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PERFORMANCE OF FACTOR INVESTING IN NORDIC COUNTRIES

Bachelor's thesis

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I hereby declare that I have compiled the thesis independently

and all works, important standpoints and data by other authors

have been properly referenced and the same paper

has not been previously presented for grading.

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ABSTRACT

The central idea of portfolio theory is to reduce the risk inherent in the investment by diversifying. One way to enhance diversification and mitigate volatility is through factor-investing. Factor investing is the selection of securities based on certain characteristics and quantitative information to achieve higher returns. The aim of this study is to test the performance of key systematic style factors in Nordic stock market from 2008-2019. Factors that are used in this study are quality, size, momentum, volatility and value. To measure performance, a fundamentally weighted indices are done based on financial metrics as revenue, rate of change, price to book value, return on equity and standard deviation. The results show that all factor investing indices outperform the benchmark index which represents Nordic market.

Keywords: Factor investing, Nordic stock market, performance evaluation, fundamental weighting, style factor, portfolio construction

INTRODUCTION

Factor investing is an investment method where the investor selects portfolio instruments using certain characteristics or factors that have been researched to promote the company's return. The whole structure of factor investing is based on certain style factors found by academics and investors. According to Invesco, MSCI and Fidelity Investments these style factors are size, value, quality, volatility and momentum (Fidelity Investments 2016, MSCI 2013, Invesco 2017). The possibilities for factor investing are still much wider than just style factors and certain metrics that measure factor exposure. Factor exposure can be brought into the portfolio in many different ways. Different weighting methods, different metrics to weight factor exposure and different rebalancing styles can be used to make portfolio (Fidelity Investments 2016). A stock with certain factors may be exposed to macroeconomic forces differently than the rest of the market. Factor investing strategies often produce returns cyclically and it is important to know how different market forces affect certain factors. At certain times a certain factor investing strategy may underperform market but in the long run factor investing has been researched to outperform the market. Time of underperformance can also be shortened by diversifying the portfolios to many factors (MSCI 2013).

The reason for this research topic is to find alternative solutions for portfolio construction which helps investors to outperform the market. Contribution for this study is relevant. Performance of factor investing has not been measured in the Nordic countries and at the same time this research will help investors find ways to outperform the Nordic market. Factor investing is an investment method that focuses on company characteristics that would outperform stock market and leads into higher stock returns. These characteristics known as factors have impact on stock returns and acts as a tool to harvest risk premia (MSCI 2013). The aim of this study is to find out how factor investing methods perform in the Nordic countries. Which factor characteristics have biggest impact in Nordic stock market and whether factor investing as an investing method is a profitable strategy compared to the market. The data used for the study are from 2008-2019. This period also marks one of the world's greatest financial crises and crisis recovery. The study also aims to examine what kind of economic situation is best suited for each factor. The interval

contains a lot of economic fluctuations and during the fluctuations it is good to monitor how the factors are performing. The expectation in the study is that factor investing methods will outperform the market. It is also assumed that some factors perform better than others at different times and factors perform in cycles. The quality factor is expected to perform well during a crisis situation while the size factor does not. Smaller companies do not have accumulated capital and a so-called buffer to overcome the crisis situation, unlike a company with quality characteristics such as low debt.

Research methods in this study were quantitative. All data from 2008-2019 were collected from 90 different Nordic companies by using Thomson Reuters Eikon database. The time interval was chosen according to where the most data were found from as many companies as possible over longest period possible. Due to missing data, 26 companies were excluded from 90 companies and 64 companies remained in the study. Data were collected from each company to obtain the necessary amount to measure factor performance. Certain metrics measured the impact of the factors on the company and on the basis of the metrics the companies were ranked in the order every quarter.

The literature review section discusses the theory related to factor investing. On the basis of the theory, the factors and characteristics describing the factors are selected. The performance of the factors is compared to the benchmark index in the results section. The results include the percentage difference in the performance of factor strategies compared to the market cap weighted benchmark index. In addition to returns, the results include stocks volatility, Sharpe's ratio, transaction costs and statistical significance test. In the study, all factor investing methods outperformed the market. Considering costs, factor investing produced better results than benchmark index in 2008-2019. Based on this research, factor investing is way to diversify the portfolio but also to find factors that outperform other stocks in the Nordic market.

This research paper starts with literature review. The literature review is divided into two parts where first deals with origins of factor investing and the other part examines the performance of factor investing methods. Second chapter discusses how the study is conducted and how the data used for it is collected. This section covers how each of the different research portfolios including the benchmark index is weighted and constructed. The third chapter contains the results of the study. After the results there is a conclusion chapter where the whole study is gone through from start to finish.

1. LITERATURE REVIEW

1.1. ORIGINS OF FACTOR INVESTING

This paper basis its academic research to Capital Asset Pricing Model, Arbitrage Pricing Theory and Three-Factor model. Capital Asset Pricing Model was result from Markowitz´s model of portfolio selection (1952) and was introduced later by Jack Treynor (1961), Sharpe, W. F. (1964), John Lintner (1965) and Jan Mossin (1966). In 1964 key measurements to evaluate the performance of an investment portfolio was separated and Capital Asset Pricing Model was developed. CAPM was developed from Markowitz´s model and theories broadened understanding of portfolio diversification and the relationship between systematic risk and expected return. In 1972 first style factor was discovered when Haugen and Heinz proved that low volatility stocks lead into higher risk-adjusted returns. Three years later first index mutual fund was released by John Bogle. This mutual fund tracked S&P 500 and it brought more investors to the stock market as diversification and investing at all became easier. Banz, R. W. (1981) noticed that market capitalization size affects the return on the security. In the same year S. Basu finds that PE ratio have also negative correlation towards returns. In 1993 Fama and French invented 3-factor model by adding these size and value factors into Capital Asset Pricing Model. Same year Jagadeesh and Titman find that momentum also affects the success of a share, i.e., a share in good growth will continue to perform better in the future compared to other stocks (Invesco 2017).

Markowitz's modern portfolio theory was to eliminate idiosyncratic risk by diversifying portfolio. MPT helps to understand why the best option when creating a portfolio is not to put all funds on security what has greatest expected return even hypothetically it would make sense. The problem is that the variance between expected yield and actual yield in a non-diversified portfolio grows really large. Investor should invest funds among all those securities which give the largest expected return and average of the yield obtained from a large number of securities should be close to the expected value of portfolio and reduce variance between expected yield and actual yield. However, the law of large numbers does not eliminate all variance, securities

returns are too inconsistent. In addition to many different securities, the securities should have as little covariance with each other as possible. Small covariance is achieved by investing in different industries with different economic characteristics (Markowitz 1952). CAPM and MPT can both be described with efficient frontier, where minimum variance frontier demonstrates all portfolio possibilities and how portfolios ranks in relation to expected return and risk (Fama, E. F., French, K. R. 2004).

Based on the Markowitz model, capital asset pricing model was created that serves as a basis for all factor models. Capital asset pricing model is used in financing to calculate the expected rate of return on a security. One of the key concepts is the security market line which describes the ratio of the expected return on a share to market risk, i.e. the beta of the share. The steepness of the slope of the securities market line describes the market risk premium, i.e. the Sharpe ratio. Risk premium on an asset is a linear function of a single market risk premium (Sharpe 1964, 1966, 1994).
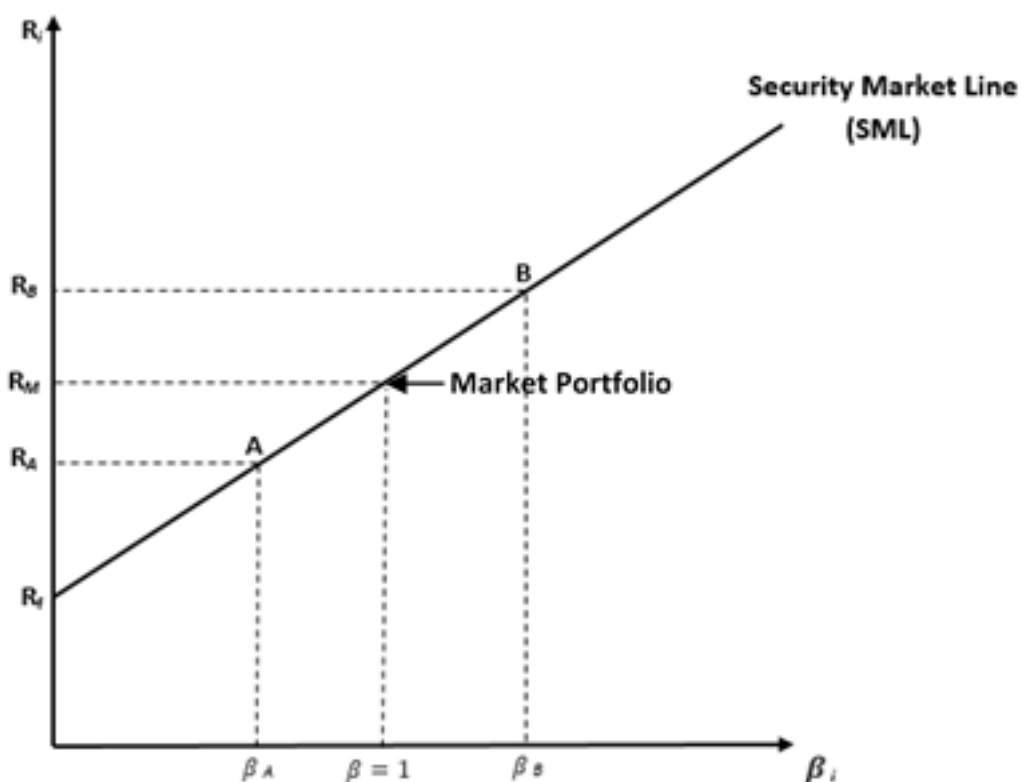

Figure 1. CAPM Model

Source: Institute for Financial Analysts- CAPM

https://ifamena.com/capital-asset-pricing-model-capm/

Mathematically capital asset pricing model goes:

$$\mathbb{E}(R_i) - R_f = \beta_i \left(\mathbb{E}\big((R_m)\big) - R_f \right)$$

Where $\mathbb{E}(R_i)$ is the expected return on the security or investment. R_f is risk-free interest rate and if we only want to calculate the return of the investment then we add the risk-free interest rate to the other side of the equation. β_i is a beta factor that describes the systematic risk of an investment and $\mathbb{E}(R_m)$ represents the expected return of portfolio. It is important to note that this in an expected return, by no means a guaranteed return. Volatility causes deviations from expected returns in the short to medium term. According to the theory in the very long run, the return is on average the same as the actual return. However, CAPM has been criticized because its underlying assumptions only work in a simple world where all investors are rational and seek to avoid risks. Theory called Arbitrage Pricing theory was developed by Stephen Ross (1976) and it was developed to fill the gaps brought by Capital Asset Pricing Model.

The returns of two different portfolios are sometimes difficult to compare visually when looking at both average rate of returns. Portfolio with greater variability may seem more attractive when potential individual returns may rise higher. Studies show that in the long run, a portfolio with less dispersion in monthly returns brings better returns on average than a portfolio with more dispersion (Haugen, R. A., Heins, A. J. 1972). According to Capital Asset Pricing Model, the expected return on stock is the relationship with the return and volatility (Sharpe 1964). Volatility is also big part of Sharpe's ratio which measures investments risk-adjusted returns (Sharpe 1966). Volatility is part of the factor-investing and it produces excess risk-adjusted returns to stocks with lower volatility.

The only variable in the CAPM is market risk until two new factors were added to the CAPM equation and three-factor model was developed. In three-factor model there is two factors that affect stock returns and are able to outperform the market. All three variables in three-factor model are market risk, size and value. Value investing has been proven to work and gives more returns than the market. Value investing strategies includes to invest in stocks that has good ratio between its book value and current value. Size investing strategy based on the growth potential of a company with a small market capitalization (Fama, E. F., French, K. R. 1993, Barber, B. M., Lyon, J. L. 1997)

$$\mathbb{E}(R_i) - R_f = \beta_i \left(\mathbb{E}((R_m)) - R_f \right) + b_s \, x \, SMB + b_v \, x \, HML + \alpha$$

SMB stands for small caps and HML high value and these factors were added into capital asset pricing model equation. Three-factor model was a long step towards other factor investing strategies. Next factor was added to the three-factor model and Carhart four-factor model was created. Momentum factor was added to the factor model. It has been proven that momentum factor investing strategies outperform the market and that stocks whose prices rise will also continue to rise and stocks whose prices fall will continue the same trend. One way of factor-investing is to buy past winners and sell past losers. A portfolio of previously high-yielding stocks has been shown to produce significantly good returns. (Carhart 1997, Jegadeesh, N., Titman, S. 1993)

These studies have brought main style factors to awareness which are value, low size, momentum, low volatility, and quality. Today there is a growing awareness of investor behavior and habits. We are also aware of how different characteristics affect the behavior of a stock and possibly following certain factors can overperform the market. There are also many other so called macrofactors that affect returns. (Invesco 2017)

1.2. FACTOR INVESTING STRATEGIES

Factor investing is an investment strategy where the investor chooses instruments to portfolio according to certain factors that drives securities returns. Factor investing is also the basis for other investment strategies such as "smart" and "strategic" beta strategies (Fidelity Investments 2016). Some experts think there are only a few factors and some think there are hundreds. A factor can be defined as any characteristic that drives a company's performance in a certain direction (Huij 2018). Investors want to find ways to outperform the market consistently, so it is good for the factor to find other criteria as well. Factor investing has been researched to be profitable in the long run. It is important that the factor lasts for long periods of time and remains steady in economic changes. The factor must also be profitable in different regions and sectors of the economy. Factor investing is great way to diversify portfolio when certain factor is not limited to a certain industry and the instruments to portfolio with the highest exposure to this

factor come randomly from different industries. Good feature for factor is also that it can be measured in many different ways with many different metrics. There are several factors, and several different metrics can be used to measure them. Different measurement styles and factors make up a myriad of different factor investing strategies (Berkin, A., Swedroe, L. 2016).

Factors can be separated into two different categories "style factors" and "macro factors". According to Fidelity Investments, Invesco and MSCI these style factors are value, size, momentum, volatility and quality. Invesco (2017) also has dividend yield as style factor. These style factors are the most well known and most studied to drive stock returns. In addition to style factors, there are macro factors that are more related to the economy as a whole rather than in a single sector. Macro factors are, for example, inflation, liquidity, economic growth and currency rates. Macro factors are often used also in different asset classes than in equities alone. Factor investing strategies can also be divided into two different investment styles, active and passive factor investing. The passive approach is much more common in factor investing strategies. The impact of the factors is best seen in the long run and is sought to be exploited. Passive factor investing is suitable for the long term as it seeks to minimize transaction costs.

1.3. EVALUATING PERFORMANCE OF FACTOR INVESTING

Researchers have made various arguments as to why factor investing brings certain types of results. Some returns are based on risk and potential growth and some are based on human behavior or structure. The risk of factor investing becomes, for example, when implementing a size factor strategy when companies with a small market value are less diversified in their business operations and more prone to economic fluctuations (FTSE Russell 2016). Factor investing has the potential to outperform the market due to market inefficiencies and illogical investor behavior (Invesco). Even if the momentum factor strategy encourages to buy successful stocks still is important to buy cheap and sell expensive. It is difficult to choose which factors to include in a portfolio, especially when there are different numbers according to different theorists. Whatever characteristic that drives a company´s performance in any direction can be counted as a factor (Huij 2018).

Low-volatility drives stock returns positively but also reduces risk. In an 80-year term, a portfolio that follows a low volatility investing strategy has made positive profit every decade.
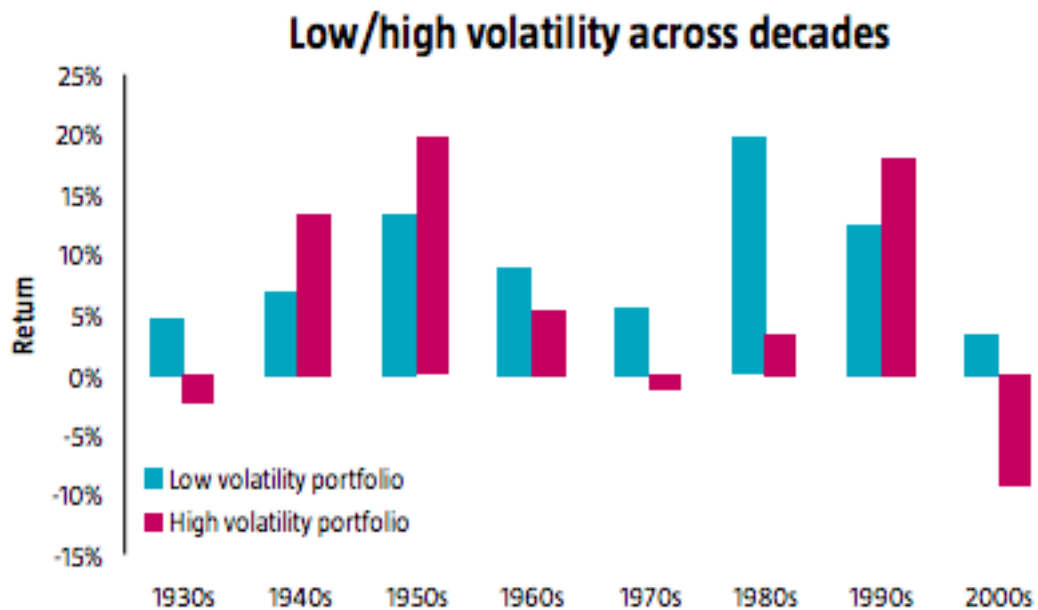

Figure 2. Low volatility performance
Source: Robeco, Low-volatility investing: a long-term perspective
https://www.robeco.com/media/c/c/2/cc285a51d699d7e3309ed66d5cfa4a9e_low-volatility-investing-a-long-term-perspective_tcm27-2161.pdf

Factors performances in the market tends to be cyclical. Factors performance is greatly affected by the economic situation and for example strong market equity can have a significant impact on to the return brought by the factor. Figure 2 shows that a low-volatility portfolio does not outperform a high volatility portfolio every decade but in the long run it gives better returns because low volatility reduces risk and seeks to eliminate maximum losses. The same study found that the low volatility portfolio outperformed the market every decade. (Pim van Vliet 2012, MSCI. 2013).

Fama and French (1992) found that between 1962 and 1990 small cap stocks got more returns on average per month than large cap stocks. Studies also shows that in 49 years from 1926 to 1975 US small cap stocks has given an average monthly return of 1% more than large cap stocks. Shares with low market capitalization involve greater risk but in the long run small cap investing strategy produces a better return than the market (Banz 1981, Fama, E. F., French, K. R.

1992,1993). Small cap investing gained great popularity when the first small cap funds were created and in the first years they did well but next few years they performed lower than large cap funds because all factor investing strategies tends to be cyclical. Legislation, taxation and economic crises affect small cap businesses more, which makes them much riskier than large cap stocks (Invesco 2016).

Quality investing is an investment method there you invest in companies that have the highest quality features e.g. high return on investment (ROE) percentage or stronger balance sheet than other companies. Although quality companies sound like safe investments, it has also been studied that these certain factors bring greater results. The risk of investing in quality companies brings that quality stocks are often expensive compared to so-called junk stocks. Quality stocks usually have low volatility which also brings a return as a feature. High quality brings higher results and quality stocks tend to outperform the rest of the market during a crisis. (Asness, C., Frazzini, A., Pedersen, L. 2018)

Value investing is strategy where investor buys investments that are underpriced, for example through P/E ratio. Portfolios that have securities with low P/E ratio earn higher absolute rate of return than portfolios that includes securities with high P/E ratio. Basu, S. (1977). According to Bank of America value investing has gained double of returns than growth investing in long time period. Value stocks outperform the market best when inflation or interest rate is high (Berger, R. 2020).

The momentum factor has also been found to produce results similar to other style factors. Research has been carried out that in the course of one year, by buying very successful shares and selling underperforming stocks, a positive result can be achieved. The results of the momentum strategy are not easily explained when they are based a lot on human behavior (Jegadeesh, N., Titman, S. 1993., MSCI).
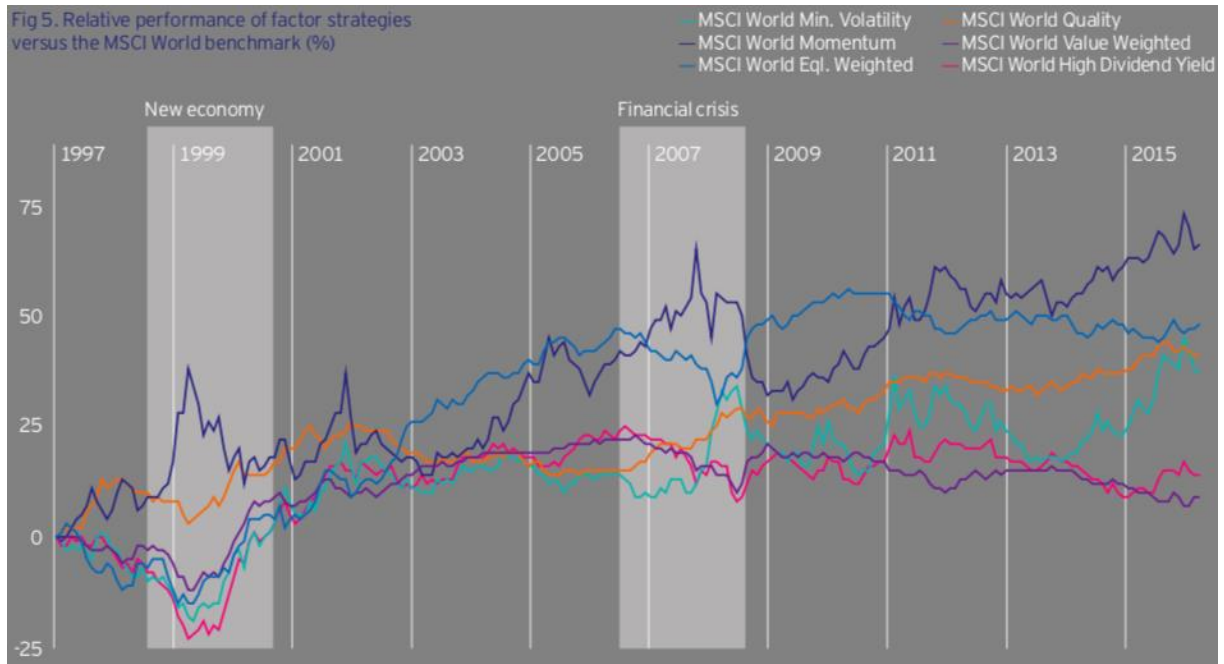
Figure 1. MSCI Factor investing total returns

Source: Invesco, MSCI as of 30 September 2016 (total return, in USD).

Figure 3 shows how different stages of the economy affect factor returns. The quality factor makes the best results during a financial crisis. Momentum factor is another factor that succeed well during a crisis this may be due to the fact that during the crisis all companies with good momentum are also qualitatively very stable and people transfer their money from more unstable companies to high quality ones. In the long run all factors will produce a good and steady results. Momentum gives the best result in a study done by MSCI of all the factors. In this study from MSCI, factor investing seems to produce good result and everything makes a long-term positive result. The worst performers are value and high dividend yield factors.
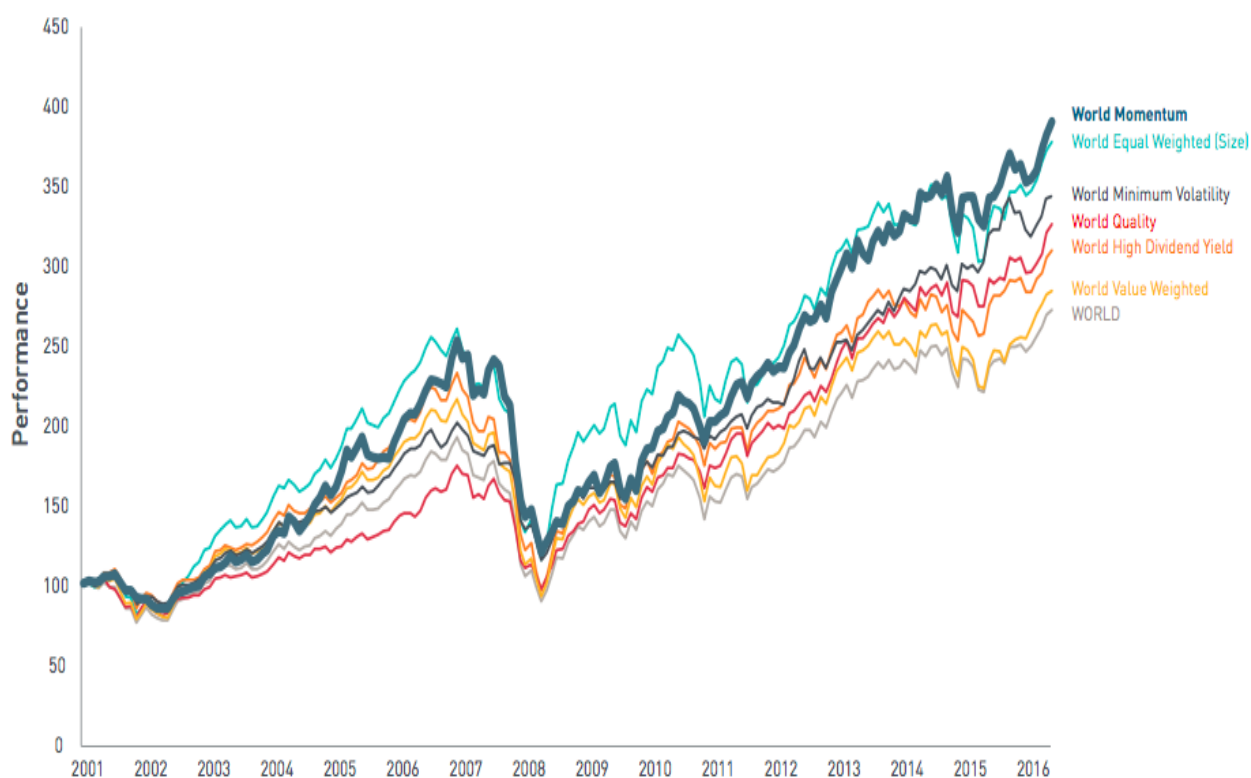
MSCI WORLD FACTOR INDEXES

Figure 4. MSCI World factor indexes

SOURCE: MSCI. Focus:Momentum

https://www.msci.com/documents/1296102/1339060/Factor+Factsheets+Momentum.pdf/a766ef
6b-cd24-4460-8163-900323fc2957

In figure 4 there is seven different MSCI Indexes which tracks different factors, and all of those
factor indexes outperforms WORLD index in that specific time period. The MSCI World Index
is the stock index following the developed world stock market, with the largest weight in the
United States. The graph shows how the financial crisis that began in 2007 affects the success of
the indices and in this study, the quality factor, which has been successful in crisis situations in
the past, performs similarly to other indices. The best way to recover from a crisis is the size
factor which should be most affected by the crisis. The results show that long-term factor
investing outperforms the market in terms of at least six style factors. A study by MSCI from
2013 proves that the returns made by factors is a cyclical and not so easy returns as figure 4
suggests. It has been found that each factor at some point experiences about two-three
consecutive years of underperformance relative to the market.

2. DATA AND METHODOLOGY

2.1. DATA COLLECTION

This research was conducted by using data of listed Nordic companies. All companies were selected from OMX Nordic indexes which were OMX Copenhagen 25, OMX Stockholm 30, OMX Helsinki 25 and OMX Iceland 10. All indexes include overall 90 companies, but with some missing values 26 companies were left out. Either that some data were not found at all from those 26 companies or that not all data were found over a 10-year period. The remaining 64 companies included 28 Swedish -, 13 Danish -, 22 Finnish – and 1 Icelandic companies.

Selection of the companies was successful if you want companies from every Nordic country, taking into account the size of the country. The largest countries received more representatives for the study and only one company was found in Iceland. The ideal situation would have been to find even more companies that met the criteria for research, but the Icelandic crisis, for example, made it difficult to find. OMX indexes consist of the most traded stocks in that country. The data was obtained using Thomson Reuters Eikon.

The dataset has been collected from 30 June 2008 to 31 December 2019, resulting 47 quarters. Time interval does not include 2020 because it would have pruned too many companies out of the study due to limited or missing data. The time interval has been chosen taking into account the market environment and the period is long enough to achieve the best possible results. Although the time interval can hold one of the largest financial crises which happened in 2007-2008, economic problems are a part of our lives and they happen from time to time. Time interval also includes 2008-2011 Icelandic financial crisis, but the number of Icelandic companies in the study is so small that it should not affect the outcome of the study.

The data was collected from companies included information on five key factors with systematic exposure to quantifiable investments. Factors that are selected for this study are value, size, momentum, volatility and quality. Different factors were tracked by using different ratios and

measures. Price-to-book ratio (P/B) have been used to measure value. Price-to-book ratio measures relationship between company´s market value and book value. Price-to-book ratio helps to capture stocks that have low prices relative to their fundamental value. Market capitalization was used to measure company´s size. Stock´s momentum was measured with the rate of change (ROC). Quality was measured with return on equity (ROE) and volatility was measured with standard deviation (SD).

2.2. WEIGHTING METHODS

Big part of this study is choosing weighting method to define how factors and benchmark index would be weighted. The weighting method affects portfolio performance in addition to portfolio instruments. Benchmark index for this study will be weighted by market capitalization which means that biggest market capitalization will get the biggest weight on the portfolio. Market capitalization is also characteristic with which we measure the size factor so the size factor portfolio will also be market cap weighted. The difference in weighting method between size factor portfolio and benchmark index is that in size factor portfolio the smallest market capitalization will get the biggest weight. Other factor portfolios in this study are fundamentally weighted so that the factor metric gets as much weight in the portfolio as possible and the effect of the factors is seen as maximized. In this study it has taken into account that the fundamentally weighted index alone outperforms the market cap weighted index by about 1.91% each year. The fundamentally weighting method is better at proving the importance of factors in a company´s success. (Arnott, R., Hsu, J., Moore, P. 2004).

2.3. BENCHMARK INDEX

To compare the results, study needed a benchmark index that would reflect the Nordic stock market. The benchmark index contains data on all 64 companies that were used in the study. In this study benchmark index was weighted by market capitalization.

All data from 64 different companies were collected in separate excel file. Data was collected from 30 June 2008 to 31 December 2019 and it was rebalanced in every quarter. For benchmark

index the market capitalization of each company was listed separately for each quarter. All market capitalizations were summed up to calculate weight of each stock. Weight is calculated by dividing companies' current quarters market capitalization with market capitalization of all companies. It means that the largest company also has the largest weight in the portfolio. Change in market capitalization was calculated by dividing current market capitalization with previous quarters market capitalization. After change in market capitalization and stock weights were calculated, those numbers were multiplied together to get change in stocks market capitalization in quarter. Starting from index number 100 and multiply that with change of each quarter, a value is obtained for each quarter to describe the index and the index can be plotted.
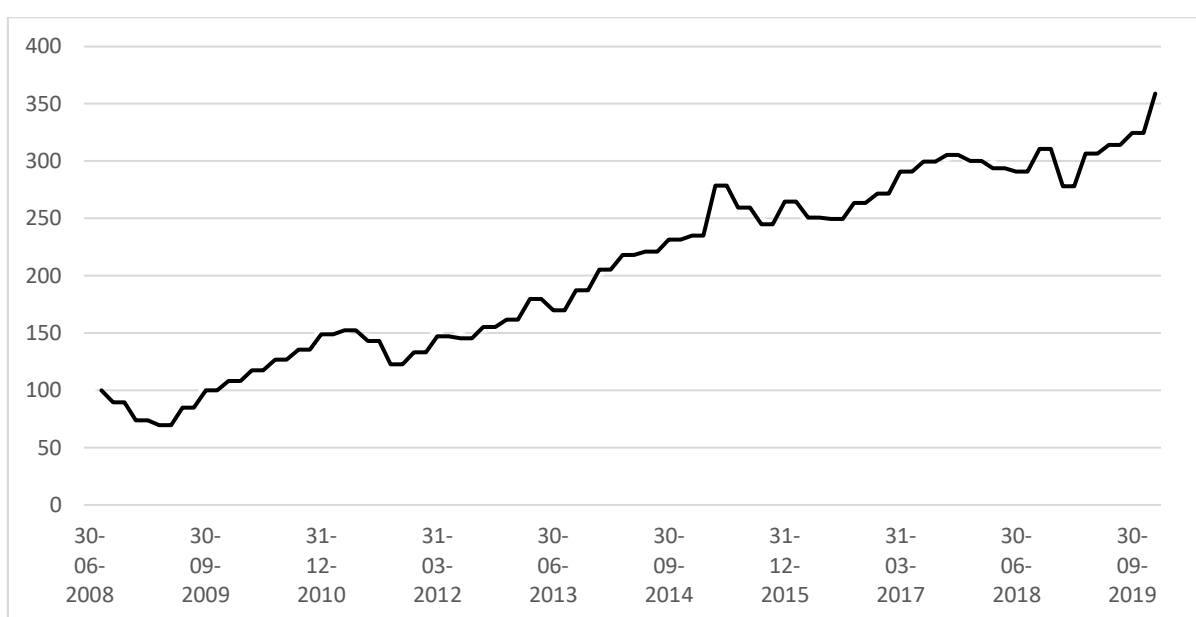

Figure 2. Capitalization-Weighted Benchmark Index

Source: Based on authors´ calculations

2.4. PORTFOLIO CONSTRUCTION

Five different portfolios were created according to the characteristics of five different style factors. A fundamentally weighted indices was created from all portfolios and their results were compared with the benchmark index. Fundamentally weighted index is based on different characteristics that instruments inside portfolio has. Those characteristics are measured by metrics like revenue, return on equity or volatility. All stocks are weighted by that specific metric and index is created with those stock weights. Metrics used in five different portfolios are

return on equity to measure quality, rate of change to measure momentum, market capitalization to measure size, standard deviation to measure volatility and P/B to measure value. All metrics were ranked from highest to lowest to highest depending on which metric was measured. For example, price to book value was ranked from lowest to highest and return on equity was ranked from highest to smallest. Then the top 20 companies from 64 different Nordic companies were selected according to this particular metric.

The weight of the stock was calculated by adding all the metric results together and then dividing the metric result by the total result. Then the change of market capitalization was compared of each of the top 20 companies over each quarter. Change of the market capitalization was calculated by dividing market capitalization with previous quarters market capitalization and this result was subtracted by "1". Change of the market capitalization and stock weight was multiplied together and these results were summed together to get change in the index for the quarter.

Every index starts with index value of 100 in 30.06.2008. During each quarter index number is multiplied with change in the index for the quarter plus "1". Each index number is counted until 31.12.2019. The change in the index number reflects the success of the factor. The index number is directly correlated with the index return, if the index number increases then the factor makes a positive result i.e., its market capitalization increases.

2.5. MARKET ENVIRONMENT

Time period between 2008-2019 contains overall three financial crisis that has effect on Nordic countries. These crises are 2007-2009 Financial Crisis (GFC), 2008-2012 Icelandic financial crisis and European sovereign debt crisis. The financial crisis of 2007-2009 was a global banking and financial crisis. The crisis originated in the United States, due to low-interest rates maintained by the central bank for a long time, reckless mortgage lending by insolvent customers under federal pressure, and the tax benefits provided for mortgages in 1997 (Roberts 2008). The Icelandic crisis began when they made themselves more attractive to foreign companies and investors through low tax rates. This led to a huge increase in Iceland´s three largest banks and

the Icelandic krona becoming a major trading currency. Banks assets increased tenfold relative to Iceland's GDP and banks capital buffer was insufficient to cover any operations. Through the difficult situation of the banks, the Icelandic krona collapsed, almost every company in Iceland went bankrupt and the Icelandic stock market fell by about 95% (Matsangou, E. 2015).
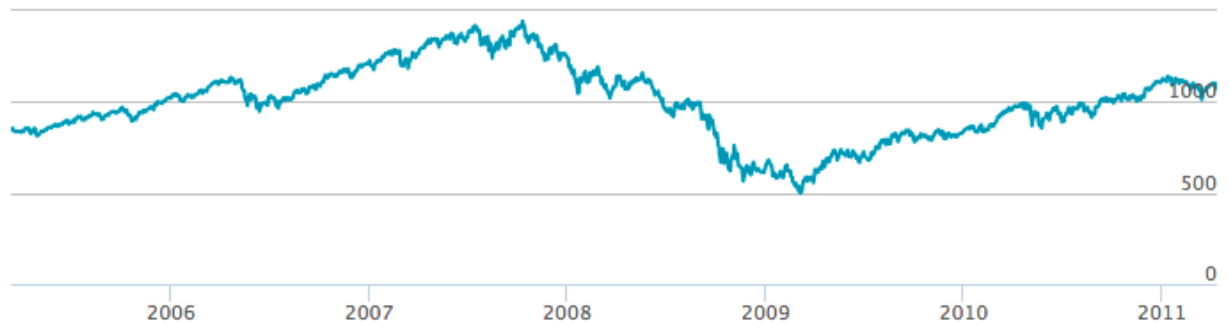

Figure 3. OMX Nordic 40 (2005/03/12-2011/04/13)

SOURCE: Nasdaq, OMXN40, OMX Nordic 40

http://www.nasdaqomxnordic.com/indexes/historical_prices?Instrument=SE0001809476

Figure 6 reflects development of OMX Nordic index from 2005 to 2011. The graph clearly shows when the financial crisis started to affect the Nordic countries and when it started to recover. This studies first data was collected from 30 June 2008 which is why approximately the first four quarters are the time of the financial crisis. After the first four quarters, the stock market will begin to recover. The study includes only one Icelandic company because there were not many Icelandic companies left over from Icelandic financial crisis.

Figure 4. EUR USD Exchange Rate

SOURCE: Macrotrends Euro Dollar Exchange Rate (EUR USD)

https://www.macrotrends.net/2548/euro-dollar-exchange-rate-historical-chart

European sovereign debt crisis refers to the plunge of the euro into a deep crisis in the 2010s. The graph in figure 7 demonstrates how the price of the euro has fallen against the dollar from 2008-2010 to the present day. There are many reasons for the collapse of the euro, but an important reason is the sovereign indebtedness of the eurozone countries.

3. RESULTS

3.1. PERFORMANCE OF FACTOR INDICES

In given research, all different used factor investing strategies outperformed the benchmark index. Study contained five different portfolios who carried out certain factor investing strategy. Each portfolio was created on the basis of a specific metric that would differentiate the best performing companies from the overall market and thus achieve a better result than benchmark index. The benchmark index, which included a total of 64 Nordic stocks, achieved a return of 258.96% in 11 years which is a really good return compared to that it is much more than cumulative inflation for 11 years. Benchmark index would give your 100€ invest return of 358.96€ and if cumulative inflation for 11 years is about 23% you would end up with 77€. Opportunity cost for not investing 100€ at all would be 281.96€. This doesn´t sound like much in 11 years but the opportunity cost grows exponentially the bigger the investment.

Table 1. Performance of Factor Investing

Index	Metric	Return (%)	Performance compared to benchmark index (%)
Benchmark	Market capitalization	258.96	-
Quality	Return on equity	540.65	281.69
Momentum	Rate of change	562.22	303.26
Size	Market capitalization	1151.42	892.46
Volatility	Standard deviation	528.35	269.39
Value	Price to book	515.07	256.11

Source: Based on authors´ calculations

Table 1 shows that the factor investing results have been significant compared to the benchmark index over the time period under review. Table 1 includes in first column index name. Second column represents the metric used in that specific index. Last columns show return of the index and how it is compared to the benchmark index. Each factor has exceeded the benchmark index

describing the Nordic market by at least 250%. All results with the exception of the benchmark index has made really positive results in the time interval. The results are affected by the fact that the companies selected for the study have had to be involved in the business for 11 years, which already says that the company is likely to be very successful. The stocks were also collected for this study by using OMX indices and the OMX indices include the shares that have been traded the most on the stock exchange. This does not eliminate the fact that among these stocks, the companies that had best characteristics for factor investing were the most successful.

All other factors had approximately similar returns during the time interval except for the size factor that outperformed each index. The size index portfolio consisted 20 of the smallest companies. The fact that it did best is not surprising when small cap stocks have a really high risk and are really vulnerable to economic changes, but they have a really high potential to grow and the risk is basically completely eliminated by going back 11 years and it is known that the company is still listed today.

Table 2. Performance of Factor Investing with Average returns and Volatility

Index	Metrics	Return (%)	Performance compared to benchmark index (%)	Average quaterly return (%)	Volatility (%)
Benchmark	Market capitalization	258.96	-	3.08	8.25
Quality	Return on equity	540.65	281.69	4.45	9.35
Momentum	Rate of change	562.22	303.26	4.73	11.59
Size	Market capitalization	1151.42	892.46	6.08	11.00
Volatility	Standard deviation	528.35	269.39	4.40	9.39
Value	Price to book	515.07	256.11	5.09	16.33

Source: Based on authors´ calculations

Table 2 includes average quarterly returns where every factor index outperforms benchmark index average return by over one percentage point. Benchmark index has return of 258.96% over this time period it means that if you have invested 100€ 11 years ago you would have 358.96€ and profit would be 258.96€. Although doubling the funds in 11 years is a good achievement but whit any style factor strategy of this study you would have earned more than 250% more which is over 250€ more profit for that 100€ investment. In best scenario all 100€ in size factor

portfolio would have returned 1151.42€ profit. The least return was brought by the value factor which may be due to the fact that the value factor can fight against the momentum when the company's book value is high, but people are not interested investing in it. The momentum factor is based solely on investor behavior and a good momentum performed better in this study than a good value by 47.15 percentage points.

Table 3. Performance of Factor Investing with average return, volatility and Sharpe ratio

Index	Metrics	Return (%)	Performance compared to benchmark index (%)	Average quaterly return (%)	Volatility (%)	Sharpe ratio
Benchmark	Market capitalization	258.96	-	3.08	8.25	0.37
Quality	Return on equity	540.65	281.69	4.45	9.35	0.48
Momentum	Rate of change	562.22	303.26	4.73	11.59	0.41
Size	Market capitalization	1151.42	892.46	6.08	11.00	0.55
Volatility	Standard deviation	528.35	269.39	4.40	9.39	0.47
Value	Price to book	515.07	256.11	5.09	16.33	0.31

Source: Based on authors´ calculations

Table 3 shows the Sharpe ratio of each index in addition to the previous statistics. Sharpe ratio compares the return on an investment with the volatility of its return, i.e. the fluctuation in value. The higher the Sharpe ratio, the better because then its return to volatility ratio is high, which indicates that the investment has been low risk. Factor investing is way to diversify portfolio which gives better Sharpe ratio. All other factor investing methods outperformed the benchmark index in Sharpe ratio except the value factor. Benchmark index was diversified in 64 different companies and the factor indices were into 20, the factor indices were still able to be preferred in terms of risk and return.
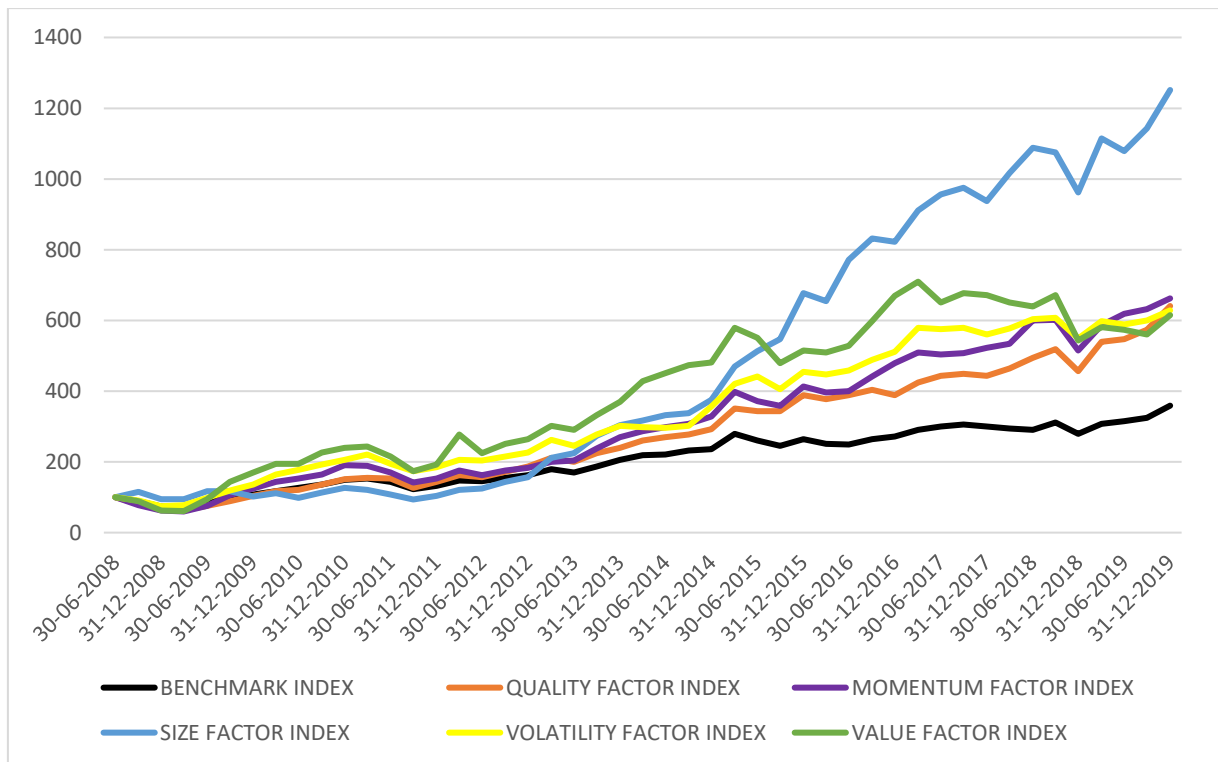
Figure 5. Performance of Factor investing strategies

Source: Based on authors´ calculations

Figure 8 use indices to reflect the return of factor strategies relative to a benchmark index. In the graph, each different factor is depicted in a different color and their performance is shown over an 11- year period. Stocks based on value thrive best after years of crisis and recover well which is really logical and expected. The graph shows that the value factor does better than other factors from 2009 to 2015 where it drops under size factor. It would have been expected that the quality factor would have been successful after financial crisis, but it is even under benchmark index in the start. At the beginning of 2013, all the indices will really start to differ from each other which reflects the profitability of factor investing in long-term investment. The size factor that at the end produced the best result in returns is below the benchmark index until beginning of 2013. Momentum -, quality – and volatility factors make a really steady return, and their indices follow each other.
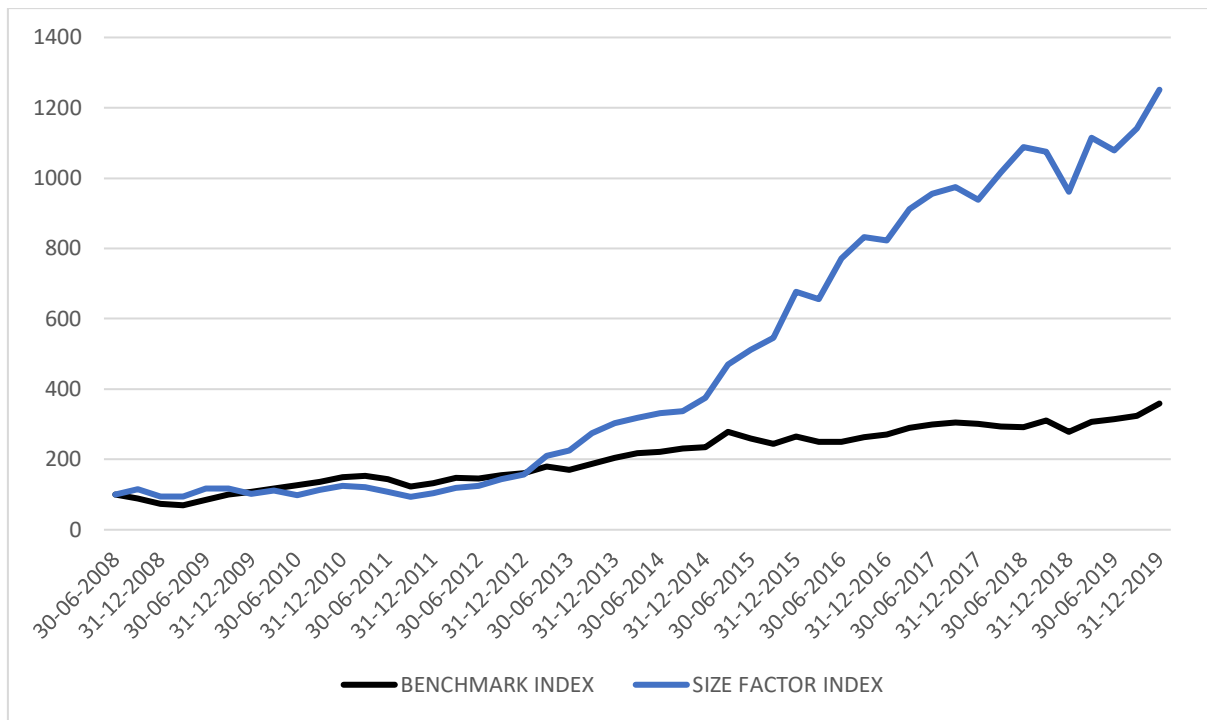
Figure 6. Size factor comparison

Source: Based on authors´ calculations

Size factor exposure was measured with market capitalization. Small cap stocks are prone to
crisis due to their low solvency and small assets. The graph shows that the size factor index takes
more to recover from the crisis than the benchmark index. 2008-2012 the size factor
underperforms the market but in the long run the result is better than the benchmark index. The
results clearly show that the theory behind small cap investing strategies also applies in the
Nordic countries. Small cap stocks probably made the biggest drop in prices in the early stages
of the financial crisis in 2007, which is not yet shown in this graph. Size factor investing is really
risky but now it was noticed how small companies have a really great potential to grow and, in
this situation, taking a risk brought a multiple result compared to the benchmark index. Size
factor investing strategy performed best of all factor investing strategies. It outperformed the
market by 892.46%. Size factors volatility was significantly higher than the volatility of the
benchmark index, but its Sharpe ratio was higher due to high returns. Although the size factor
investing strategy is considered very risky it still had the best Sharpe ratio of all the indices.
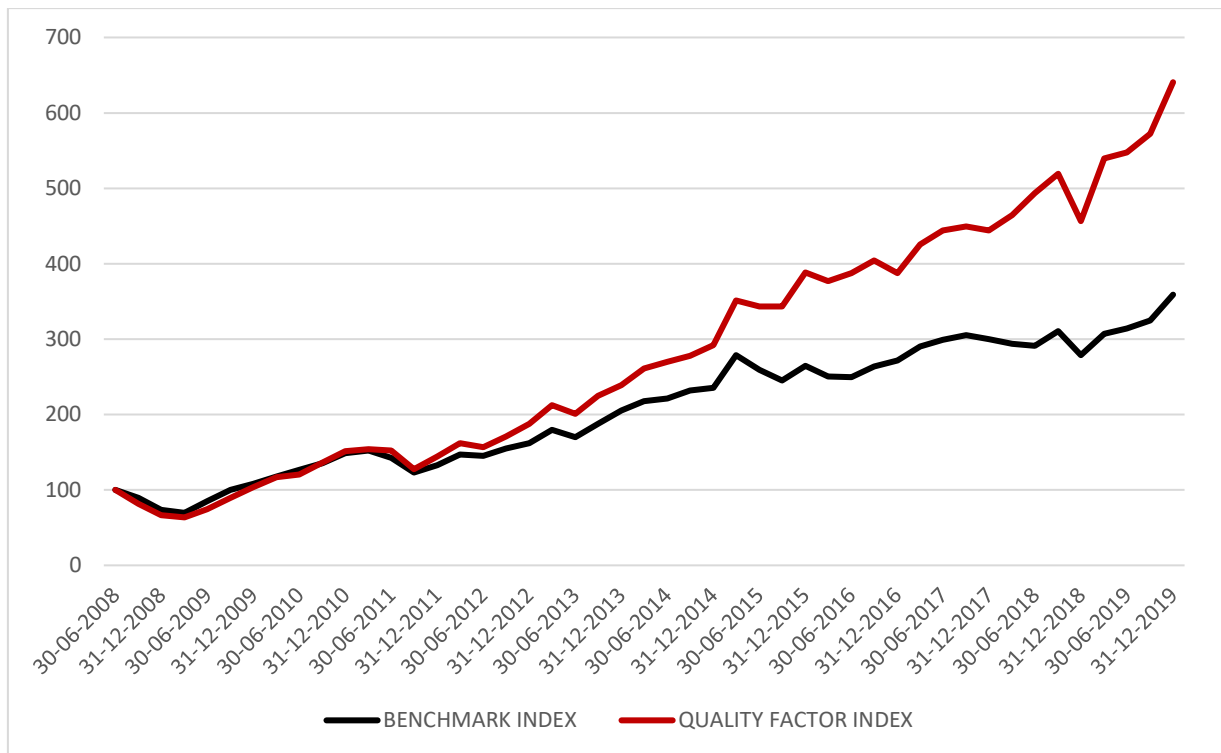
Figure 7. Quality factor comparison

Source: Based on authors´ calculations

Quality factor exposure was measured with return on equity. The quality factor underperformed during the crisis, although it was as good a trend as the benchmark, but the expectation was that quality companies would outperform other factors and the benchmark during the crisis. There are many ways to measure quality and some measurement style could have produced a different result. With this data return on equity was not the best metric to measure quality because the index did not perform as expected during the crisis. Figure 10 shows how for the first three years the quality factor produces the same result as the benchmark index but in the long run the quality index produces a much higher return than the benchmark. The expectation was that the first three years which included the crisis and recovery from it would be time where quality factor outperforms the market. Quality factor outperformed the benchmark index in returns and in Sharpe ratio. During 2008-2019 quality factor outperformed Nordic market by 281.69% with 0.48 Sharpe ratio. Volatility of quality factor was the lowest compared to other factor investing strategies.
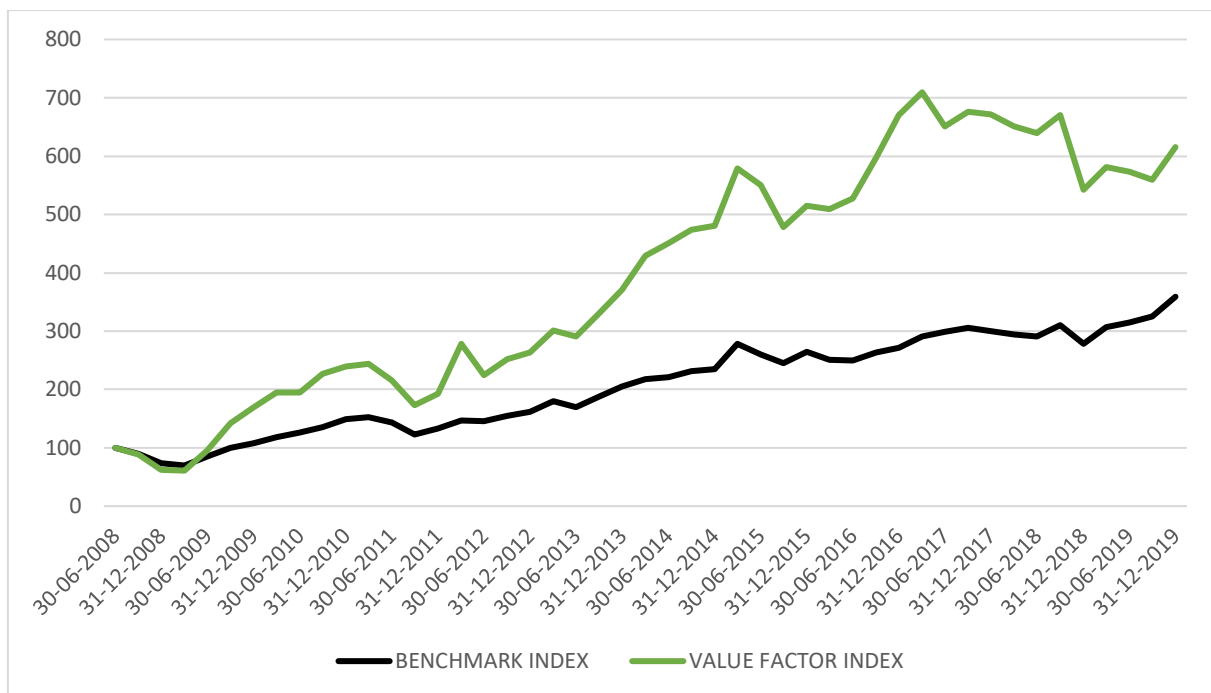
Figure 8. Value factor comparison

Source: Based on authors´ calculations

Value factor exposure was measured with price-to-book value. Value stocks tempt to outperform the market best when inflation or interest rate is high. This means that the at the beginning 2008-2009 Value index should be strong against the benchmark index when interest rates and inflation were really high in the Nordic countries. In figure 11 the value index performs approximately the same in the first year as the benchmark, which is unexpected. After the first year, the value index outperforms the benchmark index steadily until the end of the study. The value index recovers from the financial crisis at its best momentum after 2009 but in the end the result does not grow exponentially. Despite a steady result, the value factor method had the highest volatility and lowest returns of all factor investing methods. Value factor outperformed the benchmark index by 256.11% which was lowest return of all factor investing strategies. Value factor had also biggest volatility which was 16.33 % and lowest Sharpe ratio. The results clearly show that the value factor performed by far the worst from all factor indices during 2008-2019. Metric used to measure factor exposure has huge role in results. Dividends or price to earnings as metric to measure value could have brought better returns. In Figure 11 shows that the value factor starts to rise sharply after the financial crisis, but the result eventually remains low and statistics show it includes high risk levels.
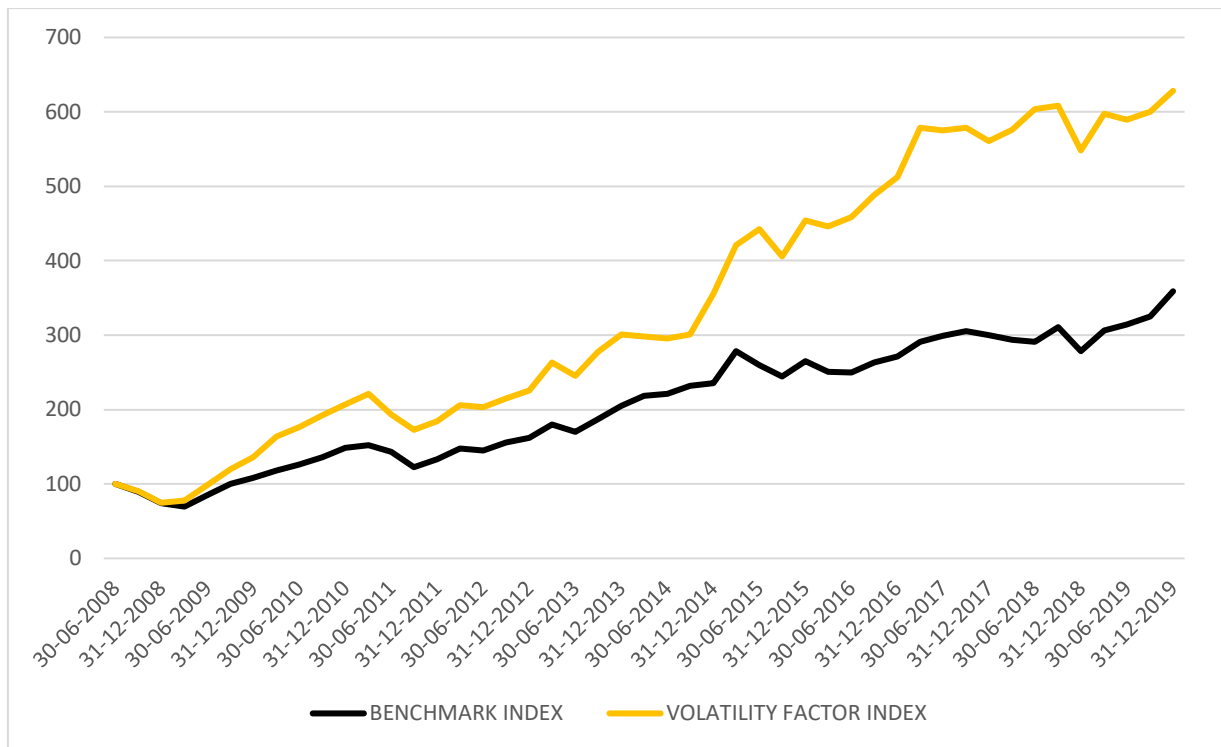
Figure 9. Volatility factor comparison

Source: Based on authors´ calculations

Volatility factor exposure was measured with standard deviation. Volatility index outperformed the market by 269.39%. Result is significant because the index includes companies whose share price has made as little dispersion as possible. This also means that the index has had small risk because its diversified over companies in different sub-sectors because price fluctuations are not based on specific industries and the prices of these shares do not fluctuate much. The volatility index makes better results than benchmark index during whole research interval 2008-2019. The biggest difference to the benchmark index is at the end of 2014 where the volatility index will start to rise sharply. After 2014 volatility index trendline is ascending and probably in the longer term it would have done an even better result. Volatility factors volatility and Sharpe ratio were mediocre compared to other factor strategies.
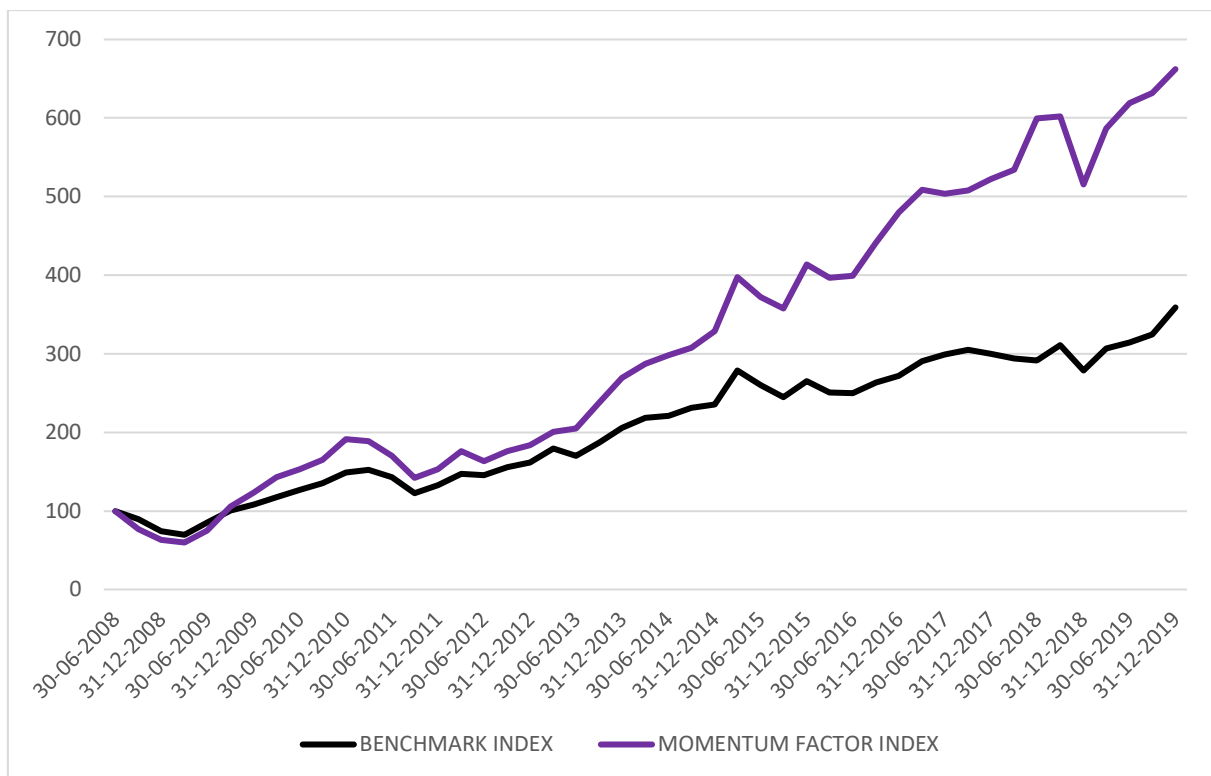
Figure 10. Momentum factor comparison

Source: Based on authors´ calculations

Momentum factor exposure was measured with rate of change. In Figure 3 previous MSCI study shows how momentum factor methods have outperformed the market in times of financial crisis. During the dot-com bubble and GFC momentum factor has outperformed the market in previous study made by MSCI. Figure 13 shows that in the Nordic countries, the momentum factor methods did not perform as expected during the crisis. For the first year, the momentum factor underperforms all indices including the benchmark index. The volatility of the momentum strategy was the highest of all indices, but the result outperformed the market by 303.26%. The momentum strategy had a high risk with 11.59 % volatility which was biggest of all indices. The risk was partially acceptable when the strategy made the best result after the size factor. Sharpe ratio of 0.41 reveals that return was not as good as other factor investing returns in relation to risk when Sharpe ratio was the second lowest with momentum strategy.

3.2. TRANSACTION COSTS

To make the research as realistic as possible and to see if the results are worthwhile, we need to add transaction costs into every portfolio. Transaction cost is formed when the instruments in the portfolio are bought and sold on a quarterly basis and the content of the portfolio changes. This may change the result as the instruments of the benchmark index remained constant throughout the term but the portfolios of factor investing strategies changed quarterly total of 47 times. Annual transaction cost in this study will be 1.44% which was in 2007 the average annual transaction cost for mutual funds in United States (Edelen, R., Evans, R., Kadlee, G. 2007).

Table 4. Average annual transaction costs

Fund Group:	Trading Volume Mean	Per-Unit Trading Costs				Annual Trading Costs Volume*Per-Unit Costs		Expense Ratio	
		Commissions	Mean + Spread +	Price Impact=	Per-Unit Cost	Mean	Median	Mean	Median
All	181%	0.13%	0.13%	0.49%	0.76%	1.44%	0.89%	1.21%	1.17%
Large Relative Trade Size	195%	0.12%	0.13%	0.68%	0.94%	1.89%	1.28%	1.21%	1.15%
Small Relative Trade Size	165%	0.13%	0.13%	0.30%	0.56%	0.96%	0.57%	1.20%	1.20%
Large-cap Stks	159%	0.11%	0.07%	0.26%	0.45%	0.77%	0.55%	1.12%	1.07%
Mid-cap Stks	212%	0.13%	0.14%	0.56%	0.84%	1.73%	1.30%	1.30%	1.26%
Small-cap Stks	207%	0.16%	0.28%	1.03%	1.46%	2.85%	2.33%	1.34%	1.31%
Value	163%	0.13%	0.12%	0.50%	0.74%	1.21%	0.77%	1.14%	1.11%
Blend	144%	0.12%	0.11%	0.41%	0.66%	1.04%	0.59%	1.07%	1.07%
Growth	215%	0.13%	0.15%	0.55%	0.84%	1.84%	1.32%	1.33%	1.28%
Large TNA	147%	0.11%	0.10%	0.65%	0.86%	1.44%	1.01%	0.94%	0.97%
Small TNA	188%	0.13%	0.14%	0.46%	0.73%	1.44%	0.87%	1.27%	1.23%

SOURCE: Edelen, R., Evans, R., Kadlee, G. (2007). Scale effects in mutual fund performance: The role of trading costs

New returns were calculated with annual transaction cost of 1.44%. All returns fell by about 100 percentages points but each factor investing strategy still remained profitable and outperformed the benchmark index. Transactions costs had biggest impact on size factor and volatility factor.

Table 5. Returns with transaction costs

Index	Metrics	Returns with transaction cost (%)	Performance compared to benchmark index (%)
Benchmark	Market capitalization	258.96	-
Quality	Return on equity	440.08	181.12
Momentum	Rate of change	458.03	199.07
Size	Market capitalization	961.30	702.34
Volatility	Standard deviation	419.85	160.89
Value	Price to book	429.70	170.74

Source: Based on authors´ calculations

3.3. IMPACT OF WEIGHTING METHOD

When comparing the performances of indices, the performance of portfolios is not only affected by the selection of companies. In addition to the selection, the results are also affected by the weighting method used in the portfolios. The fundamental weighting method used in factor indices gives different results from the capitalization weighted benchmark index. Previous studies have compared the performance of fundamental weighted indices to the performance of S&P 500 which is market capitalization weighted index. Study made in 2004 showed that fundamentally weighted indices outperformed S&P 500. In that study all companies from S&P 500 index were re-weighted by different measures and six different indices were created. These six indices outperformed the S&P 500 by an average of 1.91% per year for 42 years (Arnott, R., Hsu, J., Moore, P. 2004). In order to be able to assess the impact of factors on returns in the Nordic countries, the impact of weighting method must be noted. If it is assumed that the fundamental weighting method brings 1.91% more returns in year than the market capitalization weighted index, then these returns can be deducted from our study. The result is a rough estimate of the returns brought by the factors in the Nordic countries.

Table 6. Returns after taking weighting method into account

Index	Metrics	Returns with transaction cost (%)	Performance compared to benchmark index (%)	Return after taking weighting method into account (%)	Performance compared to benchmark index (%)
Benchmark	Market capitalization	258.96	-	-	-
Quality	Return on equity	440.08	181.12	331.49	72.53
Momentum	Rate of change	458.03	199.07	346.89	87.93
Size	Market capitalization	961.30	702.34	745.81	486.85
Volatility	Standard deviation	419.85	160.89	323.40	64.44
Value	Price to book	429.70	170.74	313.23	54.27

Source: Based on authors´ calculations

Table 6 reflects the returns of factor investing after deducting transaction costs and impact of weighting method. After taking weighting method into account all factor indices outperform the benchmark index. Factor indices outperform the benchmark index by an average of 153% during 2008-2019.

3.4. STATISTICAL SIGNIFICANCE

To test how likely it is that the results from the study are just gained by chance, T-statistics test was performed. T-test is statistical test for testing the means of normally distributed random variables. In T-statistics the excess return and sample size is compared to standard deviation. The larger the average excess return and sample size is compared to standard deviation, the larger the T-value. Excess return is obtained by subtracting the result produced by the benchmark index from the returns of other indices. T-value represent how statistically significant results are and P-value is the percentage probability of whether the results have been obtained by chance. To be 95% sure that the results are significant, T-value must give a P-value of 0.05 or less. T-value is defined by equation:

$$t = \frac{\overline{x} * \sqrt{n}}{s}$$

Where x-bar represents average excess returns. "n" represents number of observations and s represents standard deviation (IFA 2013). P-value of 0.05 represents that there is 5% chance that results were obtained by chance.

Table 7. Statistical significance results

Index	Average quaterly return (%)	Excess return (%)	T-statistics of excess return	P-value
Benchmark	3.08	-	-	-
Quality	4.45	1.37	0.99	0.164
Momentum	4.73	1.65	0.97	0.169
Size	6.08	3.00	1.85	0.035
Volability	4.40	1.32	0.95	0.173
Value	5.09	2.01	0.83	0.205

Source: Based on authors´ calculations

In table 7 there is results from statistical significance testing. Excess return of each index is calculated in the third column. In the next column there is T-value for each index. The higher the T-value, the more reliable the average excess return can be considered. Of all excess returns, the size index reached the highest T-value which also results in the lowest P-value. If significance level is set to 5% only size index would be considered as significant with 0.035 P-value. This means that there is only a 3.5% chance that the size index results came by chance and such a low probability is interpreted that the results are significant. Probability of chance in other indices was about 16-20%.

CONCLUSION

The purpose of this study was to find out how well the factor investing strategy works on the Nordic stock market. To implement this idea there needed to be good metrics to measure how big a characteristic this factor is in that stock and put together a portfolio that has the 20 out of 64 strongest companies based on these factors relative to the rest of the market. Metrics that were used in this study was price-to-book ratio to measure value, standard deviation to measure volatility, market capitalization to measure size, return on equity to measure quality and rate of change to measure momentum. Five fundamentally weighted indices were created based on these metrics and their result were compared to a benchmark index. The benchmark index was created from 64 Nordic companies that are from the OMX indices of their own countries. Companies were weighted by market capitalization and this market capitalization weighted index represent Nordic market.

When the results are compared, each factor investing strategy outperformed the benchmark index. Before adding any costs the returns were 256.11%-892.46% better compared to benchmark index which is significant result. Overall factor investing strategies outperformed benchmark index from Nordic countries by 400% on average. This means that any style factor will give double returns in about 10 years compared to market. The best performance in the term included in the study was made by size factor. Size factor gave 1151.42% returns over period of about 10 years which was 892.46% more than benchmark index. The result is surprising when there is a big economic crisis during the time interval and small cap stocks includes very high risk and are really vulnerable to economic changes. The result is really affected by the fact that the companies has been selected for the study 10 years after the financial crisis and small cap companies that went bankrupt during the financial crisis have been excluded from the study. The benchmark was least overperformed by value factor. Value factor outperformed benchmark by 256.11% and its overall return was 515.07%. The problem with the value factor is that some companies price to book ratio can be really good but it doesn't tell you anything about the company's success or potential.

After transaction costs and impact of weighting method returns dropped from average of 400% to 153%. All factor investing methods outperformed the market, but only the result given by the size factor can be considered as statistically significant. The results were still significant and proved the long-term viability of factor investing strategies in the Nordic countries. Statistical

significance testing showed that the standard deviation became too high for most factor indices and only the size factor reached less than 5% significance level. The result given by other indices were about 16-20% conceded by chance which is not as statistically significant as the result given by the size factor. Each factor investing method that received a 16-20% significance level obtained consistent results similar to previous studies which reduces the possibility of chance. Despite statistical significance the results show that factor investing is significant way to diversify portfolio and outperform the market in Nordic countries.

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