

Portfolio construction based on value and momentum: a winning strategy?

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Abstract

This study examines if there are positive effects of constructing portfolios based on value and momentum. Three value portfolios (low, medium, high) and three momentum portfolios are constructed using large cap stocks from the four Nordic Nasdaq OMX exchanges. The portfolios are then re-sorted on an annual basis over the test period 2005-2016. Furthermore, two long-short market neutral portfolios are constructed using the full sample of stocks for both the value and momentum measure. The result shows a positive average value effect over time but a negative average momentum effect. For all portfolios, increased return is accompanied with increased volatility. The market neutral portfolios confirm that there might be a positive value effect and a small negative momentum effect. Moreover, a 50/50 combination strategy of value and momentum is employed that decreases the portfolio volatility due to negative correlation. The momentum effect seems to have been impacted by the financial crisis in 2008 with small positive effects being observed before the crisis that then disappears, inconsistent with the value effect which starts to appear after the crisis. This might have to do with momentum as a concept being destroyed after the crisis or possibly that an increased interest to invest based on momentum has arbitrated such benefits away.

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Andreas Grann

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1. Introduction

As long as the modern stock markets have existed, there have been investors trying to successfully create portfolios by selecting stocks that they believe will outperform others in the future. A lot of research have been made to examine if this kind of stock picking could be profitable and which variables can explain those returns. The most famous model used to estimate expected return of a stock is the capital asset pricing model, CAPM. The model, which was developed by Sharpe (1964) and Lintner (1965), relies on only one explanatory variable and has been preferred by practitioners for many reasons, not least for its simplicity and the intuition surrounding the model. However, for a few decades research has proven this model to have unsatisfactory empirical performance as many of the underlying assumptions in the framework can't be justified. For instance, there is a tendency for small stocks and so-called value stocks (high book to market ratio) to outperform the market, something not always captured by the CAPM that relies on the efficient market hypothesis (Fama and French, 1993; Reinganum, 1981; Chan and Lakonishok, 2004). There have been many attempts to examine which firm characteristics or variables that is associated with a return-premium. One of the most well-known developments of Fama and French (1993) three factor model is the model by Carhart (1997) which not only includes the market risk premium, size and book to market but also a measure of recent stock-performance called momentum. The momentum factor is included based on the findings of Jegadeesh and Titman (1993). They found that portfolio strategies based on holding stocks with good recent performance could earn abnormal returns not explained by their systematic risk. Rouwenhorst (1998) tests the momentum strategy by sorting stocks into portfolios based on recent performance. He finds international evidence that portfolios constructed using previous high-performing stocks (winners) outperforms portfolios of previous losers.

A recent article by Asness, Moskowitz and Pedersen (2013) show that portfolios constructed based on value and high-momentum stocks earn a significant premium in excess of portfolios based on growth stocks (low book to market) and low-momentum stocks. More interestingly they find that portfolios based on a combination of value and high-momentum stocks have an even better performance. This also turns out to hold not only for equities and the American market, but for a broad set of asset classes and eight markets.

The work by Asness, Moskowitz and Pedersen (2013) adds to the research of Fama and French (2012) which found size, value and momentum premiums across a diverse set of markets. Asness, Moskowitz and Pedersen (2013) however put focus on the importance of studying value and momentum in a joint manner rather than separately. Based on their findings they propose a three-factor model including the market excess return as well as value and momentum factors.

While the value and momentum effects has been documented many times in the American and European market there is limited evidence in the Nordic countries. There seems to be a need for more detailed research showing if portfolio strategies based on value and momentum could be reasonable in the Nordic markets. Furthermore, it would be interesting to examine the performance of value and momentum strategies during the last decade, which not only has been heavily influenced by the great financial crisis in 2008 but also the European debt crisis. Events like this might have an impact on investors behavior. Cooper, Gutierrez and Hameed (2004) and Muga and Santamaria (2007) for example shows that the success of momentum strategies is heavily dependent upon the state of the market. It should therefore be important to continuously examine possible return effects attributed to for instance value and momentum. It is also of interest to examine a combination of value and momentum as proposed by Asness, Moskowitz and Pedersen (2013).

This essay will look at these problems in a focused geographical area. More particularly it will examine the value, momentum and its combined effects in portfolios constructed using the large cap stocks listed on the Nasdaq OMX Nordic exchanges. The size of this sample makes it a reasonable limitation regarding the data processing. This thesis will add to the research by Asness, Moskowitz and Pedersen (2013) and Fama and French (2012) among others who examines the European market as a region. This study breaks out the Nordic markets in Sweden, Denmark, Finland and Iceland and examines if the same pattern can be found here.

The results are interesting for portfolio construction and gives an increased knowledge about the worthwhileness of stock picking based on certain variables compared to passive market strategies as proposed by CAPM. As this kind of portfolio strategies contradicts the underlying assumptions in CAPM, this study will add to recent studies on asset pricing and efficient markets.

2. Theory

2.1 Modern portfolio theory and CAPM

Most of the modern finance theory has its roots in the portfolio selection theory by Markowitz (1952). He derived a mathematical framework for optimal portfolio selection in a world of risky assets and risk-averse investors. His theory, named modern portfolio theory, shows how investors can construct optimal portfolios in the sense of maximizing expected return per unit of risk. While the expected return on a portfolio is just a weighted average of the included assets expected return, the portfolio variance takes correlation between the assets into account. This means there is a diversification effect when assets are not perfectly correlated. In matrix notation, the portfolio variance is calculated as:

$$\sigma_p^2 = [w_1 \quad \cdots \quad w_n] \begin{bmatrix} \sigma_{11} & \cdots & \sigma_{1n} \\ \vdots & \ddots & \vdots \\ \sigma_{n1} & \cdots & \sigma_{nn} \end{bmatrix} \begin{bmatrix} w_1 \\ \vdots \\ w_n \end{bmatrix} \quad (1)$$

Where $[w_1 \quad \cdots \quad w_n]$ is the weight in each asset which is multiplied by a covariance matrix of the asset returns. Expected return on the portfolio is given by:

$$E[r_p] = \sum_{i=1}^N w_i E[r_i] \quad (2)$$

Where $E[r_i]$ is the expected return on each individual asset i in the portfolio.

Given this diversification principle and a set of underlying assumptions about the investors and the market we can form optimal portfolios that in a risk-return diagram lies on a parabola called the efficient frontier. In a world of only risky assets and risk-averse investors these portfolios will be the optimal when trying to maximize expected return per unit of risk (measured as standard deviation). Given a risk-free asset in the economy¹ we can combine this with one of the efficient portfolios to form portfolios with other risk-return characteristics not possible with only risky assets. The diagram below shows why the best portfolio to combine with the risk-free asset is the one that is tangent to a line from the risk-free asset to the efficient frontier.

¹ The risk-free asset was introduced to this mean variance framework by Tobin (1958)

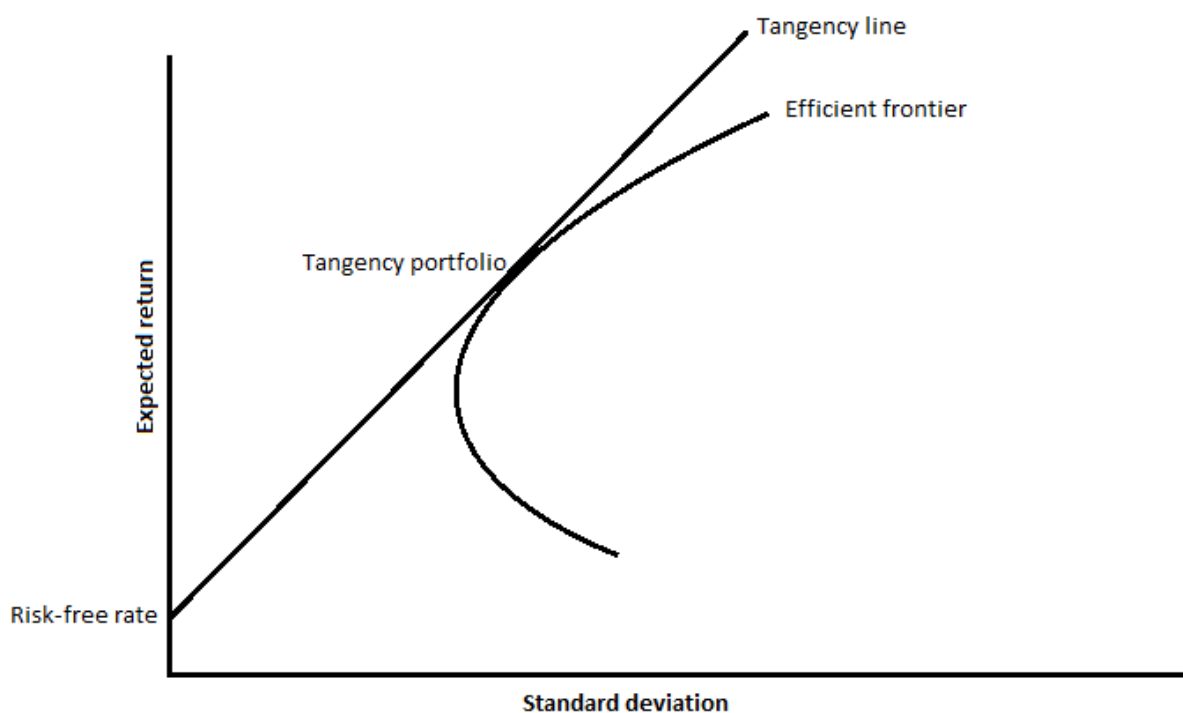


Figure 1: Efficient frontier and tangency portfolio. The picture shows the efficient frontier and the tangency line from the risk-free rate of return. In the CAPM framework the tangency is the market portfolio which in a mix with a risk-free asset makes up all optimal portfolios. In CAPM the tangency line is the capital market line (CML).

The picture above shows the efficient frontier. This is the part of the parabola above the minimum standard deviation point and contains all efficient portfolios in a mean-variance framework with only risky assets. Combined with a risk-free asset it is possible to achieve the set of portfolios that is located on the tangency line. Note that it is possible to achieve points on the tangency line above the efficient frontier due to unrestricted lending and borrowing at the risk-free rate. The slope of the tangency line is usually referred to as the Sharpe ratio² (Sharpe, 1966) and is used as a performance measurement tool for portfolios.

Sharpe (1964) and Lintner (1965) later developed this theory to the capital asset pricing model, CAPM. In this model, the tangency portfolio developed by Markowitz (1952) and Tobin (1958) is a so-called market portfolio containing all outstanding risky assets weighted with respect to their market capitalization. This holds because of the underlying assumption of efficient markets. Especially that all investors are rational and share the same expectations, hence holds the same assets. If an asset is on the market but not held by any investor the price would drop and return go up. This eventually means return-risk maximizing investors would buy the stock and hold it in their portfolios. The price will therefore adjust upwards until equilibrium. It can be shown

² Originally called the “reward to variability ratio” in his article from 1966

that for all assets in the economy this equilibrium would be when the portfolio contains the asset in a proportion equal to its market capitalization relative to the sum of all outstanding assets market capitalization. Hence the tangency portfolio which is optimal to combine with the risk-free asset is the market portfolio containing all assets in the economy. In practice, a well-diversified benchmark index containing a large amount of stocks are used.

CAPM is a linear model describing the relationship between return and a single risk factor in the form of beta. Mathematically the formula is:

$$E[r_i] = r_f + \beta_i(r_m - r_f) \quad (3)$$

The intuition behind CAPM is, that in an efficient market setting, all firm specific risk can be diversified away and hence only risk not possible to diversify, systematic risk, should be rewarded with expected return. The exposure to systematic risk of an asset is measures by Beta, β , and is defined as:

$$\beta_i = \frac{cov(r_i; r_m)}{Var(r_m)} \quad (4)$$

Beta is the only factor in the model and $(r_m - r_f)$ the slope of the so-called security market line which is a graphical representation of CAPM and shows the amount of return per unit of systematic risk. If CAPM holds then all portfolios would have the same slope because the only tradeoff is return versus systematic risk. This however has been shown not to hold empirically, for example with portfolios of small stocks being able to beat the market in a way not explained by Beta (Reinganum, 1981). Though, even if the size premium is well known in the financial world, there are also research pointing in the opposite direction showing no consistent size-return relationship, see for example Horowitz, Loughran and Savin (2000).

2.2 Return premiums

Since the development of the modern portfolio theory and CAPM, many asset pricing models has evolved trying to explain the returns not captured by the CAPM. The most famous of these should be the Fama and French three factor model (Fama and French, 1993) that includes both book to market and size as additional factors to the Beta. This model has proved to perform empirically better than CAPM since it captures some of the return premium associated with small stocks and value stocks (Fama and French, 1996). Small stocks in this case is the ones with relative low market capitalization and value stocks those with relative high book to market

ratio. The size premium has long been recognized and means that there is a negative relationship between market capitalization and return with small stocks consistently being able to beat large stocks over the long run (Banz, 1981). However, this extra return is not free of risk as smaller companies are more risky than large.

The book to market is usually viewed as a proxy for under or overvaluation of a stock with high book to market meaning a low price relative to the company's book value. Fama and French (1998) showed that during a test period of 1975-1995, global portfolios consisting of high book to market stocks outperformed portfolios with low book to market stocks by 7,68% on a yearly basis. Why this return premium exists is not completely acknowledged.

Jegadeesh and Titman (1993) found that portfolios constructed based on momentum could earn abnormal returns over three to twelve-month holding periods. Their momentum strategy is to buy stocks with a good recent performance and sell the low performing stocks. According to their research, these significant abnormal returns is not due to systematic risk nor due to delayed stock price adjustments. Rouwenhorst (1998) test this momentum strategy in twelve countries and find that a strategy of buying past winners outperforms a strategy of buying past losers in all countries. They also find that this effect is present for around one year on average. This one year effect is confirmed by Forner and Marhuenda (2003) who favor a 12-month momentum strategy on the Spanish stock market. Furthermore, Cooper, Gutierrez and Hameed (2004) shows that the performance of a momentum strategy is deeply dependent upon the market state, something that is reinforced by Muga and Santamaria (2007) who find that the momentum effect disappears after the 1997 Spanish stock market crisis. Fama and French (2012) tests for return momentum in North America, Europe, Japan and Asia pacific. They find momentum effects in all markets expect for Japan and additionally present evidence against the existence of integrated pricing across these regions.

Asness, Moskowitz and Pedersen (2013) find evidence for the existence of a global value and momentum premia. They also stress the importance of studying value and momentum in a joint manner. In their study, they show that portfolio strategies based on both value and momentum can earn significant abnormal returns. However, their result in particular supports a portfolio strategy where the construction is based on a combination of value and momentum rather than looking at these characteristics separately. They therefore propose a so-called combo-factor made up of equal parts value and momentum factors to be included in asset pricing models. A

literature review by Chan and Lakonishok (2004) also shows that investing based on value can produce higher returns.

2.3 Random walk theory

The random walk theory has its roots in the efficient market hypothesis. This theory states that the market consists of a large amount of profit maximizing investors that all tries to predict future stock prices and all have access to all available information. This means that the stock prices reflect both the past and the expected future events that effect the price. However, some disagreement amongst investors regarding the fundamental value of the stocks will result in fluctuations of the market price around this fundamental value. The random walk theory states that these fluctuations will be completely random (Fama, 1995).

More technically, the information that all investors have access to are considered to arrive to these market participants in a statistically independent way. Hence this information reach the investors in an unpredictable manner. If the efficient market hypothesis holds and all investors act immediately to all newly available information, then this also means that these actions and the following price movements of the stock should be statistically independent as well (Danthine and Donaldson, 2015).

Under the efficient market framework, the return of a stock is assumed to be independently and identically distributed across time (i.i.d.). This holds for stock returns as they can be considered a stationary process which usually is not the case for stock prices. The independently and identically distributed property means that the returns comes from the same distribution and are independent of each other over time. This would then lead to a completely random walk of the return within the limits of a certain distribution. The equation below can typically be used to model stock returns over shorter time periods (Danthine and Donaldsone, 2015):

$$r_{t,t+\Delta t} = \mu\Delta t + \sigma\sqrt{\Delta t}\varepsilon_t \quad (5)$$

Where μ is the long run mean and ε_t a stochastic process with mean zero and constant variance, i.e. $\varepsilon_t \sim N(0, 1)$. The returns are assumed to be normally distributed with a variance that is scaled based on the change in time:

$$r_{t,t+\Delta} \sim N(\mu\Delta t, \sigma^2\Delta t) \quad (6)$$

3. Data and Method

3.1 Data

The sample from which the stocks in this study are selected from consists of all large cap stocks included in the Nasdaq OMX Nordic exchanges (Nasdaq, 2017)³. The stocks on this list consist of all large cap stocks combined from the Swedish, Danish, Icelandic and Finish Nasdaq exchanges. As of April 2017, the total number of stocks in this list is 180. The test period for which value and momentum effects will be measured are 2005-01-01 to 2016-01-01 and hence only stocks listed over the full test period are included in the study. Furthermore, only one stock per company are included. This means that if a company has more than one stock outstanding (e.g. a, b and c stocks) then only one of these are included. This especially makes sense when testing for value effects as the book value of a company with more than one stock are not used twice. The selection of stocks for these companies is based on the turnover of the stocks. When a company has multiple stocks, the one with highest turnover are included. Data on stock prices, book value and market values are collected from Thomson Reuters DataStream.

Country	Denmark	Sweden	Finland	Iceland	Total
Nr of stocks	28	57	22	1	108
Avg book to market	0,601	0,677	0,732	0,719	0,664
Stdev	0,385	0,416	0,377	-	0,397
Min	0,114	0,026	0,186	0,719	0,026
Max	1,465	1,713	1,509	0,719	1,713
Avg momentum	0,185	0,156	0,113	0,198	0,154
Stdev	0,089	0,118	0,088	-	0,107
Min	0,007	- 0,015	- 0,057	0,198	- 0,057
Max	0,410	0,540	0,260	0,198	0,540

Table 1: Descriptive statistics. The chart above shows the number of stocks from each country on the Omx Nordic large cap list. The sample is skewed towards Swedish stocks which take up more than half of the sample. The average yearly book to market and momentum are shown together with standard deviation and max/min values. Finland has the highest average book to market but the lowest average momentum. Denmark on the other hand has the lowest average book to market and the highest momentum (Iceland excluded).

³ <http://www.nasdaqomxnordic.com/index>

One company lacks book value and are therefore excluded from the sample⁴. Furthermore, there is a need for 12 months of price data before the test period to calculate momentum. Therefore, the companies included must have been listed at least one year before the test period starts. This is extended to 24 months to get rid of possible return-effects after the listing of a stock (IPO effects). Several studies have shown that initial public offerings of stocks (IPO) are underpriced and therefore experience large returns over the first trading day. However, after the initial price increase there is a tendency for these stocks to underperform relative to its market peers, see for example Ritter (1991) and Carter, Dark and Singh (1998). Thus, the stocks included are the ones that fulfil the requirements listed above and have price data between 2003-01-01 to 2016-01-01. This leaves us with a sample of 108 stocks which should be acceptable for this kind of study.

The method of including only large cap stocks is also applied by Asness, Moskowitz and Pedersen (2013). Including only the largest and most liquid stocks is a good idea as it takes away some of the possible liquidity premium effects that could be associated with smaller stocks. Thus, it is possible to make more conclusions about value and momentum effects as these effects and liquidity effects are separated in a better way than if mid and small cap stocks was included. The results will also be more conservative as the small cap stocks has tendency to outperform the large caps.

3.2 Data processing

The data for all stocks are imported to and processed in Microsoft Office Excel. The measures used in this study are stock return, book to market and momentum. Returns are calculated using the arithmetic method rather than the geometric because of the possibility to calculate portfolio returns using a simple average of the stock returns included in the portfolio. This is in line with the modern portfolio theory developed by Markowitz (1952) which uses arithmetic returns for calculating weighted portfolio returns. Monthly stock prices are used to calculate stock returns.

$$R_t^i = \frac{P_t^i}{P_{t-1}^i} - 1 \quad (7)$$

Where R_t^i is the return of a stock between time t-1 and t and P is the price.

Book to market are the company's book value of equity divided by the market value of equity. These values are needed in January every new year to re-sort the portfolios. Asness, Moskowitz

⁴ See appendix A for information about which stocks are included

and Pedersen (2013) uses book values which are lagged 6 months. This is common when testing factor pricing models as it ensures the availability of book values to investors. It however complicates data processing and interpretation in this study why I chose to use book values not lagged. This is the method of Fama and French (1992) and due to Asness, Moskowitz and Pedersen (2013) there is only a small gain using lagged values as the two methods yield nearly identical results. Also, this study is not about testing asset pricing models but rather to examine the possible advantages of using portfolio strategies based on value, momentum or a combination of both. Book to market are calculated as:

$$Book\ to\ Market_t^i = \frac{BE_t^i}{ME_t^i} \quad (8)$$

Where BE_t^i is the book value of equity for a firm i at time t and ME_t^i the market value of equity at the same time. The book and market value of equity are therefore matched simultaneous in time.

Momentum is measured as the previous 12-month cumulative return excluding the very last month to avoid the one month reversal in stock returns that could be described by microstructure or liquidity effects (Asness, Moskowitz and Pedersen, 2013; Jegadeesh and Titman, 1993).

$$Momentum_t^i = \prod_{t=t-12}^{t=t-1} (1 + R_t^i) - 1 \quad (9)$$

Where R_t^i is the return of each asset i at every time t . The next side shows a graph presenting the development of momentum over time for the full sample of stocks. It is evident that the financial crisis in 2008 caused a massive drop in momentum. It can also be seen that the period after the financial crisis experienced some really high cumulative returns.



Figure 2: Momentum development. The diagram above shows the average monthly momentum for all 108 firms over the test period. As seen there is a large momentum “crash” during the financial crisis around 2008. There is also a large recovery in terms of momentum after the crisis when stock prices move back old levels.

3.3 Portfolios

Based on the measures presented above all stocks are sorted into three portfolios (small, medium, high) based on the stocks relative book to market (value) against the other stocks. This is repeated for momentum which means a total of 6 portfolios will be examined ($3 \times 2 = 6$). Thus the 1/3 of stocks with a low book to market are sorted into the “low” BE/ME portfolio, the 1/3 of stocks with medium book to market in the “medium” BE/ME portfolio and the rest 1/3 in the BE/ME portfolio labelled “high”.

The same process is made using momentum, i.e. the 1/3 of stocks with low momentum goes in the “low” momentum portfolio and so forth. It should be noted that the sorting based on book to market and momentum are separate and hence the stocks used in both sorting’s are the same (i.e. same stocks used in both BE/ME and momentum-portfolios)⁵. The first sorting is made at the beginning of year one in the test period (2005-01-01) and the stocks are thereafter resorted the first day of each year in the test period, hence 11 re-sorting’s of the stocks (in total $11 \times 2 = 22$ sorting’s). Yearly resorting follows the methodology of Fama and French (1992) which sorts their stocks in June each year. However, semi-annual, quarterly or monthly re-sorting might perform better empirically in an efficient market setting. This might be an important point in theory, especially for the momentum measure which might have a decaying effect. But more than annual re-sorting might also increase transaction costs and the time put on sorting which is an important practical effect that could diminish the possible advantages of frequently

⁵ See appendix B and C for detailed information about how the portfolios are constructed.

updating the portfolios. Furthermore, Jegadeesh and Titman (1993) found significant momentum effects over three to twelve months and Rouwenhorst (1998) found evidence that this effect is present for about one year on average. Forner and Marhuenda (2003) found a 12-month momentum strategy to be especially effective. Therefore, it could be considered that annual re-sorting is a reasonable.

The return of each portfolio is measured as an equal weighted return of the stocks included in the portfolio. Asness, Moskowitz and Pedersen (2013) value weights the return. However, because we are only dealing with the largest and most liquid stocks on the Nordic exchanges the results should not be substantially affected. The return on the portfolios is calculated as:

$$R_t^{P,S} = \frac{1}{n} \sum R_t^i \quad S \in (BE/ME, momentum) \quad (10)$$

Where $R_t^{P,S}$ is the return of a portfolio formed is based on the signal S and n is the number of stocks included in the portfolio (n=108/3=36 stocks).

The excess return that will be used when presenting the results are therefore:

$$r_t^{P,S} - r_{ft} = \frac{1}{n} \sum r_t^i - r_{ft} \quad S \in (BE/ME, momentum) \quad (11)$$

The average excess portfolio returns are simply an average of the monthly excess returns over the test period. It will be converted to an annualized value using:

$$\bar{r}_{annual}^P = (1 + \bar{r}_{monthly}^P)^{12} - 1 \quad (12)$$

Where the average monthly return during the test period (excess returns) are compounded to an annual figure.

3.4 Market-neutral portfolios

To further investigate the book to market and momentum effects, two market neutral-portfolios are formed (one based on book to market and one based on momentum). These portfolios are so called zero-cost portfolios which mean they are made up of a combination of long and short positions in the stocks included. The negative and positive positions should be bought simultaneously at an equal amount summing up to a zero net-investment portfolio. For these portfolios, all stocks in the sample are included which means there are 108 stocks in the value (BE/ME) portfolio and the same amount in the momentum portfolio. The strategy of combining long and short positions are used to hedge a portfolio against unwanted risk which means lower

but more stable returns. In reality, this hedge-strategy should carry some costs and involve collateral for the short positions. This study will work under the assumptions of zero trading costs and unrestricted short selling which is not unrealistic since we deal with the largest securities that should trade at very low transaction costs.

The same weighting system as in Asness, Moskowitz and Pedersen (2013) are used which mean that each stock is weighted in respect to its cross-sectional rank based on either value or momentum.

$$w_{it}^S = c \left(rank(S_{it}) - \frac{\sum rank(S_{it})}{N} \right) \tag{13}$$

Where w is the weight given to stock i on time t and N the total number of stocks (108). C is a constant which is included to scale the portfolio to 1 SEK long and 1 SEK short. The weights will be linearly increasing from the 1st to the 54th ranked stock (negative) as well as for the 55th to 108th ranked stocks (positive). The 54th and 55th stock will therefore act as the breaking point for the long and short side of the portfolio at every re-sorting meaning the market neutral portfolios are divided into equal amount of long and short positions.

This type of weighting will remove potential problems with outliers compared to a weighting based on each stocks signal (value or momentum). The scaling constant c will ensure that the portfolios are 1 SEK long and 1 SEK short, meaning the weights sum to one and can be interpreted both in terms of percentage or currency of that stock.

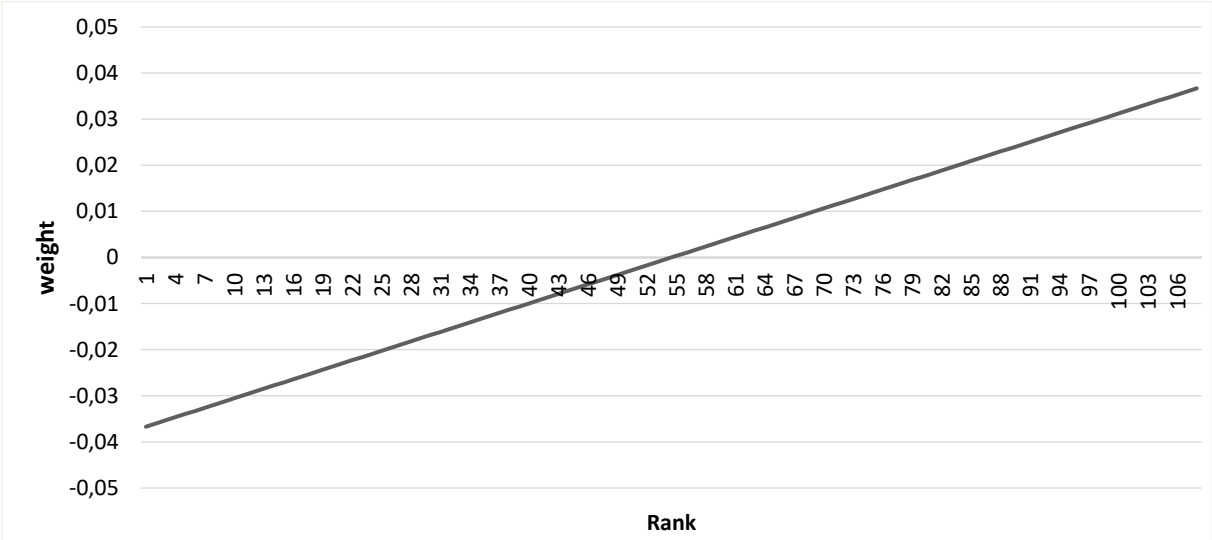


Figure 3: Weighting of market-neutral portfolios. The diagram above shows the weights given to all 108 stocks based on their cross-sectional ranking at every re-sorting. The weights are linearly increasing from -0,03669 to 0,03669 with a breaking point between the 54th and 55th stock.

The return of the market neutral portfolios is thereafter computed as a weighted sum of the individual stocks return:

$$r_t^S = \sum w_{it} r_{it} \quad (14)$$

Where w_{it} is the weight given to each stock based on its cross sectional ranking with respect to the signal S (value and momentum). The portfolio return is therefore the sum of each stocks weighted return.

In line with Asness, Moskowitz and Pedersen (2013) a so-called combo measure is also constructed which is made up of equal parts from the value and momentum factors. This will examine if there are additional benefits of combined portfolio strategies based on both measures. The return of the combined factor is the equal weighted return of the two market-neutral value and momentum portfolios:

$$r_t^{COMBO} = 0.5r_t^{VALUE} + 0.5r_t^{MOMENTUM} \quad (15)$$

3.5 Testing portfolios

To examine the difference in performance between the “low” and “high” portfolios the high minus low spread will be calculated as the difference in average monthly return on the low and high portfolios. This measure will be labelled High-Low and is expected to be positive if looking at old research. The statistical significance of this difference is then estimated using a two-sample t-test of the two portfolios return:

$$H_0: \bar{r}_{high} - \bar{r}_{low} = 0$$

$$H_A: \bar{r}_{high} - \bar{r}_{low} > 0$$

The Sharpe ratio and Jensen’s alpha will be used as performance evaluation tools. The Sharpe ratio measures the amount of excess return of each portfolio relative to its standard deviation in return (risk). A higher Sharpe ratio therefore means a better performance in terms of return per unit of risk. The formula is:

$$Sharpe\ ratio = \frac{r_p - r_f}{\sigma_p} \quad (16)$$

Where $r_p - r_f$ is the annualized excess return of the portfolio and σ_p the annualized standard deviation of the portfolio return. Because this study uses monthly data the standard deviation must be approximated annually using:

$$\sigma_p^{Annual} = \sigma_p^{monthly} * \sqrt{12} \quad (17)$$

Jensen's alpha is another way of examining the portfolios and looks at the performance relative to some benchmark index (market index). Jensen's alpha for a given portfolio p is given by the intercept term α in the following OLS regression:

$$r_{pt} - r_{ft} = \alpha_p + \beta_p(r_{mt} - r_{ft}) + u_t \quad (18)$$

Where r_{pt} is the return on portfolio p at time t and r_{ft} the risk free rate. The market return at every time is given by r_{mt} and u_t is the error term. The Nordic index Nasdaq OMX Nordic all-share will be used as the market index. If α_p is statistically different from zero then the portfolio of interest has under or outperformed the market portfolio in a statistical significant way depending on the sign in front of the term. The null hypothesis of interest is therefore:

$$H_0: \alpha_p = 0$$

$$H_A: \alpha_p \neq 0$$

The risk-free rate used for these tests is the Swedish statslåneräntan, SLR, (Riksgälden, 2017). This is a weighted interest rate from all government bonds with a remaining time to maturity of at least 5 years. It is made to reflect the current long term risk-free market rate and should be a good proxy for the risk-free rate in this study. This is also the interest rate that will be used to calculate excess returns of all portfolios when presented in the result section.

The SLR is only presented once a week (every Thursday) and is thereafter valid until the next rate is released. The interest rate used is the one that is valid on the 1st every month between 2005-01-01 until 2016-01-01. This matches the monthly stock price data that is also updated on the 1st every month. The interest rate from Riksgälden is expressed as an annual percentage and must be converted to monthly values to fit the data in this study:

$$r_f^{monthly} = (1 + r_f^{annual})^{1/12} - 1 \quad (19)$$

Where r_f^{annual} is the annual interest rate retrieved from Riksgälden (Riksgälden, 2017) and $r_f^{monthly}$ the calculated monthly values. This approximates the monthly risk-free interest rate and hence matches the monthly return data of the portfolios. The graph below shows the development of SLR over time:

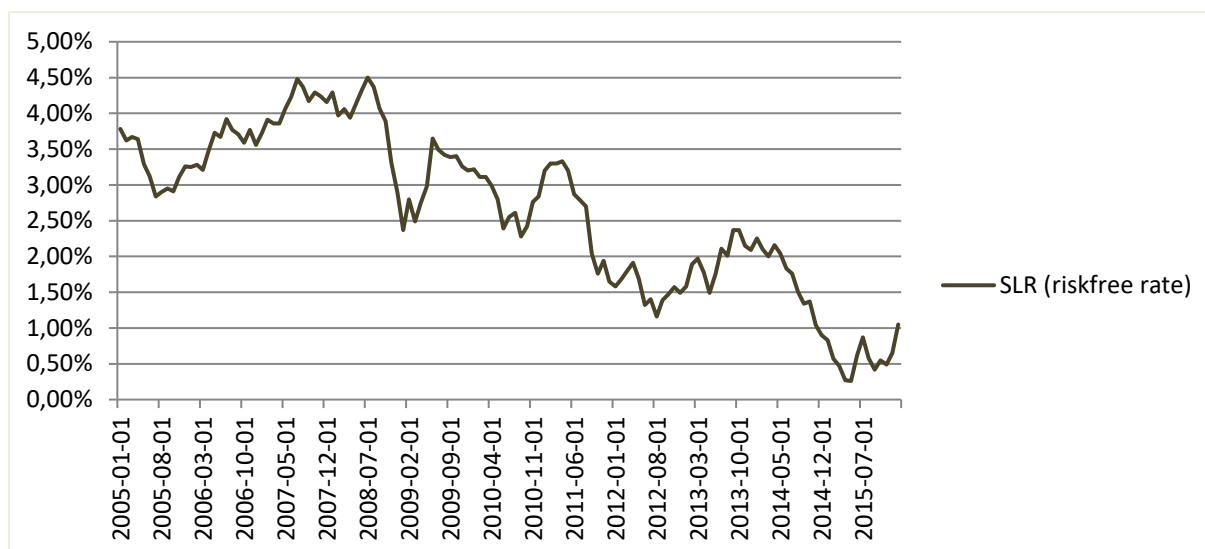


Figure 4: Development of statslåneräntan. The development of statslåneräntan over the test-period shows a decrease over time.

3.6 Criticism of the method

Even though the sample size and the timeframe chosen should be appropriate to do inferences from the data there is of course drawbacks that should be mentioned. One of them is the test period at 11 years which makes the data mining manageable and also covers the financial crisis. However, Asness, Moskowitz and Pedersen (2013) for example uses around 40 years of data which smoothens out effects of turbulent periods and makes it easier to draw conclusions based on cumulative returns. Also, a bigger timeframe would increase the number of data-points which helps when making statistical inference, especially with monthly return-data which should have large variance. Another thing to criticize is the sample size which is important in this kind of study that sorts a sample into a set of portfolios. 108 stocks in total makes the number of stocks in each portfolio 36 which should be enough to weaken the effects of individual stocks. However, one important aspect is to get enough of stocks between the low and high portfolios so that conclusions can be made about the difference in return. If the amount of stocks in the portfolio that separates these two groups (the medium portfolio) is too small then it would be hard to make any inferences. Asness, Moskowitz and Pedersen (2013) uses an average (minimum) of 147 (76) stocks in the United Kingdom which in terms of size could be considered fairly similar to the Nordic countries included combined. For the full Europe sample

they use an average (minimum) of 290 (96) stocks. 108 stocks could therefore be considered appropriate. 108 stocks are furthermore all available stocks on the Nordic Nasdaq exchanges when removing inappropriate stocks. This study solely focuses on the on the large cap companies that is listed on the Nasdaq OMX Nordic exchanges. Including Norway would have made it possible to draw conclusions about the whole Nordic region that now only focuses on Sweden, Denmark, Finland and Iceland. Excluding Norway has some small advantages. For example, that they are not part of the European union which might mean higher transaction costs and different behaviour of the firms, but also that they are heavily influenced of the energy, oil and shipping industries.

4. Results

The table below shows the annual return of all low, medium and high portfolios together with two of the most common performance indicators, the Sharpe-ratio and Jensen's alpha. The annual returns and standard deviations are calculated from the monthly return-series. As can be seen for the portfolios sorted on value, there is a larger average return for the medium portfolio than the low and an even higher return for the high portfolio. However, the increased return based on the sorting is also accompanied with an increased standard deviation which leads to the low portfolio getting the highest Sharpe-ratio. This means that the low portfolio has the highest return to risk ratio of all three portfolios formed based on value. Jensen's alpha is positive for all portfolios with the high portfolio showing the largest absolute figure. This result, and the alpha for the low portfolio, is also significantly different from zero at a 5% significance level. However, with the high and low portfolio showing almost the same alpha (despite an 4% higher return of the high portfolio) means that the high portfolio has about the same performance as the low when adjusting for systematic risk. The analysis shows a higher absolute performance for the high portfolio but it seems that it is mainly attributed to a higher risk which lowers the return to risk ratio, something that is important for investors when evaluating performance.

	Value			Momentum		
	Low	Medium	High	Low	Medium	High
Mean return	12,00%	12,84%	15,96%	15,24%	12,27%	13,27%
Stdev	15,18%	19,88%	22,38%	22,62%	17,46%	18,29%
Sharpe ratio	0,79	0,65	0,71	0,67	0,70	0,73
Jensen's alpha	5,21%	3,90%	5,88%	5,26%	4,41%	5,31%
(t-value)	2,85	1,73	2,05	1,70	2,24	2,07
(p-value)	0,005	0,086	0,042	0,092	0,027	0,041

Table 2: Portfolio results. The table shows the excess return of the portfolio strategies based on either value or momentum. Returns and standard deviation are presented as an annual figure but is calculated using the monthly return-data. Furthermore, two common portfolio evaluation measures are presented, the Sharpe-ratio and Jensen's alpha. The t-statistic and p-value for the alpha (intercept) is also reported.

The momentum portfolios show no clear return patterns but the low portfolio has a higher average return compared to the two other portfolios, contradictory to much previous research. Looking at the data in detail shows that the sorting in 2009 has a big impact on the average return of the momentum portfolios. The financial crisis makes the bad performing stocks in 2008 to be sorted in the low portfolio in 2009 and the decent performing stocks to be sorted in

the high. During 2009, the stocks that fell a lot in 2008 shows a strong recovery while the stocks that more or less kept its level in 2008 doesn't rise as much during 2009. This makes the low portfolio perform really well in 2009 which increases the average return. This is important to keep in mind as it might affect the conclusions being made from this study. The standard deviation (risk) of the momentum portfolios show the same pattern as the value portfolios with a higher average return being accompanied with higher standard deviation. The Sharpe-ratios are similar and the medium and high portfolio have a significant intercept at the 5% significance level. The intercepts are high both for the value and momentum stocks which might be to the weighting or possibly an underperformance of the small and mid-cap companies in the OMX Nordic all-share index during the test-period.

Below are diagrams showing the cumulative return of all value and momentum portfolios during the test period. This gives a view of the development over time in addition to the averages presented above.

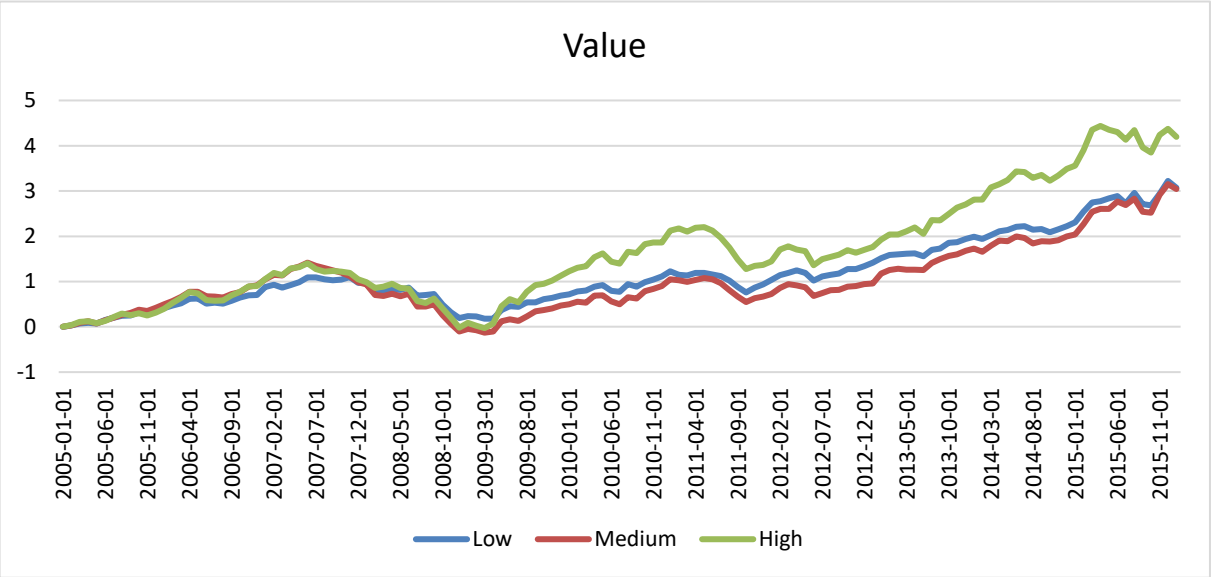


Figure 5: Cumulative return, value-portfolios. The figure shows the cumulative return for all portfolios sorted on book to market (value). They seem to perform similarly before the financial crisis but the high value portfolio thereafter drifts away upwards from the other portfolios.

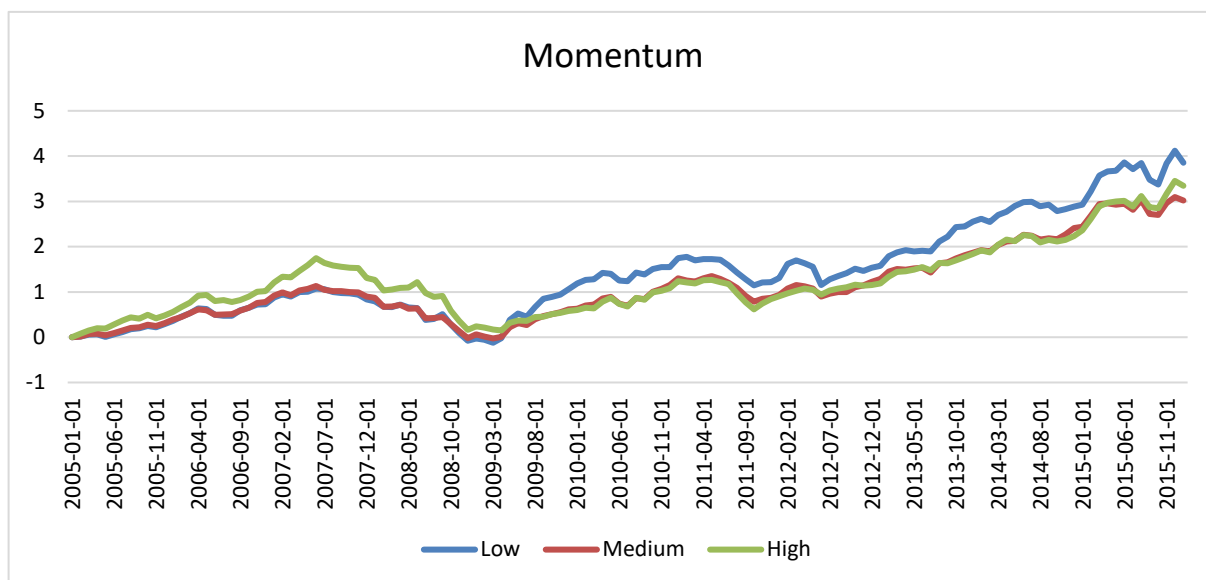


Figure 6: Cumulative return, momentum portfolios. The figure shows the cumulative return for all portfolios sorted on momentum. The momentum effect seems to disappear after the financial crisis.

All three value portfolios experience a large downturn during the financial crisis. The high portfolio shows the fastest and largest recovery and outperforms the two other portfolios to the end of the test-period. The medium and high portfolio seems to experience a larger drop during the crisis compared to the low portfolio. But the medium portfolio doesn't show the same recovery as the high. The high momentum portfolio starts of well but then has the largest downturn during the financial crisis in 2008. After this point, the high portfolio shows no sign of the additional performance before the crisis as the low portfolio outperforms the others over the full test-period. This could be due to the frequency of which the momentum portfolios are re-sorted or a changed view regarding the momentum as a concept. The result is interesting as a strategy based on buying previous winners and selling previous losers doesn't seem to be a very good approach at this frequency of updating and/or at this sample of stocks.

To further examine the possible advantages of picking stocks based on value and momentum, the high minus low spreads and market neutral portfolios are presented. Also reported are the 50/50 combination strategy of value and momentum. The high minus low spread for the portfolios sorted on value could be seen as the average spread between a value and growth portfolio. The high minus low spread for the portfolios sorted on momentum could be viewed as the average spread between a portfolio containing past winners and a portfolio containing past losers (relatively bad performing stocks).

	High minus Low		Market neutral portfolios		
	Value	Momentum	Value	Momentum	50/50 combo
Mean	3,57%	-1,73%	2,31%	-4,01%	-0,90%
Stdev	11,86%	14,14%	11,78%	13,97%	5,92%
(t-value)	0,43	-0,20	0,65	-0,95	-0,50
(p-value)	0,333	0,421	0,266	0,241	0,339
Sharpe ratio	0,30	-0,12	0,20	-0,29	-0,15

Corr(Value, Momentum)=-0,59

Table 3: Results for zero-cost strategies. The table presents the annualized mean return, standard deviation and t-statistic for the high minus low spreads and market neutral/zero-cost portfolios. The high minus low spread is simply the difference in return of the high and low portfolios for both the value and momentum strategies. The 50/50 combination strategy of the zero-cost value and momentum portfolios are the equal weighted return of the zero-cost value and momentum portfolios. Shown are also the Sharpe-ratio for all portfolios and the correlation between the zero-cost value and momentum returns. All figures are annual but calculated from the monthly data.

The high minus low spread for the value portfolios shows a positive value that could be viewed as economically meaningful. This figure is however insignificant when performing a two-sample t-test of the two portfolios. The mean return and the Sharpe-ratio is in line with the results of Asness, Moskowitz and Pedersen (2013). The momentum spread however show a negative mean return of -1.73% and hence a negative Sharpe-ratio. This means that on average the portfolio containing past losers has outperformed the portfolio containing past winners in terms of return. As mentioned earlier, this could be due to the frequency of re-sorting, the financial crisis or just that it is not worthwhile to do this kind of sorting based on momentum. The result is statistically insignificant at the 5% level which is the case of all results reported in the table above.

The market neutral portfolios show the same tendency as the high minus low spreads. The market neutral portfolios however consider the full sample of stocks and gives further evidence compared to the high minus low spreads. Still the results are positive returns for the value portfolio and negative returns for the momentum portfolio. The 50/50 combination strategy has a lower volatility due to negative correlation between the return of the value and momentum strategies. This increases the performance (Sharpe-ratio) which is in line with the results of Asness, Moskowitz and Pedersen (2013).

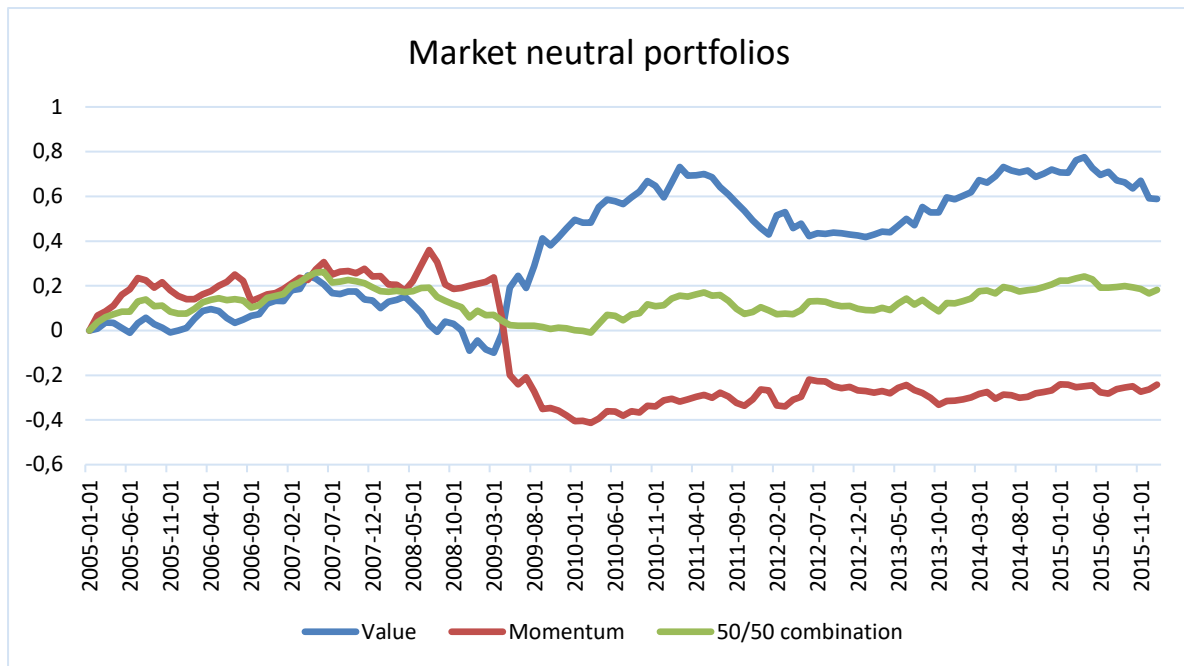


Figure 7: Cumulative return, market neutral portfolios. The graph above shows the cumulative return of the zero-cost value, momentum and 50/50 combination strategies.

The diagram above shows the cumulative return for the long-short, zero-cost value, momentum and 50/50 combination strategy. The momentum portfolio has a slight advantage up to the financial crisis but then experience a large drop and never really recover compared to the value portfolio. The zero-cost value portfolio has a large cumulative return between 2009 and 2011 and is also the portfolio with the highest average performance after the financial crisis in 2008. Based on the results above there seem to be no advantages of sorting stocks based on momentum, at least not on a yearly basis. The value strategy shows more promise as both the high minus low spread and the zero-cost strategy has positive returns that are not statistically significant but might be economically meaningful. The 50/50 combination strategy are an average of the two other strategies when looking at the graph above. However, when considering that the combination strategy decreases the volatility it does show an increased performance.

5. Discussion and conclusions

The results of this study don't give a clear answer to whether portfolio construction based on picking value and/or high momentum stocks earn higher returns. The large variance in the data makes it hard to draw any safe conclusions. What can be said is that the portfolio with high book to market has a large and economically meaningful excess return over the low portfolio. It however also has a higher volatility which means that the return to risk ratio falls at the same level as the low portfolio. Jensen's alpha for the high portfolio is larger than for the low but the difference is not as big considering the difference in average return. This indicates that the increased return also carries a higher systematic risk as the systematic risk-adjusted return is similar between the high and low portfolio. It therefore seems as the higher return is attributable to higher risk. This contradicts the findings of Huang, Yang and Zhang (2013) who find that value stock has lower return volatility than growth stocks in the Chinese stock market. It also in some sense contradicts Denis et al (2013) who find that the value premium is driven by mispricing, i.e. undervaluation of value stocks compared to growth stocks.

The same pattern as for value stocks can be found for the momentum portfolios with higher return being accompanied with higher risk in terms of variance. The momentum portfolios, both the standard ones and the zero-cost, give no support to strategies based on picking previous winners. This supports the random walk theory which suggests that stock picking based on this kind of measure can't produce superior results as the stock movements are random. The underperformance in terms of return of the high-momentum portfolio cast doubts to whether it is worthwhile to pick stocks based on recent performance. Following the results in this thesis it could possibly even be harmful to do so, at least when there is a long investment-horizon. A detailed momentum study in the Nordics comparing different frequencies of re-sorting would be interesting as it is reasonable to believe that the return effect is decaying at a rate that might make semiannual, quarter-annual or even monthly re-sorting more appropriate. Furthermore, the financial crisis seems to have had a large impact on the momentum portfolios. It looks like a momentum effect is present before the financial crisis in 2008 and then disappears. This is in line with the result of Muga and Santamaria (2007) who found that the momentum effect vanished after the 1997 Spanish stock market crisis. It is possible to believe that the large downturn around 2008 made investors more careful about investing in stocks solely based on recent performance. The results also support the efficient market hypothesis as obvious momentum effects should be arbitrated away by informed investors in such a setting. It is

possible that the momentum effects experienced earlier have become evident to investors which in turn drives up the prices of these assets and hence diminished or erases these profits.

One interesting aspect of this study is that the financial crisis act as a breaking point when it comes to value and momentum effects. After the crisis, a value effect seems to appear, while at the same time the momentum effect seem to disappear. This is supported by both the standard and market neutral portfolios, even though the test period before the crisis is a bit too short to make any conclusions. It might have been that the financial crisis had an impact on the behavior of investors which led to these changes. As this is an interesting topic, I propose a study that examine what factors drove the possible development of the value and momentum effect around and after the financial crisis.

The suggestion by Asness, Moskowitz and Pedersen (2013) to consider value and momentum strategies together seems to be a valid idea as the combination lowers the volatility. The 50/50 combination strategy gives a negative average return in this study. However, it is still possible to draw the conclusion that value and momentum strategies indeed should be examined together as the returns of the separate strategies are negatively correlated. It would be interesting to further investigate this relationship and create portfolios that are double-sorted using both value and momentum.

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Appendix A: Included stocks

Company	Ticker	Company	Ticker
ASTRAZENECA (OME)	W:AZNS(P)	FINGERPRINT CARDS 'B'	W:FING(P)
WILLIAM DEMANT HLDG.	DK:WDH(P)	MODERN TIMES GP.MTG 'B'	W:MOTB(P)
ABB LTD N (OME)	W:ABB(P)	ALFA LAVAL	W:ALF(P)
HENNES & MAURITZ 'B'	W:HMBF(P)	LUNDIN PETROLEUM	W:LUPE(P)
COLOPLAST 'B'	DK:COL(P)	FLSMIDTH & CO.'B'	DK:FLB(P)
NOVOZYMES	DK:NZY(P)	ROYAL UNIBREW	DK:RBR(P)
SWEDISH MATCH	W:SWMA(P)	NOBIA	W:NOB(P)
AXFOOD	W:AXFO(P)	SKANSKA 'B'	W:SKBF(P)
NIBE INDUSTRIER 'B'	W:NIBE(P)	SKF 'B'	W:SKFB(P)
NOKIA	M:NOK1(P)	SVENSKA HANDBKN.'A'	W:SVK(P)
MAREL	IC:MAR(P)	AMER SPORTS	M:AMEAS(P)
TIETO OYJ	M:TIE1(P)	VESTAS WINDSYSTEMS	DK:VEW(P)
ELEKTA 'B'	W:ELKB(P)	SWEDBANK 'A'	W:SWED(P)
H LUNDBECK	DK:LUN(P)	FISKARS 'A'	M:FKA(P)
NOVO NORDISK 'B'	DK:NON(P)	SEB 'A'	W:SEA(P)
KONE 'B'	M:KNEBV(P)	A P MOLLER - MAERSK 'B'	DK:DSB(P)
SIMCORP	DK:SIM(P)	SYDBANK	DK:SYD(P)
AVANZA BANK HOLDING	W:AZA(P)	ELISA	M:ELIS(P)
ERICSSON 'B'	W:SL@G(P)	HUHTAMAKI	M:HUIF(P)
GETINGE	W:GIND(P)	SAMPO 'A'	M:SAMA(P)
KONECRANES	M:KCR1(P)	JM	W:JMBF(P)
INTRUM JUSTITIA	W:INJ(P)	DANSKE BANK	DK:DAB(P)
GENMAB	DK:GEN(P)	NORDEA BANK	W:NDA(P)
ASSA ABLOY 'B'	W:ASSB(P)	JYSKE BANK	DK:JYS(P)
NOKIAN RENKAAT	M:NOKT(P)	NKT	DK:NKT(P)
SECURITAS 'B'	W:SUBF(P)	SAAB 'B'	W:SAAB(P)
AMBU 'B'	DK:AMB(P)	TELIA COMPANY	W:TEL(P)
KOBENHAVNS LUFTHAVNE	DK:KOB(P)	VOLVO 'B'	W:VOBF(P)
SANDVIK	W:SAND(P)	AF 'B'	W:AFB(P)
ORION 'B'	M:ORNB(P)	SPAR NORD BANK	DK:SNB(P)
BILLERUD KORSNAS	W:BILL(P)	HEXAGON 'B'	W:EKBF(P)
SWECO 'B'	W:SWEB(P)	WARTSILA	M:WRT(P)
TOPDANMARK	DK:TOP(P)	FORTUM	M:FORT(P)
DSV 'B'	DK:DSV(P)	HOLMEN 'B'	W:SM@G(P)
GN STORE NORD	DK:GSN(P)	ROCKWOOL 'B'	DK:ROC(P)
ATLAS COPCO 'A'	W:SR@G(P)	CARLSBERG 'B'	DK:CAB(P)

Company	Ticker
SCA 'B'	W:SW@G(P)
KESKO 'B'	M:KESK(P)
UPM-KYMMENE	M:UPM(P)
OUTOKUMPU 'A'	M:OUTO(P)
STORA ENSO 'R'	M:EGR(P)
HUFVUDSTADEN 'A'	W:HUA(P)
PEAB 'B'	W:HLNF(P)
CASTELLUM	W:CAST(P)
JEUDAN	DK:JEU(P)
ALK-ABELLO	DK:ALK(P)
TDC	DK:TDC(P)
TRELLEBORG 'B'	W:TT@G(P)
METSO	M:MEO(P)
SPONDA	M:SPO(P)
RATOS 'B'	W:RTBF(P)
ATRIUM LJUNGBERG 'B'	W:ATRJ(P)
FABEGE	W:FABG(P)
CITYCON	M:CIT(P)
NCC 'B'	W:NSTF(P)
ELECTROLUX 'B'	W:SE@G(P)
LUNDBERGFÖRETAGEN 'B'	W:LNBF(P)
LATOIR INVESTMENT 'B'	W:LTBF(P)
KUNGSLEDEN	W:KLED(P)
KEMIRA	M:KEMR(P)
BOLIDEN	W:BOL(P)
TELE2 'B'	W:TEL2(P)
DFDS	DK:DFD(P)
SSAB 'A'	W:SSAA(P)
FASTIGHETS BALDER 'B'	W:BALB(P)
METSA BOARD 'B'	M:METB(P)
INDUSTRIVARDEN 'A'	W:IU(P)
KINNEVIK 'B'	W:KIVB(P)
BETSSON 'B'	W:BETS(P)
AKTKT.SCHOUW & CO.	DK:SCB(P)
WALLENSTAM 'B'	W:WBYF(P)
INVESTOR 'B'	W:ISBF(P)

Appendix B: Value portfolios

Low

2005:W:AZNS,DK:WDH,W:ABB,W:HMBF,DK:COL,DK:NZY,W:SWMA,W:AXFO,W:NIBE,M:NOK1,IC:MAR,M:TIE1,W:ELKB,DK:LUN,DK:NON,M:KNEBV,DK:SIM,W:AZA,W:SL@G,W:GIND,M:KCR1,W:INJ,DK:GEN,W:ASSB,M:NOKT,W:SUBF,DK:AMB,DK:KOB,W:SAND,M:ORNB,W:BILL,W:SWEB,DK:TOP,DK:DSV,DK:GSN,W:SR@G,

2006:W:AZNS,DK:WDH,DK:TDC,W:ABB,W:SWMA,W:HMBF,DK:COL,DK:NZY,M:KNEBV,W:ELKB,W:AZA,M:NOK1,DK:SIM,W:AXFO,W:NIBE,M:ORNB,DK:KOB,DK:DSV,W:SWEB,DK:LUN,W:MOTB,W:INJ,DK:NON,W:GIND,M:TIE1,W:SL@G,W:SUBF,DK:GSN,W:ASSB,DK:ALK,DK:AMB,DK:GEN,W:SAND,W:SR@G,DK:FLB,W:ALF,

2007:W:AZNS,DK:WDH,W:SWMA,W:ABB,DK:SIM,DK:COL,W:HMBF,DK:NZY,W:SR@G,W:ELKB,M:KNEBV,W:NIBE,W:AXFO,DK:ALK,DK:GEN,W:AZA,DK:DSV,M:ORNB,W:MOTB,W:GIND,W:SWEB,M:KCR1,DK:NON,W:SUBF,DK:FLB,DK:TOP,DK:LUN,W:ALF,DK:TDC,DK:KOB,M:NOK1,W:SAND,DK:VEW,DK:RBR,W:INJ,DK:GSN,

2008:DK:WDH,W:AZNS,W:ABB,W:SWMA,DK:SIM,W:HMBF,DK:COL,DK:NZY,DK:VEW,M:NOK1,DK:GEN,DK:NON,W:AXFO,W:AZA,M:KNEBV,DK:KOB,W:ELKB,DK:FLB,DK:RBR,M:ORNB,DK:DSV,W:SR@G,DK:TDC,M:WRT,W:SWEB,DK:TOP,W:NIBE,M:NOKT,W:INJ,M:ELIS,W:SAND,W:ALF,DK:LUN,M:KCR1,M:FORT,W:GIND,

2009:W:AZNS,W:SWMA,W:ABB,DK:WDH,DK:GEN,W:HMBF,DK:COL,DK:SIM,DK:NON,DK:NZY,M:ORNB,W:AXFO,M:NOK1,W:SR@G,M:KNEBV,W:AZA,W:ELKB,DK:KOB,DK:ALK,W:SUBF,DK:TOP,DK:VEW,W:INJ,DK:LUN,W:ALF,W:BETS,DK:DSV,M:ELIS,W:SKFB,W:SAND,W:SWEB,W:MOTB,W:NIBE,M:KCR1,W:GIND,DK:TDC,

2010:W:SWMA,W:AZNS,W:ABB,DK:WDH,DK:SIM,W:HMBF,W:AZA,DK:COL,DK:NON,W:ELKB,M:KNEBV,M:ORNB,DK:NZY,W:SR@G,W:MOTB,W:AXFO,W:BETS,W:SWEB,DK:GEN,W:SAND,DK:VEW,W:ALF,M:ELIS,W:SKFB,DK:DSV,W:SUBF,W:INJ,DK:KOB,W:NIBE,W:JMBF,M:KCR1,W:GIND,DK:FLB,W:ASSB,W:SKBF,M:NOKT,

2011:W:SWMA,W:AZNS,W:ABB,DK:NON,W:HMBF,W:AZA,DK:WDH,W:MOTB,DK:COL,W:SR@G,W:ELKB,DK:SIM,DK:GEN,DK:NZY,M:KNEBV,W:SAND,DK:KOB,M:ORNB,DK:DSV,M:KCR1,W:AXFO,W:SKFB,W:ALF,W:LUPE,W:FING,W:SWEB,M:WRT,DK:AMB,DK:FLB,W:SUBF,M:ELIS,M:NOKT,W:ASSB,W:INJ,W:RTBF,W:NOB,

2012:W:SWMA,W:AZNS,W:ABB,DK:NON,W:HMBF,W:LUPE,DK:WDH,DK:SIM,DK:NZY,DK:COL,W:AZA,W:ELKB,M:KNEBV,W:SR@G,DK:GEN,W:MOTB,W:FING,M:ORNB,W:AXFO,DK:KOB,W:ALF,DK:DSV,W:BETS,W:SWEB,W:SKFB,M:ELIS,W:SAND,W:INJ,W:GIND,W:SUBF,DK:AMB,M:WRT,W:SKBF,DK:RBR,W:ASSB,M:NOKT,

2013:W:SWMA,W:AZNS,W:ABB,DK:NON,DK:SIM,M:KNEBV,DK:COL,W:HMBF,W:ELKB,DK:GEN,M:ORNB,W:LUPE,DK:KOB,DK:WDH,W:SR@G,W:AZA,DK:NZY,W:SWEB,DK:DSV,W:SAND,W:SKFB,W:BETS,W:ALF,M:WRT,W:SE@G,W:AXFO,M:KCR1,M:MEO,W:GIND,W:ASSB,M:ELIS,W:MOTB,DK:TOP,M:NOKT,DK:AMB,DK:RBR,

2014:W:SWMA,W:AZNS,W:ABB,DK:SIM,DK:NON,DK:COL,W:LUPE,W:FING,W:HMBF,M:KNEBV,DK:KOB,W:AZA,DK:NZY,W:ELKB,DK:GEN,M:ORNB,W:SWEB,DK:WDH,DK:DSV,W:INJ,W:AXFO,W:SR@G,DK:AMB,W:ALF,W:MOTB,M:NOKT,DK:GSN,M:WRT,M:ELIS,W:ASSB,M:KCR1,W:SKFB,W:SAND,M:MEO,W:JMBF,W:SE@G,

2015:W:LUPE,W:SWMA,W:AZNS,W:ABB,DK:COL,DK:NON,DK:SIM,W:HMBF,DK:KOB,M:KNEBV,DK:AMB,DK:NZY,W:AZA,DK:GEN,M:ORNB,W:SR@G,W:INJ,W:AXFO,W:ELKB,W:SE@G,DK:TOP,W:JMBF,DK:RBR,M:ELIS,DK:WDH,W:BETS,W:ASSB,W:MOTB,DK:GSN,W:ALF,M:WRT,M:TIE1,W:NOB,M:KCR1,W:SKFB,W:NIBE,

Medium

2005:W:FING,W:MOTB,W:ALF,W:LUPE,DK:FLB,DK:RBR,W:NOB,W:SKBF,W:SKFB,W:SVK,M:AMEAS,DK:VEW,W:SWED,M:FKA,W:SEA,DK:DSB,DK:SYD,M:ELIS,M:HUIF,M:SAMA,W:JMBF,DK:DAB,W:NDA,DK:JYS,DK:NKT,W:SAAB,W:TEL,W:VOBF,W:AFB,DK:SNB,W:EKBF,M:WRT,M:FORT,W:SM@G,DK:ROC,DK:CAB,

2006:M:KCR1,DK:RBR,W:SKFB,W:SKBF,W:NOB,DK:TOP,DK:NKT,M:NOKT,W:LUPE,DK:ROC,W:JMBF,W:SE@G,W:EKBF,DK:DSB,M:AMEAS,DK:VEW,W:BILL,M:WRT,M:ELIS,W:SAAB,W:SVK,W:SWED,DK:JYS,M:FORT,M:SAMA,IC:MAR,M:FKA,M:MEO,W:VOBF,M:HUIF,W:HLNF,W:SEA,DK:SYD,W:AFB,W:TEL,DK:DAB,

2007:W:JMBF,M:TIE1,W:NOB,DK:NKT,W:ASSB,W:BOL,W:SL@G,M:ELIS,DK:AMB,W:SKFB,M:WRT,W:FING,W:SKBF,M:NOKT,M:MEO,DK:SYD,W:HLNF,DK:ROC,W:EKBF,M:AMEAS,DK:CAB,M:FORT,W:VOBF,DK:JYS,W:RTBF,W:BILL,W:TEL,W:SAAB,W:SE@G,M:KESK,W:LUPE,M:FKA,W:SEA,M:HUIF,W:SWED,W:AFB,

2008:DK:ROC,W:JMBF,W:SUBF,W:MOTB,DK:ALK,DK:NKT,W:HLNF,M:MEO,W:EKBF,W:BETS,W:SKBF,M:AMEAS,W:VOBF,W:ASSB,W:SKFB,M:FKA,W:FING,W:NOB,M:TIE1,W:TEL,DK:JYS,DK:SYD,W:SE@G,M:KESK,W:IU,DK:AMB,DK:GSN,DK:DFD,W:RTBF,W:LTBF,W:SVK,W:SL@G,W:AFB,DK:SNB,W:SWED,W:TEL2

2009:W:ASSB,M:FORT,DK:AMB,W:SKBF,DK:FLB,W:RTBF,M:WRT,W:SL@G,W:VOBF,M:NOKT,W:TEL,W:LUPE,M:FKA,W:HUA,W:AFB,M:TIE1,DK:JEU,W:KLED,W:CAST,M:SAMA,W:SE@G,W:FING,DK:RBR,W:SM@G,W:JMBF,IC:MAR,W:ATRJ,W:SVK,M:KESK,M:EGR,DK:DFD,W:LTBF,DK:DSB,W:HLNF,W:EKBF,DK:ROC,

2010:W:SE@G,M:NOK1,DK:AMB,W:LUPE,DK:TOP,M:FORT,W:NOB,DK:ALK,W:RTBF,DK:TDC,M:TIE1,W:TEL,W:HLNF,W:VOBF,M:WRT,W:EKBF,W:FING,DK:NKT,DK:LUN,M:FKA,DK:ROC,W:SL@G,W:SVK,M:MEO,W:AFB,W:BOL,W:NDA,M:HUIF,W:TEL2,DK:RBR,W:TT@G,W:BILL,M:SAMA,M:AMEAS,W:SAAB,W:CAST

2011:W:JMBF,W:VOBF,W:SKBF,W:BETS,DK:RBR,W:SE@G,M:FKA,W:NIBE,M:NOK1,M:MEO,W:GIND,W:EKBF,DK:TOP,W:TEL2,W:HLNF,M:FORT,W:TEL,W:AFB,W:LTBF,DK:VEW,M:TIE1,W:BOL,DK:TDC,W:SL@G,DK:ROC,DK:NKT,DK:LUN,M:AMEAS,M:KESK,DK:ALK,W:TT@G,DK:GSN,W:SVK,M:HUIF,W:CAST,M:SAMA,

2012:W:NIBE,W:TEL2,W:RTBF,DK:TOP,W:JMBF,DK:FLB,W:TEL,M:FKA,M:KCR1,W:VOBF,M:NOK1,DK:TDC,W:SL@G,DK:LUN,W:SE@G,W:LTBF,W:EKBF,M:MEO,DK:GSN,M:FORT,W:NOB,M:TIE1,M:AMEAS,DK:ALK,IC:MAR,W:AFB,W:HLNF,W:SW@G,W:BOL,W:CAST,M:KESK,M:SAMA,W:TT@G,M:HUIF,W:SAAB,M:KEMR,

2013:DK:GSN,W:VOBF,W:INJ,DK:FLB,W:FING,W:EKBF,W:SUBF,M:FKA,M:TIE1,W:SKBF,W:JMBF,W:NIBE,W:TEL2,W:TEL,M:AMEAS,W:LTBF,M:NOK1,DK:ALK,W:AFB,M:HUIF,M:KEMR,DK:TDC,W:SW@G,IC:MAR,W:SL@G,W:RTBF,W:BOL,DK:ROC,M:SAMA,W:NOB,W:SVK,W:BILL,W:SWED,M:FORT,DK:CAB,DK:LUN,

2014:DK:RBR,DK:TOP,W:NOB,W:GIND,W:BETS,M:TIE1,W:SKBF,DK:ALK,M:NOK1,W:NIBE,DK:TDC,M:HUIF,W:EKBF,W:SUBF,W:AFB,W:VOBF,DK:ROC,M:AMEAS,W:TEL,W:SW@G,W:LTBF,M:SAMA,DK:VEW,DK:LUN,W:TT@G,DK:FLB,W:SL@G,DK:CAB,W:SWED,W:NSTF,W:SAAB,M:KEMR,W:SVK,W:BILL,DK:JEU,IC:MAR,

2015:DK:DSV,W:SKBF,W:SAND,DK:LUN,W:SUBF,M:MEO,DK:TDC,W:SWEB,M:NOK1,W:TEL2,DK:ALK,W:EKBF,W:AFB,DK:VEW,M:HUIF,W:TEL,W:GIND,M:NOKT,W:SL@G,M:SAMA,W:VOBF,W:LTBF,W:HLNF,M:AMEAS,W:TT@G,W:FING,W:BILL,W:SVK,W:NSTF,W:SWED,W:SW@G,DK:CAB,DK:FLB,W:SAAB,IC:MAR,W:SEA,

High

2005:W:SW@G,M:KESK,M:UPM,M:OUTO,M:EGR,W:HUA,W:HLNF,W:CAST,DK:JEU,DK:ALK,DK:TDC,W:TT@G,M:MEO,M:SPO,W:RTBF,W:ATRJ,W:FABG,M:CIT,W:NSTF,W:SE@G,W:LNBF,W:LTBF,W:KLED,M:KEMR,W:BOL,W:TEL2,DK:DFD,W:SSAA,W:BALB,M:METB,W:IU,W:KIVB,W:BETS,DK:SCB,W:WBYF,W:ISBF,
2006:W:NDA,W:TT@G,W:NSTF,DK:JEU,DK:CAB,DK:SNB,W:SM@G,M:KESK,W:RTBF,W:SSAA,W:FING,M:UPM,W:SW@G,W:BOL,M:EGR,W:CAST,W:FABG,W:KLED,M:SPO,M:KEMR,W:TEL2,DK:DFD,W:HUA,W:BALB,M:CIT,W:BETS,W:ATRJ,W:LNBF,W:LTBF,DK:SCB,M:METB,W:WBYF,M:OUTO,W:IU,W:ISBF,W:KIVB,
2007:IC:MAR,W:NSTF,DK:SNB,W:SVK,W:NDA,DK:DAB,M:OUTO,DK:DSB,M:SAMA,W:TT@G,W:SM@G,DK:DFD,DK:JEU,M:UPM,W:KLED,W:HUA,W:CAST,W:SW@G,M:SPO,M:KEMR,M:EGR,W:FABG,W:SSAA,W:TEL2,W:LTBF,W:ATRJ,M:CIT,W:LNBF,W:WBYF,M:METB,W:IU,DK:SCB,W:ISBF,W:BALB,W:BETS,W:KIVB,
2008:W:SAAB,DK:DSB,W:KIVB,W:LUPE,M:SAMA,M:EGR,DK:JEU,W:NSTF,W:NDA,DK:DAB,W:KLED,W:BOL,DK:CAB,M:OUTO,W:SEA,M:HUIF,DK:SCB,W:BILL,W:SM@G,W:SSAA,IC:MAR,W:SW@G,W:TT@G,M:KEMR,M:UPM,W:HUA,W:LNBF,W:FABG,W:CAST,M:CIT,W:ATRJ,W:ISBF,M:SPO,W:WBYF,M:METB,W:BALB,
2009:W:TEL2,M:AMEAS,W:NDA,W:LNBF,W:SAAB,W:NOB,M:UPM,W:SW@G,M:HUIF,W:SEA,DK:NKT,W:ISBF,M:OUTO,DK:JYS,DK:SNB,M:MEO,W:SSAA,W:IU,DK:SYD,M:CIT,W:FABG,W:TT@G,M:SPO,DK:CAB,W:SWED,DK:GSN,W:WBYF,W:NSTF,DK:SCB,M:KEMR,W:BILL,W:KIVB,DK:DAB,W:BALB,W:BOL,M:METB,
2010:W:LTBF,M:KESK,W:NSTF,DK:SYD,M:OUTO,W:SW@G,W:SSAA,DK:JYS,W:SEA,W:HUA,DK:JEU,W:ATRJ,W:KLED,DK:CAB,W:SM@G,DK:DSB,W:SWED,DK:GSN,IC:MAR,M:CIT,DK:DAB,M:KEMR,W:WBYF,W:LNBF,DK:DFD,DK:SNB,W:FABG,M:SPO,M:EGR,M:UPM,W:IU,W:ISBF,DK:SCB,M:METB,W:KIVB,W:BALB,
2011:M:KEMR,W:HUA,DK:CAB,W:NDA,W:NSTF,W:BILL,IC:MAR,W:SW@G,M:OUTO,DK:JYS,W:IU,W:ATRJ,DK:SYD,M:METB,DK:DSB,W:SEA,W:KLED,DK:JEU,W:FABG,W:SWED,M:EGR,W:LNBF,W:WBYF,DK:DAB,W:SAAB,M:CIT,W:SM@G,M:UPM,W:SSAA,DK:DFD,M:SPO,DK:SCB,DK:SNB,W:BALB,W:ISBF,W:KIVB,
2012:W:SVK,DK:ROC,W:HUA,DK:VEW,W:BILL,DK:JEU,W:NSTF,M:OUTO,W:ATRJ,W:SWED,W:WBYF,W:NDA,DK:CAB,W:KLED,W:SEA,W:SM@G,DK:DSB,DK:NKT,W:FABG,DK:DFD,M:UPM,M:CIT,W:LNBF,W:IU,DK:SYD,DK:JYS,M:SPO,M:EGR,W:KIVB,W:ISBF,DK:DAB,W:SSAA,M:METB,W:BALB,DK:SNB,DK:SCB,
2013:W:HLNF,W:SAAB,W:CAST,W:HUA,W:NSTF,M:KESK,W:WBYF,DK:JEU,W:ATRJ,W:SEA,W:NDA,M:OUTO,W:FABG,DK:DSB,M:METB,DK:NKT,M:CIT,M:EGR,W:SM@G,W:IU,M:SPO,W:LNBF,DK:SYD,DK:DAB,DK:JYS,M:UPM,DK:SCB,W:ISBF,W:KLED,DK:VEW,W:BALB,W:KIVB,DK:DFD,W:SSAA,DK:SNB,W:TT@G,
2014:W:HLNF,W:TEL2,M:FKA,W:SEA,M:FORT,W:RTBF,W:WBYF,W:NDA,M:METB,M:KESK,W:CAST,M:EGR,W:BOL,DK:NKT,W:HUA,W:ATRJ,DK:JYS,DK:DSB,W:SM@G,DK:SYD,W:FABG,M:CIT,W:KIVB,DK:SNB,M:UPM,DK:DFD,DK:SCB,DK:DAB,W:IU,W:KLED,W:LNBF,W:BALB,M:OUTO,M:SPO,W:ISBF,W:SSAA,
2015:M:METB,DK:ROC,W:WBYF,M:KESK,W:BOL,DK:NKT,W:NDA,M:KEMR,W:CAST,M:FKA,DK:SYD,DK:JEU,W:RTBF,M:FORT,W:KLED,W:ATRJ,DK:DAB,M:EGR,DK:DSB,DK:DFD,W:SM@G,W:HUA,DK:SCB,W:FABG,DK:JYS,DK:SNB,M:CIT,W:BALB,M:UPM,W:IU,W:LNBF,M:OUTO,W:ISBF,W:KIVB,M:SPO,W:SSAA,

Appendix C: Momentum portfolios

Low

2005:W:FING,W:TEL2,DK:VEW,W:AZNS,W:BOL,M:METB,M:NOK1,W:SM@G,W:SE@G,W:SW@G,W:KIVB,DK:RBR,W:TT@G,W:ALF,DK:CAB,W:SKFB,W:SAAB,DK:SCB,W:BILL,W:SWMA,M:SPO,M:TIE1,DK:TD C,W:TEL,DK:DSB,DK:LUN,W:MOTB,W:SAND,M:EGR,M:UPM,W:SUBF,W:BALB,W:ABB,W:SVK,W:SR@G ,M:ELIS,

2006:W:FING,W:BILL,M:METB,M:OUTO,DK:ALK,W:AXFO,W:TEL2,M:EGR,M:UPM,M:NOKT,W:SW@G, W:KIVB,DK:LUN,W:SVK,W:ASSB,W:TEL,W:HMBF,W:SM@G,W:LTBF,W:SUBF,M:SPO,M:HUIF,W:BETS,D K:NZY,M:KCR1,W:LNBF,DK:COL,M:AMEAS,W:HUA,W:TT@G,M:FKA,W:NIBE,W:NDA,DK:NON,W:SEA, W:SWMA,

2007:DK:TDC,M:TIE1,W:BETS,DK:DSB,DK:AMB,W:LUPE,W:SVK,DK:GSN,W:TT@G,W:SL@G,M:NOK1,W :AZNS,W:SKBF,DK:KOB,W:SKFB,M:HUIF,M:EGR,W:SUBF,M:METB,DK:LUN,W:TEL2,M:AMEAS,W:SE@G ,W:ASSB,DK:DAB,W:IU,W:ISBF,W:INJ,W:AZA,W:SW@G,W:SWED,W:SM@G,M:UPM,M:KNEBV,DK:JEU, W:SR@G,

2008:DK:GSN,DK:ALK,W:BOL,W:NIBE,W:SL@G,M:HUIF,M:TIE1,W:BILL,W:SAAB,W:NOB,M:OUTO,DK:A MB,W:NSTF,M:METB,DK:SIM,W:ELKB,M:SPO,M:UPM,DK:SYD,W:JMBF,M:KEMR,DK:TOP,DK:RBR,DK:D AB,W:CAST,W:SM@G,W:WBYF,M:CIT,W:AZNS,W:SWED,W:ATRJ,W:SEA,W:SUBF,DK:GEN,W:HUA,W:T T@G,

2009:W:BOL,W:JMBF,M:MEO,W:FING,W:HLNF,DK:ROC,W:NOB,W:NSTF,DK:GSN,W:SWED,M:AMEAS, DK:SYD,W:MOTB,M:SPO,W:TT@G,M:METB,DK:NKT,W:VOBF,W:FABG,W:EKBF,W:SSAA,DK:JYS,M:WR T,DK:CAB,DK:RBR,DK:DAB,M:OUTO,DK:FLB,W:KIVB,DK:SCB,M:NOKT,W:SEA,W:BILL,M:NOK1,W:SAND, W:SAAB,

2010:DK:GEN,M:NOK1,IC:MAR,DK:ALK,DK:LUN,DK:DFD,W:KLED,W:SM@G,DK:JEU,M:EGR,M:UPM,W: HUA,W:AZNS,W:SUBF,DK:TDC,DK:TOP,W:ATRJ,DK:KOB,W:ISBF,W:INJ,M:FORT,W:CAST,W:LNBF,W:AB B,M:ORNB,DK:VEW,W:SL@G,M:ELIS,DK:NZY,M:SAMA,M:WRT,DK:SCB,DK:NON,DK:COL,M:SPO,W:AXF O,

2011:DK:VEW,DK:GEN,DK:ALK,W:SSAA,M:NOK1,DK:SIM,DK:NKT,M:HUIF,M:ELIS,M:OUTO,M:CIT,W:AZ NS,M:TIE1,W:NDA,DK:JEU,W:BETS,DK:TOP,W:SAAB,DK:WDH,W:SE@G,W:ABB,W:SWEB,W:SVK,W:ISB F,W:TEL,M:ORNB,W:SKBF,DK:TDC,W:BILL,DK:LUN,W:KLED,W:SW@G,W:SUBF,M:FORT,W:INJ,DK:SYD,

2012:DK:VEW,DK:GEN,W:NOB,M:OUTO,M:KCR1,W:HLNF,M:NOK1,M:METB,W:SSAA,DK:DAB,DK:SNB, M:EGR,DK:NKT,W:SE@G,W:RTBF,DK:JYS,DK:SYD,W:SAND,W:VOBF,M:UPM,DK:FLB,W:FABG,W:SEA,D K:ROC,W:JMBF,W:IU,M:MEO,W:EKBF,W:BOL,W:AZA,W:NDA,DK:DSB,DK:CAB,W:MOTB,W:NSTF,M:KE SK,

2013:DK:VEW,M:OUTO,M:NOK1,W:MOTB,W:KLED,DK:DFD,W:AZA,W:RTBF,M:FORT,DK:TDC,DK:LUN, W:SSAA,W:HLNF,W:INJ,W:SUBF,W:TEL2,W:SL@G,DK:NZY,W:FING,M:KESK,W:NIBE,W:LUPE,W:SKBF, W:SAAB,DK:FLB,W:AXFO,W:TEL,W:KIVB,W:SWMA,W:HMBF,W:ABB,DK:NKT,W:SM@G,DK:WDH,W:AL F,M:UPM,

2014:M:OUTO,W:BOL,W:SSAA,DK:FLB,W:SAND,M:ORNB,W:LUPE,W:RTBF,W:TEL2,M:MEO,W:GIND,W :SE@G,W:SWMA,IC:MAR,W:ELKB,W:VOBF,M:KEMR,M:KCR1,W:SAAB,M:SPO,W:ATRJ,W:SR@G,W:HU A,W:BETS,M:TIE1,DK:NON,W:CAST,M:KESK,DK:WDH,W:SKFB,M:WRT,DK:CAB,M:CIT,M:ELIS,W:FABG, W:ALF,

2015:M:NOKT,W:FING,W:MOTB,DK:ROC,DK:SIM,W:GIND,M:KEMR,W:ELKB,W:RTBF,DK:WDH,W:LUPE ,DK:FLB,W:SAND,W:KIVB,DK:CAB,W:ALF,W:SW@G,DK:JEU,M:KCR1,W:SKFB,DK:TDC,W:TT@G,W:ABB, DK:GSN,W:VOBF,DK:LUN,M:EGR,W:TEL,IC:MAR,M:WRT,M:MEO,W:SWEB,W:SSAA,M:CIT,DK:KOB,DK: DSB,

Medium

2005:M:AMEAS,M:HUIF,M:SAMA,W:SWED,DK:COL,W:INJ,W:LNBF,W:AFB,W:SEA,W:GIND,M:KNEBV,DK:NZY,W:LTBF,W:ISBF,DK:DAB,W:NDA,DK:NON,W:RTBF,W:SSAA,W:ASSB,M:MEO,W:BETS,DK:WDH,W:HMBF,M:KCR1,M:OUTO,M:KESK,M:KEMR,DK:JYS,W:SKBF,W:AXFO,DK:FLB,W:LUPE,DK:TOP,W:IU,DK:SYD,

2006:M:KEMR,M:TIE1,DK:DAB,DK:CAB,W:CAST,M:ORNB,DK:TOP,W:FABG,W:SE@G,DK:RBR,M:KESK,W:GIND,W:RTBF,M:NOK1,W:SWED,DK:GSN,W:SL@G,W:IU,DK:DFD,DK:WDH,IC:MAR,DK:SNB,DK:GEN,DK:DSB,W:VOBF,W:NOB,W:SAAB,DK:SYD,M:CIT,W:ATRJ,M:ELIS,DK:JEU,M:SAMA,DK:JYS,W:SAND,DK:VEW,

2007:M:ORNB,W:NDA,W:BILL,W:BALB,W:NSTF,W:LNBF,W:SWEB,W:GIND,W:AXFO,M:KEMR,DK:JYS,W:FABG,W:VOBF,W:SAND,W:HMBF,W:SAAB,M:FKA,IC:MAR,W:SEA,DK:NON,W:LTBF,DK:RBR,W:TEL,W:HUA,DK:COL,M:ELIS,W:CAST,W:AFB,DK:DSV,W:KLED,W:SWMA,W:EKBF,W:ELKB,M:SAMA,DK:WDH,W:WBYF,

2008:W:KLED,W:FABG,W:AXFO,W:LNBF,W:IU,DK:JEU,W:LUPE,W:BALB,W:ISBF,W:ASSB,DK:SNB,W:SE@G,M:EGR,W:SKBF,DK:COL,W:MOTB,DK:LUN,W:SKFB,W:SW@G,W:FING,W:SR@G,W:SVK,DK:NKT,M:MEO,M:SAMA,DK:JYS,M:ELIS,M:KESK,M:ORNB,W:NDA,DK:WDH,W:GIND,M:FKA,W:TEL,M:AMEAS,W:AZA,

2009:DK:WDH,W:IU,W:KLED,M:CIT,M:KEMR,DK:SNB,W:BALB,DK:VEW,W:SKBF,W:WBYF,M:KCR1,M:FORT,DK:DFD,DK:SIM,W:TEL2,M:KESK,W:NDA,W:NIBE,M:TIE1,M:ELIS,DK:DSV,W:LUPE,W:SW@G,W:ABB,DK:DSB,W:GIND,W:SR@G,M:FKA,W:LTBF,W:AZA,W:SKFB,W:TEL,M:EGR,W:SWEB,W:ASSB,W:INJ,

2010:W:TEL,M:KESK,DK:DSB,W:FABG,DK:SNB,W:RTBF,W:HMBF,W:SWMA,M:AMEAS,M:OUTO,W:ALF,W:SW@G,DK:RBR,W:LUPE,W:SEA,DK:JYS,W:ASSB,W:SAAB,W:SKFB,W:SR@G,M:FKA,W:SWEB,W:GIND,W:IU,W:LTBF,DK:DSV,W:SKBF,DK:AMB,W:TEL2,W:VOBF,W:SVK,W:NIBE,DK:SIM,M:KCR1,W:BALB,W:AFB,

2011:W:GIND,DK:SNB,DK:ROC,W:HLNF,W:LTBF,W:SL@G,W:CAST,M:SAMA,W:AXFO,W:SM@G,W:JMBF,W:LNBF,W:NSTF,W:ATRJ,DK:JYS,W:SEA,DK:DFD,W:HMBF,DK:SCB,W:IU,DK:DSV,W:WBYF,W:SWMA,DK:KOB,W:HUA,M:SPO,DK:DAB,W:ALF,W:AFB,W:SWED,W:AZA,W:TEL2,W:TT@G,DK:DSB,M:AMEAS,W:RTBF,

2012:W:SKFB,M:KEMR,W:SUBF,DK:SCB,W:AFB,M:CIT,M:FORT,W:SKBF,M:SPO,W:TT@G,M:FKA,M:TIE1,W:KLED,W:LNBF,W:SVK,W:SM@G,M:WRT,M:HUIF,W:FING,W:ABB,W:ATRJ,DK:DSV,W:TEL,M:AMEAS,W:ASSB,DK:AMB,W:BALB,M:NOKT,W:ISBF,W:HUA,W:SR@G,W:LTBF,W:SWEB,DK:DFD,M:ORNB,W:SAAB,

2013:M:ELIS,M:MEO,W:AZNS,DK:AMB,W:JMBF,W:CAST,M:EGR,W:NSTF,DK:DSB,IC:MAR,M:FKA,W:SKFB,W:LNBF,M:CIT,DK:KOB,W:NOB,M:SPO,W:IU,DK:JYS,DK:JEU,W:NDA,W:BOL,DK:SNB,DK:SYD,DK:ALK,W:SAND,W:LTBF,W:SR@G,W:BILL,W:ATRJ,W:WBYF,W:ISBF,W:HUA,W:VOBF,W:SWEB,W:FABG,

2014:W:IU,M:FKA,DK:DSV,W:WBYF,W:SUBF,W:SKBF,M:FORT,M:NOKT,W:SM@G,W:LNBF,DK:TOP,M:KNEBV,W:TEL,W:AZNS,W:EKBF,W:ABB,DK:TDC,W:HMBF,W:SL@G,W:ISBF,W:SWEB,W:HLNF,W:KLED,W:BILL,DK:NKT,M:AMEAS,DK:DAB,DK:DSB,W:SVK,DK:COL,W:SWED,W:LTBF,W:AXFO,DK:NZY,M:METB,W:NDA,

2015:DK:JYS,M:SPO,W:AFB,W:NDA,DK:DSV,W:IU,W:SWED,W:HMBF,M:AMEAS,W:SM@G,W:NSTF,M:UPM,M:HUIF,M:SAMA,DK:ALK,M:FKA,DK:NZY,M:KNEBV,W:SVK,W:HUA,M:NOK1,M:KESK,W:SEA,W:AZA,W:NOB,W:EKBF,W:SR@G,W:SAAB,DK:NKT,DK:SNB,W:ASSB,W:SL@G,W:LTBF,M:FORT,M:ELIS,W:SWMA,

High

2005:W:VOBF,W:KLED,DK:ROC,W:HUA,W:ATRJ,W:NOB,DK:NKT,W:ELKB,W:CAST,W:AZA,DK:DSV,DK:JEU,M:ORNB,DK:DFD,W:HLNF,M:FKA,W:NIBE,DK:KOB,W:EKBF,DK:SNB,W:FABG,W:NSTF,DK:GSN,M:FO
RT,W:WBYF,M:CIT,W:JMBF,W:SWEB,M:WRT,W:SL@G,M:NOKT,DK:AMB,DK:SIM,DK:GEN,IC:MAR,DK:
ALK,

2006:DK:AMB,W:ISBF,M:WRT,DK:SIM,W:SKBF,W:INJ,W:SKFB,M:FORT,W:SWEB,W:ALF,W:HLNF,W:AZ
NS,M:KNEBV,DK:TDC,W:WBYF,W:AFB,W:NSTF,DK:KOB,W:SSAA,W:MOTB,DK:NKT,W:BALB,DK:FLB,DK:
SCB,DK:DSV,W:SR@G,W:BOL,W:AZA,W:JMBF,W:ABB,W:ELKB,M:MEO,DK:ROC,W:EKBF,W:KLED,W:LU
PE,

2007:DK:NZY,W:MOTB,M:SPO,DK:SNB,W:HLNF,W:KIVB,M:FORT,M:NOKT,W:ATRJ,M:CIT,DK:ROC,W:A
BB,W:SSAA,M:WRT,DK:SCB,M:MEO,DK:NKT,W:ALF,W:NOB,DK:CAB,DK:SYD,DK:TOP,W:JMBF,M:KESK,
W:NIBE,DK:ALK,W:RTBF,DK:FLB,DK:DFD,DK:SIM,M:KCR1,M:OUTO,DK:GEN,DK:VEW,W:FING,W:BOL,

2008:W:SWEB,W:AFB,W:RTBF,DK:CAB,DK:DFD,W:HMBF,DK:DSV,DK:DSB,M:KCR1,W:LTFB,DK:NZY,W:
SWMA,W:SAND,W:HLNF,M:KNEBV,W:SSAA,W:VOBF,IC:MAR,W:INJ,DK:KOB,M:WRT,DK:TDC,W:ALF,D
K:SCB,W:KIVB,M:FORT,DK:FLB,DK:NON,W:TEL2,W:EKBF,W:ABB,DK:ROC,M:NOKT,M:NOK1,DK:VEW,W
:BETS,

2009:DK:KOB,M:KNEBV,W:AFB,W:SE@G,W:SVK,W:AXFO,M:HUIF,W:ATRJ,W:ALF,W:LNBF,DK:NZY,W:C
AST,W:RTBF,M:ORNB,W:SL@G,W:HUA,DK:TDC,W:HMBF,M:SAMA,W:ISBF,M:UPM,IC:MAR,W:BETS,W
:SWMA,W:SM@G,DK:COL,W:ELKB,DK:GEN,DK:LUN,DK:JEU,W:SUBF,DK:NON,DK:TOP,DK:ALK,DK:AMB
,W:AZNS,

2010:DK:WDH,W:SSAA,W:SAND,W:NDA,W:KIVB,DK:ROC,M:CIT,W:FING,W:WBYF,M:KNEBV,W:BETS,D
K:FLB,M:METB,M:TIE1,W:MOTB,DK:SYD,W:SWED,M:KEMR,M:HUIF,W:ELKB,W:HLNF,DK:DAB,DK:CAB,
M:NOKT,W:TT@G,W:AZA,W:NSTF,W:EKBF,W:SE@G,M:MEO,DK:GSN,DK:NKT,W:NOB,W:JMBF,W:BILL
,W:BOL,

2011:W:KIVB,W:NOB,W:NIBE,DK:FLB,W:BOL,M:KNEBV,M:FKA,M:EGR,W:ASSB,M:UPM,DK:CAB,DK:NZ
Y,W:ELKB,W:SAND,W:MOTB,W:EKBF,DK:AMB,W:FABG,M:NOKT,W:SR@G,M:KESK,W:SKFB,IC:MAR,M:
KCR1,W:LUPE,M:KEMR,DK:COL,M:METB,M:MEO,DK:NON,DK:GSN,W:VOBF,W:BALB,M:WRT,DK:RBR,
W:FING,

2012:W:SL@G,W:ALF,W:SW@G,W:CAST,DK:JEU,DK:RBR,W:HMBF,W:SWED,W:TEL2,W:BILL,DK:GSN,D
K:LUN,M:SAMA,DK:TDC,DK:ALK,M:ELIS,W:AXFO,W:KIVB,M:KNEBV,W:AZNS,W:NIBE,DK:NON,W:WBYF
,DK:SIM,W:INJ,DK:KOB,W:ELKB,DK:WDH,DK:COL,DK:NZY,W:SWMA,W:GIND,IC:MAR,DK:TOP,W:BETS,
W:LUPE,

2013:W:GIND,M:KEMR,M:NOKT,M:AMEAS,M:SAMA,W:ELKB,W:BETS,DK:DAB,W:SVK,DK:ROC,DK:DSV
,W:SW@G,W:SEA,W:TT@G,M:TIE1,DK:CAB,DK:TOP,M:ORNB,W:SWED,M:HUIF,DK:NON,DK:RBR,DK:S
CB,W:ASSB,M:WRT,W:AFB,W:BALB,M:KNEBV,DK:SIM,M:METB,W:EKBF,W:SE@G,DK:COL,DK:GSN,M:
KCR1,DK:GEN,

2014:W:ASSB,DK:JEU,W:SW@G,DK:SCB,DK:KOB,W:AFB,M:EGR,M:UPM,M:SAMA,DK:LUN,W:SEA,W:
MOTB,M:HUIF,W:NSTF,DK:ROC,DK:SIM,W:JMBF,DK:SYD,DK:RBR,DK:ALK,W:TT@G,W:NIBE,W:BALB,D
K:GSN,W:AZA,DK:AMB,DK:DFD,W:INJ,DK:SNB,DK:JYS,W:KIVB,M:NOK1,W:NOB,DK:GEN,DK:VEW,W:FI
NG,

2015:W:CAST,W:LNBF,W:SKBF,W:KLED,W:ATRJ,W:INJ,M:METB,W:BOL,W:ISBF,DK:DFD,M:TIE1,W:WB
YF,DK:SYD,W:JMBF,DK:SCB,W:HLNF,W:FABG,W:TEL2,M:OUTO,W:SE@G,W:SUBF,W:BETS,DK:TOP,DK:
DAB,W:BILL,DK:VEW,W:NIBE,M:ORNB,DK:NON,W:AXFO,DK:RBR,DK:GEN,W:AZNS,DK:COL,DK:AMB,W
:BALB,

Appendix D: DataStream symbols

The following Datastream variables were used when retrieving data:

P: Price (adjusted – default)

WC05476: Book value per share

PI: Price index

Source: Thomson Reuters DataStream, 2017