LUND UNIVERSITY
School of Economics and Management

The Effects of Equal Weighting and Rebalancing on Portfolio Performance

A study on the Swedish Equity Market

Author:
Magdalena Stefanovska

Supervisor:
Hossein Asgharian

Bachelor Thesis, Spring 2020

Abstract

This study compares the performance of equal- and value-weighted portfolios using a broad investment universe consisting of the stocks from the Swedish stock market. While implementing random sampling in the portfolio construction procedure, three rebalancing schemes are applied on the equally weighted portfolio in order to observe differences in performance among these. In order to compare how much of the total mean return can be attributed to the systematic components and how much stems from the various rebalancing schemes the Fama and French (1993) and Carhart (1997) four-factor model is used. The empirical results show that all three equal-weight portfolios with various rebalancing frequencies outperform the value weighted benchmark, both before and after transaction costs. The alphas are highly significant, positive in absolute terms and substantial in relative terms. Within the equally weighted, tough differences are relatively minor, the weekly rebalancing scheme outperforms before transaction costs and the quarterly after taking these into consideration.

Keywords: Equal weighting, rebalancing, Swedish stock market, equity portfolio, contrarian, idiosyncratic risk, four-factor model

Table of Contents

Introduction

Over the past decade, the demand for passive investment strategies has steadily been increasing. In August of 2019, the investment industry reached the end of an era when passive equity funds surpassed active for the first time, as assets in U.S. index-based equity mutual funds and ETFs topped those in active stock funds. This trend accelerated after the financial crisis when investors, burned by the market, turned to low-cost passive alternatives (Gittlesohn 2019). In Sweden, the same shift has been observed, as the amount of savings in index-based equity funds has grown from SEK 62 billion in 2009 to SEK 502 billion in 2019. Investors have thus actively opted out of active management in favor of index funds (Dahlberg & Eklund, 2019). Indexes weigh together certain securities to show the average development in a market. An equity index fund replicates the composition of stocks in a selected index and thus the aggregated development of those shares. The majority of index funds trading on the market today are value-weighted, in which securities are weighted proportionally to their market value: the larger the company, the larger the weight in the portfolio and vice versa (Nasdaq).

As this trend, where investors move from actively managed mutual funds to indexing, has continued to grow, considerable research effort has gone into investigating how different passive and semi-passive weighting choices affect portfolio performance. A relatively low effort alternative to the traditional value-weighted portfolio is the equally weighted, where an equal monetary value is placed on each stock regardless of their market capitalization (Bodie et al., 2011). Even though security selection is not involved, this method, by constructions, requires rebalancing and it can therefore be viewed as a semi-passive approach. Studies have shown that this weighting scheme seems to outperform several other strategies throughout various asset classes and different data sets. DeMiguel, Garlappi, and Uppal (2009) found that the out-of-sample performance of an equal-weighted portfolio of stocks is significantly better than that of a value-weighted portfolio. From a number of optimal portfolio selection models, evaluated across seven different empirical data sets, none was consistently better in terms of Sharpe ratio, certainty-equivalent return, or turnover than the equally weighted portfolio. Plyakha, Uppal & Vilkov (2015) compare the performance of the equal-weighted portfolio relative to the value-and price-weighted

portfolios, and their objective was to understand the reasons for difference in performance across these three weighting rules. They find that the equal-weighted portfolio with monthly rebalancing outperforms the value- and price-weighted portfolios in terms of total mean return and four-factor alpha from the Fama and French (1993) and Carhart (1997) models, even after transaction costs are considered. The difference in performance is found to depend only partly on the difference in the exposure to systematic risk factors and that a substantial part is attributable to the monthly rebalancing. Another important insight from the paper is that the alpha is found to depend only on the monthly rebalancing and not on the choice of initial weights.
Although portfolios can be rebalanced using a variety of methods, research shows that any disciplined approach tends to add value over a long-term investment horizon by greater returns and/or reduced risk. Studies such as Arnott and Lovell (1993), Plaxco and Arnott 2002 and Buetow et al. (2002) have supported this conclusion using both historical and simulated data (Institute, 07/2017).

Active vs. passive investing, portfolio rebalancing and weighting schemes are intertwined concepts when it comes to the investor's decision on how and where to allocate within the equity space. This decision could prove to be a key determinant of future performance, and ultimately the investor's cumulative return, and is therefore important to take into consideration. Based on these findings, this thesis aims to examine weather equally weighted portfolios constructed from the Swedish stock market universe outperform a value-weighted benchmark portfolio. In addition to comparing these two weighting choices, the objective is to compare three different rebalancing schemes in order to observe differences in performance among these. The four-factor model is used to decompose total returns in order to compare how much can be attributed to the systematic components and how much stems from the various rebalancing schemes, *i.e.* alpha.

The few studies previously conducted on equally weighted portfolios on the Swedish stock market are based on the stocks in the OMXS30 Index, which can be viewed as a shortcoming due to the restricted sample. To add to the existing empirical research, this study therefore uses a broader investment universe consisting of the stocks in the OMX all Share index while also implementing random sampling to ensure that the results do not depend on a specific set of stocks. Except for using a more comprehensive data set to examine whether the positive effects of equal weighting can be observed on the Swedish stock market, this study is also focusing on the rebalancing procedure. Based on the results of existing research, rebalancing seems to have a positive effect on returns. This motivates a study of how different rebalancing methods or frequencies can contribute to the performance of an equally weighted portfolio. To my knowledge, this has not yet been investigated and will therefore be an interesting contribution to the existing studies on equal weighting on the Swedish stock market.

The main empirical results of this study show that all three equal-weight portfolios with various rebalancing frequencies outperform the value weighted benchmark, both before and after transaction costs. The equal weight portfolios all display alphas that are highly significant, positive in absolute terms and substantial in comparison to the value-weighted portfolio. Within the equally weighted, tough differences are relatively minor, the weekly rebalancing scheme outperforms before transaction costs and the quarterly after taking these into consideration.

The remainder of the paper is organized as follows. In section 2, a review of previous studies is provided. Following this, section 3 presents the theory and characteristics of equal weighting and rebalancing as well as an introduction to the four-factor model, relevant to the return decomposition. Section 4 is devoted to methodology: it presents the portfolio construction methods that are employed in the study and further describes the resampling and rebalancing procedures as well as performance measurements. In section 5, the empirical results are presented, followed by the last section, which covers final conclusions and suggestions for further research.

Chapter 2: Literature Review

This section presents an overview of the empirical research previously conducted on equal weighting in comparison to the traditional value-weighted portfolio and outlines the direction of this study. Many papers confirm the outperformance of the equal weight portfolio but few study the differences in the alpha and systematic component of returns of equal and value-weighted portfolios, however there are some prominent papers on the subject which give a clearer view on this matter.

Given the central role that the value-weighted market portfolio plays in the well-known Capital Asset Pricing Model (CAPM) and in performance evaluation (as its commonly used as a benchmark which portfolio managers are evaluated against), it is understandable that substantial research effort has gone into investigating how it holds up against different weighting schemes such as the equally weighted portfolio. Clare, Motson and Thomas (2013) examine how alternative weighting strategies perform in relation to a cap-weighted index comprising 1000 of the largest US stocks and find that an equal-weighted index generates a higher risk-adjusted return than the corresponding cap-weighted index over a 43-year period from 1968-2011. Bolognesi, Torluccio, Zuccheri (2013) compare the total return of equal- and value-weighed portfolios in the European market focusing on the constituents of the DJ Euro Stoxx index from January 2002 to December 2011. Their findings add to the established literature on this topic, that higher risk-adjusted returns are achieved by equally weighted portfolios. Further, Chow, Hsu, Kalesnik, Little (2011) examine a large database of U.S and global equities and find that many passive equity strategies, including an equal-weighted index, outperform their value-weighted counterparts by loading more on size and value factors. Monnier, Rulik (2011) attribute a major part of the excess performance of the equally weighted portfolio to the size effect when studying a broad European universe, represented by the components of the Stoxx Europe 600 index, with the portfolio being rebalanced quarterly.

In their paper Plyakha, Uppal, Vilkov (2015) thoroughly study the source of, and difference in, the alpha and the systematic component of returns in equal-, value-, and price-weighted portfolios. They examine the performance of portfolios of stocks from the leading Standard & Poor's U.S. indices between February 1967 to December of 2009. They find that the equal-weighted portfolio with monthly rebalancing outperforms the value- and price-weighted portfolios in terms of total mean return and four-factor alpha from the Fama and French (1993) and Carhart (1997) models, even after transaction costs are considered. They also conclude that higher mean return of the equal-weighted portfolio arises from its higher exposure to the market, size and value factors. But in contrast to Monnier, Rulik (2011), they find that the outperformance only partly depends on the difference in the exposure to systematic risk factors and that a substantial part is attributable to the monthly rebalancing. They conduct two experiments in which they test their hypothesis of rebalancing alpha.

First, they reduce the rebalancing frequency of the equal weight portfolio from 1 month, to 6 months and then to 12 months. The authors claim that if there is any alpha stemming from rebalancing, it should decrease with the reduced rebalancing frequency to the levels of the value-weighted portfolio, which does not entail any rebalancing. In addition to this, a second experiment is conducted in the opposite direction. By artificially fixing the weights of the value weighted portfolio by changing the weights back to the initial values each month, *i.e.* rebalancing, there should be an increase in alpha towards levels of the equally weighted portfolio.

Both these experiments confirmed the authors' claim on a monthly rebalancing alpha. This is in contrast to Bolognesi, Torluccio, Zuccheri (2013) which test four different rebalancing frequencies: monthly, quarterly, semi-annually and annually and conclude that the decreasing rebalancing frequency in their study does not eliminate the difference in alpha between equal- and value-weighted portfolios. Further, Booth and Fama (1992) and Willenbrock (2011) compare arbitrary fixed-weight portfolios to a buy-and-hold strategy. They find that a rebalanced portfolio has a higher total return than the corresponding buy-and-hold portfolio. Willenbrock (2011) argues that the source of the incremental return is the rebalancing, which is driven by the volatility of asset returns. However, these papers do not study differences in the alpha and systematic component of returns of equal- and value-weighted portfolios.

Chapter 3: Theory

The following section describes the traits of the equally weighted portfolio, along with the required rebalancing and the factor model used for return decomposition. First, the inherent characteristics of the equal weighting scheme compared to the value-weighted approach are described. Next, rebalancing effects are discussed along with different techniques for the procedure. Finally, a review of the appropriate factor model to be used.

3.1 Characteristics of Equal Weighting

There are several weighting schemes to choose from when constructing a portfolio or an index and each will result in different properties for otherwise identical portfolios. The choice of weights leads to a difference in risk factor exposure and thus in performance characteristics. In the traditional value-weighting approach these exposures depend on the size of the specific companies and not so much of how many stocks there are in each sector or country. The risk and return will be driven to a greater extent by the largest companies in the investment universe unlike the equal-weight approach where each stocks contribution is the same (Solactive, 2018).

The tendency to overweight a few very large companies might not be desirable from a diversification point of view as the performance of the entire portfolio will get more dependent on the firm specific exposure. The equal weighting scheme, also known as naïve diversification, greatly reduces the concentration of the nonsystematic risk of the portfolio when the number of randomly chosen stocks included are at least 30-40 (Statman, 1987). On the other hand, the equal weighting approach results in a higher exposure to smaller capitalization stocks, which are prone to higher systematic risk (Solactive 2018). The effect of company size on performance has been documented in a number of studies, e.g. Banz (1981) and Fama and French (1992), where equities of small-cap companies tend to outperform equities of large-cap companies on a risk-adjusted basis (Institute, 2015). Consequently, equally weighted portfolios tend to display higher volatility and superior performance because the method, by definition, overweight's small size stocks compared to a value-weighted portfolio.

Another trait of the equally weighted portfolio is the inherent "buy low, sell high" feature which is a consequence of the rebalancing procedure to maintain equal weights. As such, continuously equally weighting a portfolio can act as an implicit trading strategy that takes advantage of mean-reversal in stocks by selling shares of the stocks that rose in value, and buying more of the stocks that fell following the previous rebalancing – effectively locking in gains, and increasing exposure to the now cheaper stocks that previously underperformed. Therefore, when equity returns are characterized more by reversals than by trends, the equally weighted portfolio tends to offer superior returns compared to the value weighted. In contrast, strong bull and bear markets favor a buy-and-hold strategy, to which the value weighted portfolio can be compared (Institute, 2017).

3.2 Rebalancing

Due to daily changes in equity prices the equally weighted portfolio requires regular weight redistribution to stay true to its name. Portfolio rebalancing is therefore a necessity and the chosen frequency or method will depend on a simple trade-off between the cost of rebalancing versus the cost of not rebalancing. Although portfolios can be rebalanced using a variety of methods any disciplined approach to rebalancing tends to add value over a long-term investment horizon by enhancing portfolio returns and/or reducing portfolio risk (Institute, 2017). Studies such as Arnott and Lovell (1993), Plaxco and Arnott (2002), and Buetow et al. (2002) have supported this conclusion using both historical and simulated data.

Rebalancing involves both selling appreciated assets and buying depreciated assets, this can be viewed as a contrarian investment discipline that can be expected to earn a positive return for supplying liquidity (Institute, 2017). Furthermore, Plyakha, Uppal, Vilkov (2015) demonstrate that the "contrarian" rebalancing, which is required to maintain equal weights, is the source of the extra alpha in their equally weighted portfolio compared to the value-and price weighted portfolios.

There are also several risk-management benefits to rebalancing, the overall level of portfolio risk is actively managed as the drift is controlled by resetting the original weights, thus maintaining stable portfolio systematic risk characteristics over time as well as the firm specific risk. However, transaction costs offset the benefits of rebalancing which can make the difference between success and failure for the equal weighting scheme. Therefore, the choice of rebalancing discipline could have a big impact on portfolio performance. In practice, portfolio managers commonly adopt either calendar rebalancing or percentage-of-portfolio rebalancing. The calendar rebalancing approach involves rebalancing a portfolio to target weights on a periodic basis, for example, monthly, quarterly, semiannually, or annually. Because this approach is unrelated to market behavior a drawback to consider is the fact that on any given rebalancing date, some or all securities could be very close, or very far, to the predetermined weights. In the former case, rebalancing might incur transactions with little benefit while in the latter case the costs of rebalancing might require larger transactions and thus higher costs than would be the case if the drift was controlled at an earlier stage. An alternative to calendar rebalancing is the Percentage-of-portfolio rebalancing (also called percent-range or interval rebalancing). This method involves setting rebalancing thresholds or trigger points stated as a percentage of the portfolio's value, thus the security weights are allowed to drift within a predetermined corridor. The portfolio is rebalanced only when a security weight first passes through one of its rebalancing thresholds, or equivalently, outside the corridor (Institute, 2017).

Aside from the above-mentioned methods the literature includes a broader range of rebalancing disciplines, for example, a combination of the calendar and the Percentage-of-portfolio rebalancing. Goodsall and Plaxco (1996) and Plaxco and Arnott (2002) discuss a variation of calendar rebalancing, so called tactical rebalancing, which specifies less frequent rebalancing when markets appear to be trending and more frequent rebalancing when they are characterized by reversals. This approach seeks to add value by tying rebalancing frequency to expected market conditions (Institute, 2017).

3.3 The Four-Factor Model

Sharpe (1964), Lintner (1965) and Blacks (1972)'s classic pricing model CAPM is based on a set of assumptions with which the relationship between risk and expected return in equilibrium can be explained. The model assumes that the market portfolio, consisting of all assets, is mean-variance effective in agreement with Markowitz (1959) work in diversification and modern portfolio theory. CAPM describes the linear relationship between systematic risk and expected return, in this model the market risk premium is the only explanatory factor. This is because the firm-specific risk is assumed to be diversifiable and all rational investors are assumed to pursue diversification (Bodie et al., 2011). CAPM is a model that simplifies a complex investment environment and enables investors to understand the relationship between risk and return, but its assumptions can be limiting and unrealistic (Institute, 2015). A series of empirical studies (such as Banz, 1981; De Bondt & Thaler, 1985; Fama & French, 1992; Asness, Moskowitz, & Pedersen 2009; Bornholt, 2012) have demonstrated the existence of well-known anomalies in the market, which CAPM fails to capture.

The model that has become conventional in explaining the variation in returns is an expansion of CAPM and consists of four factors instead of one (Bodie et al., 2011). Fama and French developed the three-factor model to be able to explain the two well-known anomalies, the size premium and the value premium while Carhart (1997) added the fourth factor – momentum.

Fama and French (1992) found that two easily observed variables, size and the relationship between book equity and market value, constitute a simple but powerful way of explaining average returns. Their model, which was introduced in Fama French (1993), therefore included, in addition to the market factor, the size factor (SMB - small minus big) and the value factor (HML - high minus low). Where SMB capture the difference in returns between small and large companies (measured by the market value of its equity) and HML capture the difference between growth and value companies (measured by the company's book value of equity divided by its market value of equity). Based on the Fama French three-factor model, Carhart (1997) constructs a four-factor model that captures Jegadeesh and Titman (1993) momentum anomaly (UMD - up minus down). Momentum in stock prices is described as a tendency for returns to continue to move in line with the prevailing trend, i.e. to rise if it rises and continue to fall if it falls. Jegadeesh and Titman (1993) found that this effect could be observed to generate significant positive returns over 3- to 12-month holding periods.

Chapter 4: Methodology

The following section describes empirical methods employed, and sample data used, to construct and evaluate the equally weighted portfolios with different rebalancing schemes and their corresponding value-weighted benchmark. First, the data and resampling procedure is described. Next, the rebalancing procedure and the transactions costs are covered followed by a description of the four-factor model used to decompose total returns. Finally, various performance metrics for the risk-return trade-off are presented.

4.1 Data Specification and Sample Selection

Since this thesis is aimed at the Swedish stock market, historical price data used for portfolio construction are retrieved on daily closing prices for equity securities trading on the Stockholm Stock Exchange, which have been included in the OMX Stockholm All Shares index. After retrieving daily prices for the period 2006-01-01 until 2016-12-01 the initial raw sample consists of 322 securities over 2755 price observations.

Firms with thinly traded shares have been excluded from the sample, where thinly traded is defined as a stock missing greater than 10% of the total number of price observations during the entire sample. Stocks with price gaps missing less than 10% of the observations have been filled by rolling forward the price from the previous day. After screening for, and excluding illiquid securities, the final data sample used for evaluation and testing purposes consists of 144 stocks (the securities used are included in Table. 3 in the appendix).

To be able to decompose total returns and compare how much can be attributed to the systematic risk components, data on the factor portfolios from the four-factor model (Rm-rf, HML, SMB, and UMD) are also needed. These are retrieved from The Swedish House of Finance where data are calculated over every Swedish stock and aggregated by day. Also, as a proxy for the Swedish risk-free rate, r_f, 1-month Swedish T-Bill from the same source is used when calculating the risk adjusted performance metrics.

4.2 Resampling and Portfolio Construction

In line with Plyakha, Uppal and Vilkov (2012), random sampling is used in the portfolio construction procedure to avoid results being driven by a specific set of stocks. For the sampling procedure 30 stocks are randomly chosen from the set of the 144 securities with no repeating elements, meaning no single stock is selected twice per sample. The random sampling procedure for each weighting and rebalancing scheme is carried out 1000 times to form 1000 portfolios consisting of 30 stocks each with no overlap. The results reported are based on the returns averaged across these 1000 portfolios.

To form the equally weighted portfolios, at the start of the period (2006-01-01), they are given a Net Asset Value (NAV):

$$\mathrm{NAV}_t = \sum_{i,t}^{N} p_{i,t} * s_{i,t} \tag{1}$$

where $p_{i,t}$ is the price of the i:th stock and $s_{i,t}$ is the number of shares to buy of each at the start of the period for $t = 0$.

The number of shares of each security one needs to buy is defined by:

$$s_{i,t} = \frac{w_{i,t} * \mathrm{Cash}}{p_{i,t}} \tag{2}$$

where $w_{i,t}$ becomes the weights in fractions given by $\frac{1}{\mathrm{N}}$ and Cash is defined as the start out monetary value for each portfolio. By construction, equation 2 makes sure that the number of shares held for each stock ensures that the portfolio will be equally weighted at the beginning (and subsequently at each rebalancing date).

Aside from the equally weighted portfolios a value-weighted benchmark portfolio is formed in the same manner, that is, with the random sampling procedure described above. Initial weights are assigned to each stock at the start of the period, $t = 0$, by dividing the stocks market capitalization (Mcap) with the sum of the market capitalization for all the stocks in the set, formally:

$$w_{i,t} = \frac{Mcap_{i,t}}{\sum_{i,t}^{N} Mcap_{i,t}} \qquad 3$$

Since this weighting scheme does not entail any rebalancing, the weights will automatically increase or decrease with the stock price.

4.3 Rebalancing and Transaction Costs

Since prices drift over time, by construction, an equally weighted portfolio needs to be rebalanced on a periodic basis in order to stay equally weighted. Using the calendar rebalancing approach three different rebalancing schemes for equally weighted portfolios will be employed and evaluated: Weekly, Monthly and Quarterly. For example, this means that at the start of each week, the Weekly rebalancing scheme will need to buy and / or sell the required number of shares of each stock satisfied by the equation:

$$s_{i,t} = \frac{w_{i,t} * \mathrm{NAV}_t}{p_{i,t}} \qquad 4$$

This equation is similar to equation 2 with the difference being that the former starts out with free available cash, which from that point on becomes the portfolio NAV.

Since buying and selling securities is not for free in the marketplace, to make a proper evaluation, transaction costs need to be considered. Therefore, both Net-of-Fees and Gross-of-Fees returns are calculated and presented in the performance metrics. Transaction costs are set to 10 basis points and actual fees are calculated based on the turnover at each rebalancing date and subtracted from the portfolio returns. Hence, transaction costs are based on the number of shares of each stock that needs to be bought or sold in order to bring back the portfolio to an equal weighting. At each rebalancing date, this means calculating the new number of shares of each stock needed for these transactions and subtracting the number of shares held for each stock since the last rebalancing date. The resulting differences is multiplied with the stock price at the time of rebalancing, to calculate the turnover, which is multiplied again with the commission fee (in basis points), formally:

$$transaction\ cost_t = \left(\sum p_{i,t} * \left|s_{i,t} - s_{i,t-1}\right|\right) * bps \qquad 5$$

The method used to calculate the required number of shares to buy and / or sell in order to make the portfolio equally weighted leads to a case where any single stock might be bought at fractions of a share. While most brokers do not allow fractional trading, it is being offered by a few international platforms, allowing retail investors to buy the shares of companies with a relatively high nominal price (e.g. Amazon.com Inc) (Levine, 2019). The practical implications on the results are minor but simplifies the modeling.

4.4 The Four-Factor Model and Rebalancing Alpha

As described in section 3.3, the Fama French three-factor model reinforced with the momentum factor has become a common model for evaluating equity portfolios. Therefore, the four-factor model is used to decompose the total returns in order to obtain how much can be attributed to the bearing of systematic risk components and how much is not explained by these factors, i.e. alpha.

The portfolio's sensitivity to the four factors: Excess Market return, Size factor, Value factor and a Momentum factor represent systematic risk; exposure to them is expected to be compensated for in the form of differences in portfolio return.

The model to estimate is:

$$r_p - r_f = \alpha_p + \beta_{1,p}RmRf + \beta_{2,p}SMB + \beta_{3,p}HML + \beta_{4,p}UMD + \varepsilon_p \qquad 6$$

where,

$r_p - r_f =$ the return on the portfolio in excess of the risk-free rate,

α_p = the regression intercept to be interpreted as alpha, i.e. portfolio return variability in excess of that which is explained by the risk factors

RmRf = the return on the market portfolio in excess of the risk-free rate

SMB = (small minus big) is the Size factor

HML = (high minus low) is the Value factor

UMT = (winners minus losers) is the Momentum factor

4.5 Performance Metrics

To answer the question of how the equally weighted portfolios compare among each other, and to the value-weighted benchmark, appropriate evaluation metrics are required. As a measure of absolute performance, the annualized mean returns as well as cumulative returns, are calculated for all portfolios. As a corresponding measure of absolute risk, the periodic maximum drawdown is computed. Considering the risk-return trade-off, the Sharpe, Traynor and Sortino ratios are calculated, for both Net-of-Fees and Gross-of-Fees portfolio returns. As a proxy for the Swedish risk-free rate of return the Rf (during the period of evaluation), is used from the Swedish House of Finance dataset.

4.5.1 Sharpe Ratio

The Sharpe ratio is one of the most commonly used risk-adjusted return metrics. It provides a measure of how much the investor is receiving in excess of a risk-free rate for assuming the total risk of the portfolio, measured as the standard deviation of the returns The Sharpe ratio is calculated as follows:

$$SR_p = \frac{r_p - r_f}{\sigma_p} \qquad (7)$$

where r_p is the mean return on the portfolio, r_f is some risk-free rate of interest and σ_p is the standard deviation of the portfolio returns.

When using the Sharpe ratio as a measure of performance an underlaying assumption is that returns are normally distributed as the model uses the standard deviation of returns as its proxy of total portfolio risk. Therefore, both skewness and kurtosis are presented for all portfolios in the performance analysis.

4.5.2 Treynor's Measure

The Treynor measure relates the portfolios excess returns to the systematic risk assumed instead of the total risk. The Treynor measure is given by:

$$TM_p = \frac{r_p - r_f}{\beta_p} \qquad (8)$$

where r_p is the mean return on the portfolio, r_f is some risk-free rate of interest and β_p is the portfolio risk factor related to the market risk.

4.5.3 Sortino Ratio

Like the Sharpe ratio, the Sortino is a measure of risk-adjusted returns but it replaces the standard deviation of returns with a measure of downside risk and the risk-free rate with an investor defined target rate (which could be r_f). Hence, the Sortino Ratio only penalizes the downside risk.

The Sortino ratio is calculated as follows:

$$Sort_p = \frac{r_p - r_t}{\sigma_p^{dr}} \qquad (9)$$

where r_p is the mean return on the portfolio, r_t is some pre-defined hurdle, or target rate of return, and σ_p^{dr} is the downside risk. A commonly used measure to quantify downside risk is the semi standard deviation:

$$\sigma_p^{dr} = \sqrt{\frac{1}{T}\sum_{i=1}^{T}\left(\max\{\left(r_{p,i} - r_{t,i}\right), 0\}\right)^2} \qquad 10$$

Chapter 5: Results and Analysis

In this chapter the portfolio performance of the different weighting rules is analyzed along with the effects of rebalancing and the impact of transaction costs. Performance metrics for each weighting rule and rebalancing scheme presented are based on the means of 1000, randomly sampled, 30 stock portfolios constructed from the final sample. Metrics are calculated on daily returns over the period 2006-01-01 until 2016-12-31 which covers 2755 business days. Performance metrics and regression results are presented on daily returns before and after transaction costs.

5.1 Comparison of Portfolio Return Measures

Return metrics are presented in Table 1a. and Table 1b based on daily returns, before and after transaction costs, while figure 1a and figure 1b show the return distributions. Examining the first rows of Table 1a. it is clear that all three equally weighted portfolios outperform the value weighted counterpart. The portfolio with the highest annualized mean return over the 11 years is the weekly rebalanced, exhibiting 10,19% compared to 4,23% for the value-weighted portfolio. The equal-weight portfolios with monthly and quarterly rebalancing have a mean annual return of 9,84% and 10,06% respectively, leading to a difference above 550 basis points for all three equally weighted portfolios and, at 596 basis point for the weekly rebalanced compared to the value-weighted benchmark. Examining Table 1b, the same relative outperformance holds true after transaction costs with all the equal weighted portfolios outperforming the value weighted. The quarterly rebalanced portfolio is displaying the highest annualized mean return of 9,96% and despite the decrease of 10 basis points it still exhibits a difference of 573 basis points compared to the value-weighted portfolio. The weekly rebalanced portfolio return has decreased with 34 basis points to 9,85% due to the costs associated with more frequent turnover.

Moving on to the annual alphas, which are positive and highly significant for all three equally weighted portfolios, similar performance among the portfolios can be observed. The alpha of the portfolio with weekly rebalancing being the greatest at 153 basis points in absolute terms or 855 basis points relative the value weighted. Controlling for transactions costs, the alphas are still positive and highly significant.

As before, after taking transaction costs into consideration, the equally weighted portfolio with quarterly rebalancing outperforms with an average alpha equal to 138 basis points in absolute terms or 840 basis points relative the value weighted.

In summary, the equally weighted portfolios all outperform the value weighted both before and after transaction costs. The alphas are highly significant, positive in absolute terms and substantial in relative terms. Within the equally weighted, tough differences are relatively minor, the weekly rebalancing schemes outperforms before transaction costs. When taking transaction costs into consideration its performance deteriorates due to the higher turnover, in this case the quarterly rebalancing schemes is the top performer.

5.2 Comparison of Portfolio Risk Measures

Examining the first row under the risk header in Table 1a. the annualized standard deviation of returns lies in a range between 0,1890 and 0.1899 for the equally weighted portfolios and is the smallest for the quarterly rebalanced. The volatility for the value weighted portfolio is 0.2234.

The skewness of the return distribution is negative for all equally weighted portfolios. With a skewness of -0.4510 the quarterly rebalanced portfolio has the most negative skew while the equally weighted with weekly rebalancing has the least negative with a skewness of -0.4177. For the value-weighted portfolio, the skewness is higher (less negative) and closer to zero at -0.0762. Kurtosis is the highest for the returns on the weekly rebalanced portfolio at 5,98, and lowest for the returns on the value-weighted portfolio at 4,61. For the two other rebalancing schemes it is at 5.94.

Finally, looking at an absolute measure of loss, the point estimate of the maximum drawdown (MD) is relatively similar both between the weighting rules and within the equally weighted. The portfolio with quarterly rebalancing has the with smallest MD of -61.3% while the monthly rebalanced has the greatest point estimate of -61.87%.

In summary, the equally weighted portfolios all have lower annualized standard deviation of returns than the value weighted, making the weighting rule favorable in terms of total risk, which in turn compensates for the greater left tails (more negative skew) and higher kurtosis. Finally, transaction costs have very minor implications on the risk measures, not noticeable to the fourth decimal, except for the point estimates of the maximum drawdown which drop by 10-20 basis points.

5.3 Comparison of Risk-Return Tradeoff Measures

The final rows of Table 1a and Table 1b present the risk return trade-off in terms of the Sharpe Ratio, Sortino Ratio and Treynor Measure. The results follow directly from the previous absolute return and risk metrics, which overall favored the equally weighted portfolios.

The equally weighted portfolios outperform the value weighted in terms of all three risk-reward measures. The Sharpe Ratio of the equally weighted with weekly rebalancing is the greatest at 0.4852 whereas the Sharpe Ratio of the value weighted is 0.1458. The substantially greater Sharpe is a direct result from the much higher annual mean return coupled with the smaller volatility. Since transaction costs did not affect estimates of portfolio volatilities' these results hold up after transaction costs as well.

Similarly, since the Sortino and Traynor Ratios are influenced by the substantially greater numerator from the equally weighted portfolios, the results are similar even as the denominator changes.

5.4 Comparison of the Systematic Return and Alpha

In order to decompose portfolio returns the Fama and French (1993) and Carhart (1997) standard four-factor model is used. The beta parameters are estimated by regressing daily excess returns from the portfolio samples and factors (Rm-rf, HML, SMB, and UMD) retrieved from The Swedish House of Finance. The parameter estimates from the regressions are presented in Table 2a and Table 2b while figure 2a and figure 2b show the distributions of alphas. The final row in the tables show that all the R^2 are above 0.9 which suggest that the standard four-factor model fits the data well and explains most of the total return variability.

To determine the source of the difference in systematic returns for the equal- and value-weighted portfolios the variations in the exposure to the four risk factors are examined. The equally weighted portfolios exposure to the market (Rm-rf) factor is highly significant, the greatest for the weekly rebalanced at 0.8675 while the other two rebalancing schemes have slightly smaller coefficients. On the other hand, the value weighted portfolio has a market factor beta close to one (0.9968) which is also highly significant.

The sensitivities of the equally weighted portfolios to the size factor (SMB) range from 0.0991 (weekly rebalancing) to 0.1010 (quarterly rebalancing) and are all highly significant. In contrast, the value weighted portfolio has a size factor beta close to zero (significant at 5%). The exposure of the equally weighted portfolios to the value factor (HML) range from 0.0607 (quarterly rebalancing) to 0.0645 (weekly rebalancing) and are again highly significant. As with the size factor, the value factor (HML) beta for the value weighted portfolio is close to zero and not significant even at the 10% level.

The higher exposure of the equal-weighted portfolios to the size factor supports the assumption that the equal-weighted portfolio systematically overweight's small size stocks which are contributing to the risk-adjusted outperformance. Consequently, equally weighted portfolios tend to display higher volatility compared to the value-weighted portfolio, but this is contradicted by the empirical results of this study. This might be a consequence from the greater diversification of the equal-weighted portfolio scheme reducing the concentration of the nonsystematic risk.

Lastly, both weighting rules have a momentum factor (UMD) beta close to zero, not significant at 10%. The insignificant momentum factor sensitivity of the equally weighted portfolio could be explained by the period rebalancing, deterring the portfolio to "chase winner" since rebalancing will systematically follow the contrarian strategy of selling winner stocks and buying loser stocks. The insignificant momentum beta for the value weighted portfolio is somewhat surprising and gives reason for further analysis.

The results of the regression reveal that a sizeable amount of the difference in annualized mean returns between the equally weighted portfolios and their value weighted counterpart comes from the large difference in alphas. As discussed in section 5.1, alphas are positive and highly significant for all three equally weighted portfolios, both before and after transaction costs have been considered, ranging between 100-150 basis point annualized. Alphas become even more prevalent when considered relative the value weighted portfolios, where the differences are in excess of 800 basis points on an annual basis. Plyakha, Uppal and Vilkov (2012, 2015) postulate, and demonstrate, that a source of this alpha is attributable to the inherent contrarian rebalancing strategy to maintain the intended weights. They argue that the alpha should decrease with the rebalancing frequency towards the alpha of the value-weighted portfolio. However, this is not observed in the results of this study in which the alpha of the quarterly rebalanced portfolio exceeds that of the monthly rebalanced. Nevertheless, in Plyakha, Uppal and Vilkov (2012, 2015) they reduce the rebalancing frequency to semi-annually and annually which might be the reason this effect is not observed in this study. An alternative source of the alpha could be the reversal factor which has not been accounted for when regressing the returns on the four-factor model only.

Concluding Remarks

This study compares the performance of three equal-weighted portfolios amongst each other and a value-weighted benchmark. The findings add to the established literature on this topic, that higher risk-adjusted returns are achieved by equally weighted portfolios. Apart from this, all the rebalanced portfolios exhibit highly significant alphas, positive in absolute terms and substantial in comparison with the value-weighted portfolio. Within the equally weighted portfolios the weekly rebalancing schemes outperforms before transaction costs. When taking transaction costs into consideration its performance deteriorates due to the higher turnover, in this case the quarterly rebalancing schemes is the top performer.

A further finding from this study is that the rebalancing frequency seem to have little impact on the performance of the equally weighted portfolios, which all display similar return and risk characteristics. Despite this, investigating if more complex rebalancing methods could add to the performance of equally weighted stock portfolios might be of interest for further research. A natural extension would be to test the Percentage-of-portfolio rebalancing discipline which involves setting rebalancing thresholds or trigger points. The portfolio is rebalanced only when a security weight first passes through one of its rebalancing thresholds, or equivalently, outside the corridor which could control excessive trading and transaction costs. Another method of interest would be the tactical rebalancing, which specifies less frequent rebalancing when markets appear to be trending and more frequent rebalancing when they are characterized by reversals. This approach seeks to add value by tying rebalancing frequency to expected market conditions.

Appendix: Tables and Graphs

Table 1a: Portfolio Performance (before transaction costs)
This table reports the performance metrics of the 1000 30-stock portfolios constructed from final data sample used for evaluation and testing comprising a set of 144 Swedish stocks. Performance metrics are calculated using daily returns from period January 1st, 2006 until December 31st, 2016 (2755 observations). The first three columns hold the equally weighted (EW) portfolios and the last column is the value weighted (VW) counterpart. Metrics are the averages of the 1000 portfolios and mean returns; standard deviations and four-factor alphas have been annualized on a 252 business days basis.

	EW (Weekly)	EW (Monthly)	EW (Quarterly)	VW (Buy & Hold)
Return				
Mean return	0.1019	0.0984	0.1006	0.0423
Cumulative Return	3.04	2.93	3.00	1.59
Systematic Return	0.0866	0.0863	0.0859	0.1125
Four-factor Alpha	0.0153	0.0121	0.0147	-0.0702
Risk				
Volatility	0.1899	0.1895	0.1890	0.2234
Skewness	-0.4177	-0.4351	-0.4510	-0.0762
Kurtosis	5.98	5.94	5.94	4.61
Max Drawdown	0.6145	0.6187	0.6130	0.6164
Risk / Return				
Sharpe	0.4852	0.4682	0.4812	0.1458
Sortino	0.6612	0.6365	0.6538	0.2033
Treynor	0.1174	0.1137	0.1166	0.0424

Table 1b: Portfolio Performance (after transaction costs)
This table reports the performance metrics of the 1000 30-stock portfolios constructed from final data sample used for evaluation and testing comprising a set of 144 Swedish stocks. Performance metrics are calculated using daily returns (after transaction costs) from period January 1st, 2006 until December 31st, 2016 (2755 observations). The first three columns hold the equally weighted (EW) portfolios and the last column is the value weighted (VW) counterpart. Metrics are the averages of the 1000 portfolios and mean returns; standard deviations and four-factor alphas have been annualized on a 252 business days basis.

	EW (Weekly)	EW (Monthly)	EW (Quarterly)	VW (Buy & Hold)
Return				
Mean return	0.0985	0.0968	0.0996	0.0423
Cumulative Return	2.93	2.88	2.97	1.59
Systematic Return	0.0865	0.0863	0.0858	0.1125
Four-factor Alpha	0.0120	0.0105	0.0138	-0.0702
Risk				
Volatility	0.1899	0.1895	0.1890	0.2234
Skewness	-0.4177	-0.4351	-0.4510	-0.0762
Kurtosis	5.98	5.94	5.94	4.61
Max Drawdown	0.6164	0.6196	0.6136	0.6164
Risk / Return				
Sharpe	0.4675	0.4598	0.4761	0.1458
Sortino	0.6367	0.6249	0.6466	0.2033
Treynor	0.1135	0.1188	0.1155	0.0424

Table 2a: Regression output (before transaction costs)
This table reports the results of running regressions of the four-factors on the excess returns of the 1000 portfolios for each rebalancing scheme as well as for the value weighted counterpart. The regression model is estimated based on daily returns data from period January 1st, 2006 until December 31st, 2016 (2755 observations). The first three column contain the parameters and coefficient of determination for the equally weighted (EW) portfolios, the last column is the value weighted (VW) counterpart. The four-factor alphas are annualized on a 252 business days basis.

	EW (Weekly)	EW (Monthly)	EW (Quarterly)	VW (Buy & Hold)
α	0.0153 (0)	0.0121 (0)	0.0147 (0)	-0.0702 (0)
β_{mkt-rf}	0.8675 (0)	0.8653 (0)	0.8629 (0)	0.9968 (0)
β_{smb}	0.0991 (0)	0.0992 (0)	0.1010 (0)	-0.0074 (0.047)
β_{hml}	0.0645 (0)	0.0649 (0)	0.0607 (0)	-0.0013 (0.875)
β_{umd}	0.0024 (0.756)	0.0021 (0.753)	0.0029 (0.714)	-0.0065 (0.138)
R^2	0.903	0.903	0.901	0.980

Table 2b: Regression output (after transaction costs)

This table reports the results of running regressions of the four-factors on the excess returns of the 1000 portfolios for each rebalancing scheme as well as for the value weighted counterpart. The regression model is estimated based on daily returns (after transaction costs) data from period January 1st, 2006 until December 31st, 2016 (2755 observations). The first three columns contain the parameters and coefficient of determination for the equally weighted (EW) portfolios, the last column is the value weighted (VW) counterpart. The four-factor alphas are annualized on a 252 business days basis.

	EW (Weekly)	EW (Monthly)	EW (Quarterly)	VW (Buy & Hold)
α	0.0120 (0)	0.0105 (0)	0.0138 (0)	-0.0702 (0)
β_{mkt-rf}	0.8675 (0)	0.8653 (0)	0.8628 (0)	0.9968 (0)
β_{smb}	0.0991 (0)	0.0991 (0)	0.1010 (0)	-0.0074 (0.047)
β_{hml}	0.0645 (0)	0.0648 (0)	0.0606 (0)	-0.0013 (0.875)
β_{umd}	0.0024 (0.754)	0.0020 (0.792)	0.0028 (0.714)	-0.0065 (0.138)
R^2	0.903	0.903	0.901	0.980

Figure 1a: Return distributions (before transaction costs)

This figure plots a histogram of the return distributions for the average of the 1000 portfolios for both weighting rules and each rebalancing scheme within the equally weighted portfolios. The plots show daily returns data from period January 1st, 2006 until December 31st, 2016 (2755 observations).

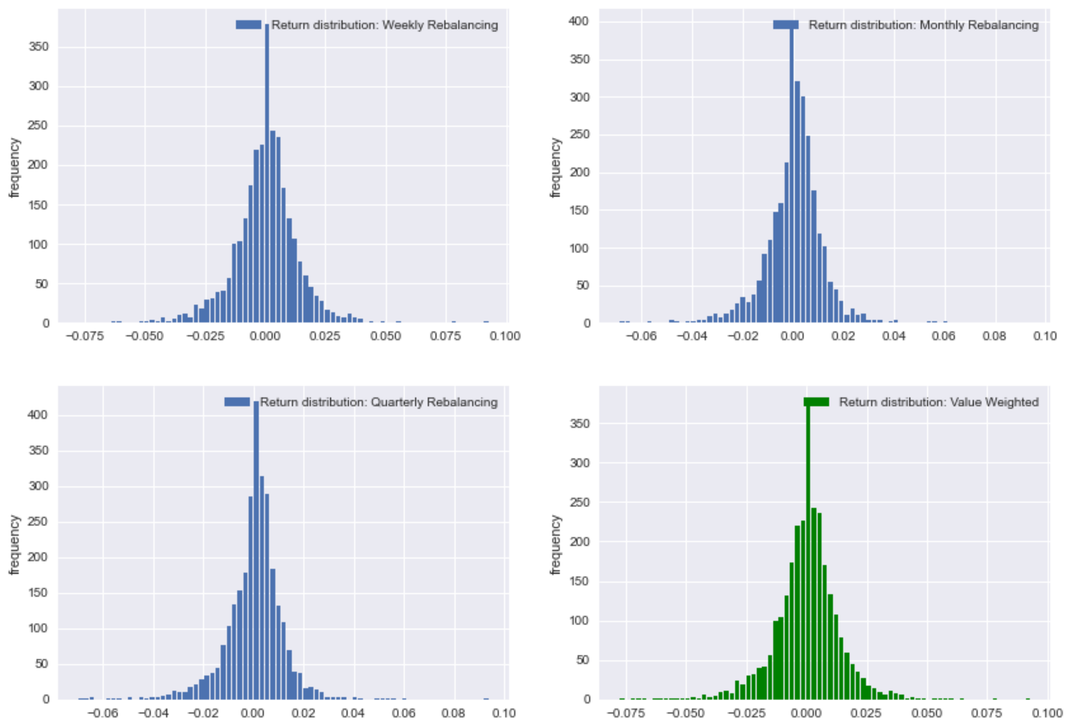

Figure 1b: Return distributions (after transaction costs)
This figure plots a histogram of the return distributions for the average of the 1000 portfolios and both weighting rules and each rebalancing scheme within the equally weighted portfolios. The plots show daily returns data after transaction costs from period January 1st, 2006 until December 31st, 2016 (2755 observations).

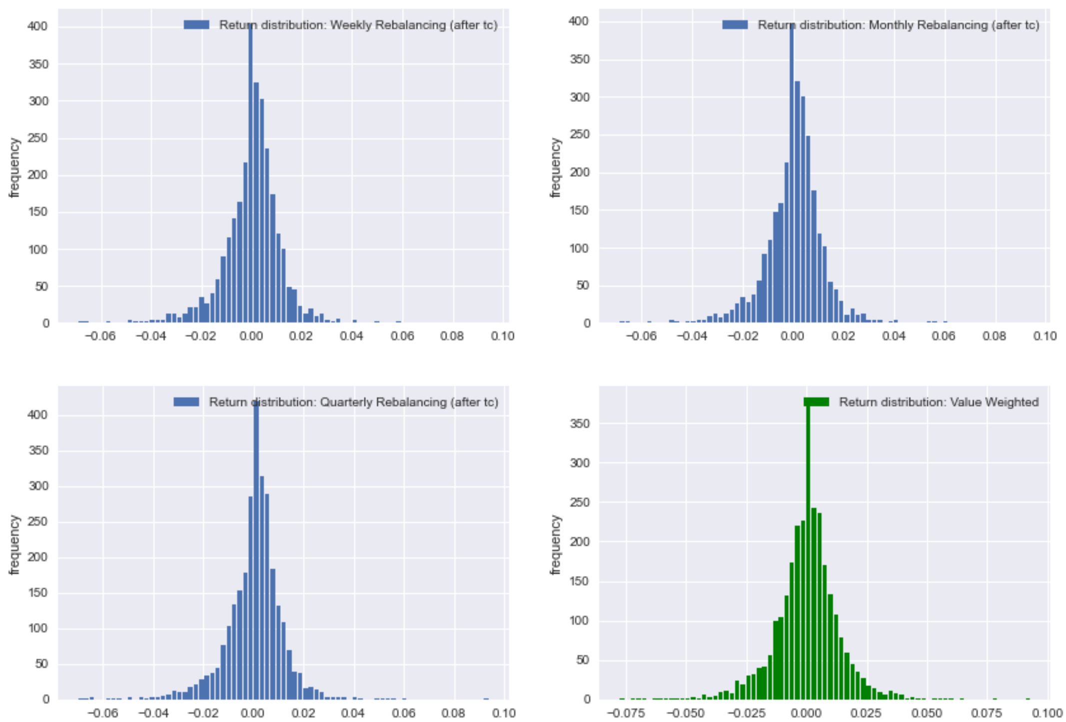

Figure 2a: Distribution of alphas (before transaction costs)

This figure plots the histogram of the distribution of the 1000 regression alphas for each rebalancing scheme for the equally weighted portfolios. The regression model is estimated based on daily returns data from period January 1st, 2006 until December 31st, 2016 (2755 observations). The regression alphas have been annualized on a 252-business day basis and are show in the histogram together with the sample mean (red vertical dotted line) as well as the mean from the value weighted portfolios (green vertical dotted line).

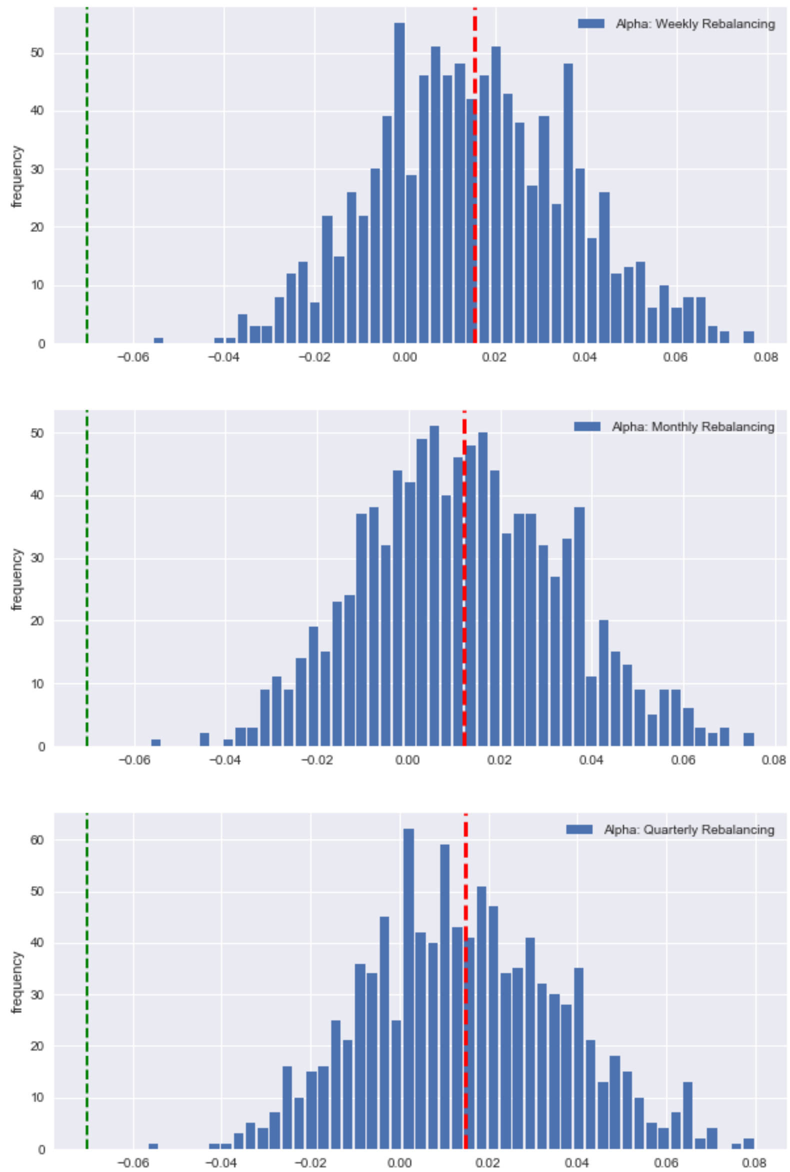

Figure 2b: Distribution of alphas (after transaction costs)

This figure plots the histogram of the distribution of the 1000 regression alphas for each rebalancing scheme for the equally weighted portfolios. The regression model is estimated based on daily returns (after transaction costs) data from period January 1st, 2006 until December 31st, 2016 (2755 observations). The regression alphas have been annualized on a 252-business day basis and are show in the histogram together with the sample mean (red vertical dotted line) as well as the mean from the value weighted portfolios (green vertical dotted line).

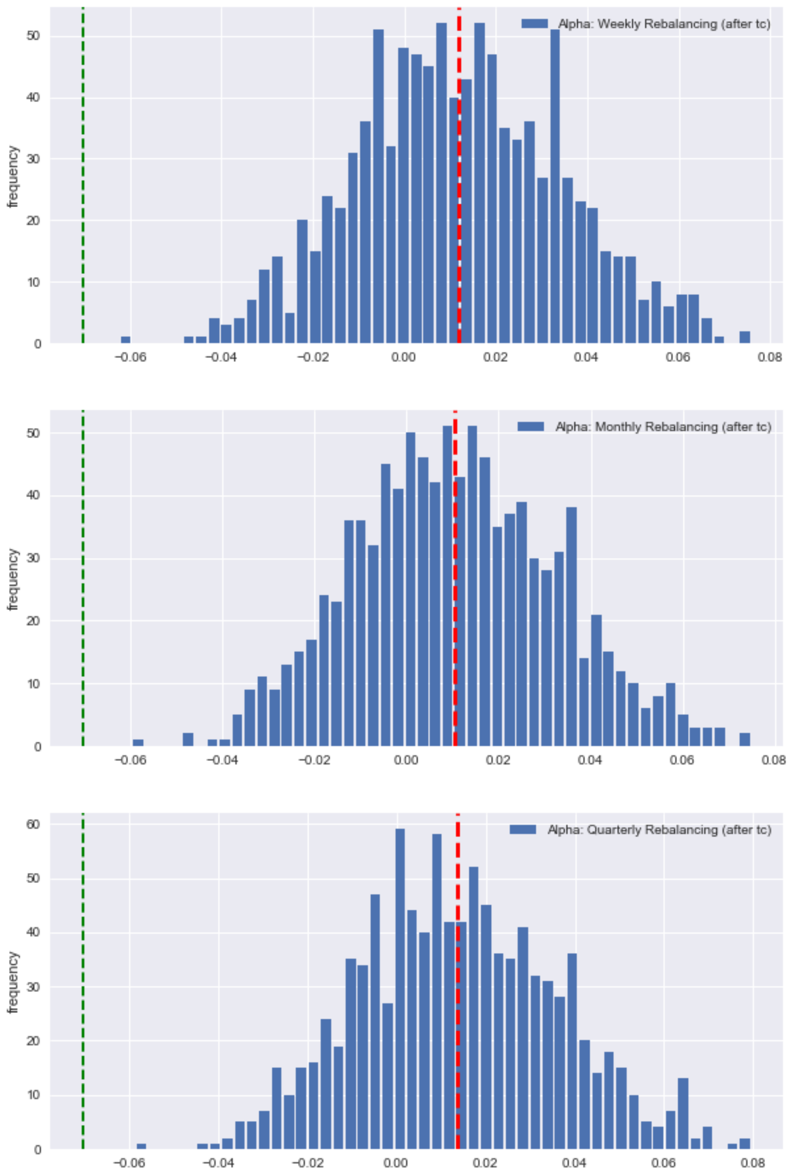

Figure 3a: Cumulative return distributions

This figure plots the cumulative returns of the 1000 randomly sampled portfolios for both weighting rule and for each rebalancing frequency within the equal weighting. The top panels show the cumulative returns for the equally weighted portfolios as well as for the value weighted while the bottom panels show cumulative returns after transaction costs. The bottom right panel compares the means of 1000 portfolios. The performance data is calculated based daily returns and covers the period January 1st, 2006 until December 31st, 2016 (2755 observations)

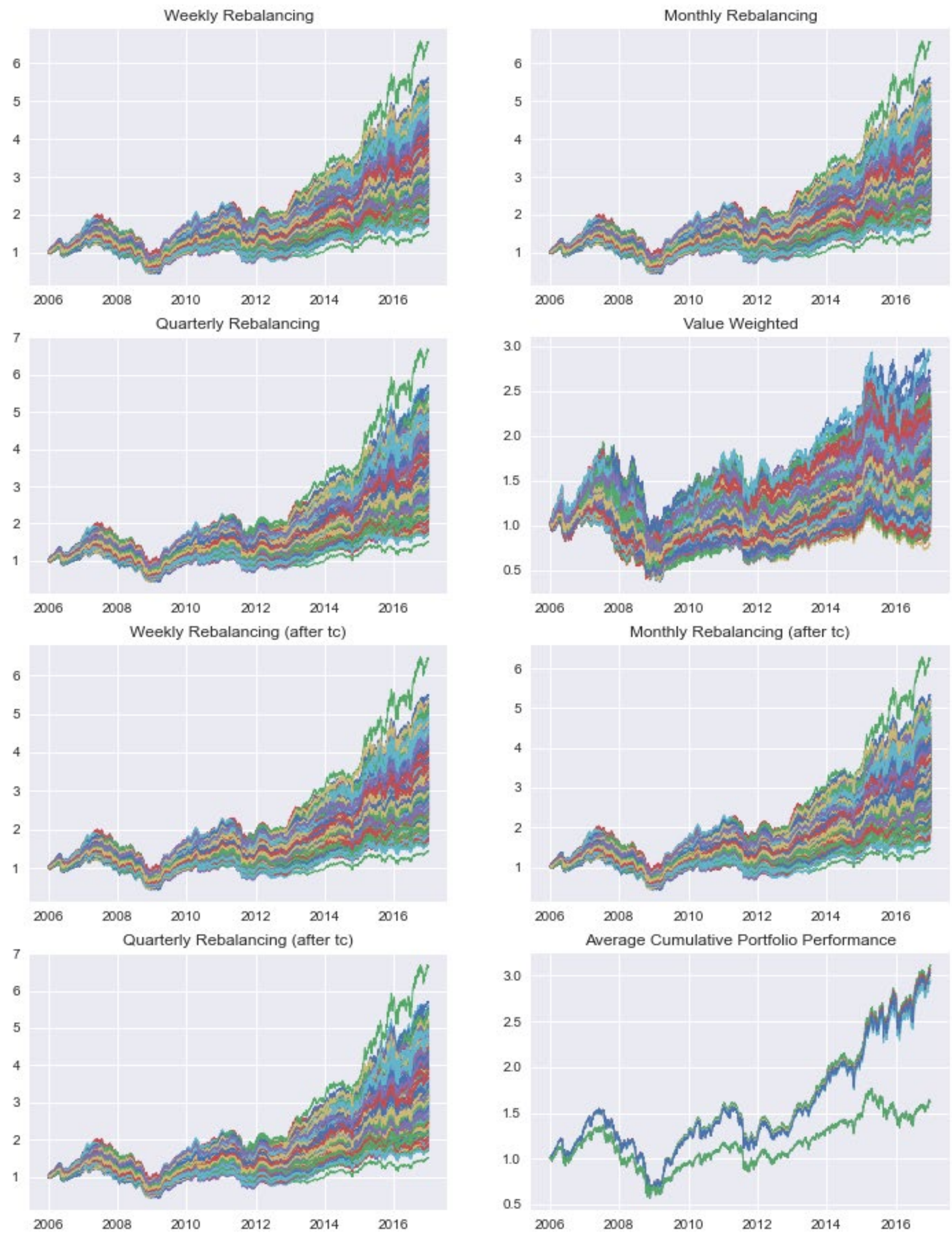

Figure 4a: Market capitalization and performance

The figure plots cumulative returns of all the individual stocks, 144 in total. The top panels show the cumulative returns for all small cap companies, the middle panel shows the cumulative returns for all the mid cap companies and the bottom panel shows the large caps. The cumulative returns are based on daily returns during the period January 1st, 2006 until December 31st, 2016 (2755observations).

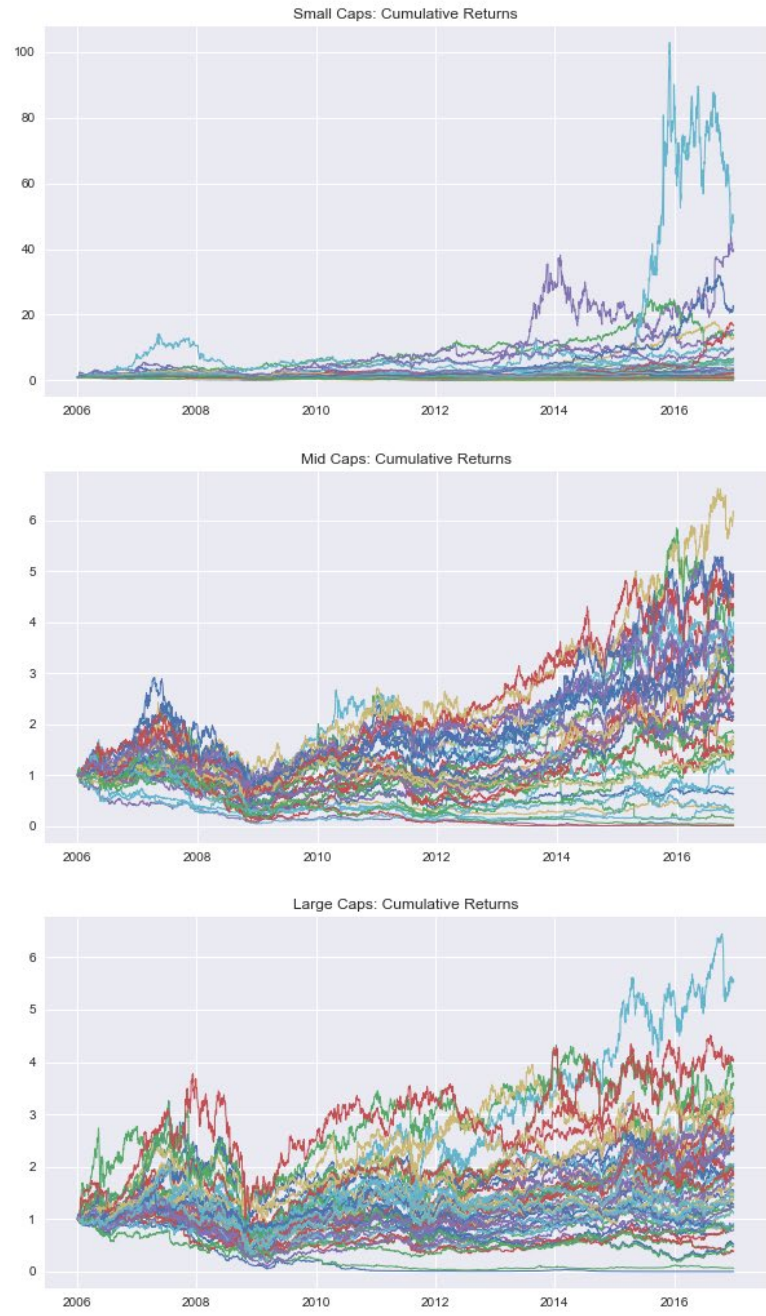

Table 3: Securities included in the study

This table presents all the securities, 144 in total, included study. The sector designations and market capitalizations are retrieved from the Bloomborg terminal. The classification into Small Cap, Mid Cap and Large is based on their market caps in SEK and a EURSEK exchange rate of 9,50 which is the approximate the actual exchange rate in 2006-01-01. The sample's division into size is: Large Cap 42%, Mid Cap 28% and Small Cap 31%. The sample's sector distribution is: Basic Materials 7%, Communications 9%, Consumer Cyclicals 14%, Consumer Non-Cyclicals 16%, Energy 1,4%, Financial 20.2%, Industrial 25.9% and Technology 6.3%.

BB Code	Security Name	Sector	Market Value (SEK)	
AAK SS	AAK AB	Consumer, Non-cyclical	7 349 309 700	Mid Cap
ABB SS	ABB Ltd	Industrial	159 414 250 500	Large Cap
ACANB SS	Acando AB	Technology	628 944 400	Small Cap
ACTI SS	Active Biotech AB	Consumer, Non-cyclical	3 109 755 900	Mid Cap
ADDTB SS	AddTech AB	Consumer, Cyclical	2 330 618 900	Mid Cap
AFB SS	AF Poyry AB	Industrial	1 383 211 600	Small Cap
ALFA SS	Alfa Laval AB	Industrial	18 928 403 500	Large Cap
ANODB SS	AddNode Group AB	Communications	466 877 400	Small Cap
ANOT SS	Anoto Group AB	Technology	3 155 729 300	Mid Cap
ARCM SS	Arcam AB	Technology	14 202 100	Small Cap
ASSAB SS	Assa Abloy AB	Industrial	46 288 630 800	Large Cap
ATCOA SS	Atlas Copco AB	Industrial	106 591 589 100	Large Cap
ATCOB SS	Atlas Copco AB	Industrial	106 591 589 100	Large Cap
ATRLJB SS	Atrium Ljungberg AB	Financial	3 069 386 900	Mid Cap
AXFO SS	Axfood AB	Consumer, Non-cyclical	12 042 223 800	Large Cap
AZA SS	Avanza Bank Holding AB	Financial	2 636 707 200	Mid Cap
AZN SS	AstraZeneca PLC	Consumer, Non-cyclical	616 130 683 600	Large Cap
BALDB SS	Fastighets AB Balder	Financial	911 799 000	Small Cap
BEIAB SS	Beijer Alma AB	Industrial	1 938 464 400	Mid Cap
BEIJB SS	Beijer Ref AB	Industrial	1 119 870 900	Small Cap
BELE SS	Beijer Electronics Group AB	Industrial	731 026 200	Small Cap
BERGB SS	Bergman & Beving AB	Consumer, Cyclical	3 213 313 100	Mid Cap
BETSB SS	Betsson AB	Consumer, Cyclical	1 058 031 900	Small Cap
BILIA SS	Bilia AB	Consumer, Cyclical	3 446 250 800	Mid Cap
BILL SS	BillerudKorsnas AB	Basic Materials	5 351 926 300	Mid Cap
BINV SS	BioInvent International AB	Consumer, Non-cyclical	356 654 800	Small Cap
BIOGB SS	BioGaia AB	Consumer, Non-cyclical	354 475 900	Small Cap
BIOT SS	Biotage AB	Consumer, Non-cyclical	922 086 900	Small Cap
BOL SS	Boliden AB	Basic Materials	18 448 434 400	Large Cap
BORG SS	Bjorn Borg AB	Consumer, Cyclical	238 857 500	Small Cap
BRGB SS	Bergs Timber AB	Industrial	151 628 800	Small Cap
BURE SS	Bure Equity AB	Financial	1 412 817 200	Small Cap
CAST SS	Castellum AB	Financial	12 104 978 900	Large Cap
CCORB SS	Concordia Maritime AB	Industrial	2 004 651 600	Mid Cap
CLASB SS	Clas Ohlson AB	Consumer, Cyclical	9 741 600 100	Large Cap
CONSB SS	Consilium AB	Industrial	235 435 200	Small Cap
CTT SS	CTT Systems AB	Industrial	544 640 000	Small Cap

EKTAB SS	Elekta AB	Consumer, Non-cyclical	11 080 239 300	Large Cap
ELANB SS	Elanders AB	Consumer, Non-cyclical	966 735 000	Small Cap
ELUXB SS	Electrolux AB	Consumer, Cyclical	64 611 854 100	Large Cap
ENEA SS	Enea AB	Technology	2 149 450 800	Mid Cap
ENRO SS	Eniro AB	Communications	15 775 652 100	Large Cap
ERICA SS	Telefonaktiebolaget LM Ericsson	Communications	443 767 984 600	Large Cap
ERICB SS	Telefonaktiebolaget LM Ericsson	Communications	443 767 984 600	Large Cap
FABG SS	Fabege AB	Financial	14 322 163 500	Large Cap
FINGB SS	Fingerprint Cards AB	Industrial	77 131 800	Small Cap
FPIP SS	FormPipe Software AB	Technology	38 860 000	Small Cap
GETIB SS	Getinge AB	Consumer, Non-cyclical	22 408 009 100	Large Cap
GUNN SS	Gunnebo AB	Industrial	3 486 432 700	Mid Cap
HEXAB SS	Hexagon AB	Industrial	18 825 073 300	Large Cap
HIQ SS	HIQ International AB	Technology	2 116 984 600	Mid Cap
HLDX SS	Haldex AB	Consumer, Cyclical	3 444 762 900	Mid Cap
HMB SS	Hennes & Mauritz AB	Consumer, Cyclical	222 607 182 800	Large Cap
HOLMB SS	Holmen AB	Basic Materials	22 514 379 700	Large Cap
HUFVA SS	Hufvudstaden AB	Financial	11 091 774 700	Large Cap
IARB SS	IAR Systems Group AB	Communications	698 612 000	Small Cap
ICA SS	ICA Gruppen AB	Consumer, Non-cyclical	7 096 455 200	Mid Cap
INDT SS	Indutrade AB	Industrial	3 450 000 000	Mid Cap
INDUA SS	Industrivarden AB	Financial	40 998 065 100	Large Cap
INDUC SS	Industrivarden AB	Financial	40 998 065 100	Large Cap
INTRUM SS	Intrum AB	Financial	5 690 809 800	Mid Cap
INVEA SS	Investor AB	Financial	105 019 037 100	Large Cap
INVEB SS	Investor AB	Financial	105 019 037 100	Large Cap
JM SS	JM AB	Industrial	8 723 107 100	Mid Cap
KABEB SS	Kabe Group AB	Consumer, Cyclical	1 270 199 900	Small Cap
KARO SS	Karo Pharma AB	Consumer, Non-cyclical	681 232 700	Small Cap
KINDSDB SS	Kindred Group PLC	Consumer, Cyclical	4 141 741 000	Mid Cap
KINVA SS	Kinnevik AB	Financial	21 291 056 700	Large Cap
KINVB SS	Kinnevik AB	Financial	21 291 056 700	Large Cap
KLED SS	Kungsleden AB	Financial	10 351 341 100	Large Cap
KLOVA SS	Klovern AB	Financial	2 900 779 700	Mid Cap
KNOW SS	KNOW IT AB	Technology	558 521 600	Small Cap
LAGRB SS	Lagercrantz Group AB	Industrial	681 544 600	Small Cap
LATOB SS	Investment AB Latour	Industrial	8 952 572 800	Mid Cap
LUNDB SS	L E Lundbergforetagen AB	Financial	21 036 251 800	Large Cap
LUNE SS	Lundin Energy AB	Energy	21 829 420 500	Large Cap
MCAP SS	Medcap AB	Consumer, Non-cyclical	48 066 500	Small Cap
MEKO SS	Mekonomen AB	Consumer, Cyclical	3 071 444 400	Mid Cap
MIDWB SS	Midway Holding AB	Diversified	890 315 400	Small Cap
MTGB SS	Modern Times Group MTG AB	Communications	21 640 991 000	Large Cap
MVIRB SS	Medivir AB	Consumer, Non-cyclical	787 058 600	Small Cap
MYCR SS	Mycronic AB	Industrial	4 249 576 000	Mid Cap

NCCA SS	NCC AB	Industrial	15 642 471 000	Large Cap
NCCB SS	NCC AB	Industrial	15 642 471 000	Large Cap
NDA SS	Nordea Bank Abp	Financial	226 655 961 900	Large Cap
NETIB SS	Net Insight AB	Communications	965 528 200	Small Cap
NIBEB SS	Nibe Industrier AB	Industrial	5 573 806 400	Mid Cap
NNB SS	Nordnet AB	Financial	3 349 883 800	Mid Cap
NOBI SS	Nobia AB	Consumer, Cyclical	9 026 872 900	Mid Cap
NOLAB SS	Nolato AB	Basic Materials	2 045 401 000	Mid Cap
NOTE SS	Note AB	Communications	601 512 500	Small Cap
ORES SS	Investment AB Oresund	Financial	7 076 603 100	Mid Cap
ORX SS	Orexo AB	Consumer, Non-cyclical	1 559 495 200	Mid Cap
PACT SS	Proact IT Group AB	Technology	280 794 800	Small Cap
PEABB SS	Peab AB	Industrial	8 719 590 000	Mid Cap
PREC SS	Precise Biometrics AB	Industrial	437 487 100	Small Cap
PRICB SS	Pricer AB	Industrial	852 405 800	Small Cap
PROB SS	Probi AB	Consumer, Non-cyclical	280 959 000	Small Cap
RATOB SS	Ratos AB	Financial	15 680 594 900	Large Cap
RAYB SS	RaySearch Laboratories AB	Consumer, Non-cyclical	2 011 258 300	Mid Cap
REJLB SS	Rejlers AB	Consumer, Non-cyclical	387 960 000	Small Cap
RNBS SS	Rnb Retail and Brands AB	Consumer, Cyclical	1 440 822 100	Mid Cap
RROS SS	Rottneros AB	Basic Materials	1 219 876 900	Small Cap
SAABB SS	Saab AB	Industrial	18 227 599 700	Large Cap
SAND SS	Sandvik AB	Industrial	87 785 238 200	Large Cap
SAS SS	SAS AB	Consumer, Cyclical	17 437 000 000	Large Cap
SCAA SS	Svenska Cellulosa AB SCA	Basic Materials	69 570 863 600	Large Cap
SCAB SS	Svenska Cellulosa AB SCA	Basic Materials	69 570 863 600	Large Cap
SEBA SS	Skandinaviska Enskilda Banken	Financial	113 272 171 200	Large Cap
SEBC SS	Skandinaviska Enskilda Banken	Financial	113 272 171 200	Large Cap
SECTB SS	Sectra AB	Communications	2 119 320 600	Mid Cap
SECUB SS	Securitas AB	Consumer, Non-cyclical	47 822 714 500	Large Cap
SEMC SS	Semcon AB	Consumer, Non-cyclical	991 287 000	Small Cap
SENS SS	Sensys Gatso Group AB	Consumer, Non-cyclical	646 059 500	Small Cap
SHBA SS	Svenska Handelsbanken AB	Financial	131 919 359 400	Large Cap
SHBB SS	Svenska Handelsbanken AB	Financial	131 919 359 400	Large Cap
SINT SS	SinterCast AB	Industrial	549 737 100	Small Cap
SKAB SS	Skanska AB	Industrial	51 100 568 500	Large Cap
SKFA SS	SKF AB	Industrial	50 543 959 500	Large Cap
SKFB SS	SKF AB	Industrial	50 543 959 500	Large Cap
SKISB SS	SkiStar AB	Consumer, Cyclical	3 814 399 800	Mid Cap
SSABA SS	SSAB AB	Basic Materials	25 986 381 800	Large Cap
SSABB SS	SSAB AB	Basic Materials	25 986 381 800	Large Cap
STER SS	Stora Enso Oyj	Basic Materials	87 732 103 700	Large Cap
SVEDB SS	Svedbergs i Dalstorp AB	Consumer, Cyclical	1 208 400 000	Small Cap
SVIK SS	Studsvik AB	Industrial	1 639 610 800	Mid Cap

SWECB SS	Sweco AB	Industrial	3 496 178 400	Mid Cap
SWEDA SS	Swedbank AB	Financial	115 062 313 400	Large Cap
SWMA SS	Swedish Match AB	Consumer, Non-cyclical	30 430 892 900	Large Cap
TEL2B SS	Tele2 AB	Communications	37 354 019 000	Large Cap
TELIA SS	Telia Co AB	Communications	201 502 496 300	Large Cap
TETY SS	Tethys Oil AB	Energy	106 112 200	Small Cap
TIETOS SS	TietoEVRY Oyj	Technology	22 953 672 400	Large Cap
TIGO SS	Millicom International Cellula	Communications	21 200 720 100	Large Cap
TRAD SS	TradeDoubler AB	Communications	3 776 070 700	Mid Cap
TRELB SS	Trelleborg AB	Industrial	15 068 922 800	Large Cap
TRENT SS	Trention AB	Financial	348 866 300	Small Cap
VBGB SS	VBG Group AB	Consumer, Cyclical	790 828 500	Small Cap
VITR SS	Vitrolife AB	Consumer, Non-cyclical	483 662 300	Small Cap
VOLVA SS	Volvo AB	Consumer, Cyclical	158 634 217 300	Large Cap
VOLVB SS	Volvo AB	Consumer, Cyclical	158 634 217 300	Large Cap
VSSABB SS	Viking Supply Ships AB	Industrial	974 007 500	Small Cap
WALLB SS	Wallenstam AB	Financial	6 005 300 000	Mid Cap
WIHL SS	Wihlborgs Fastigheter AB	Financial	3 641 090 700	Mid Cap

References

Arnott, D. R. & Lovell, D. R. 1993. *Rebalancing Why? When? How Often?* The Journal of Investing Spring 1993, 2 (1) 5-10

Asness, S. C., Moskowitz, J. T., & Pedersen, L. H. 2009, *Value and Momentum Everywhere.*

Banz, R.W. 1981. *The Relationship between Return and Market Value of Common Stocks.* Journal of Financial Economics, vol. 9:3–18.

Buetow, W. G., Sellers, R., Trotter, D. & Hunt, E. 2002. *The Benefits of Rebalancing.* The Journal of Portfolio Management 28(2):23-32

Black, F. 1972, *Capital market equilibrium with restricted borrowing*, Journal of Business 45, 444-455

Bodie, Z., Kane, A., & Marcus. A. (2011*). Investments and Portfolio Management*, 9 Edition, New York: McGraw-Hill Irwin, p.77, 161-167, 308-337, 453.

Bolognesi, E., Torluccio, G. & Zuccheri, A. 2013, *A comparison between capitalization-weighted and equally weighted indexes in the European equity market*, Journal of Asset Management, 14.

Booth, D. G., & E. F. Fama, 1992, *Diversification Returns and Asset Contributions,* Financial Analysts Journal , 48.

Bornholt, G. N., 2012. T*he Failure of the Capital Asset Pricing Model (CAPM).*

Carhart, Mark. 1997. *On Persistence in Mutual Fund Performance*. Journal of Finance, vol. 52, no. 1:57–82.

Chow, T.-m., J. Hsu, V. Kalesnik, & B. Little, 2011, *A Survey of Alternative Equity IndexStrategies*, Financial Analysts Journal, 67.

Clare, A. D., Motson, N. E. & Thomas, S. H. 2013. *An Evaluation of Alternative Equity Indices - Part 1: Heuristic and Optimised Weighting Schemes.*

Dahlberg, J. & Eklund, L. *Fler svenskar väljer att spara i indexfonder.* Svenska dagbladet. (Uppladdad: 2019-08-13)

De Bondt. W.F.M. & Thaler, R. 1985. *Does the Stock Market Overreact?.* The Journal of Finance. Vol. 40(3), p. 792-805

DeMiguel, V., L. Garlappi, and R. Uppal, 2009, *Optimal Versus Naive Diversification: How Inefficient is the 1/N Portfolio Strategy?,* Review of Financial Studies, 22, 1915–1953.

Fama, Eugene F., and Kenneth R. French. 1992. *The Cross-Section of Expected Stock Returns.* Journal of Finance, vol. 47, no. 2 (June):427–465.

Fama, E. F., & K. R. French, 1993, *Common Risk Factors in the Returns on Stock and Bonds,* Journal of Financial Economics, 33, 3–56.

Gittleson, J. 2019. *End of Era: Passive Equity Funds Surpass Active in Epic Shift.* Bloomberg. (Uppladdad: 2019-09-11)

Goodsall, B. & Plaxco, L. 1996. *Tactical Rebalancing.* Investment Management Reflections No 3, 1996

Levine, M. 2019. *Money Stuff: Half a Share of Stock Is Better Than Nothing.* Bloomberg. (Uppladdad: 2019-10-18)

Institute, C. (2015). 2016 CFA Level I Volume 5 *Equity and Fixed Income*. P. 132-133.

Institute, C. (2017). 2018 CFA Program Level III Volume 6 *Trading and Rebalancing, Performance Evaluation, and Global Investment Performance Standards*, p. 85-88, 90, 93, 96.

Institute, C. (2015). 2016 CFA Level I Volume 4 *Corporate Finance and Portfolio Managemen,* p. 427.

Jegadeesh, N., and S. Titman, 1993, *Returns to Buying Winners and Selling Losers: Implica-tions for Stock Market Efficiency,*Journal of Finance , 48, 65–91.

Lintner, John. 1965a. *Security Prices, Risk, and Maximal Gains from Diversification.* Journal of Finance, vol. 20, no. 4:587–615.

Lintner, John. 1965b. *The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets.* Review of Economics and Statistics, vol. 47, no. 1:13–37.

Markowitz, Harry. 1952. *Portfolio Selection.* Journal of Finance, vol. 7, no. 1:77–91.

Monnier, B. & Rulik, K. 2011. *Behind the performance of equally weighted indices.* Ossiam Research Team. White Paper.

Nasdaq. Vad är ett aktieindex? (Hämtad 2020-07-10) Länk: http://www.nasdaqomxnordic.com/utbildning/aktier/vadaraktieindex?languageId=3

Plyakha, Y., Uppal, R. & Vilkov, G,. 2015. *Why Does an Equal-Weighted Portfolio Outperform Value- and Price-Weighted Portfolios?*

Plaxco, L. &Arnott, D. R.2002. *Rebalancing a global policy benchmark.* The Journal of Portfolio Management Winter 2002, 28 (2) 9-22

Sharpe, William F. 1964. *Capital Asset Prices: A Theory Of Market Equilibrium under Conditions of Risk.* Journal of Finance, vol. 19, no. 3:425–442.

SOLACTIVE 2018 *WHEN SIZE DOESN'T MATTER: EQUAL WEIGHTING (VS. MARKET CAP WEIGHTING).* White Paper January 2018.

Statman, M. 1987. *How Many Stocks Make a Diversified Portfolio?* Journal of Financial and Quantitative Analysis 22(03):353-363 · September 1987)

Willenbrock, S. 2011. *Diversification Return, Portfolio Rebalancing, and the Commodity Return Puzzle,* Financial Analysts Journal , 67.