Matias Kokko

Momentum anomaly in Nordic sector indexes

Evidence from Finland, Sweden and Denmark

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Author: Matias Kokko
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ABSTRACT:

Investing and maximizing personal wealth has become more and more popular in the 21st century. This has generated a demand for new strategies to try and beat the market. Efficient market hypothesis believes that information should effectively reflect in prices. A market that reflects all the available information all the time is efficient. Usually when market doesn't act efficient it is linked with anomalies. Anomalies consist of wide range of different factors, such as size, value and momentum. The anomaly this thesis studies is price momentum. Momentum anomaly has been one of the hardest anomalies for financial models to uncover. It is believed to be more of a result of behavioral patterns and trends, than assets fundamentals. By studying Nordic sector indexes, I shed a light to market and asset class that has gained smaller attention prior. Results oof this thesis clearly shows how there is significant momentum in Nordic sector indexes.

This thesis aims to show whether Nordic stock markets experience price momentum. Momentum has been proven to be statistically viable in many different markets and asset classes, but most of the research attention has been in traditional stocks in the U.S market. This thesis studies the relation between assets historical returns and future returns in sector indexes listed in OMX Helsinki, OMX Stockholm and OMX Copenhagen between the years 2005 and 2020, thus updating the existing literature about the subject. Momentum profits are studied by creating winner and loser portfolios based on assets 3,6-,9- or 12-month historical returns and held for 3,6-,9- and 12-months. Doing this we gain monthly portfolio returns for different momentum strategies, used in most momentum strategies. Many of the momentum studies use Students t-test to test whether momentum profits are statistically significant or not. By also using t-test, I can get more easily comparable results against prior momentum literature.

It has been shown that assets historical returns can explain its future returns. The prior literature has shown significant abnormal momentum returns in stocks almost everywhere. This thesis shows more mixed set of results. As prior studies, the results show that there is significant price momentum effect, but against most studies, the winner and loser strategies exhibit almost equally strong positive returns. This diminishes the results of WML-strategies that other authors have shown to perform well. However, by using the strategies showed in this thesis it is possible for investor, especially in the short-term to gain significant returns. These returns can be found in every market studied in this thesis, best being the short-term strategies in Danish market. However, the number of indexes used in the sample is small and limited and can have an impact on the results.

KEYWORDS: Momentum, Nordic markets, Anomalies, Sector, Index

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ABSTRACT:
Sijoittaminen ja henkilökohtaisen varallisuuden maksimointi on kasvattanut suosiotaan 2000-luvulla. Tämä suosio on luonut kysyntää uusille strategioille, joilla markkinat voisi voittaa. Tehokkaiden markkinoiden hypoteesi (EMH) uskoo, että saatavilla olevan informaation pitäisi heijastua tehokkaasti hintoihin. Markkina, joka heijastaa kaikkea saatavilla olevaa informaatiota koko ajan on tehokas. Yleensä kun markkina ei toimi tehokkaasti, yhdistetään se anomalioihin. Anomaliat koostuvat laajasta joukosta erilaisia tekijöitä, kuten koko, arvo ja momentum. Tässä lopputyössä käsitellään momentum anomaliaa. Momentum anomalia on ollut taloudellisille malleille yksi vaikeimmin selitettävistä. Sen uskotaan olevan enemmänkin käyttäytymismallien ja trendien tulosta, kuin omaisuuserien perusteiden. Tämä tutkielma tähtää näyttämään, onko pohjoismaisissa osakemarkkinoissa havaittavissa hinta momentumia. Momentum on todistettu tilastollisesti merkitseväksi monissa eri omaisuuserissä ja markkinoissa, mutta suurin osa näistä tutkimuksista käsittelee tavallisia osakkeita ja Yhdysvaltojen markkinaa. Tutkimalla pohjoismaisia sektori indeksejä, tuon uuden näkökulman vähemmän huomiota saaneeseen markkinaan ja omaisuuserään.

Tämä tutkielma tarkastelee yhteyttä omaisuuserien historiallisten tuottojen ja tulevien tuottojen välillä OMX Helsingissä, OMX Tukholmassa ja OMX Kööpenhaminassa, vuosien 2005 ja 2020 välisenä aikana, täten päivittäen aiheesta tehtyä aiempaa kirjallisuutta. Momentum tuottoja tutkimaan luomalla voittaja ja häviäjä portfolioita, jotka perustuvat omaisuuserien 3,6,9 ja 12 kuukauden historiallisiin tuottoihin, ja joita pidetään 3,6,9 ja 12 kuukautta. Täten tekemällä saadaan kuukausittaisia portfolio tuottoja eri momentum strategioille, joita useimmat aikaisemmatkin tutkimukset ovat käyttäneet. Suurin osa aiemmista momentum tutkimuksista testaavat tilastollista merkitsevyyttä Studentin t-testillä. Käyttämällä t-testiä tämän tutkielman tuloksien analysoinnissa, saan paremmin vertailukelpoisia tuloksia aiemman kirjallisuuden kanssa.

Aiemmin on osoitettu, kuinka omaisuuserien historiallisilla tuotoilla on kyky selittää tulevia tuottoeriä. Edeltävä kirjallisuus on osoittanut, kuinka merkittäviä momentum tuottoja on saatavissa lähes jokaisessa markkinassa. Tämä tutkielma saa hieman risteäviä tuloksia, sillä kuten aiemmat tutkimukset saan merkittäviä momentum tuottoja, mutta vasten useimpia aiempia tutkimuksia, myös häviäjä portfoliot tuottavat lähes yhtä suuria positiivisia tuottoja, kuin voittajat. Nämä tuotot syövät melkein kokonaan voittaja miinus häviäjä portfolion tuotot, joiden muut tutkijat ovat osoittaneet suoriutuvan hyvin. Kuitenkin käyttämällä tutkimuksessa käytettyjä strategioita varsinkin lyhyellä aikavälillä, on sijoittajan mahdollista saada merkittäviä tuottoja. Näitä tuottoja on saatavilla kaikista tutkimuksessa tarkastelluista markkinoista, mutta erityisesti lyhyen pitoajan strategioista Tanskan markkinoilla. Toisaalta, koska tutkimuksen otoskoko on pieni, saattaa tällä olla vaikutusta saatuihin tuloksiin.

AVAINSANAT: Momentum, Nordic markets, Anomalies, Sector, Index

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1 Introduction

Among the vast topics in finance there seems always to be interest regarding maximizing the returns via different strategies, and even more so nowadays when investing has become all more popular. According to finance theory returns of an investment always portrays its risks, and so higher returns would mean equally high risk. This should translate into markets being efficient, meaning that information should effectively reflect in prices. A market that reflects all the available information all the time is called as efficient. This term of efficient market is based on efficient market hypothesis (EMH). When market doesn't act efficiently it is often linked to anomalies, such as momentum. This thesis studies the momentum effect in the Nordic sector indices. Momentum is widely researched anomaly across wide spread of assets and markets. However, most of the studies still tend to be about conventional stocks and the U.S market. However Nordic markets are interesting in the sense that they are a considered riskier than U.S, but lower risk than emerging markets, being this middle ground of risk. This thesis aims to investigate Nordic markets that have gained less attention from researchers. Many investors prefer active investing to benefit from short-term price fluctuations. Using momentum strategies with relatively short investment horizons I can add to existing literature by whether this strategy works with indexes and can generate significant returns to investors. By combining Nordic market with sector indexes, I aim to contribute to empirical knowledge concerning momentum in market and asset class that haven't got much attention prior. Index funds are generally considered as great long-term investments, but what if investor could also take advantages from short term price fluctuations in indexes? The indexes used in this thesis to build portfolios consist of stocks that are sorted based on their industry. By this way the research briefly touches another factor seen in anomalies, the industry factor. Usage of sector indexes can bring investors security by limiting the impact an individual stock can have. The results of the study imply that significant monthly momentum returns can be found in all three markets, but the WML strategies seem to be inefficient. This thesis also aims to study whether the Nordic periphery markets have differences or similarities within regarding price momentum.

The thesis observes the monthly average returns of momentum portfolios from three different markets, Finnish, Danish and Swedish market. The period observed ranges from January 2005 to October 2020, and so provides results from wide timeline of different market states. The first point of interest is whether investors can earn significant momentum profits by applying JxK momentum strategies, tested with t-test. Previously a study by Jegadeesh and Titman (1993) researched individual stocks with similar strategies, which gives my results good benchmark to compare with. Another thing this study intends to review is whether Nordic markets behave similarly and can a significant industry factor be found from the results.

This thesis is structured in the following way. Chapter one introduces to the research problem and hypotheses. Second chapter opens the theory of efficient market hypothesis as a base for understanding anomalies. Third chapter presents the evolution of financial models all the way to ones that include momentum factor. Fourth chapter reviews the literature surrounding the momentum anomaly. The data and methodology used in this thesis are shown in chapter 6. The results of this study are shown and analyzed in chapter 7, and conclusions are discussed in chapter 8.

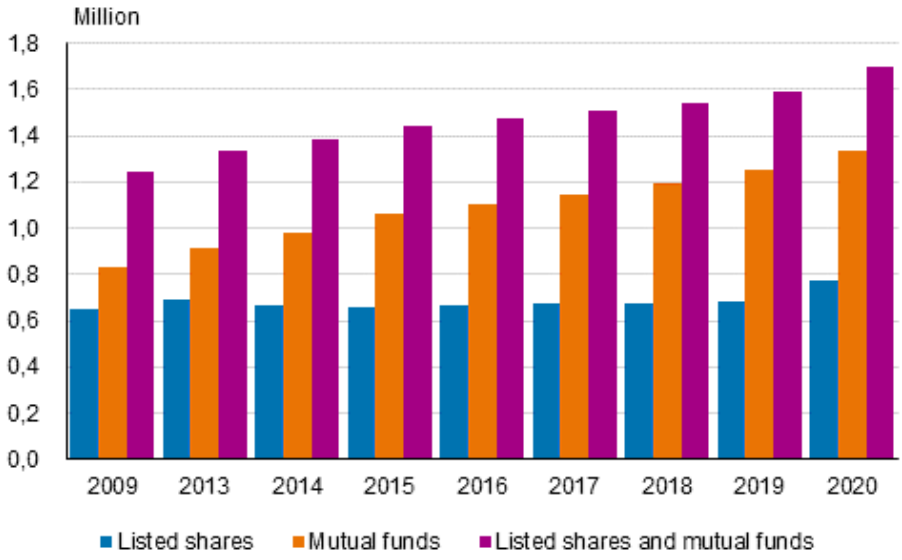
2 Theory of financial markets

One of the first researchers to talk about efficient market hypothesis (EMH) was Eugene F. Fama, who studied EMH in 1970. This hypothesis expresses how markets and investors are rational and have all the available information, so present prices reflect the true value of a stock constantly. This leads to that stocks can't be over- or undervalued, and all the excess returns can only be risk-adjusted returns. This theory ruled the finance literature for the longest of times, and even though many studies have debunked this way of thinking, some people still believe that it is valid. If assets price completely reflect all the information, it should be hard to outperform the market by choosing misvalued securities. Fama (1970) suggested that assets are priced according to their fundamentals assuming that market has full information, and when new information arises there is congruent adjustment in prices. Fama introduces 3 different forms of efficiency in his paper. These three forms of efficiency are tested as in: weak form tests use set of historical prices as information, semi-strong form tests investigate whether prices adjust to other information that is publicly available, as in stock splits and announcements of the quarterly earnings and strong form tests investigates if some groups have monopolistic access to any information that is important to assets price formation (Fama 1970). Fama's conclusions indicate that support for efficient markets model is extensive and contradictory evidence sparse.

According to the theory of efficient markets, it should not be possible for investors to consistently beat the market average by using publicly available information, such as data on a company's book-to-market ratio, market capitalization, or past share prices. However, prior studies have revealed that smaller firms and companies with higher book-to-market ratios have historically outperformed larger firms and companies with lower book-to-market ratios. Additionally, the performance of a company's stock in the past has often been correlated with its future performance. These patterns, which cannot be explained by traditional financial models, are referred to as anomalies (Bodie, Kane & Marcus, 2011). Even after being studied for decades, researchers still have not

yet reached a consensus about if financial markets really are efficient or not (Lo & MacKinlay, 2002).

This revelation that markets aren't efficient, and it can be beaten by investor, has created many different investment strategies. These strategies aim to generate returns and beat the market by taking advantage of simple trading strategies focused on different factors such as value, industry and momentum. Investing has risen greatly in popularity and in Finland, approximately 1,7 million individuals owned shares in investment funds or domestic listed shares in 2020. (Official Statistics of Finland, 2020). The interest in asset management and different investment strategies also reflects in the growth of European assets under management (AuM) which has grown from EUR 10.8 trillion in 2008 to EUR 23.1 trillion at the end of 2018 (European Fund and Asset Management Association, 2020). Another development in European market is the rise of smart beta's share of the total ETP market, that has increased from less than 1% in 2005 to approximately 6% in 2020. Towards the end of 2020, the number of ETPs got to 160 with the total AuM reaching to EUR63 billion (Deloitte, 2021). A paper by Grinblatt, Titman and Wermers (1995) examines momentum investment strategies, portfolio performance and herding with respect to mutual fund behavior. The result shows that around 77% of the mutual fund investors are 'momentum investors, as in buying the past winners.



Picture 1. Number of persons owning listed shares, mutual funds or both in 2009 to 2020. (Official Statistics of Finland, 2020)

2.1 Financial Models

The finance research is full of different models that try to explain the relationship between assets risk and return. Over time these models have evolved as researchers have added in factors that they have believed would help to explain this relationship. In this chapter is compiled the development from simple CAPM model to six-factor model that includes momentum factor.

2.2 CAPM

One of the most known financial models is the CAPM model developed by William F. Sharpe (1964), John Lintner (1965), and Jan Mossin (1966) (Bodie, Kane, & Marcus, 2011). The model gives powerful and intuitively explanation for the relation between risk and expected return, which is one of the reasons for its huge popularity (E. F. Fama & French, 2004). The model claims that the expected risk premium over the risk-free rate for an asset, should be proportional to its exposure to overall market risk, that in CAPM is measured by beta. (Dempsey 2013). CAPM consists of few underlying assumptions. Firstly,

model assumes investors are unwilling to take risks and they care purely about optimizing mean and variance of their one-period investment return. Investors are also assumed to have equal information. The model also assumes that there is borrowing and lending at a risk-free rate, as well as that market is in equilibrium. (Bodie et al., 2011) (Dempsey 2013). As one can interpret, these assumptions are quite unrealistic in real market scenario, so also the model has performed insufficiently in empirical tests (Fama & French, 2004).

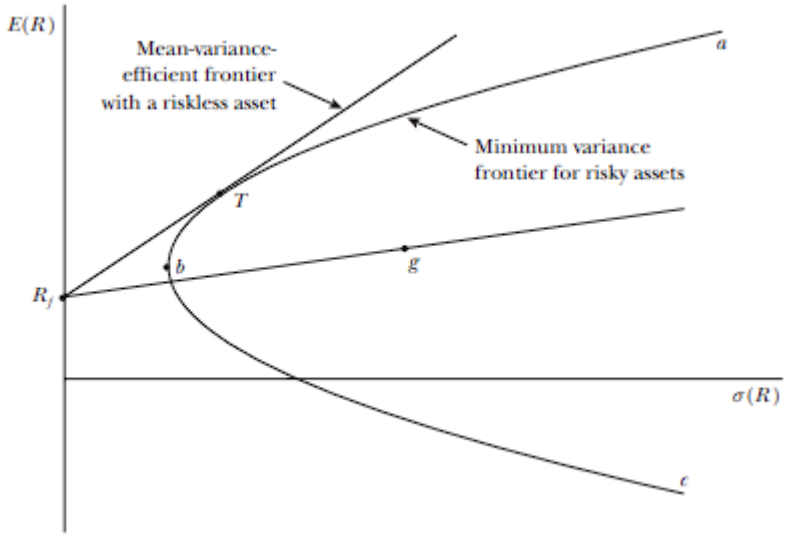


Figure 1. Investment opportunities. (Fama & French, 2004)

Figure 1 shows the relationship between the expected return and market risk, as stated in CAPM. In the figure (R) is the standard deviation of portfolio return and indicates portfolios risk, and E(R) is the expected return. The minimum variance frontier abc shows combinations between expected return and risk for portfolios of risky assets that minimize return variance at different levels of expected return. Portfolios combining risk-free lending or borrowing with some risky portfolio g plot along a straight line from Rf (risk-free rate) through g. T is the mean variance optimal tangency portfolio, which all investors hold. (Fama & French, 2004)

By following the example set by previous figure can we express CAPM model by:

$$(1) \quad E(R_p) = r_f + \beta_p[E(r_m) - r_f]$$

where $E(R_p)$ is the expected return on asset p, r_f is the risk-free rate, $E(r_m)$ is the expected market return and beta measures the contribution of individual asset to the variance of the market portfolio as a fraction of the total variance of the market portfolio (Bodie et al., 2011). So β is the assets systematic risk.

2.3 Fama-French Three-Factor Model

The Fama-French three factor model is a financial model that attempts to explain the variation in stock returns by looking at the exposure of a stock from three factors: market, size, and value. Fama and French (1993) explains in their paper that size, assessed by market capitalization, and value, assessed by book-to-market ratio are important proxies to explain all the risk exposures that CAPM β doesn't catch. Fama and French's model can explain much of the variation in average returns for portfolios that are based on factors such as the size of the company, the book-to-market value of the company's equity, and other price ratios that are not accounted for by the Capital Asset Pricing Model (CAPM). The model is also able to explain most of the cross-sectional variation in stock returns. (Fama & French 1993,1996)

This model can be expressed as:

$$(2) \quad R_i - R_f = a_i + \beta_i(R_M - R_f) + s_i SMB + h_i HML + \varepsilon_i$$

SMB and HML are measures of the returns on diversified portfolios of stocks that are grouped based on their different characteristics. SMB (small minus big) represents the difference in returns between portfolios of small and large stocks, while HML (high minus low) represents the difference in returns between portfolios of stocks with high and low book-to-market ratios. β Is the assets exposure to market risk, s to size and h to value. The three-factor model has been criticized for its lack of empirical motivation. The SMB and HML factors are constructed in an ad-hoc manner to explain the observed patterns

in stock returns, that previous studies haven't been able to uncover. (Dempsey 2013). In 1993 Black criticized the model for its lack of theoretic principles, and data fitting/data mining.

2.4 The Carhart 4-Factor Model

In 1997 Carhart added based on the findings of Jegadeesh and Titman (1993), another momentum factor to the Fama French 3 Factor model. This new momentum factor measures the trend in stocks, meaning that stocks that have performed well in the recent continue to outperform in the future, and vice versa. The Carhart model is widely used by practitioners and academics to evaluate the performance of different investment strategies and to understand the factors that drive stock returns. Carhart (1997) expressed in his findings that momentum strategy's gains are consumed by its high expenses, simultaneously indicating that Jagadeesh and Titman's (1996) momentum strategy wasn't feasible. He also stated that similarly constructed contrarian strategy outperformed momentum funds.

The Carhart regression is illustrated as:

$$(3)\quad r_{it} = a_{it} + b_{iT}RMRF_t + s_{iT}SMB_t + h_{iT}HML_t + p_{iT}PR1YR_t + e_{it}$$

In addition to the factors introduced in previous models, *PR1YR* is the new momentum factor that is constructed as the zero-cost portfolio.

2.5 The six-factor model

Fama and French made a new updated model consisting of 5 factors (2015), by adding profitability and investment factors to the three-factor model. Because of many studies debunking prior models as well as their own findings, Fama and French (2018) included a momentum factor to their previous five-factor model making it the six-factor model,

$$(4)\quad Rit - Ft = \alpha i + \beta iMktt + siSMBt + hiHMLt + riRMWOt + ciCMAt + miUMDt + \epsilon it$$

where first the new factors introduced to the 3-factor model is profitability factor RMW_t (robust minus weak) and investment factor CMA_t (conservative minus aggressive). The update to this model UMD_t is the momentum factor, which is the difference in returns of past winner and loser portfolios. This is the only factor that is updated monthly instead of annually.

3 Behavioural Finance, the Pathway Towards Momentum Studies

At present times it is more common to think that investors are not completely rational all the time, because humans have tendency to irrational decision making and mistakes. This thinking refers to behavioral finance. Behavioral finance is the study of how psychology affects financial decision-making process and financial markets (Shefrin, 2001). Behavioral finance in a wide perspective can be divided into behavioral finance macro and behavioral finance micro (Pompian, 2006). Behavioral finance micro (BFMI) examines behaviors or biases of individual investors that distinguish them from the rational actors envisioned in classical economic theory. Behavioral finance macro (BFMA) detects and describe anomalies in the efficient market hypothesis that behavioral models may explain. Under the assumptions of the efficient market hypothesis securities prices are right, in that they reflect their fundamental value, and no investment strategy can earn excess risk-adjusted returns, often described in the finance literature as: “no free lunches” (Barberis & Thaler, 2003). However, this theory got lots of backlash as many studies challenged efficient markets with their findings. These alternative explanations that investors are not rational and why prices fluctuate from their fundamental price, emerged under new part of finance studies, behavioral finance. (Barberis & Thaler, 2003).

One theory that follows the same concept of flawed irrational humans is the theory of market inefficiency by Shiller (1981). Shiller believes that security market prices deviate from fundamentals as a result of human errors and people being prone to common biases that do not cancel out in aggregate. Pedersen (2015) states that markets are not efficient nor inefficient, but rather efficiently inefficient. Prices are driven away from their fundamental values by mixture of demand pressures and institutional frictions, and while prices are contained due to strong competition among money managers, leads this to markets being inefficient to efficient extent. By inefficient the author means that cost and risk money managers and active investors take is getting compensated by better performance, and the efficiency portraying in a way that the compensation to money

management when all costs are taken into account, does not encourage entry of new investors or additional capital. (Pedersen 2015)

Another challenge to efficient market theory is the study by (Barberis, Shleifer & Vishny, 1997). This study of theirs took upon the underreaction and overreaction security prices have when reacting to news. On one-to-twelve-month time horizon security prices underreact to news, as the news are slowly incorporated into the prices. On a longer time horizons of 3 to 5 years the prices tend to overreact, as securities that have had a long record of good news tend to be overpriced. This challenges efficient market hypothesis, as it shows that well informed investor can make excess returns by using the under- and overreaction of prices, without taking in extra risk. (Barberis, Shleifer & Vishny, 1997). This leads to a momentum like behavior. One of the authors also took this further by stating that when a market where EMH is used, the best strategy should be to passively invest to and hold the market portfolio (Shleifer, 2000). Hong and Stein (1997) also study markets reactions to news, by modelling an asset market that contains two populations: news watchers and momentum traders. News watchers underreact to new private information, which momentum traders can exploit by trend-chasing. Their findings suggest that momentum effect is more persuasive in information that is initially private, than in public. They also conclude that the effect is stronger with smaller firms, as larger firms are more covered by analysts and the information spreads out more gradually in the short horizon.

3.1 Birth of momentum research

Multiple studies and researchers have found numerous anomalies in the stock market. One of the most studied of these anomalies is the momentum anomaly. This anomaly has also been identified in between different sectors. This study takes these prior studies one step deeper and investigates whether momentum effect is persistent in Nordic sector indices.

The base of momentum strategy is trying to exploit stock price volatility and buy good performers and sell bad performers based on their past performance. The idea behind this, is that we assume this phenomenon to be continuous, meaning that good performers will continue to perform good. When we take the assumptions of weak form efficiency into account, states said assumptions that, past prices should not indicate the future movements of the stock prices. Price momentum is widely researched topic as it has been studied in different timeframes and asset classes. Even though it has been widely studied, researchers still have no consensus about what is driving these profits. The finance literature can't say for certain whether market inefficiency is a result of behavioral explanations or whether they are the result of the rational reaction of investors to market constraints. Also, no harmony exists either about what is the level that momentum is found before it diminishes, is it the stock level, industry or country level. Fama and French have later been vocal about how the momentum anomaly is "the biggest embarrassment" to the efficient market hypothesis, and how he thinks that momentum is the "premier anomaly" (Fama & French, 2008).

3.2 Early days of momentum studies

The Relative Strength as a Criterion for Investment Selection by Robert A. Levy (1967) was one of the first to examine what people later started to call momentum. His study examined stocks that had largely greatly exceeded their 26-week historical average continued to earn excess returns. Levy's early work considering momentum was promptly replaced and discarded by Jensen and Benington (1970), as they presented that with

transaction costs and the higher level of risk, strategies created with Levy's rules earned less than buy and hold strategy. After this study momentum did not gain much of attention as researchers were more interested in contrarian strategies. One of the studies that contributed to this interest was the study of De Bondt and Thaler (1985) who showed evidence against momentum profits, when they studied stock market overreaction. They found out long-term reversals in stocks, as former poorly performed stocks repeatedly outperformed former winners in upcoming 3–5-year period. Similar results were also experienced by Poterba and Summers (1988) and Fama and French (1988). The concept of momentum was introduced for the wider audience by the study of Jegadeesh and Titman in 1993 and served as a base for many momentum studies ever since. They studied the momentum anomaly in the US stocks for the period of 1965 to 1989, by buying winner stocks and selling loser stocks based on the 3-to-12-month past performance of these stocks. This strategy experienced a significant positive return for the following holding periods of 3 to 12 months. Jegadeesh and Titman (1993). This study of them reviews the cumulative returns of the previous 3, 6, 9, and 12 months to form portfolios, and measures the return of the following 12 months of these portfolios. They also try to avoid price pressure, bid ask spread and lagged reactions effect issues that were found prior by Jegadeesh (1990) and Lehmann (1990). They avoid those issues by skipping the last week, a behavior adopted by many studies after them. Jegadeesh and Titman (2001) came back to review their original study and discovered that momentum anomaly has existed also after their initial time period and that the results were not a product of data mining. Authors also went through different evidence that suggested momentum strategies would be due to delayed overreactions which are eventually reversed and proved these assumptions to be also right (Jegadeesh & Titman, 2001). Ever since this study, momentum has been examined across different markets, securities, timeframes, industries etc. Lehmann (1990) was one of the first to exhibit reversals in stock returns, although the term he analyzed was rather short, only a week. The best-performing stocks of the previous week were more likely to be one of the poor performers of the following week or month. In 1997 Carhart stated that transaction costs consume the profits from momentum strategy, and so you can't exploit momentum after

expenses are taken into account. Korajczyk and Sadka (2004) as well as Lesmond, Schill, and Zhou (2004) later also came to same conclusions. Lesmond, Schill, and Zhou (2004) show that momentum strategies require large trading costs, and those costs make the momentum profits disappear after adjusting for. Their results also suggest that most of the momentum profits can be explained by constant trading on high-cost securities.

3.3 Momentum the world wide anomaly

Evidence about the momentum anomaly has been encountered in all markets globally. Rouwenhoorst (1998) conducted research on momentum in 12 European countries during the period 1980-1995. His internationally diversified portfolio of former winners outperformed the loser portfolio by about 1 % per month. The study by Rouwenhoorst also discovers that the results using European companies is very similar and correlates significally with the results of Jegadeesh and Titman (1993) from the U.S market. This gives the indication that those earlier results were not by chance. Schiereck, De Bondt, and Weber (1999) Studied German market in same methods as the prior studies of US market and experienced how basic buy and hold strategy earned excess returns of 8 percent annually, and so these two markets behave very similary (Schiereck et al., 1999). Their conclusion is that asset prices reflect the level that investors forecast them to earn, but which are profoundly wrong. Griffin, Ji, and Martin (2003), show significant value and momentum excess returns in multiple different markets and asset classes. They also conclude that some of the negative correlation among value and momentum is driven by exposure to liquidity risk. Even though studies about momentum anomaly seems mostly to review stock market, has it also been discovered in other asset classes that have different investors, institutional structures, and information environments. (Asness, Moskowitz & Pedersen, 2013). Some researchers have brought up the possibility that data mining is the reason momentum strategies perform well, but Asness (2011) states that even regarding this, momentum still works everywhere. Studies show that only market where momentum doesn’t work is Japan (Asness, 2011).

As stated earlier in the thesis, many researchers tend to think that behavioral aspects are what enables momentum. One approach behavioral finance uses to explain phenomenon such as overconfidence, anchoring, herding etc. is to review how mental biases affect the way investors react to past returns or fundamentals (Daniel, Hirshleifer & Subrahmanyam, 1998). Daniel et al. (1998) study the overconfidence investors tend to have about accuracy of private information and biased self-attribution, which causes irregular shifts in investors' confidence as a part of their investments results. The theory implies that investors overreact to private information indicators and underreact to public information indicators. Daniel, Hirshleifer, and Subrahmanyam (1998 & 2001) hypothesize that uncertainty tends to increase the impact and amount of psychological biases. Hwang and Salmon (2004) studied another bias, herding, which is basically eliminating private information and imitation, in US and South Korean markets and find it in both markets and in all market conditions. Another interesting behavioral bias is the anchoring effect. In anchoring two different starting values produce different estimates, that are affected and biased towards the initial values. (Tversky & Kahneman, 1974). Another paper discussing anchoring, to be more specific cross-sectional anchoring was produced by Cen, Hilary and Wei. They find that analysts' earnings forecasts are influenced by the level of the firms' forecasted earnings per share. Their second remark is that there is a positive relationship between firm CAF and future stock returns which they are not able to explain by a known risk-factors. (Cen, Hilary, Wei, Zhang 2010). Yet another study around same behavioral issues were made by Shefrin and Statman (1985). They touch an issue called disposition effect concerning about a bias to sell good performers too early and hold bad performers too long. In their previous studies they have built a framework, that includes elements like mental accounting, regret aversion, self-control, and tax considerations (Shefrin & Statman, 1985). Lee and Swaminathan (2000) addressed momentum trough different proxy of past trading volume. According to them the magnitude and persistence of future price momentum can be forecasted through trading volume, as it portrays investors interest in a stock and might also be connected to how fast information connected into stock prices.

While Bandarchuk and Hilscher (2013) show how most of the previous literature has centralized their studies to show how same characteristics, such size, analyst coverage, market-to-book, price, etc. affect momentum profits. Their revelation is that all these strategies utilizing these common characteristics seem to get their advantage from stocks with extreme past returns. This revelation can be seen as evidence for behavioral explanations. Using weekly returns, Conrad and Kaul (1989) and Lo and MacKinlay (1988) find positive serial correlation over short horizon which suggested that momentum investing is profitable for US stock market and thus suggesting market is not weak form efficient. Lo and MacKinlay show that, even when individual stock returns are negatively autocorrelated still weekly portfolio returns are significantly positively autocorrelated. Authors call these as cross-autocorrelation. Authors show that in their research the returns of large stocks lead the returns of smaller stock. They also show evidence that overreaction isn't the only source of momentum profits. MacKinlay (1999) later added that these previously mentioned cross-correlations could account for the majority of the momentum effect. Forner (2003) shows that the momentum strategies for 12-month periods and contrarian strategies for 60-month periods yield positive abnormal results in the Spanish stock market. He also adds how momentum strategies work better on short term and contrarian strategies on longer horizon. Author concludes the paper by stating that his research adds to the evidence that momentum results aren't because of data mining.

3.4 Investors reaction to information, the root cause of momentum?

Zhang (2006) proves that when there is more information uncertainty it is compensated by higher expected returns when the news are positive and lower returns when the news are negative. In conclusion this means that prices should move more when there is more information uncertainty, as price continuation is due to investor behavioral biases. These findings by Zhang also fit in the narrative of prior literature, like Jegadeesh & Titman (1993). Antonacci (2017) tried to add his own idea of dual momentum, that means the relative strength momentum and absolute momentum combined to achieve higher re-

turns. Antonacci approaches momentum by using modules of asset pairs so he can isolate volatility related risk factors which leads to excess returns. His opinion is that investors should base their strategies on diversified risk factors and not only worry about the asset class. On the other hand, Gray and Vogel (2016) built an improved quantitative momentum that can be concluded as a strategy that seeks to buy stocks with the highest quality momentum. They point out a processing delay with continuous information, meaning that investors underreact due to steady and slow-paced flow of returns. Another study revolving around investors reaction to information by Da, Gurun, & Warachka (2014), asses a frog-in-a-pan hypothesis that implies investors get distracted when the information is presented to them in small portions in continuous manner. They find that continuous information results in the stock having persistent strong return. Another finding is that stocks that have the same cumulative return for a period, differentiate on what kind of media coverage they have had. The one that's had smaller amounts of coverage moves not in the scope of investors, thus resulting in a longer-lasting momentum. Lo and MacKinlay (1990) studied whether momentum is due to stock market overreaction, and came to conclusion that the effect is just an reflection of how prices are recorded. They state that when stock is traded pretty occasionally, tend those trades to generate a bid–ask bounce. If the bid-ask spread is significantly large could this result in short-term return reversals.

3.5 Momentum to overcome the changing market states

Daniel and Moskowitz (2013) examined momentum crashes across multiple different equity markets. As momentum strategies are generally supposed to outperform the market, Daniel and Moskowitz decided to address the times it significantly underperforms the market. These momentum crashes happen in panic states, in the beginning of new bull market, when volatility is high, and are coexistent with market rebounds. Including the previous finding, they also show that strategy which uses forecasted return and variance of WML strategy, to dynamically adjust the weights of the basic strategy generates

a Sharpe ratio approximately twice the size of the basic WML strategy, often used in finance literature (Daniel & Moskowitz, 2013, 2016).

Even before the study of Daniel and Moskowitz (2013), Moskowitz, Ooi, and Pedersen (2012) inspected assets absolute performance as a proxy to forecast future returns. This approach uses time series momentum strategies across all asset classes and shows considerable abnormal returns. Their closing remark is how this strategy performs best during extreme markets.

Pastor & Stambaugh (2003) found out that stocks liquidity risk factor affects half of the momentum profits of these stocks. Illiquid stocks returns were annually 7,5 percent higher than their liquid counterparts during their 34-year period, despite offsetting value, size and momentum factors. Similar movement was also experienced by Sadka (2006), who noticed in his article how components of liquidity risk in U.S stocks, affected the performance of momentum portfolios. Authors main finding is that during positive liquidity shocks momentum portfolios outperform their benchmarks and underperform in negative shocks. Brunnermeier & Pedersen (2009) isolate liquidity risk into market liquidity and funding liquidity and show how under some specific conditions margins are destabilizing, and market liquidity and funding liquidity are mutually reinforcing, leading to liquidity spirals". This entails how investors might be the ones who drive risk premiums and market liquidity.

The paper by Chordia and Shivakumar (2002) show how excess returns that momentum strategies produce can be defined by a set of lagged macroeconomic variables as in: dividend yield, default spread, yield on three-month T-bill, and term structure spread. Their paper also points out how these excess returns to momentum strategies fade when the stock returns are adjusted based on the variables. Authors state that returns to momentum strategies are positive only during expansionary periods, and in recession these strategies output a negative return, that however, are statistically insignificant. The main

culprit that causes momentum is the predicted part of returns, as the stock-specific returns adds marginally to returns of momentum strategies. Chordia, Roll & Subrahmanyam (2011) find that in the US market increase in the trading activity has been followed by improvement in the market quality like decreased bid-ask spreads as well as better market efficiency that can be proxied by return serial correlation. They also find that cross-sectional return anomalies have weakened in recent years.

Barroso & Santa-Clara (2015) state in their paper how momentum has had the worst crashes considering all the factors like size and value. This fact may drive investors away from using the momentum strategy, as these crashes generate kurtosis and negative skewness to momentum strategy's returns, which many investors tend to try and avoid to. However, this risk of momentum crash varies a lot over time, and it can be predicted and managed. By managing this risk investor can get rid of the crashes and almost double the Sharpe ratio of the strategy.

3.6 Industry momentum

As stated in previous studies about momentum, it can be found in many different markets and asset classes. What I try to additionally find out in this study is that is momentum persistent in industry level on the Nordic markets. During the latest decades, studies have revealed that significant part of momentum returns can be attributed to momentum within an industry.

Moskowitz and Grinblatt (1999) studied a sample period of July 1963 to July 1995 by examining formation periods of 1, 6, and 12-months and holding periods of 1, 6, 12, 24, and 36-months, where they invested the top 30 percent of individual stocks and industries and simultaneously shorted the bottom 30 percent. This showed the authors how industry momentum strategy generates lions hare of its profits on the long side, as individual equity strategies tend to be mainly driven by the short side. Because these two momentum strategies exhibit such similar returns, drives this researchers to make the statement that momentum returns are not well-diversified, as winners and losers often

come from the same industries. Also, it can be ruled that major part of momentum can be attributed to the momentum of a particular sector (Moskowitz & Grinblatt, 1999). Also, in the case of controlling for the industry momentum, turns momentum strategy of buying past winners and selling past losers significantly less profitable. In 2004 Grinblatt and Moskowitz found that short positions in small and illiquid stocks and December tax-loss trading affect momentum profits significantly. Their initial argument about industry momentum is that overconfidence and self-attribution in certain industries is the root cause of it all. It is also possible for investors not to update their preceding opinions on industries they don't know all too well. All these mentioned biases might cause temporary fluctuations which will lead to industry momentum effect.

Grundy and Martin (2001), experience that neither industry effects nor cross-sectional differences in expected returns are the main cause of the momentum, which leads to being on the same line with Rouwenhoorst (1998), as it can be stated that a common momentum factor exists. Hong et al. (2007) later came out to state that the returns of some industry portfolios that are descriptive about macroeconomic fundamentals will lead the aggregate market and, therefore, other industries.

Su (2011) studies industry momentum profits in Chinese stock markets. Author finds industry momentum to be significant, and even when lead-lag effect, the January effect, and individual stock momentum are controlled for. This study by Su takes a stand how momentum profits generated by industry-specific components are much more sizeable than what you get from common-factor components that the Fama–French three-factor model applied. According to the paper the source of these excess momentum returns is the idiosyncratic risk and the underreaction that investors have to industry-specific information.

Avramov, Chordia, Jostova & Philipov (2007) found a sturdy link between momentum and firm credit rating. Momentum strategies are significantly profitable among low-

grade firms but absent with high-grade ones. Likewise, Korajczyk and Sadka (2004) indicate that loser stocks are biased towards smaller companies that have lower level of liquidity and their short selling might be restricted. However, Korajczyk and Sadka also state that when price impacts of trades and spreads a are considered, they cannot completely explain the performance of previous winners.

Nijman, Swinkels and Verbeek (2004). Introduced portfolio-based regression approach to review momentum profits in European markets. They conclude that the main driver for momentum in European stock markets is individual stocks, industry momentum is significally weaker and country specific momentum weakest of these three drivers.

4 Data & Methodology

The data used in this thesis ranges from January 2005 to October 2020 for three Nordic exchanges. This paper studies indices in the Nordic stock markets, divided to industry indices. Nordic stock markets consist of Norway, Sweden, Denmark, Finland and Iceland. In this study Iceland is excluded following previous studies in the Nordic framework have indicated that it is too small to include (low trading volume and small capitalization). Also, Norway is excluded as other three stock exchanges are owned by same entity OMX, and I was able to get data divided into matching categories from OMX indices. Nordic stock markets have enjoyed rapid growth from 90s to this day, and foreign ownership in the public has similarly majorly increased. Foreign ownership in terms of market value was 57 per cent in Denmark (Nationalbanken 2021), 39.1 per cent in Sweden (Statistics Sweden, 2018) and 54 per cent in Finland (Bank of Finland, 2022). This has led to stock markets becoming more active in terms of number of stocks and increased trading volume. Nordics have stable political environment and are considered low risk. This places Nordic markets still with higher risk premiums than U.S, but lower than emerging markets. This brings an interesting perspective to this study, as previous studies are majorly reviewing U.S, so Nordic periphery markets bring a new viewpoint to the discussion. The sample dataset consists of all sector indices which are, and has been listed on OMX Stockholm, OMX Copenhagen, OMX Helsinki. I have chosen to only include stocks with data for the entire observation period, and so excluding delisted stocks. There are multiple different reasons for why stocks might be involuntarily or voluntarily delisted. These reasons include not meeting listing requirements, takeovers, mergers, leverage buyouts, going private, bankruptcy etc. This decision will make my results prone to survivorship bias introduced by Lakonishok, Shleifer and Vishny (1994). The dataset used for this thesis was processed using Microsoft Excel and its VBA programming language. I also manually removed duplicate indexes from the dataset, so the momentum effect from those stocks wouldn't also be doubled. This means sector indices that were mainly consisting of same stocks got reduced so only one index holding that stock remain. For all indices the dataset includes month-end close price as total return index collected from Thomson Reuters Datastream. In total return indexes it is assumed that dividends are reinvested, and

stock splits are taken into account. When I removed all the stocks with missing observations from my dataset during the recent 15 years the dataset remain with 117 indices. I also removed all the indexes that consisted of less than three stocks. By doing so the previous number of 117 indexes got dropped down to 80, Denmark 21 indexes, Finland 21 indexes and Sweden 38 indexes. Also, because all of the Nordic markets reviewed in this thesis have their own currencies, every index is converted to Euro using corresponding exchange rates. The list of indices used can be found in Appendix I. Usage of monthly stock return data is motivated by previous studies, like the one by Rouwenhoorst (1998). This thesis uses monthly data due following the footsteps of previous literature and to ease the comparison to the results of those studies. The 15-year period also benefits the empirical section of the study as it offers large number of observations for t-tests and is long enough to have different business cycles.

The methodology chosen to this thesis follows closely the prior study by Jegadeesh & Titman (1993). I observe indices returns and pick the indices with best past performance over 3-, 6-, 9- or 12-months formation period. Similarly, the holding period is 3, 6, 9 or 12 months. This means that each of the observed market gets 16 different momentum strategies each, consisting of mix of different formation and holding periods. I don't follow the methods of Jegadeesh and Titman to build 10 portfolios, and continue with winner, loser and winner minus loser portfolios and nothing in between.

Previous literature has shown multiple different ways to assess the portfolio size. As previously mentioned, Jegadeesh & Titman (1993) as well as Rouwenhoorst (1998) approach this with decile portfolios, but for example Griffin, Ji, & Spencer Martin (2005) use top 20% and bottom 20%, and Asness (2013) top and bottom thirds. My approach is closest to Griffin, Ji, & Spencer Martin (2005) as I choose to use the top 19% and bottom 19% portfolio size. This limitation is due the sample being too small to build 10 portfolios, as well as even percentage of 20% not being possible as it doesn't give even number of indexes.

Another aspect that varies in the momentum literature is the used weighting scheme. The schemes used in previous literature are value weighted, equally weighted and weighting related to assets market cap. All these schemes come with their own benefits and shortcomings. The different weighting schemes also have differentiating impacts on gross returns and transaction costs (Asness, Moskowitz & Pedersen, 2013). Value weighted portfolios can experience dominance from large companies' stocks as their market cap can be major portion out of the whole market, and lead to portfolio consisting almost entirely of one stock. When we consider market cap weighted portfolio, similar issue with largest stocks dominating portfolio returns arises (Nijman, Swinkels & Verbeek, 2004). Equal weighted portfolios have opposite issue. In this scheme portfolio returns are prone to be dominated by small stocks that are small in market capitalization but high in total number of stocks. I do not see that as an issue because my dataset consists of indices portraying whole sectors, and so decide to follow the example set by previous momentum studies of Davydov, Tikkanen and Äijö (2016), Jegadeesh and Titman (1993) and Jegadeesh and Titman (2001) and use equal weights.

I calculate the returns on indexes using compounded returns. Using continuously compounded returns is advantageous when considering multi-period returns as the continuously compounded multiperiod return is simply the sum of continuously compounded single period returns (Campbell, Lo and Mackinlay, 1997). The compounded return used to calculate for a monthly return for an index in time t is denoted as $r_{i,t}$ and is calculated:

(5) $$r_{i,t} = \ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right)$$

Depending on what holding, and formation periods are used, for the reviewed amount of periods k the compounded monthly returns Cr is:

(6) $$Cr_{i,t}(k) = \sum_{t=1}^{k} r_{i,t}$$

After getting the compounded returns for the indexes, they get ranked based on these returns. I follow the methods of Chang, Cheng and Khorana (2000), with slight modifications to better suit this thesis. The winner (W) and loser portfolios (L) comprises approximately the 19 percent best and worst performers respectively. The portfolio consists of equally weighted number of indexes N and its returns are calculated as:

(7) $$Cr_{W,t}(k) = \frac{1}{N}\sum_{t=1}^{N} Cr_{i,t}(k)$$

The return on winner minus loser portfolio WML is calculated as:

(8) $$Cr_{WML,t}(k) = Cr_{W,t}(k) - Cr_{L,t}(k)$$

The monthly average return of strategy is denoted *MAR* and calculated by taking the average of all the momentum portfolios formed throughout the period and dividing that average with the length used in holding period. This is denoted as:

(9) $$MAR = \frac{1}{H}\sum_{t=1}^{T} Cr_{W,t}(k)$$

These steps are used with every strategy and market.

4.1 Overview of the construction of the different investment strategies

In the construction of equally weighted portfolios this thesis follows the study of Jegadeesh and Titman (1993). On the last weekday of each month all indexes are ranked into top and bottom 19 percent based on their past 3,6,9 or 12 month (J) cumulative returns. Based on these formation periods best performing 19 percent are assigned to winner portfolio and worst performing 19 percent to loser portfolio. After formation these portfolios are held for 3,6,9 or 12 months (K) after what they are rebalanced. These trading strategies that are based on the returns from the past J-months and held

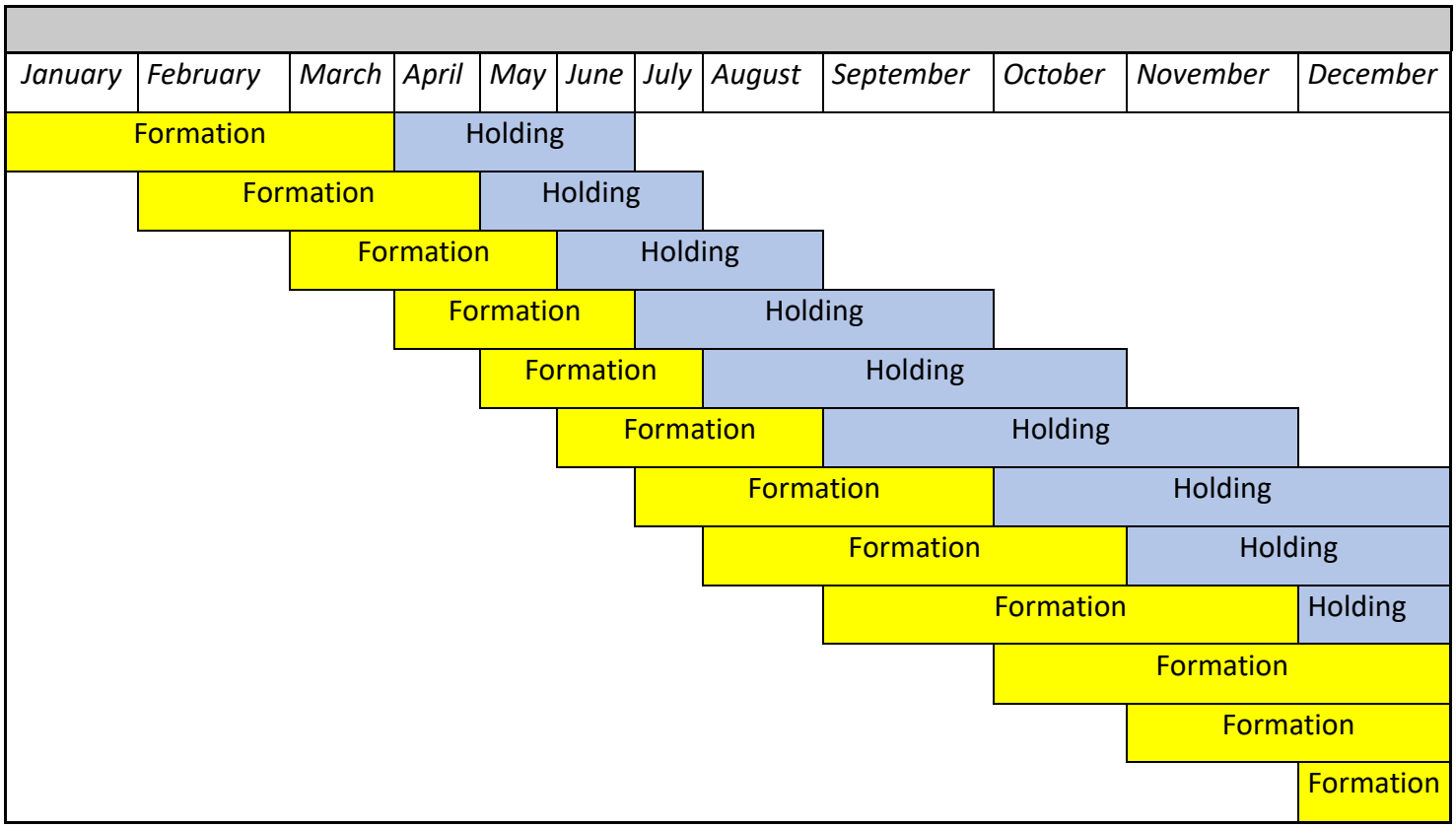
for K-months will be referred later in the results section as “J-months x K-months –strategy”. A winner portfolio consists of long positions of past best performers and loser portfolio of short positions in worst performers. In addition to winner and looser portfolios, a WML portfolio gets constructed. As some studies also call it a zero-cost portfolio, buys the winner portfolio and shorts the loser portfolio. If WML portfolio strategy shows significant positive returns, can it be stated that momentum exists in the market.

Table 1. Different JxK strategies

	Holding period (months), K			
Formation period (months), J	**3**	**6**	**9**	**12**
3	3x3	3x6	3x9	3x12
6	6x3	6x6	6x9	6x12
9	9x3	9x6	9x9	9x12
12	12x3	12x6	12x9	12x12

In this thesis, I use a method called overlapping portfolios to analyze the portfolio returns This involves creating a new portfolio every month, as well as using portfolios from the previous K-1 months (K=holding period). By using overlapping holding periods, I aim to reduce the possibility of small sample bias and increase the reliability of my statistical tests. The use of overlapping portfolios is illustrated in a figure x. Another possibility would be to use non-overlapping holding periods, where only one portfolio is held at any point in time. However, most momentum studies use overlapping holding periods even though non-overlapping holding periods result in lower trading volume leading to smaller costs. I also follow prior studies with skipping the most recent month. This is done to avoid the 1-month return reversal, that might be because of liquidity or microstructure issues (Jegadeesh, 1990) (Lo & MacKinlay, 1990). Another study that shows the effect size has to momentum returns was made by Blume and Stambaugh (1983). They indicate that due measurement errors in the returns and bid-ask bounce make long

Table 2. Example of an overlapping 3x3 strategy



term performance measures that are calculated from daily closing prices, upwards biased. This upwards bias reflects to buy and hold strategies due past losers being on average smaller than past winners. (Blume, Stambaugh 1983).

4.2 Testing statistical significance

To assets whether the results obtained are statistically significant, I use a two sided one-sample Students t-test (Student 1906). It is common for momentum studies to use one sided t-test, as it is expected that winners generate positive returns and losers' negative returns. But as my results show winners and losers both generate positive and negative returns, so two-sided test suits the purpose better. For the two-sided test the null hypothesis is set to test value is equal to zero, and rejecting this hypothesis means the value is statistically different from zero.

$$t = \frac{\bar{X} - \mu_0}{\frac{\sigma}{\sqrt{n}}}$$

Where: $\bar{X}$ is the sample mean, μ_0 is the value tested against, σ is the sample standard deviation. n is the sample size. The degrees of freedom used in this test are $n - 1$.

To assess whether the results obtained statistically significant, are the calculated t-values assessed against critical values from students t-distribution. Each t-value is evaluated at 10, 5 and 1 percent significance level demonstrated as 10% significance level = *, 5% = ** and 1% = ***.

5 Results

In this chapter we will present the results from our empirical analysis. Section 7.2 present the results from overlapping holding periods. The results presented in Table 3,4 & 5 are monthly return data for the different momentum strategies using overlapping holding periods.

5.1 Results from the short and medium-short term formation period strategies

The investors tend to be more interested in short term momentum as the funds invested aren't tied for too long. This better liquidity compared to longer term investments allows investor to get their cash to circulate more frequently and to possibly enjoy bigger returns. This flexibility in short term momentum strategy makes it more favorable for investor to use, and as the results will show shorter holding periods generate more profits.

Table 3. The results and t-statistics of Finnish, Swedish and Danish 3xK strategies

		Holding period, K			
Formation period, J	***Country***	**3**	**6**	**9**	**12**
3 Winner	**DEN**	1,381 %	1,244 %	1,183 %	1,129 %
		(-0,17)	**(2,58)****	**(40,08)*****	**(5,36)*****
	FIN	0,791 %	0,861 %	0,622 %	0,636 %
		(1,78)*	**(9,17)*****	**(2,91)*****	**(3,92)*****
	SWE	1,326 %	0,899 %	0,957 %	0,891 %
		(3,96)***	**(4,38)*****	**(6,95)*****	**(7,50)*****
3 Loser	**DEN**	0,528 %	0,464 %	0,438 %	0,524 %
		(-2,95)	(-0,95)	**(16,68)*****	(0,93)
	FIN	0,489 %	0,569 %	0,498 %	0,532 %
		(0,77)	**(1,99)****	**(2,31)****	**(2,88)*****
	SWE	0,962 %	1,011 %	0,892 %	0,894 %
		(2,57)**	**(4,46)*****	**(5,39)*****	**(6,43)*****
3 WML	**DEN**	0,852 %	0,756 %	0,744 %	0,605 %
		(-2,78)	(0,34)	**(19,02)*****	**(18,92)*****
	FIN	0,303 %	0,291 %	0,124 %	0,104 %
		(-0,19)	(0,50)	(0,10)	(0,07)
	SWE	0,364 %	-0,112 %	0,065 %	-0,003 %
		(0,04)	(-2,34)	(-0,69)	(-0,96)

Looking at the momentum portfolios with three-month formation periods 2 out of 36 strategies generate a negative return. These strategies are both observed in Swedish market and are the 3x6 WML and 3x12 WML strategies. This indicates that in these strategies the loser portfolio outperformed the winner portfolio. The Danish market strategies have strongest returns in each holding period when looking at the winner portfolios, the best being the 3x3 strategy generating 1,381 percent monthly returns. The worst performing winner portfolio was the Finnish 3x9 strategy that generated monthly return of 0,622 percent. The loser portfolios all performed against the intended strategy generating positive returns, twice even outperforming the winner portfolio. Even the worst performing 3xK loser strategy, the Danish 3x9 strategy generated 0,438 percent monthly returns. The loser strategy generating highest monthly returns was the Swedish 3x6 strategy with very hish 1,011 percent. 1 out of 12 winner portfolios did not generate statistically significant returns, that being the Danish 3x3 strategy. In loser portfolios the same ratio is 4 out of 12, and the strategies that did not have statistically significant returns being, Danish 3x3, 3x6, 3x12 and the Finnish 3x3 strategy. WML strategies behaved as winner and loser returns indicate. Danish WML strategies performed strongest as they benefitted from their lower positive loser portfolio returns, and Swedish/Finnish WML strategies performed poorly as their loser portfolios generated higher positive returns. Only statistically significant strategies are the Danish 3x9 and 3x12 strategies.

In the 6xK strategies, it can clearly be seen from Table 4, that the best performing strategy by a huge margin is the Swedish 6x3 winners strategy that generates 3,587 percent monthly returns. The same consistencies can be seen in both the 3xK and 6xK strategies results. Again, the best performing winner strategies originate from the Danish market, despite the all-around best performer being from Swedish market, and worst from Finnish market. The loser and WML strategies also behave similarly to their 3xK counterparts. Statistically significant are 9 out of 12 winner strategies, 6 out of 12 loser strategies and 3 out of 12 WML strategies. Based on the tables 3. and 4. it seems that momentum returns are strongest on the short- and medium-short terms as returns deplete with longer holding periods.

Table 4. The results and t-statistics of Finnish, Swedish and Danish 6xK strategies

		Holding period, K			
Formation period, J	***Country***	**3**	**6**	**9**	**12**
6 Winner	**DEN**	1,362 %	1,233 %	1,236 %	1,140 %
		(-0,13)	**(2,74)*** **	**(4,95)*** **	**(5,54)*** **
	FIN	0,643 %	0,591 %	0,623 %	0,184 %
		(0,84)	**(2,08)** **	**(3,11)*** **	(1,46)
	SWE	3,587 %	0,892 %	0,871 %	0,782 %
		(9,22)* **	**(4,14)*** **	**(6,11)*** **	**(6,26)*** **
6 Loser	**DEN**	0,327 %	0,301 %	0,342 %	0,475 %
		(-3,34)	(-1,47)	(-0,56)	(-0,63)
	FIN	0,589 %	0,525 %	0,524 %	0,531 %
		(1,08)	**(1,82)***	**(2,45)** **	**(2,73)*** **
	SWE	0,109 %	0,940 %	0,866 %	0,895 %
		(-0,65)	**(4,11)*** **	**(5,23)*** **	**(6,73)*** **
6 WML	**DEN**	1,035 %	0,931 %	0,895 %	0,665 %
		(-1,89)	(1,33)	**(2,94)*** **	**(2,73)*** **
	FIN	0,054 %	0,067 %	0,099 %	-0,347 %
		(-1,23)	(-0,61)	(-0,09)	(-2,45)
	SWE	3,478 %	-0,048 %	0,005 %	-0,113 %
		(13,33)* **	(-1,81)	(-1,06)	(-2,17)

Even though I previously stated that investors might be more interested in shorter term momentum strategies, might it be still reasonable to consider medium-long- and long-term strategies. As in previous 3xK and 6xK strategies, also in the 9xK strategies the shortest holding periods generate the most momentum profits. Again, the strongest performing winner portfolios are the Danish market ones, best being 9x3 winner strategy with 1,191 percent monthly returns. One difference to previous observations is that Finnish market strategies are not as clearly the worst performer, as their returns are very even with the Swedish markets returns. Another differentiation to first results, is that almost every Swedish loser portfolio outperformed the Swedish winner portfolios, resulting in three WML portfolios generating negative returns. Only Swedish WML strategy to generate positive returns was the 9x3 strategy. Almost all winner strategies are statistically significant, and the only one that is not happens to be the best performer out of them all. Also most of the loser strategies are statistically significant, except for all the Danish

loser strategies and Finnish 9x3 strategy. Only WML strategy to be statistically significant is the Danish 9x9 strategy.

Table 5. The results and t-statistics of Finnish, Swedish and Danish 9xK strategies

		Holding period, K			
Formation period, J	***Country***	**3**	**6**	**9**	**12**
9 Winner	**DEN**	1,191 %	1,178 %	1,106 %	1,006 %
		(-0,73)	**(2,47)****	**(4,26)*****	**(4,56)*****
	FIN	0,757 %	0,742 %	0,730 %	0,758 %
		(1,68)*	**(3,00)*****	**(3,83)*****	**(4,62)*****
	SWE	1,036 %	0,877 %	0,776 %	0,743 %
		(2,71)***	**(4,17)*****	**(5,16)*****	**(5,75)*****
9 Loser	**DEN**	0,071 %	0,243 %	0,368 %	0,480 %
		(-3,97)	(-1,81)	(-0,43)	(0,71)
	FIN	0,590 %	0,581 %	0,507 %	0,502 %
		(1,08)	**(2,03)****	**(2,32)****	**(2,52)****
	SWE	0,878 %	0,926 %	0,893 %	0,905 %
		(1,95)*	**(3,98)*****	**(5,65)*****	**(7,23)*****
9 WML	**DEN**	1,120 %	0,935 %	0,738 %	0,526 %
		(-1,21)	(1,28)	**(1,91)***	(1,29)
	FIN	0,167 %	0,161 %	0,224 %	0,256 %
		(-0,83)	(-0,08)	(0,79)	(1,45)
	SWE	0,158 %	-0,049 %	-0,117 %	-0,162 %
		(-1,14)	(-1,64)	(-2,06)	(-2,46)

Even the longest formation period of 12 months acts similarly to prior results. Winner portfolios all generate positive returns, and 10 out of 12 are also statistically significant. Returns are strongest in the shorter holding periods but seem to rebound as Finnish and Swedish 12x12 winner strategies generate bigger monthly returns than 12x9 winner strategies. Loser portfolios follow very closely the results of other formation period strategies. Biggest difference is the performance of the WML strategies. In this long formation period strategy half of the strategies generate negative returns, and so it can be stated that with long formation period loser portfolios tend to overperform winner portfolios. However this only seems to be the case with Finnish and Swedish markets as Danish portfolios exhibit positive returns.

Table 6. The results and t-statistics of Finnish, Swedish and Danish 12xK strategies

		Holding period, K			
Formation period, J	***Country***	**3**	**6**	**9**	**12**
12 Winner	**DEN**	1,345 %	1,215 %	1,129 %	0,997 %
		(-0,33)	**(2,63)*** **	**(4,07)*** **	**(4,26)*** **
	FIN	0,593 %	0,538 %	0,608 %	0,616 %
		(1,01)	**(1,79)***	**(2,84)*** **	**(3,39)*** **
	SWE	0,816 %	0,698 %	0,667 %	0,692 %
		(1,75)*	**(2,88)*** **	**(3,95)*** **	**(5,25)*** **
12 Loser	**DEN**	0,017 %	0,324 %	0,408 %	0,523 %
		(-4,29)	(-1,52)	(-0,32)	(0,88)
	FIN	0,652 %	0,613 %	0,551 %	0,546 %
		(1,11)	**(2,02)** **	**(2,35)** **	**(2,33)** **
	SWE	0,823 %	0,882 %	0,806 %	0,825 %
		(1,65)	**(3,82)*** **	**(5,07)*** **	**(6,21)*** **
12 WML	**DEN**	1,328 %	0,891 %	0,721 %	0,474 %
		(-0,45)	(1,07)	**(1,71)***	(0,91)
	FIN	-0,059 %	-0,074 %	0,057 %	0,070 %
		(-1,74)	(-1,40)	(-0,36)	(-0,09)
	SWE	-0,007 %	-0,184 %	-0,161 %	-0,133 %
		(-1,87)	(-2,44)	(-2,27)	(-2,06)

To conclude, during this sample period of 15 years, it can be stated that investing in the past winner indexes in the Nordic stock markets has generated significant returns. However shorting past losers did only result in bad performance of the WML strategies. It can be also seen that the best performing portfolios are formed and held for short periods. The formation period doesn't affect the results as much, but it can still be seen that longer the holding period is, smaller the monthly average returns. The effect a holding period has is much more clear, as monthly returns weaken as holding period grows. One

distinction is the behavior of Finnish strategies. Previous statements work well with Finnish markets results, but one thing to notice is that third, fourth, fifth and sixth strongest returns come from 9x3,6,9,12 strategies.

In Jegadeesh and Titmans (1993) study, the best WML strategy yields 1,31% per month without lag, and 1,49% with lag, being the 12x3 strategy. With 1-week lag between formation and holding, the 6-month formation strategies 6x3, 6x6, 6x9 and 6x12, all yield 1% a month. Only market in this thesis to achieve similar WML strategy yields is the Danish market. Other markets experience too large positive returns from loser portfolios to perform as the WML strategies of Jegadeesh and Titman (1993). The 6-month formation winner strategies also act similarly with their results by achieving around 1% monthly returns. Thus, it can be stated the results of this thesis are somewhat similar to Jegadeesh and Titman, but there is huge difference in the performance of WML strategies.

In conclusion it can be stated that buy and hold strategies work well with winner portfolios in every market. Also, each WML strategy would be simply better off without shorting the loser portfolio, as this action only eats off the returns generated by the winner strategies. However, because momentum provides statistically significant returns the hypothesis of momentum existing in Nordic markets is proven to be right. Also, because the three Nordic markets researched in this thesis have similarities, but perform differently in key metrics, can the assumption of similar behavior be discarded.

5.2 Results on the possible industry factor in the Nordic sector indexes

Another interesting issue is how the number of times certain sector index is picked into a portfolio. As we can see from the Appendix 2 the amount of times index gets picked is highly dependent about the length of the formation period. If the formation period is for example 3 months, it doesn't matter if the strategy is 3x3, 3x6, 3x9 or 3x12, as the number of times portfolio gets selected stays almost constant. The most selected sector indexes for winner portfolios in the Finnish market were CONS PROD & SVS (759), HEALTH

CARE (787), INDL MET & MNG (817) and INV. BANK, BROKER (781). Most selected for the loser portfolios were INDL MET & MNG (1224), INDS TRANSPT (1090), TECHNOLOGY (1107) and TRAVEL & LEIS (979). For the Swedish market the most selected sector indexes were ELTRO/ELEC EQ (1167), ENERGY (878), LEISURE GDS (935) and OIL, GAS, COAL (864). As the most used indexes in the loser strategies were INDL MET & MNG (1088), INDS TRANSPT (1088), OIL, GAS, COAL (1057) and TCH H/W & EQ (1139). Lastly the most selected indexes in Danish market winner strategies were CONS PROD & SVS (997), MEDIA (763), PHARM & BIO (840) and TECHNOLOGY (808). On the loser side of things there were three indexes that were included most: FINANCIAL SVS (949), CONS PROD & SVS (1012), INDS ENG (861) and TELECOM.SVS PRVD (1004). There are interesting similarities as both Finnish and Danish portfolios had CONS PROD & SVS. These similarities can also be seen with loser portfolios, as both the Swedish and Finnish loser portfolios had INDL MET & MINING and INDS TRANSPT indexes as ones of the most selected ones. Another thing to point out is how same index can be picked most as a winner and a loser. In the case of Finnish market this index is INDL MET & MNG, in the Swedish market OIL, GAS, COAL and in the Danish market the CONS PROD & SVS index. As it can be seen there might be industry factor in play in these results as some industries tend to be winners more often than others. None of these industry factors seems to cover the whole Nordics, as at best sector is in most winner/loser portfolios in 2/3 markets. However, the impact a sector has isn't as clear cut, and so it is in the line with other studies about industry factor discussed in section 5.5.

6 Conclusions

The aim of this study was to verify the significance of price momentum in the Nordic sector indexes. To test this significance, monthly return data are collected in order to rank these indexes. After ranking the indexes each month, winner, loser and WML portfolios are constructed and used in JxK strategies following the work of Jegadeesh and Titman (1993). Sample used in this thesis is gathered from OMX Helsinki, OMX Stockholm and OMX Copenhagen during the period January 2005 to October 2020, consisting of 117 indexes. By using sector indexes instead commonly used stocks, this thesis contributes to existing literature. While multiple different asset classes and markets have been studied, the Nordic markets have been left with minor attention, and indexes are also very seldom used for momentum research. Most studies research U.S listed stocks before or in the beginning of 21st century. Also utilizing sector indexes this study briefly studies the effect industry classification has to momentum returns.

The results of this thesis show that statistically significant momentum profits can be achieved by following the strategies of Jegadeesh and Titman (1993), so my initial assumption of momentum existing in Nordic sector indexes, can be proven to be right. The strategies used doesn't work as intended as the loser portfolios exhibit positive returns and so ultimately make the WML strategies perform worse. Also, it can be stated that certain industries experience stronger momentum as those sectors were picked to portfolios much often than others.

These results show how investors can beat the market by using short term momentum strategies in the Nordic stock markets. Because frequent buying and selling and the fees involved the most realistic possible users could be institutional investors or other professionals such as fund managers. I also further prove how Nordic markets are not efficient in the sense of EMH, and how this inefficiency of momentum anomaly can be used to obtain significant returns. If we take a role of active investor, it would be logical to use short holding periods in the Danish market as those performed the best. Even still which-

ever market investors choose there is significant returns to benefit from. For future studies it would be important to include fees to see whether it changes the usability of these strategies to investors. These results might also change the common ideology that indexes are great long-term investment and switch the discussion to how they can be beneficial for short-term investing too.

As the indexes consist of multiple stocks within an industry, the momentum effect of an index might get evened out by opposing movement of individual stocks. However, if there is industry factor to be found it might be that individual stocks in certain industry exhibit similar price movements. As stated in results section, it can be stated that some industries were picked in the winner or loser portfolios more often than others, whether this is indeed industry factor in action remains unclear. Also, there were similarities in the behavior of industries across the markets, but still no clear market wide industry factors. This aligns with previous studies of Grundy and Martin (2001) and Rouwenhoorst (1998), who expressed how industry factor isn't the main driver for momentum.

For further research it would be interesting to include the current Covid-19 period as markets have been in decline. This way it could be viewed whether momentum has prevailed in adverse scenario. The models used in this study to determine momentum could be evolved to additional factors to get more significant results. Also because of the smallish sample size used in this study it would be beneficial to broaden the markets viewed, maybe to the extent of whole Europe. These steps can provide stronger results. However, these results can be affected by multiple different reasons, like the limited number of indexes to construct the portfolios with, might affect the number of times certain index is picked.

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Appendice

Appendix 1. List of sector indexes used

OMX STOCKHOLM	
NOMXS AERO/DEFENCE - TOT RETURN IND	OSX3ADL(RI)
NOMXS AUTO & PARTS - TOT RETURN IND	OSX2A2L(RI)
NOMXS BANKS - TOT RETURN IND	OSX2B2L(RI)
NOMXS BASIC MATS - TOT RETURN IND	OSX1BML(RI)
NOMXS BASIC RESOURCE - TOT RETURN IND	OSX2BAL(RI)
NOMXS CON & MAT - TOT RETURN IND	OSX2S2L(RI)
NOMXS CONS PROD & SVS - TOT RETURN IND	OSX2HHL(RI)
NOMXS ELTRO/ELEC EQ - TOT RETURN IND	OSX3ELL(RI)
NOMXS ENERGY - TOT RETURN IND	OSX1O1L(RI)
NOMXS FD PRODUCERS - TOT RETURN IND	OSX3FCL(RI)
NOMXS FINANCIAL SVS - TOT RETURN IND	OSX2FSL(RI)
NOMXS FINANCIALS - TOT RETURN IND	OSX1FNL(RI)
NOMXS FOOD, BEV, TOBAC - TOT RETURN IND	OSX2FBL(RI)
NOMXS HEALTH CARE - TOT RETURN IND	OSX1H1L(RI)
NOMXS HSGD & HM CON - TOT RETURN IND	OSX3HGL(RI)
NOMXS IND. MATERIALS - TOT RETURN IND	OSX3PFL(RI)
NOMXS IND. SUPPORT SVS - TOT RETURN IND	OSX3SVL(RI)
NOMXS INDL MET & MNG - TOT RETURN IND	OSX3IUL(RI)
NOMXS INDS ENG - TOT RETURN IND	OSX3IEL(RI)
NOMXS INDS GDS & SVS - TOT RETURN IND	OSX2IGL(RI)
NOMXS INDS TRANSPT - TOT RETURN IND	OSX3IPL(RI)
NOMXS INDUSTRIALS - TOT RETURN IND	OSX1IDL(RI)
NOMXS INV. BANK,BROKER - TOT RETURN IND	OSX3GFL(RI)
NOMXS LEISURE GDS - TOT RETURN IND	OSX3LGL(RI)
NOMXS MEDIA - TOT RETURN IND	OSX2M2L(RI)
NOMXS MEDICAL EQ. SVS - TOT RETURN IND	OSX3HEL(RI)
NOMXS OIL, GAS, COAL - TOT RETURN IND	OSX3OGL(RI)

NOMXS PERSONAL GOODS - TOT RETURN IND	OSX3PGL(RI)
NOMXS PHARM & BIO - TOT RETURN IND	OSX3PBL(RI)
R/E IVST – TOT RETURN IND	OSX3RML(RI)
NOMXS REAL ESTATE - TOT RETURN IND	OSX2RLL(RI)
NOMXS RETAIL - TOT RETURN IND	OSX2RTL(RI)
NOMXS RETAILERS - TOT RETURN IND	OSX3GRL(RI)
NOMXS S/W & COMP SVS - TOT RETURN IND	OSX3SSL(RI)
NOMXS TCH H/W & EQ - TOT RETURN IND	OSX3THL(RI)
NOMXS TECHNOLOGY - TOT RETURN IND	OSX1G1L(RI)
NOMXS TELECOM - TOT RETURN IND	OSX1T1L(RI)
NOMXS TRAVEL & LEIS - TOT RETURN IND	OSX2R2L(RI)
OMX COPENHAGEN	
NOMXC BANKS - TOT RETURN IND	OCX2B2L(RI)
NOMXC BEVERAGES - TOT RETURN IND	OCX3BVL(RI)
NOMXC CON & MAT - TOT RETURN IND	OCX2S2L(RI)
NOMXC CONS PROD & SVS - TOT RETURN IND	OCX2HHL(RI)
NOMXC ELTRO/ELEC EQ - TOT RETURN IND	OCX3ELL(RI)
NOMXC FINANCIAL SVS - TOT RETURN IND	OCX2FSL(RI)
NOMXC FINANCIALS - TOT RETURN IND	OCX1FNL(RI)
NOMXC FOOD, BEV, TOBAC - TOT RETURN IND	OCX2FBL(RI)
NOMXC GENERAL INDS - TOT RETURN IND	OCX3GIL(RI)
NOMXC HEALTH CARE - TOT RETURN IND	OCX1H1L(RI)
NOMXC IND. SUPPORT SVS - TOT RETURN IND	OCX3SVL(RI)
NOMXC INDS ENG - TOT RETURN IND	OCX3IEL(RI)
NOMXC INDS TRANSPT - TOT RETURN IND	OCX3IPL(RI)
NOMXC INDUSTRIALS - TOT RETURN IND	OCX1IDL(RI)
NOMXC INSURANCE - TOT RETURN IND	OCX2INL(RI)
NOMXC MEDIA - TOT RETURN IND	OCX2M2L(RI)
NOMXC MEDICAL EQ. SVS - TOT RETURN IND	OCX3HEL(RI)

NOMXC PHARM & BIO - TOT RETURN IND	OCX3PBL(RI)
NOMXC REAL ESTATE - TOT RETURN IND	OCX2RLL(RI)
NOMXC TECHNOLOGY - TOT RETURN IND	OCX1G1L(RI)
NOMXC TELECOM.SVS PRVD - TOT RETURN IND	OCX1T1L(RI)
OMX HELSINKI	
NOMXH BASIC MATS - TOT RETURN IND	OHX1BML(RI)
NOMXH CON & MAT - TOT RETURN IND	OHX2S2L(RI)
NOMXH CONS PROD & SVS - TOT RETURN IND	OHX2HHL(RI)
NOMXH ELTRO/ELEC EQ - TOT RETURN IND	OHX3ELL(RI)
NOMXH FD PRODUCERS - TOT RETURN IND	OHX3FCL(RI)
NOMXH FINANCIALS - TOT RETURN IND	OHX1FNL(RI)
NOMXH FOOD, BEV, TOBAC - TOT RETURN IND	OHX2FBL(RI)
NOMXH GENERAL INDS - TOT RETURN IND	OHX3GIL(RI)
NOMXH HEALTH CARE - TOT RETURN IND	OHX1H1L(RI)
NOMXH HSGD & HM CON - TOT RETURN IND	OHX3HGL(RI)
NOMXH IND. MATERIALS - TOT RETURN IND	OHX3PFL(RI)
NOMXH IND. SUPPORT SVS - TOT RETURN IND	OHX3SVL(RI)
NOMXH INDL MET & MNG - TOT RETURN IND	OHX3IUL(RI)
NOMXH INDS ENG - TOT RETURN IND	OHX3IEL(RI)
NOMXH INDS GDS & SVS - TOT RETURN IND	OHX2IGL(RI)
NOMXH INDS TRANSPT - TOT RETURN IND	OHX3IPL(RI)
NOMXH INDUSTRIALS - TOT RETURN IND	OHX1IDL(RI)
NOMXH INV. BANK,BROKER - TOT RETURN IND	OHX3GFL(RI)
NOMXH LEISURE GDS - TOT RETURN IND	OHX3LGL(RI)
NOMXH MEDIA - TOT RETURN IND	OHX2M2L(RI)
NOMXH REAL ESTATE - TOT RETURN IND	OHX2RLL(RI)
NOMXH RETAIL - TOT RETURN IND	OHX2RTL(RI)
NOMXH TECHNOLOGY - TOT RETURN IND	OHX1G1L(RI)
NOMXH TELECOM - TOT RETURN IND	OHX1T1L(RI)

NOMXH TELECOM.SVS PRVD - TOT RETURN IND	OHX3F3L(RI)
NOMXH TRAVEL & LEIS - TOT RETURN IND	OHX2R2L(RI)

Appendix 2. Number of portfolios the sector index is part of, OMXH, OMXC & OMXS

NOMXH

LOSERS	BASIC MATS	CON&MAT	CONS PROD&SVS	ELTRO/ELEC EQ	FINANCIALS	FOOD,BEV,TOBAC	HEALTH CARE	HSGD&HM CON	IND. MATERIALS	IND. SUPPORT SVS	INDL MET & MNG	INDS ENG	INDS TRANSPT	INDUSTRIALS	INV. BANK,BROKER	LEISURE GDS	MEDIA	REAL ESTATE	RETAIL	TECHNOLOGY	TRAVEL&LEIS
3x3	32	34	19	22	14	32	36	27	39	46	74	6	70	1	22	41	46	28	31	63	65
3x6	31	34	19	22	14	30	33	27	38	46	72	6	69	1	22	41	45	26	31	63	62
3x9	31	33	19	22	11	30	33	27	38	44	70	6	68	1	22	41	45	26	31	63	59
3x12	29	33	19	22	11	29	33	25	36	44	70	6	68	1	22	41	44	26	31	62	56
6x3	36	46	18	18	13	26	28	24	38	49	78	8	72	1	15	36	49	23	24	69	61
6x6	34	45	18	18	11	26	28	24	37	49	76	8	71	1	15	36	49	23	24	69	58
6x9	33	44	18	18	10	26	28	23	36	49	76	7	70	0	15	36	49	23	24	68	55
6x12	33	44	17	18	10	26	28	20	36	49	76	7	70	0	15	33	49	23	24	65	53
9x3	33	40	19	19	6	36	22	28	40	41	77	6	65	0	17	34	53	22	20	78	64
9x6	31	40	19	19	6	36	22	27	38	41	76	6	63	0	17	34	53	22	20	77	61
9x9	31	40	19	19	6	36	22	24	38	41	76	6	61	0	17	33	53	22	20	74	58
9x12	31	40	18	19	6	36	22	21	38	41	76	6	59	0	17	31	53	22	20	71	57
12x3	25	47	24	16	7	31	20	20	30	41	84	4	74	0	15	33	50	23	17	75	72
12x6	24	47	23	16	7	31	20	19	30	41	82	4	72	0	15	33	50	23	17	73	69
12x9	24	47	23	16	7	31	20	17	30	41	81	4	69	0	15	33	50	23	17	70	66
12x12	24	47	20	16	7	31	20	16	30	41	80	4	69	0	15	32	50	23	17	67	63
Total of portfolios that sector index is part of	482	661	312	300	146	493	415	369	572	704	1224	94	1090	6	276	568	788	378	368	1107	979
WINNERS																					
3x3	29	33	26	47	16	18	55	37	43	31	55	34	38	11	40	51	25	43	30	50	36
3x6	29	33	25	46	16	18	55	36	43	30	55	34	36	10	39	48	25	42	27	49	36
3x9	29	33	23	45	16	18	53	35	43	30	55	34	36	10	39	45	24	41	26	49	36
3x12	29	33	23	44	16	18	52	35	43	28	52	34	36	10	36	45	23	40	26	49	36
6x3	29	29	25	50	17	16	50	32	51	36	56	44	30	12	45	50	21	35	33	41	30
6x6	29	29	24	48	17	16	50	30	51	36	56	44	30	12	44	47	21	34	32	40	30
6x9	29	29	24	47	17	15	47	30	51	36	56	44	30	12	41	44	21	33	32	40	30
6x12	29	33	23	41	16	18	50	35	41	27	52	34	36	10	36	45	22	38	25	49	36
9x3	23	24	25	52	24	12	52	30	46	28	46	53	32	13	60	50	19	26	33	39	33
9x6	23	24	25	50	24	12	51	30	46	28	46	53	32	13	58	47	19	25	31	38	33
9x9	23	24	25	47	24	12	48	30	46	27	46	53	32	13	56	47	19	24	29	38	33
9x12	23	24	25	44	24	12	47	30	46	26	46	53	32	13	55	47	18	21	27	38	33
12x3	18	18	31	54	24	13	46	31	31	32	49	59	29	24	62	53	20	26	26	32	30
12x6	18	18	31	51	24	13	45	31	31	32	49	59	29	24	59	52	20	25	23	32	30
12x9	18	18	31	48	24	12	43	31	31	32	49	59	29	24	57	52	20	23	21	32	30
12x12	18	18	31	45	24	12	43	31	31	29	49	59	29	24	54	52	20	20	21	32	30
Total of portfolios that sector index is part of	396	420	417	759	323	235	787	514	674	488	817	750	516	235	781	775	337	496	442	648	522
Total portfolios **5666**	878	1081	729	1059	469	728	1202	883	1246	1192	2041	844	1606	241	1057	1343	1125	874	810	1755	1501

NOMXC

LOSERS	BANKS	BEVERAGES	CON & MAT	CONS PROD & SVS	ELTRO/ELEC EQ	FINANCIAL SVS	FINANCIALS	FOOD, BEV, TOBAC	GENERAL INDS	HEALTH CARE	IND. SUPPORT SVS	INDS ENG	INDS TRANSPT	INDUSTRIALS	INSURANCE	MEDIA	MEDICAL EQ, SVS	PHARM & BIO	REAL ESTATE	TECHNOLOGY	TELECOM SVS PRVD
3x3	48	26	36	54	45	59	22	19	26	15	41	58	36	22	32	39	21	20	40	27	62
3x6	47	26	36	54	45	58	22	19	26	14	38	54	36	22	32	39	21	20	36	27	78
3x9	45	26	36	53	45	58	21	19	26	14	35	51	35	21	32	39	21	20	36	27	60
3x12	45	25	36	53	45	57	21	18	26	14	32	50	33	19	32	39	21	20	36	27	59
6x3	40	24	34	62	52	57	18	21	15	16	43	50	35	23	35	44	16	25	44	14	64
6x6	39	24	34	62	52	57	18	21	15	16	40	47	35	23	35	44	16	25	42	14	61
6x9	38	23	33	61	52	57	18	21	15	16	37	45	34	22	35	44	16	25	42	14	60
6x12	38	22	31	61	52	57	18	20	15	16	34	43	34	22	32	44	16	25	42	14	60
9x3	41	26	32	68	42	56	20	21	8	16	40	59	34	20	25	42	21	26	41	13	69
9x6	41	23	32	68	42	55	20	20	8	16	36	55	34	20	25	42	21	26	41	13	66
9x9	41	23	31	68	42	55	20	20	8	16	34	53	34	20	23	42	21	26	41	13	65
9x12	41	23	29	68	42	54	20	20	8	16	31	50	34	20	21	42	21	26	41	13	64
12x3	45	16	24	70	47	68	12	19	6	19	41	66	36	21	19	44	14	24	45	10	62
12x6	45	16	24	70	47	68	12	19	6	19	38	63	36	21	16	44	14	24	45	10	59
12x9	42	16	23	70	47	68	11	19	6	19	35	60	36	21	16	44	14	24	45	10	58
12x12	42	16	21	70	47	65	11	19	6	19	32	57	36	21	16	44	14	24	45	10	57
Total of portfolios that sector index is par	678	355	492	1012	744	949	284	315	220	261	587	861	558	338	426	676	288	380	662	256	1004
WINNERS																					
3x3	13	39	47	61	53	18	10	27	46	28	32	48	31	19	49	54	39	38	22	45	29
3x6	13	39	44	59	51	18	10	27	46	28	32	48	28	18	49	50	39	38	22	44	29
3x9	13	39	43	58	51	18	10	27	46	26	32	48	28	18	49	48	36	36	22	42	46
3x12	13	39	43	57	48	18	10	27	45	26	32	47	27	18	49	47	36	36	20	41	29
6x3	14	30	44	68	41	13	6	24	47	39	18	48	21	17	54	48	39	56	29	49	27
6x6	14	30	42	65	41	13	6	24	47	38	18	48	21	17	54	45	37	56	29	48	27
6x9	14	30	42	64	40	13	6	24	47	35	18	48	21	17	54	44	34	54	28	48	27
6x12	13	30	42	62	37	13	6	24	47	35	18	48	21	17	54	43	34	53	25	47	27
9x3	14	37	43	64	45	13	4	22	44	42	14	48	21	15	47	54	32	60	27	55	19
9x6	14	37	42	60	43	13	4	22	44	42	14	48	21	15	47	51	31	59	27	51	19
9x9	14	37	42	60	42	13	4	22	44	40	14	48	21	15	47	51	29	57	26	51	19
9x12	14	37	42	58	39	13	4	22	44	40	14	48	20	15	47	49	29	56	23	51	19
12x3	14	35	40	68	44	12	0	26	48	44	11	45	21	13	40	48	40	62	21	61	15
12x6	14	35	40	65	41	12	0	26	48	44	11	45	21	13	40	45	40	61	21	59	15
12x9	14	35	40	64	40	12	0	26	48	41	11	45	21	13	40	44	37	59	20	59	15
12x12	14	33	40	64	38	12	0	25	48	41	11	45	21	13	40	42	36	59	18	57	15
Total of portfolios that sector index is par	219	562	676	997	694	224	80	395	739	589	300	755	365	253	760	763	568	840	380	808	377
Total portfolios **5666**																					

NOMXS

LOSERS	AERO/DEFENCE	AUTO & PARTS	BANKS	BASIC MATS	BASIC RESOURCE	CON & MAT	CONS PROD & SVS	ELTRO/ELEC EQ	ENERGY	FD PRODUCERS	FINANCIAL SVS	FINANCIALS	FOOD, BEV, TOBAC	HEALTH CARE	HSGD & HM CON	IND. MATERIALS	IND. SUPPORT SVS	INDL MET & MNG
3x3	45	22	30	30	35	17	12	17	65	43	6	13	43	38	40	36	31	54
3x6	47	31	34	33	42	13	13	24	66	31	4	15	31	31	42	27	26	62
3x9	44	30	33	33	42	13	13	24	65	31	4	15	31	31	40	27	25	62
3x12	43	28	32	32	41	13	13	24	64	30	4	15	30	31	37	27	24	62
6x3	48	36	42	28	38	9	11	18	65	34	0	8	33	20	39	30	18	61
6x6	47	35	42	28	38	9	11	18	62	33	0	8	33	20	39	30	18	61
6x9	44	32	42	28	38	9	11	18	61	33	0	8	33	20	36	30	16	61
6x12	44	30	42	28	38	9	11	18	60	30	0	8	30	20	33	30	16	61
9x3	47	41	34	29	39	8	9	19	69	32	1	7	31	23	36	28	20	69
9x6	46	39	34	29	39	8	9	19	67	30	1	7	30	23	36	28	20	69
9x9	44	37	34	29	39	8	9	19	65	28	1	7	28	23	34	28	18	69
9x12	44	35	32	29	39	8	9	19	65	28	1	7	28	23	31	28	17	68
12x3	47	34	40	26	44	13	10	20	62	25	0	6	25	24	40	25	22	83
12x6	45	33	40	26	44	13	10	20	60	22	0	6	22	24	39	25	21	83
12x9	42	30	38	26	44	13	10	20	59	22	0	6	22	24	36	25	18	82
12x12	39	27	36	26	44	13	10	20	58	22	0	6	22	24	35	25	18	81
Total of portfolios that sector index is part of	716	520	585	460	644	176	171	317	1013	474	22	142	472	399	593	449	328	1088
WINNERS																		
3x3	53	32	30	26	24	83	12	12	45	72	69	43	19	16	43	32	43	17
3x6	50	35	26	23	32	15	16	64	62	33	15	13	33	29	36	28	18	46
3x9	50	35	26	23	32	15	16	63	62	33	15	13	33	26	36	25	18	46
3x12	50	35	25	23	32	15	16	60	62	33	15	11	33	26	36	25	18	43
6x3	52	35	19	24	25	12	13	69	52	39	13	10	39	27	41	30	16	55
6x6	52	35	19	24	25	12	13	69	52	39	13	10	39	26	41	29	16	55
6x9	52	35	19	24	24	12	13	67	52	39	13	10	39	24	41	26	16	55
6x12	52	35	18	24	24	12	13	65	52	39	13	9	39	24	41	24	16	54
9x3	56	37	20	25	25	19	12	89	53	35	16	8	35	23	37	30	14	45
9x6	56	37	20	25	25	19	12	86	53	35	15	8	35	23	37	29	14	45
9x9	56	37	20	24	24	19	12	84	53	35	14	8	35	23	37	26	14	45
9x12	56	37	20	24	24	17	12	82	53	34	14	8	34	23	37	25	14	45
12x3	51	36	20	26	29	17	16	93	57	37	21	12	37	22	30	25	18	51
12x6	51	36	20	26	29	17	16	90	57	37	19	12	37	22	30	23	18	51
12x9	51	36	20	26	29	17	16	88	57	36	16	12	36	21	30	20	18	51
12x12	51	36	20	26	29	15	16	86	56	35	15	12	35	21	30	20	18	51
Total of portfolios that sector index is part of	839	569	342	393	432	316	224	1167	878	611	296	199	558	376	583	417	289	755

Total portfolios **5666**

NOMXS

LOSERS	INDS ENG	INDS GDS & SVS	INDS TRANSPT	INDUSTRIALS	INV. BANK,BROKER	LEISURE GDS	MEDIA	MEDICAL EQ. SVS	OIL, GAS, COAL	PERSONAL GOODS	PHARM & BIO	R/E IVST & SVS	REAL ESTATE	RETAIL	RETAILERS	S/W & COMP SVS	TCH H/W & EQ	TECHNOLOGY	TELECOM	TRAVEL & LEIS
3x3	12	4	70	1	6	34	53	19	65	26	57	22	22	41	38	23	66	53	40	66
3x6	19	7	61	1	4	30	58	35	68	31	37	20	20	45	50	18	63	48	39	47
3x9	19	7	59	1	4	29	58	35	67	31	37	18	18	44	48	18	63	48	38	47
3x12	19	7	59	1	4	29	57	35	65	31	37	18	18	43	47	18	61	48	37	47
6x3	17	5	74	0	1	19	55	32	69	32	35	17	17	53	59	20	72	62	46	44
6x6	17	5	72	0	1	19	55	32	67	32	35	14	14	52	56	20	72	62	45	44
6x9	17	5	71	0	1	19	55	32	65	32	35	14	14	51	53	20	72	62	43	44
6x12	17	5	71	0	1	18	55	32	63	31	35	14	14	50	53	20	70	61	42	44
9x3	17	3	67	0	1	17	58	27	74	22	40	8	8	51	55	16	76	59	52	54
9x6	17	3	67	0	1	17	58	27	71	22	40	7	7	49	52	16	76	59	49	54
9x9	17	3	67	0	1	16	58	27	69	22	40	7	7	48	51	16	76	59	47	54
9x12	17	3	67	0	1	15	58	27	67	22	39	7	7	48	51	16	73	56	45	54
12x3	15	6	71	1	1	10	64	32	65	22	41	2	2	50	56	14	76	57	43	55
12x6	15	6	71	1	1	10	64	32	62	22	41	2	2	49	55	14	76	57	40	55
12x9	15	6	71	1	1	10	63	32	61	22	41	2	2	49	55	14	75	57	38	55
12x12	15	6	70	1	1	10	63	32	59	22	39	2	2	49	55	14	72	56	37	55
Total of portfolios that sector index is part of	265	81	1088	8	30	302	932	488	1057	422	629	174	174	772	834	277	1139	904	681	819
WINNERS																				
3x3	12	51	35	18	24	12	19	54	27	49	69	28	41	71	53	53	43	48	19	43
3x6	30	20	44	14	16	60	32	38	62	34	36	43	43	37	38	30	38	31	28	41
3x9	30	20	44	14	16	59	32	38	62	32	33	43	43	37	38	30	35	29	28	38
3x12	29	19	43	14	15	58	31	38	62	32	33	41	41	37	38	30	35	29	28	36
6x3	42	20	41	10	12	56	38	38	52	41	41	42	42	35	43	34	39	30	28	39
6x6	42	20	41	10	12	53	36	38	52	40	39	42	42	35	43	31	37	27	28	36
6x9	42	20	41	10	11	52	36	38	52	39	36	42	42	35	43	29	36	26	28	33
6x12	40	20	39	10	11	52	34	38	52	39	36	40	40	35	41	28	36	26	28	32
9x3	45	25	41	13	16	68	36	38	54	43	38	43	43	28	35	29	29	20	23	34
9x6	45	25	41	13	15	65	33	38	54	42	37	43	43	28	35	26	29	19	23	31
9x9	45	25	41	13	14	64	32	38	54	41	36	42	42	28	35	24	29	18	23	28
9x12	44	24	40	13	14	64	32	38	54	41	36	39	39	27	33	23	29	18	23	27
12x3	47	32	30	11	19	69	30	36	57	43	34	42	42	25	31	27	20	14	18	36
12x6	47	32	30	11	17	68	28	36	57	42	33	42	42	25	31	24	20	13	18	33
12x9	47	32	30	11	15	68	28	36	57	40	31	42	42	25	31	23	20	13	18	30
12x12	46	32	30	11	14	67	28	36	56	40	31	39	39	24	28	23	20	13	18	30
Total of portfolios that sector index is part of	633	417	611	196	241	935	505	616	864	638	599	653	666	532	596	464	495	374	379	547

Total portfolios **5666**