI and OMX Small Cap Sweden PI. Interestingly, the results based on these indexes do not show the pattern we expected: instead of following the same trend as the portfolios already presented, the mid cap index is the superior one with a yearly average return of 18,27% as shown in Table 2C, outperforming the large cap index and the small cap index. Second best is the large cap index (15,63%) and the small cap index performed worse with a yearly average return of 5,01% (10,06% if using all available data from year 2009).

In Appendix 3 we can see the differences in return between the equally weighted portfolios and the portfolios weighted by market capitalization. The main result do not differ due to different way of weighting the portfolios, but we can see a slightly difference between the two in terms of yearly returns. The biggest differences are to be found in year 2010 where the small cap portfolios differ 6,46 percentage points and the large cap portfolios differ 3,50 percentage points. In average the small cap portfolios differ the most, followed by the mid cap ones and the large cap portfolios differ the least.

Furthermore, Table 3A, Table 3B and Table 3C shows the standard deviation measure for the years 2009-2012 as well as the average yearly value. The mean standard deviation was highest for the small cap portfolio: 19,08% and 17,98%, and lowest for the large cap portfolio: 9,36% and 9,54% respectively, in accordance with the risk-return tradeoff assumption, weighted equally among the portfolios and weighted by market capitalization. The highest value of standard deviation is to be found in 2009 where the small cap portfolio reached a value at 25,19% for the equally weighted portfolio and 23,38% for the portfolio weighted by the market capitalization. For the indexes in Table 3C the mid cap index has the highest standard deviation with an yearly mean average of 6,23% followed by the small cap index with 5,44% and the lowest standard deviation had the large cap index with 4,93%. In this case, the assumption is valid in regards to the large cap index which has the lowest standard deviation in accordance with the risk-return tradeoff hypothesis.

The monthly mean variance in Table 4 was highest for Fingerprint Cards and lowest for Ericsson B between 2009 and 2012. The small cap portfolios both adopted high values of variance, followed by the mid cap portfolios and finally by the large cap portfolios. The difference between the mid- and the large cap portfolio variance were very small, whereas the difference between the small cap portfolios and the mid cap portfolios were much higher. As expected, the indexes all had variances close to the variance of the market index.

Table 5 shows the monthly and yearly Sharpe-ratio for all of the stocks, portfolios and indexes. The greatest yearly ratio among the stocks has Lagercrantz Group B of 5,7412 and hence has generated the best risk-adjusted performance. Hennes & Mauritz yearly Sharpe-ratio of -0,4616 indicates that the investor would have been better off invested in the risk free asset. For the portfolios, the greatest yearly ratio was generated by the mid cap portfolios, followed by the small cap and lastly the large cap ones, and this pattern is also true for the monthly Sharpe-ratio. On the other hand, the large cap index had the greatest Sharpe-ratio, followed by the mid cap index and lastly the small cap index, and this pattern is also true for the monthly Sharpe-ratio.

5.2 Results from the CAPM calculations

The results from the CAPM calculations and the expected return-beta relationship differ a bit from the results presented above in section 5.1 in regards to the portfolios created. Now the assumption of the risk-return tradeoff is not valid throughout the research. Table 6 shows the monthly expected return-beta relationship for each of the stocks as well as for the portfolios and the indexes. Starting by looking at each individual stock we see that from small cap Fingerprint Cards has the highest expected monthly return-beta relationship of 1,31%. Fingerprint Cards is, based on market capitalization, the smallest company from the small cap portfolio. While having the highest expected return Fingerprint Cards also have the highest average risk; far higher than the other companies, with a monthly mean variance of 15,38% (Table 4) and a yearly mean standard deviation of 39,64% (Table 3A). In the mid cap portfolio JM has the highest expected monthly return-beta relationship of 1,83% and is the second largest company of the three.

The second largest company is also the one with highest monthly return-beta relationship in large cap, Nordea Bank of 2,12%. Large cap is the portfolio where the values for the CAPM calculations differ the most, as Nordea Bank with a return-beta value of more than 2% and Hennes & Mauritz B and Ericsson B both with values below 1%: 0,80% and 0,63% respectively.

Note that the expected monthly return-beta relationships from the CAPM for the OMXSPI and the SSVX 3M are equal to their monthly average mean return. (See section 4.1 for calculation formula.)

For the portfolios, the equally weighted small cap portfolio has an expected return from CAPM of 1,04% compared to mid cap 1,37% and large cap 1,18%. Here we see that the risk-return tradeoff does not hold as the expected return from mid-, and large cap outperform the expected return from small cap. But the expected return from mid cap is greater than the expected return from large cap, as the risk-return tradeoff assumes. Moreover, the result from the portfolios weighted by market capitalization is slightly different from the equally weighted portfolio, but not a difference that changes the result stated above. As for the equally weighted portfolio the mid cap generates the greatest expected return, outperforming both the small-, and large cap portfolio, with a monthly expected return of 1,37%.

The returns for the small-, and mid cap portfolios weighted by market capitalization are both 0,2 percentage points lower than for the equally weighted portfolio; 1,02% for the small cap portfolio and 1,35% for the mid cap one. The large cap portfolio however has a higher value for the market capitalization portfolio: 1,20% by comparison to 1,18%, for the equally weighted portfolio.

In regards to the indexes, Table 6 shows that the mid cap index managed to outperform both the small cap index (1,01%) and the large cap index (1,17%), with an expected return from CAPM of 1,25%.

The purpose of calculations made with the CAPM is to compare the expected return from the market index to the portfolios', the stocks' or the indexes' expected return-beta relationship. The average return of the market index in my research is 1,22% (Table 6) and as proved in section 4.1, also the expected return-beta relationship from CAPM. This return is to be compared to the return of the portfolios to investigate if any portfolio outperformed the market, hence; if the investor should have invested in the market portfolio or one of the portfolios created for this research in the beginning of 2009. If the expected return from a portfolio is higher than the expected return from the market index, then this portfolio outperformed the market. Table 6 exposes an overview from the monthly expected return-beta for the portfolios compared to the market index. From small cap, Fingerprint Cards was the only stock which manages to outperform the market index by an monthly average return of 1,31%. From mid cap, both JM and Höganäs B did and from large cap portfolio Nordea was the only stock that outperformed the market index. Looking at the portfolios, the mid cap portfolios were the only ones managing to outperform the market index, both for the equally weighted portfolio version and for the one weighted by market capitalization by an average monthly expected return-beta of 1,37% and 1,35%. For the indexes, also here the mid cap equivalent was the only one outperforming the market index, with an average monthly expected return-beta of 1,25%.

For the beta values the mid cap portfolios not only have the highest expected return-beta but also the highest betas. Table 7 shows us that the mid cap portfolios are the only portfolios with betas exceeding 1, as opposed to the small-, and large cap portfolios with betas below 1. This result is also true for the indexes where the mid cap index is the only one with a beta exceeding 1. From the formula for CAPM in section 4.1 we know that CAPM states that all portfolios have different expected return because they have different betas. Portfolios with betas exceeding 1 tells us that the portfolio moves in the same direction as the market index, but is more volatile than, in this case, the OMXSPI. The OMXSPI's beta is equal to 1 as proved in section 2.12. As mentioned, the small cap and large cap portfolio both have betas less than 1 hence they both move in the same direction as the index OMXSPI but are less volatile. The stock with the beta value closest to 1 is Fingerprint Cards and could therefore be seen as the stock with the risk closest to the market risk. The index with beta closest to 1 is the mid cap index: 1,0256 and the large cap portfolio (weighted by market capitalization) is the one closest with a beta of 0,9837. Ericsson B is the stock with beta closest to zero; 0,4804 and is therefore less correlated to the movements of the market index.

Furthermore, CAPM assumes alpha to be zero as we expect the market to be transparent, efficient and perfect-competitive, i.e. no underprices stocks can be found to obtain a profit. Jensen's alpha is the average return on the portfolio over and above that predicted by the capital asset pricing model, given the portfolio's beta and the average market return. In this study we find that small cap and mid cap both have positive Jensen's alphas, hence abnormal returns, as well have all the indexes. The large cap portfolios have negative alphas and looking at Hennes & Mauritz B, Nordea Bank and Ericsson B individually they all has negative alphas. Negative alphas means that the stock failed to outperform the market index, e.g. Ericsson failed to outperform the market index OMXSPI, thus an underperformance of 0,0012% and is said to be too risky for the return. As proved in section 2.10 the OMXSPI has an alpha value of zero: the market index is in equilibrium.

To summarize, if an investor would have kept her investments during and after the crisis, she would have yield most return from investing her money in an equally weighted small cap portfolio, generated a yearly mean return of 56,01% and a monthly mean return of 5,16%. Using the CAPM to calculate for the expected return-beta relationship she would be best off by investing in an equally weighted mid cap portfolio with a monthly expected return of 1,37%. For individual stocks, according to the simple return calculations made, from daily stock prices to yearly returns, an investor should have invested all her money in Fingerprint Cards and by doing so generated a yearly average return of 88,83%. From the mid cap stocks she should have selected JM and from the large cap Nordea Bank. From the CAPM calculations, the same choice of stocks should have been made: Fingerprint Cards, JM and Nordea Bank. If would have to choose from any of the indexes, she would have been best off by investing in the OMX Mid Cap Sweden PI generating a yearly mean return of 18,27% and a monthly mean return of 1,27%. Also when using CAPM the mid cap index performs best with an expected monthly return-beta relationship of 1,25%, although not outperforming the equally weighted mid cap portfolio.

6. Conclusion

Based on the risk-return tradeoff hypothesis, I found that the growth companies do outperform value companies: the large cap portfolio had the lowest rate of return for the given time period, based on historical stock prices calculated using the simple return, whilst the mid cap portfolio had lower rate of return than the small cap portfolio. But the risk-return tradeoff assumption is not totally true when using the Capital Asset Pricing Model: the small cap portfolio did not manage to outperform the mid cap, hence the best performance made after the crisis was by the mid cap portfolio. Also, the indexes did not follow the assumptions of the risk-return tradeoff as the mid cap index outperformed both the small- and the large cap one. I therefore conclude that the risk-return tradeoff is partly true and that more data need to be used in this kind of research, to give a more exact result.

6.1 Suggestions for further research

If doing the same kind of research I will strongly suggest using a larger number of stocks to create the portfolios, to make them more representable for the whole list. Only three stocks each could have made the result skewed. Individual stock abnormalities affect the whole portfolio if having unusual large rate of return, betas etcetera. (See discussion in 5.2).

If time would not have been a constraint I would have wished to compare an equally weighted portfolio of all the nine stocks chosen, to OMX30, since that portfolio, at least theoretically, should correlate well with OMX30.

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8. Tables

TABLE 1A Mean monthly and mean yearly returns			
Small Cap	Nederman Holding	Lagercrantz Group B	Fingerprint Cards
Mean monthly	2,45%	3,40%	9,63%
Mean yearly	29,11%	50,10%	88,83%
Mid Cap	AarhusKarlshamn	JM	Höganäs B
Mean monthly	2,34%	2,82%	3,11%
Mean yearly	28,63%	49,65%	49,15%
Large Cap	Hennes & Mauritz B	Nordea Bank	Ericsson B
Mean monthly	-0,03%	0,79%	0,46%
Mean yearly	-3,56%	5,74%	3,41%
OMXSPI		**SSVX 3M**	
Mean monthly	1,22%	Mean monthly	0,08%
Mean yearly	16,33%	Mean yearly	0,95%

TABLE 1B Mean monthly and mean yearly returns			
Equally weighted portfolios	Small Cap	Mid Cap	Large Cap
Mean monthly	5,16%	2,76%	0,41%
Mean yearly	56,01%	42,47%	1,86%
Weighted by market capitalization	Small Cap	Mid Cap	Large Cap
Mean monthly	4,93%	2,71%	0,38%
Mean yearly	54,22%	41,86%	1,51%

TABLE 1C Mean monthly and mean yearly returns				
	OMX Stockholm 30 Index	OMX Mid Cap Sweden PI	OMX Small Cap Sweden PI	OMX Small Cap Sweden PI v.2
Mean monthly	1,19%	1,27%	N/A	0,91%
Mean yearly	15,63%	18,27%	5,01%	10,06%

TABLE 2A

Yearly returns and mean yearly returns

Small Cap	Nederman Holding	Lagercrantz Group B	Fingerprint Cards
Date			
2009	28,83%	57,46%	59,15%
2010	50,65%	90,02%	249,56%
2011	0,12%	-16,41%	4,81%
2012	36,84%	69,34%	41,79%
Mean value	29,11%	50,10%	88,83%

Mid Cap	AarhusKarlshamn	JM	Höganäs B
Date			
2009	50,67%	194,36%	138,90%
2010	19,09%	29,44%	60,29%
2011	3,73%	-29,71%	-19,92%
2012	41,03%	4,52%	17,33%
Mean value	28,63%	49,65%	49,15%

Large Cap	Hennes & Mauritz B	Nordea Bank	Ericsson B
Date			
2009	29,66%	33,53%	13,32%
2010	-43,48%	-0,21%	18,68%
2011	-2,89%	-28,29%	-11,45%
2012	2,49%	17,91%	-6,91%
Mean value	-3,56%	5,74%	3,41%

OMXSPI		**SSVX 3M**	
Date		Date	
2009	46,89%	**2009**	0,40%
2010	23,13%	**2010**	0,50%
2011	-16,73%	**2011**	1,65%
2012	12,06%	**2012**	1,25%
Mean value	16,33%	**Mean value**	0,95%

TABLE 2B Yearly returns and mean yearly returns			
Equally weighted portfolios	Small Cap	Mid Cap	Large Cap
Date			
2009	48,48%	127,96%	25,50%
2010	130,06%	36,27%	-8,34%
2011	-3,82%	-15,30%	-14,21%
2012	49,32%	20,96%	4,50%
Mean value	56,01%	42,47%	1,86%
Weighted by market capitalization	Small Cap	Mid Cap	Large Cap
Date			
2009	47,87%	125,32%	26,54%
2010	123,60%	35,01%	-11,84%
2011	-4,27%	-14,59%	-13,88%
2012	49,68%	21,67%	5,20%
Mean value	54,22%	41,86%	1,51%

TABLE 2C Yearly returns and mean yearly returns				
Indexes	OMX Stockholm 30 Index	OMX Mid Cap Sweden PI	OMX Small Cap Sweden PI	Calculated with all available data from 2009
Date				
2009	43,76%	64,96%	N/A	25,20%
2010	21,44%	21,16%	27,61%	27,61%
2011	-14,53%	-24,99%	-21,54%	-21,54%
2012	11,84%	11,94%	8,96%	8.96%
Mean value	15,63%	18,27%	5,01%	10,06%

TABLE 3A

Yearly standard deviation and average yearly standard deviation

Small Cap	Nederman Holding	Lagercrantz Group B	Fingerprint Cards
Date			
2009	9,79%	6,69%	59,10%
2010	10,04%	8,67%	40,83%
2011	7,80%	9,76%	16,18%
2012	9,21%	8,22%	33,91%
Mean value	9,05%	8,56%	39,64%

Mid Cap	AarhusKarlshamn	JM	Höganäs B
Date			
2009	10,92%	12,82%	10,78%
2010	9,48%	10,18%	8,49%
2011	6,66%	14,60%	8,67%
2012	3,34%	6,35%	7,41%
Mean value	7,98%	11,95%	9,33%

Large Cap	Hennes & Mauritz B	Nordea Bank	Ericsson B
Date			
2009	7,84%	19,10%	8,81%
2010	16,29%	7,05%	7,62%
2011	5,46%	6,94%	6,83%
2012	5,94%	7,33%	5,21%
Mean value	9,76%	11,24%	7,09%

OMXSPI		**SSVX 3M**	
Date		Date	
2009	6,08%	**2009**	0,36%
2010	4,60%	**2010**	0,37%
2011	4,82%	**2011**	0,19%
2012	4,13%	**2012**	0,23%
Mean value	5,11%	**Mean value**	0,05%

TABLE 3B

Yearly standard deviation and average yearly standard deviation

Equally weighted portfolios	Small Cap	Mid Cap	Large Cap
Date			
2009	25,19%	11,50%	11,92%
2010	19,84%	9,38%	10,32%
2011	11,25%	9,97%	6,41%
2012	17,11%	5,70%	6,16%
Mean value	19,08%	9,75%	9,36%

Weighted by market capitalization	Small Cap	Mid Cap	Large Cap
Date			
2009	23,38%	11,51%	11,95%
2010	18,72%	9,41%	10,78%
2011	10,98%	9,92%	6,34%
2012	16,21%	5,58%	6,22%
Mean value	17,98%	9,71%	9,54%

TABLE 3C

Yearly standard deviation and average yearly standard deviation

Indexes	OMX Stockholm 30 Index	OMX Mid Cap Sweden PI	OMX Small Cap Sweden PI	Calculated with all available data from 2009
Date				
2009	5,99%	6,97%	N/A	2,14%
2010	4,24%	6,47%	6,54%	6,54%
2011	4,61%	5,65%	5,64%	5,64%
2012	4,20%	4,33%	3,85%	3,85%
Mean SD	4,93%	6,23%	N/A	5,44%

TABLE 4				
Variance				
Small Cap	Nederman Holding	Lagercrantz Group B	Fingerprint Cards	
Monthly mean value	0,80%	0,72%	15,38%	
Mid Cap	AarhusKarlshamn	JM	Höganäs B	
Monthly mean value	0,62%	1,40%	0,85%	
Large Cap	Hennes & Mauritz B	Nordea Bank	Ericsson B	
Monthly mean value	0,93%	1,24%	0,49%	
Equally weighted portfolios	Small Cap	Mid Cap	Large Cap	
Monthly mean value	5,63%	0,96%	0,89%	
Weighted by market capitalization	Small Cap	Mid Cap	Large Cap	
Monthly mean value	5,11%	0,95%	0,92%	
OMXSPI		**SSVX 3M**		
Monthly mean value	0,26%	Monthly mean value	0,35%	
Indexes	OMX Stockholm 30 Index	OMX Mid Cap Sweden PI	OMX Small Cap Sweden PI	Calculated with all available data from 2009
Monthly mean value	0,24%	0,38%	N/A	0,29%

TABLE 5

Monthly and yearly Sharpe-ratio

Small Cap	Nederman Holding	Lagercrantz Group B	Fingerprint Cards	
Monthly Sharpe-ratio	0,2616	0,3879	0,2409	
Yearly Sharpe-ratio	3,1106	5,7412	2,2171	
Mid Cap	AarhusKarlshamn	JM	Höganäs B	
Monthly Sharpe-ratio	0,2841	0,2295	0,3254	
Yearly Sharpe-ratio	3,4702	4,0748	5,1675	
Large Cap	Hennes & Mauritz B	Nordea Bank	Ericsson B	
Monthly Sharpe-ratio	-0,0115	0,0630	0,0539	
Yearly Sharpe-ratio	-0,4616	0,4257	0,3466	
Equally weighted portfolios	Small Cap	Mid Cap	Large Cap	
Monthly Sharpe-ratio	0,2661	0,2750	0,0348	
Yearly Sharpe-ratio	2,8854	4,2583	0,0973	
Weighted by market capitalization	Small Cap	Mid Cap	Large Cap	
Monthly Sharpe-ratio	0,2700	0,2708	0,0315	
Yearly Sharpe-ratio	2,9629	4,2117	0,0582	
OMXSPI		**SSVX 3M**		
Monthly Sharpe-ratio	0,2233	Monthly Sharpe-ratio	0,0000	
Yearly Sharpe-ratio	3,0098	Yearly Sharpe-ratio	0,0000	
Indexes	OMX Stockholm 30 Index	OMX Mid Cap Sweden PI	OMX Small Cap Sweden PI	Calculated with all available data from 2009
Monthly Sharpe-ratio	0,2250	0,1904	N/A	0,1519
Yearly Sharpe-ratio	2,9770	2,7790	0,7464	

TABLE 6				
CAPM				
Risk premium	0,0114			
Small Cap	Nederman Holding	Lagercrantz Group B	Fingerprint Cards	
Expected return-beta relationship, monthly	1,04%	0,76%	1,31%	
Mid Cap	AarhusKarlshamn	JM	Höganäs B	
Expected return-beta relationship, monthly	0,70%	1,83%	1,60%	
Large Cap	Hennes & Mauritz B	Nordea Bank	Ericsson B	
Expected return-beta relationship, monthly	0,80%	2,12%	0,63%	
Equally weighted portfolios	Small Cap	Mid Cap	Large Cap	
Expected return-beta relationship, monthly	1,04%	1,37%	1,18%	
Weighted by market capitalization	Small Cap	Mid Cap	Large Cap	
Expected return-beta relationship, monthly	1,02%	1,35%	1,20%	
OMXSPI		**SSVX 3M**		
Expected return-beta relationship, monthly	1,22%	Expected return-beta relationship, monthly	0,08%	
Indexes	OMX Stockholm 30 Index	OMX Mid Cap Sweden PI	OMX Small Cap Sweden PI	Calculated with all available data from 2009
Expected return-beta relationship, monthly	1,17%	1,25%	N/A	1,01%

TABLE 7				
Alphas and betas				
Small Cap	Nederman Holding	Lagercrantz Group B	Fingerprint Cards	
Alpha	0,0142	0,0267	0,0831	
Beta	0,8418	0,5940	1,0809	
Mid Cap	AarhusKarlshamn	JM	Höganäs B	
Alpha	0,0169	0,0095	0,0149	
Beta	0,5401	1,5340	1,3280	
Large Cap	Hennes & Mauritz B	Nordea Bank	Ericsson B	
Alpha	-0,0080	-0,0139	-0,0012	
Beta	0,6316	1,7835	0,4804	
Equally weighted portfolios	Small Cap	Mid Cap	Large Cap	
Alpha	0,0413	0,0138	-0,0077	
Beta	0,8388	1,1339	0,9651	
Weighted by market capitalization	Small Cap	Mid Cap	Large Cap	
Alpha	0,0391	0,0138	-0,0082	
Beta	0,8262	1,1102	0,9837	
OMXSPI		**SSVX 3M**		
Alpha	0,0000	Alpha	0,0008	
Beta	1,0000	Beta	-0,0034	
Indexes	OMX Stockholm 30 Index	OMX Mid Cap Sweden PI	OMX Small Cap Sweden PI	Calculated with all available data from 2009
Alpha	0,0002	0,0001	N/A	0,0014
Beta	0,9546	1,0256	N/A	0,8148

9. Appendix

APPENDIX 1			
	Market Capitalization, MSEK*	**Total Market Capitalization**	**Calculated weights**
Small cap			
Nederman Holding	1980		0,3526
Lagercrantz Group B	1965		0,3499
Fingerprint Cards	1671		0,2975
		5616	**1,0000**
Mid Cap			
AarhusKarlshamn	13149		0,3637
JM	12070		0,3338
Höganäs B	10935		0,3025
		36154	**1,0000**
Large Cap			
Hennes & Mauritz B	336831		0,3872
Nordea Bank	296861		0,3413
Ericsson B	236160		0,2715
		869852	**1,000**

APPENDIX 2

	Market Capitalization, MSEK	Introducion year at Nasdaq OMX	Industry	Lowest share price, SEK between 2008-03-01--2013-03-01	Highest share price, SEK between 2008-03-01--2013-03-01	Turnover per share, SEK	Number of outstanding shares, kSEK
Small cap							
Cavotec	*1 999*	*20111019*	*Industrials*	*12,50*	*30,80*	*27,23*	*67 549*
Nederman Holding	1 980	20070516	Industrials	50,00	180,00	193,99	11 715
Lagercrantz Group B	1 965	20010903	Industrials	16,40	100,75	99,73	22 081
Fingerprint Cards	1 671	19980623	Industrials	2,20	28,70	0,24	49 704
Mid Cap							
AarhusKarlshamn	13 149	20050929	Consumer goods	77,00	312,50	416,13	40 898
JM	12 070	19881101	Financials	26,30	176,50	149,81	83 671
Hexpol B	*11 629*	*20080602*	*Basic Materials*	*14,50*	*381,00*	*232,63*	*32 944*
Höganäs B	10 935	19940407	Basic Materials	66,25	330,00	192,85	34 118
Large Cap							
Hennes & Mauritz B	336 831	19790102	Consumer services	178,80	503,00	73,33	1 460 672
Nordea Bank	296 861	20000418	Financials	38,06	105,40	21,86	4 049 952*
Ericsson B	236 160	19790102	Technology	10,05	96,65	70,83	3 043 296**
Data sources: Finansportalen, Avanza Bank, Nasdaq OMX Nordiq							
*NDA SEK (NDA1V excluded) **Ericsson B (Ericsson A excluded)							

APPENDIX 3			
	Difference in calculated return between the equally weighted portfolio and the portfolio weighted by market capitalization, in percent points.		
	Small Cap	Mid Cap	Large Cap
2009	0,61	2,64	1,04
2010	6,46	1,26	3,50
2011	0,45	0,71	0,33
2012	0,36	0,71	0,70
Mean value	1,79	0,61	0,35